

## The Correlation between Waist Circumference and Cognitive Function in Type II Diabetic Mellitus Patients in the Work Area of the Public Health Center Sedayu 2 Bantul, Indonesia

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### Abstract

**Background:** The prevalence of diabetes mellitus continues to increase every year, the increasing in cases of diabetes mellitus that increases occurs in many people with changes in consumption patterns of high fat and low physical activity habits, so that problems of motion tend to be overweight and obese. Obesity has strong relationship with diabetes mellitus, particularly in type 2 diabetes. Obesity occurs when excessive fat accumulation increases health risks. Increased body fat mass, especially in excessive central fat can lead to an increased risk of vascular and metabolic disorders which are risk factors for cognitive decline.

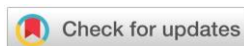
**Aims:** To identify the relationship between waist circumference and cognitive function in type II DM patients in the Work Area of the Sedayu 2 Public Health Center, Bantul

**Methods:** Type of research is quantitative research by a cross-sectional approach design. The population in this study were respondents with type 2 diabetes mellitus aged 45 years with a sampling technique using simple random sampling with a total of 110 samples. The instruments of this research used the midline and MMSE (Mini-Mental State Exam) questionnaire.

**Results:** This study using Kendall's tau correlation analysis with 110 respondents showed that there was a significant relationship between waist circumference and cognitive function in type II DM patients in the working area of the Sedayu 2 Bantul Public Health Center. The results of analysis showed a p-value of 0.000 (<0.05).

**Conclusion:** There is a significant relationship between waist circumference and cognitive function in type II DM patients in the working area of the Sedayu 2 Public Health Center, Bantul.

**Keywords:** Cognitive Function, Type 2 DM, Waist Circumference



## 1. Introduction

According to the World Health Organization, diabetes is a chronic disease that occurs when the insulin produced by the pancreas is inadequate, or when the body cannot use insulin effectively (World Health Organisation (WHO), 2008). Moreover, according to the International Diabetes Federation (IDF), 463 million people worldwide had diabetes in 2019. This number is expected to reach 578 million in 2030 and 700 million in 2045 (Kementrian kesehatan republik indonesia, 2020). The 2018 Basic Health Research Report (Riskesdas) states that the DM prevalence increases every year where DKI Jakarta Province occupies the province with the highest prevalence of 3.4% and in the Special Region of Yogyakarta by 3.1% (Pusat Data Dan Informasi Kementrian Kesehatan RI, 2019). Data from the Bantul District Health Office in 2021 showed that the highest number of visits for people with type 2 DM was at the Sedayu 2 Public Health Center in Bantul with 1,552 patients. The latest data were taken at the Sedayu 2 Public Health Center with a total of 2,378 patients (Dinas Kesehatan Kabupaten Bantul, 2020).

The prevalence of diabetes mellitus continues to increase every year. It shows that diabetes is a health problem that needs special attention to be controlled because it is one of the global health threats in Indonesia (Bataha, Fehni Vietryani Dolongseda Gresty, 2017). The increasing cases of diabetes mellitus are caused by changes in high-fat consumption patterns and low physical activity habits so they tend to be overweight and obese. (Sari, Agata, 2017). Several factors that can affect DM are a person's characteristics (age, gender, heredity), nutritional knowledge, stress, lifestyle, physical activity, and nutritional status both obesity and central obesity (Sapang, Puili, 2018).

Obesity has a strong relationship with diabetes mellitus, especially in patients with Type 2 DM. Obesity is an independent risk factor for dyslipidemia, hypertension and cardiovascular disease Obesity occurs when excessive fat accumulation increases health risks (Sari, 2018). A person is called obese if the waist circumference in men  $> 90$  cm and women  $> 80$  cm in women has a 73% possibility of having type 2 diabetes (Adwinda & Srimati, 2019). Waist circumference is one of the anthropometric indicators that can be used to measure nutritional status, especially in central obesity. Central obesity is the type of obesity most associated with the risk of Met-S (Metabolic Syndrome) (Iniche Tinta, 2019).

Accumulation of fat in the waist will affect the release of several products, namely non-esterified fatty acids (NEFA), cytokines, PAI-1 and adiponectin. Increased lipid can interfere with memory formation in the brain (Iniche Tinta, 2019). Increased body fat mass, particularly in excessive central fat, can lead to an increased risk of vascular and metabolic disorders. It can cause risk factors for cognitive function (Cahyaningrum, 2015). The decline in cognitive function is affected by several factors such as depression, neurology and diabetes mellitus. Diabetes mellitus causes an increased risk of cognitive decline, where the incidence of cognitive function in DM patients is eight times that of the non-DM group. Signs of declining of cognitive function in people with type 2 diabetes mellitus, namely increased memory impairment, decreased exercise speed, impaired attention and decreased executive function

(Nugroho et al., 2021). Therefore, one of the declines in cognitive function can be affected by central obesity.

## **METHODS**

### **Study Design**

This research is quantitative research with a cross-sectional approach design.

### **Sample/Participants**

This study used simple random sampling, which is a technique of taking samples from the population that is carried out randomly without regard to the strata that exist in the population. Respondents involved in this study were patients diagnosed with type 2 DM without complication, aged  $\geq 45$  years, and respondents who lived in the Work Area of the Sedayu 2 Public Health Center Bantul. Meanwhile, the exclusion criteria in this study were patients who were not willing to become research respondents. This study involved 110 respondents with type 2 diabetes.

### **Instrument**

This study uses two instruments, namely the midline to measure the patient's waist circumference and the MMSE (Mini-Mental State Exam) questionnaire to measure cognitive function. The MMSE used was modified from Folstein by the University of North Sumatra (Komalasari, 2014). The MMSE questionnaire is a standard questionnaire that has been tested for validity using the Person Product Moment, the results of which are  $r = 0.357$ , and the  $r$  value in the table is 0.355. This instrument has also been tested for reliability using the Cronbach's Alpha formula with a value of 0.765 and an  $r$ -value of 38 in the reliability test of 0.6 in previous studies (Widyantoro et al., 2021). The MMSE examination questionnaire takes 5-10 minutes. The examination consists of 30 questions from the domains of orientation, registration, attention and calculation, memory, and language. The total score of this instrument is 30. The categorization of cognitive function is a score of 25-30 normal cognitive, a score of 20-24 mild impairment, a score of 13-19 moderate impairment, and a score of 0-12 severe cognitive impairment (Kartolo, 2020).

### **Data Collection**

After receiving permission from the Ethics Review Board Committee for Research Involving Human Research Subjects, Alma Ata University researchers asked for data from the

Sedayu 2 Public health Centre to obtain data on type 2 Diabetes Mellitus sufferers. After getting the names of participants selected randomly using the Microsoft Excel application, the researcher met with the participants door to door. The researcher asked the potential participants for their willingness to participate in the research, explaining clearly about the study. The sample then signed the informed consent form. Data were collected through interviews following all items in the questionnaire from 10-18 June 2022. Each interview took 45 minutes.

### Data Analysis

Researchers analysed univariate and bivariate data by using the SPSS version 22 application. The researcher used a bivariate analysis test by Kendall's Tau to test the hypothesis.

### Ethical consideration

Approval to conduct this research was given by Ethics Review Board Committee for Research Involving Human Research Subjects, with the code ERB KE/AA/VI/10840/EC/2022 Alma Ata University

## RESULTS

Characteristics of respondents based on waist circumference and cognitive function in type 2 DM patients.

**Tabel 1. Characteristics Distribution of Waist Circumference in patients with Type 2 DM**

Gender	Normal		Central Obesity	
	f	%	f	%
Male	13	11,8	16	14,5
Female	44	40,0	37	33,6
<b>Total</b>	<b>57</b>	<b>51,8</b>	<b>53</b>	<b>48,1</b>

**Tabel 2. Characteristic of Cognitive Function in patients with Type 2 DM (N=110)**

Categories	f	%
Normal	38	34,5
Mild Impairment	28	25,5
Moderate Impairment	32	29,1
Severe Impairment	12	10,9

**Table 3. Association Between Waist Circumference and Cognitive Function in patients with Type 2 DM**

Waist Circumference	Cognitive Function										<i>r</i>	<i>p</i> -value
	Normal		Mild		Moderate		Severe		Total			
	f	%	f	%	f	%	f	%	f	%		
Normal (Male)	8	7,3	4	3,6	0	0,0	1	0,9	13	11,8	<b>0.329</b>	<b>.000</b>
Normal (Female)	18	16,4	12	10,9	12	10,9	2	1,8	44	44,0		
Obese (Male)	6	5,5	5	4,5	4	3,6	1	0,9	16	14,5		
Obese (Female)	6	5,5	7	6,4	16	14,5	8	7,3	37	33,6		
<b>Total</b>	<b>38</b>	<b>34,5</b>	<b>28</b>	<b>25,5</b>	<b>32</b>	<b>29,1</b>	<b>12</b>	<b>10,9</b>	<b>110</b>	<b>100</b>		

## DISCUSSION

Regarding on table 1 showed that most respondents have central obesity in female respondents as many as 37 people (33.6%), but female respondents have normal waist circumference as many as 44 people (40.0%). On the other hand, 13 (11.8%) male respondents have normal waist circumference and 16 males (14.5%) had central obesity. Table 1 revealed that the majority of female respondents have waist circumferences that have above normal waist circumferences which are influenced by lack of exercise activity and unhealthy eating patterns, and the majority of respondents in this study were women and the majority did not work.

The size of the waist circumference can be affected by lifestyles such as diet, sleep patterns, and physical activity. An unhealthy lifestyle can trigger the onset of type 2 diabetes mellitus. This study is also in line with previous studies. It explained that central obesity based on the excessive abdominal circumference is at risk of developing type 2 diabetes mellitus (Natawirarindry, Stevi, 2022). Central obesity is the trigger for metabolic disorders in the body, one of which can lead to the inability of insulin to enter cells that affecting hyperglycemia. (Natawirarindry, Stevi, 2022) (Silmi, Kinanti, 2018). According to Riskesdas based on Septyaningrum and Martini, impaired glucose tolerance and diabetes are higher in people who are centrally obese. Obesity can cause insulin resistance when the body cannot work properly, causing type 2 diabetes mellitus. Central obesity is a risk factor for type 2 diabetes (Septyaningrum & Martini, 2018).

Table 2 revealed that most respondents have normal cognitive function as many as 34 people (34.5%), and 32 (29.1%) respondents have moderate cognitive impairment. Based on the MMSE questionnaire, most respondents had difficulty answering questions on the place orientation item and had difficulty explaining completely their residential address as well as difficulty in mentioning the designated object. The most of respondents had normal cognitive because the respondents in this study were >45 years old and they haven't experienced a significant decrease in function. This study is in line with the research of Pratiwi et al, that the

majority of people with type 2 diabetes mellitus have impaired cognitive function as much as 64.6% (Siman, Pratiwi, An An, 2016).

As a person's age increases, there can be changes and decreases in anatomical functions such as shrinking of the brain and biochemical changes that can cause a decline in cognitive function. Various homeostatic reserves experience a decrease in vulnerable age, so there can be a decrease in glucose and oxygen in the brain, where oxygen and glucose are the main sources of nutrients in brain metabolism. This interferes with the brain's metabolic pathways which result in impaired cognitive function (Zara, 2021). In patients with type 2 diabetes mellitus, hyperglycemia occurs which can cause organ damage, including microvascular disease, which is characterized by diffuse brain degeneration, demyelination in the nervous system, and the occurrence of nerve fibrosis. It is characterized by apoptosis and hippocampal atrophy. So that there is a decrease in cognitive function in patients with type 2 diabetes mellitus (Faiza & Syafrita, 2020).

Based on the results of the statistical correlation test results from Kendall's tau analysis test, a p-value of 0.000 was obtained, which was smaller than 0.05 ( $0.000 < 0.05$ ) It means that there is a relationship between waist circumference and cognitive function. The closeness of the relationship or the Correlation Coefficient ( $r$ ) is 0.329. It means that the relationship between the two variables is weak.

Waist circumference above normal is associated with increasing age. Increasing age causes changes in body composition in the form of an increase in fat mass, a decrease in fat mass, and a slackening in bone mass. Epidemiologically, changes in body composition will cause an increase in central fat accumulation in the waist which results in central obesity (Wahid, Billy Dema Justia, 2020). Waldstein's research states that central obesity is associated with various neuroendocrine disorders, one of which is hypercortisolemia. Increased cortisol levels can be correlated with hippocampal atrophy, causing a decrease in memory function (Pradini, 2016).

Decreased memory function in central obesity is more common in peripherally obese patients. This can be caused by central obesity, and greater inflammation, resulting in changes in adipokines, cytokine release, hyperinsulinemia, and advanced glycosylation end products (AGEs), which can interfere with cerebrovascular function. The decrease in adiponectin in central obesity can lead to an increase in cholesterol which causes a worsening of memory function. Central obesity is associated with cerebral atrophy and alba substance, where inflammatory factors are suspect to correlated with changes in cognitive function (Iniche Tinta, 2019).

Total fat mass and central obesity are suspected to be one of the risk factors for decreased cognitive function in the elderly who have diabetes mellitus. Angela's research suggests that measurement of fat tissue through total fat mass and fatty acid distribution is correlated with cognitive decline in elderly obese people with diabetes mellitus. This study proves that total fat mass and central obesity are independent risk factors for cognitive decline in the elderly with DM. (Pradini, 2016).

Accumulation of fat in the abdomen will cause the release of several products, namely non esterified fatty acids (NEFA), cytokines, PAI-1 and adiponectin. Increased lipid profile can interfere with memory formation (Iniche Tinta, 2019). Escalation body fat mass, especially in excessive central fat, can lead to an increased risk of vascular and metabolic disorders which are risk factors for age-related decline in cognitive function (Cahyaningrum, 2015).

When the amount of visceral fat is excessive, it will stimulate inflammation in the body that will affect the brain. Visceral fat can also cause unstable hormone production and cause the brain's ability to decline. The more visceral fat, the smaller the brain size. Smaller brain volume can cause a person's cognitive function to deteriorate and can increase the risk of dementia (Pradini, 2016).

According to research by Billy and Verawati, waist circumference has a significant relationship with cognitive function ( $p=0.016$ ). Central obesity has been studied as a potential risk factor for cognitive decline. Waist circumference that exceeds normal is associated with psychomotor speed, executive function, and attention (Wahid, Billy Dema Justia, 2020). According to research by Billy and Verawati, waist circumference has a significant relationship with cognitive function ( $p=0.016$ ). Central obesity has been studied as a potential risk factor for cognitive decline. Waist circumference that exceeds normal is associated with psychomotor speed, executive function, and attention (Pradini, 2016). According to study by Billy and Verawati, waist circumference has a significant relationship with cognitive function ( $p=0.016$ ). Central obesity has been studied as a potential risk factor for cognitive decline. Waist circumference that exceeds normal is associated with psychomotor speed, executive function, and attention

## CONCLUSION

In this study, there was a relationship between waist circumference and cognitive function in type 2 DM patients. In this study, it was also found that the waist circumference of central obese patients was quite a lot, so it is suggested that the Sedayu 2 Public Health Centre can pay attention to type 2 DM patients to maintain a healthy lifestyle and can maintain a normal waist circumference to prevent cognitive function decline.

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