



The Relationship Between Fasting Blood Sugar Levels and Waist Circumference with Cognitive Function in Diabetes Mellitus Patients

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Abstract. Diabetes mellitus is currently a major public health problem in the world. *International Diabetes Federation* (IDF) stated that in 2021 around 537 million people will suffer from diabetes, it is estimated that this will increase to 643 million in 2030 and 783 million in 2045. Impaired cognitive function is one of the complications that can occur in patients with diabetes mellitus. Impaired cognitive function in patients with diabetes mellitus can cause a decrease in the function of the patient's quality of life. Examination of cognitive function using the *Mini Mental State Examination* (MMSE). This research activity was carried out with the aim of early detecting the presence or absence of impaired cognitive function in patients at the Gatak Sukoharjo Health Center, Central Java. The subjects of this study were 65 prolanis participants at the Gatak Sukoharjo Health Center, Central Java, consisting of 54 (83.1%) women and 11 (16.9%) men with an average age of 62 years, both women and men. This research is descriptive analytic with cross sectional approach. The sampling technique used is using total sampling. Of these patients, the average results of fasting blood sugar were obtained 192.62, waist circumference 92.25 and MMSE score 25.54. The results of the Chi-square correlation test showed a relationship between fasting blood sugar and cognitive function ($p = 0.971$) and waist circumference and cognitive function ($p = 0.598$). In conclusion, this study shows that there is no relationship between fasting blood sugar and cognitive function and waist circumference with cognitive function. The need for a wider number of subjects for this research in order to get even better results.

Keywords: Fasting Blood Sugar (GDP) · Waist Circumference · Cognitive Function · Mini Mental State Examination (MMSE) · Diabetes Mellitus

1 Introduction

Diabetes Mellitus is a metabolic disease characterized by hyperglycemia that occurs due to the inability of the pancreas to secrete insulin, impaired insulin action, or both (American Diabetes Association, 2020). Diabetes mellitus is a major health problem

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that is rapidly developing. The prevalence of this disease is increasing every year around the world.

Diabetes mellitus can cause a risk of impaired cognitive function through disruption of blood vessels including blood vessels in the brain (Tsalissavrina et al., 2018). According to Seyfaddini (2006) in his research, he explained that cognitive function decline is eight times more risky for people with diabetes mellitus than non-diabetes mellitus. High levels of glucose in the blood can activate pro-inflammatory cytokines through several intracellular biochemical mechanisms thereby increasing the risk of cognitive decline (Salim *et al.*, 2016). The higher the fasting blood sugar level, it can cause a decrease in cognitive function in a person (Nariswari, 2015). Diabetes mellitus can occur due to obesity (Simbar et al., 2015). Measuring waist circumference is a simple and easy way to find out if someone is obese. Increased lipids can cause impaired cognitive function due to inflammatory processes in neurons. Abdominal fat accumulation causes the release of several products such as non-esterified fatty acids (NEFA), cytokines, PAI-1, and adiponectin (Ink, 2019). Fat tissue in diabetes mellitus patients experiences increased production of pro-inflammatory cytokines. The effect of an increase in pro-inflammatory cytokines can affect cognitive function decline (Chen *et al.*, 2015). Based on the description above, the researcher wants to identify what factors are owned by Prolanis DM patients at the Gatak Health Center which will increase the potential for cognitive function disorders so that pharmacological and non-pharmacological interventions can be carried out earlier.

2 Method

This research is an analytical descriptive with a cross sectional approach which was carried out at the Gatak Sukoharjo Health Center, Central Java in July-September 2022. The sampling technique used total sampling. The research subjects taken were elderly patients with prolanis diabetes mellitus with a recorded risk of impaired cognitive function and met the research criteria at the Gatak Sukoharjo Health Center, Central Java. The inclusion criteria examined in this study were elderly prolanis patients at the Gatak Sukoharjo Health Center, Central Java who suffered from diabetes mellitus and were > 18 years old. Exclusion criteria in this study were patients who had a history of post-craniotomy surgery, had a history of epilepsy, had a history of stroke, had a history of malignant autoimmune disease, recurrent anemia, transfusions within the last 3 months, were pregnant, suffered from encephalopathy and patients who were uncooperative.

All patients who meet the inclusion and exclusion criteria will be included in the study, then the prolanis participants will fill out a questionnaire regarding identity, medical history and history of drug use and then proceed with an examination in the form of GDP with a digital blood sugar checking tool (glucometer) using the enzymatic colorimetric method and measure waist circumference using metline. Cognitive function assessment using the Mini Mental State Examination questionnaire. Descriptive data is presented in the form of mean, standard deviation and proportion. All data were organized and statistically analyzed using the social science statistical package (IBM SPSS Statistics) version 25. The hypotheses of the study were tested using the Chi Square test. A p value of less than 0.05 was considered statistically significant for all purposes. Ethical

permission for this research was obtained from the Health Research Ethics Commission at RSUD Dr. Moewardi Number: 1.427/XI/HREC/2022.

3 Results and Discussion

The subjects of this study were 65 people consisting of 11 (16.9%) men and 54 (83.1%) women. The average age of the research subjects was 62 years. Table 1 shows the basic characteristics of the subjects including percentage and standard deviation sex, age, HbA1c, GDP, waist circumference, BMI, and hypertension.

Based on the Table 1 it can be concluded that the number of subjects was 65 people with a larger number of women, namely 11 subjects (83.1%). According to Beauchet (2006) explained that the hormone testosterone can bind to proteins, so it can reduce the secretion of β -amylode proteins and Tau proteins which function in the neuropathological process of dementia sufferers. It can be concluded that men are more likely to experience cognitive dysfunction than women.

Based on age, the average age of the subjects was 62.43. The largest number was in the elderly with 37 subjects (56.9%). Age can be a factor in the decline in cognitive function. According to research conducted by Gillis *et al.*, (2019), it is explained that

Table 1. Shows the basic characteristics of the subjects

Number of subject	Mean age \pm SD* (years old)	
65	62.43 \pm 9.43	
Variables	number	percent
Gender (n = 65)		
Male	11	16.9%
Female	54	83.1%
Age (n = 65) 62.43 \pm 9.47		
Early (Early Mature)	0	0%
Central (Parubaya)	28	43.1%
Late (Elderly)	37	56.9%
HbA1c (n = 65) 34.558 \pm 43.59		
Controlled	13	20%
Not controlled	52	80%
BMI (n = 62)		
Normal	49	79%
Fat	13	21%
Hypertension (n = 63) (Systolic 148.24 \pm 19.449) (Diastolic 87.11 \pm 17.181)		
Normal	11	17.5%
Hypertension	52	82.5%

a decrease in cognitive function will occur with increasing age. This cognitive decline is also influenced by the presence of sensory perception and processing speed which decreases with age (Riasari *et al.*, 2022).

Based on the HbA1c examination, the average was 34.558. Subjects with controlled HbA1c of 20% and uncontrolled of 80%. According to a study by Huang *et al.*, (2012), reported that high HbA1c is associated with poor memory.

Based on BMI (Body Mass Index) examination, it was found that 49% of patients were normal and 21% of patients with obese BMI. In contrast to research conducted by Manoux *et al.*, through a cohort study for 10 years, subjects who were obese showed a sharp decline in their cognitive function.

Based on hypertension, 52 subjects (82.5%) had hypertension. According to Taraghi *et al.*, (2016) hypertension can be a risk factor for impaired cognitive function in the elderly. Chronic hypertension can cause proliferation of smooth muscle cells in the blood vessels of the brain, this results in narrower lumens and thicker blood vessel walls so that the nutrients carried by the blood to the brain are also disturbed (Iadecola *et al.*, 2016).

Based on Table 2 the results of the MMSE examination, it was obtained an average of 25.54 with 13 subjects (20.6%) who had mild cognitive function disorders and 4 people (6.3%) with severe cognitive function disorders. While the subjects who got normal MMSE results were 46 people (73%). Based on the results of fasting blood sugar examinations, it was found that the average was 192.62, with the number of fasting blood sugar controlled by 18 people (27.7%) and not controlled by 47 people (72.3%). Based on the waist circumference examination, the results showed that there were 26 patients (47.3%) with normal waist circumference and 29 patients (52.7%) with abnormal waist circumference.

Table 2. Shows the variable univariate results

Number of subjects	Mean age \pm SD* (years old)	
65	62.43 \pm 9.43	
Variables	Number	Percent
MMSE (n = 63) 25.54 \pm 4.845		
Normal	46	73%
light	13	20.6%
Heavy	4	6.3%
GDP (n = 65) 192.62 \pm 86.924		
controlled	18	27.7%
Not controlled	47	72.3%
Waist Circumference (n = 55) 92.25 \pm 10.950		
Normal	26	47.3%
Abnormal	29	52.7%

Based on Table 3, the results of bivariate analysis between fasting blood sugar levels and cognitive function, a total sample of 63 samples was obtained. In total, there were 13 samples of patients who had uncontrolled fasting blood sugar with mild and severe cognitive impairment. Meanwhile, patients with controlled blood sugar and experiencing mild and severe cognitive function impairment were 5 samples. But on the other hand, patients with uncontrolled fasting blood sugar were also found but had not experienced cognitive function disorders, this could be caused by other factors such as the duration of diabetes mellitus. From the results of the Chi-square test, the p value was 0.971 which indicated that the p value was not significant. This is in accordance with research conducted by Tsalissavrina et al., (2018) which obtained a result of 0, 376 which means that there is no relationship between fasting blood sugar and cognitive function. When compared with the theory, high fasting blood sugar should result in the formation of free radicals, thereby triggering oxidative stress which can lead to impaired cognitive function. From some patients with diabetes mellitus, it was found that patients with normal cognitive function were 73%. This can happen because patients who may have severe cognitive impairment do not come for the examination. From some patients with diabetes mellitus, it was found that patients with normal cognitive function were 73%. This can happen because patients who may have severe cognitive impairment do not come for the examination. From some patients with diabetes mellitus, it was found that patients with normal cognitive function were 73%. This can happen because patients who may have severe cognitive impairment do not come for the examination.

Based on the results of bivariate analysis between waist circumference and cognitive function, a total sample of 54 samples was obtained. In total, there were 9 samples of patients who had abnormal waist circumference with mild and severe cognitive impairment. Meanwhile, there were 8 samples of patients who had normal waist circumference and experienced mild and severe cognitive impairment. From the results of the Chi-square test, the p value was 0.598 which indicated that the p value was not significant. This is supported by research by Luchsinger *et al.*, (2007) which explains that there is no relationship between waist circumference and cognitive function. Abnormal waist circumference is a symptom of metabolic syndrome. so that it can pose a risk of more severe cognitive dysfunction if it is not routinely screened. Increased fat metabolism will lead to the production of Reactive Oxygen Species (ROS). Increased ROS production will cause a deficiency of antioxidants, causing oxidative stress which can eventually cause damage to brain tissue. This will affect a person's cognitive function.

Based on these data, the results show that the incidence of macrovascular complications in prolans patients who look normal but after examination it turns out that there are those who have a risk of macrovascular complications. Seeing the magnitude of the benefits of this research activity towards improving the health status of patients with diabetes mellitus, it is necessary to make efforts so that this activity can be continued. Similar activities also need to be carried out in populations with other macrovascular risk factors such as hypertensive patients, smokers, obesity, dyslipidemia and others. It is necessary to monitor and evaluate the results of cognitive function examination using the MMSE questionnaire or brain exercises. Can also use pharmacological therapy. This is done for the purpose promotive and preventive of this activity can be achieved.

Table 3. Shows the results of the bivariate analysis of the basic characteristics of the research subjects

Risk factor	MMSE n or mean \pm SD			<i>p</i>
	24–30 (Normal) n = 46	18–23 (mild abnormalities) n = 13	0–17 (Severe Disability) n = 4	
GDP	192.62 \pm 86.924	192.62 \pm 86.924	192.62 \pm 86.924	
Controlled: < 126mg/dL	13	4	1	0.971
Uncontrolled: \geq 126 mg/dL	33	9	3	
Waist size				
Normal	17	7	1	0.598
Abnormal	20	6	3	

4 Conclusions and Suggestions

The results of the examination of prolans patients at the Gatak Health Center, Central Java above show that there is no relationship between fasting blood sugar and impaired cognitive function. In addition, the relationship between waist circumference and cognitive function also obtained insignificant results, which means there is no relationship between the two. Suggestions that can be given in this study is to be able to increase the number of subjects examined so as to get even better results.

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