Abdominal Obesity as a Risk Factor of Ischemic Stroke Incidence in Lamongan Distric, Indonesia

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ORIGINAL ARTICLE

Abdominal Obesity as a Risk Factor of Ischemic Stroke Incidence in Lamongan Distric, Indonesia

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ABSTRACT

Introduction: One factor that contributes to ischemic stroke is obesity. This research aims to show a positive effect between abdominal obesity and BMI in ischemic stroke. **Methods:** This study used a case control design. The case group was patients who diagnosed ischemic stroke and the control group was patients who diagnosed but not as ischemic stroke (inflammatory disease, epilepsy, movement disorders and peripheral nerve disorders). The number of samples for each group is 44 which was obtained by carrying out the purposive sampling technique. Waist circumference data was obtained from waist circumference measurements using metline, while BMI is obtained by measuring the weight using TANITA brand digital scales and height using microtoise. The statistical tests used were Pearson parametric correlation test and simple logistic regression analysis. **Results:** There is a significant relationship between abdominal obesity and p value 0.0000 and BMI with p value 0.0260 for ischemic stroke. The probability of abdominal obesity in ischemic stroke was (1.75), and BMI was (0.794). **Conclusion:** someone who has abdominal obesity was 1.75 times more at risk of having an ischemic stroke, with a probability event of 85%.The best method of identifying the risk of ischemic stroke was to use the measurement of abdominal obesity.

Keywords: Abdominal Obesity, Body Mass Index (BMI), Ischemic stroke

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INTRODUCTION

Stroke in Indonesia has reached the first rank in Asia, and the number will double by 2020(1).In Indonesia, it is estimated that the number of stroke increases by 500,000 people every year and 2.5% or 125,000 people die (2).Based on research data from the GBD and WHO databases on mortality and morbidity, stroke deaths in Asian countries, stated that Indonesia has the second highest mortality rate (193.3/100,000 person-years) (3).

Ischemic stroke is a sort of stroke with the highest prevalence in Indonesia (4). Obesity is one of the factors that can cause the ischemic stroke. Based on the prospective study, it is known that a person with obesity (the increasing of abdominal fat) is at risk of cardiovascular disease and can cause death. This is due to an increase of fat in the blood vessels in the abdomen (5).Another study stated that an increase in BMI is not associated with the incidence of stroke in women, but it is a prospective factor in men [p = 0.0300, OR = 0.59 0 (0.37-0,94)]. Abdominal obesity is a risky factor of stroke for women and men, but is significantly higher for women (6).

Obesity is a disorder that occurs due to the accumulation of excessive fat in the body. According to WHO, overweight and obese is the fifth largest cause of death. At least 2.8 million people worldwide die per year due to excessive nutrition (7). The incidence of abdominal obesity is associated to health problems related to vascular disease (8). Based on data from Basic Health Research (Riskesdas), the incidence of abdominal obesity increased from 18.8% in 2007 and still increased to 26.6% in 2013. The increasing of obesity prevalence in Indonesia will cause serious problems with the development of the nation, especially in the health sector (9).

Obesity can be defined simply as a problem of being overweight for an assessment of body weight and height, which can also manifest metabolically. In addition, it is not only a problem in body size but can also be used as an indication of degenerative diseases. Some studies stated that measurement of abdominal fat is a predictor of ischemic stroke. Furthermore, a study about comparing the measurements of BMI and waist circumference in the population in Caucasians, showed that the results of BMI measurements were not an independent predictor of ischemic stroke, whereas waist measurements showed a significant relationship (RR 1.39. 95% CI 1.12-1. 73) (6). The greater the value of the waist circumference, the riskier it leads to cardiovascular disease. Waist circumference data is more informative than body mass

index data. Therefore this study aims to analyze the effect of abdominal obesity and BMI on the possible ischemic stroke (10).

MATERIALS AND METHODS

Methods

This research method used an observational approach with a case control design. The sampling technique uses purposive sampling technique. BMI data were obtained from measurements of body weight and height. while data on abdominal obesity were obtained from waist circumference measurements. In the case group, it was obtained from patients who enrolled in neuropathy while the control group was obtained from patients who enrolled in outpatient poly. Patients who will be measured in weight are advised to remove footwear, jackets, watches, belts, bags, and all that is attached to their body. The measuring instrument used to measure body weight is using a calibrated TANITA brand digital weight scale. Furthermore, a measuring instrument used to measure height uses microtoise attached to a flat wall with an upright position. Measurements must be carried out in accordance with standard operating procedures (SOP). The first step for measuring waist circumference is to determine the points to be measured using the Onemed brand metline. The first step of measurement begins by determining, where the last rib is used to determine the top edge, then marked with a pen. Then determine the lower edge, which is from the tip of the hip and then marked. After that, determine the measured midpoint from the last rib to the tip of the hip. After finding the midpoint then the middle value is calculated and then wrap the metline to the waist so that the waist circumference value is obtained. Cut off point for determining abdominal obesity status for men waist circumference is ≥90 cm and for women ≥80 cm. whereas to determine BMI by calculating height x height / weight, if the BMI> 30 kg /m² means that the patient is obese, and if the BMI <29.9 kg /m² patient is not obese (11). This study has passed the ethical review conducted by the Ethics Commission on Health Research in the Faculty of Public Health with No: 600-KEPK 2016, which was approved by the Chair of the Ethics Commission at the Faculty of Public Health, Airlangga University, Surabaya- Indonesia.

Sampel Collection

The population in this study was divided into the cas group (ischemic stroke) and the control group (non-ischemic stroke). The case group was patients with a diagnosis of ischemic stroke who had been diagnosed for the first time by health professionals (doctor) by showing the patient's medical record data accompanied by the results of the MRI examination. Meanwhile, the control group was pastients who diagnosed but not as ischemic stroke such as inflammatory disease, epilepsy, movement disorders, peripheral nerve disorders and other diagnoses that are not a risk factor for ischemic stroke. Recruitment from the subjects was conducted at nerve poly and outpatient poly Ngimbang Hostpital, Lamongan-Indonesia. This research was conducted in August until December 2016. The sample size was calculated using the Lemeshow calculation (12). Below is the formula of sample calculation.

$$n = \frac{\left[Z_{1-\alpha/2}\cdot\sqrt{2.P2(1-P2)}+Z_{1-\beta}\sqrt{P1(1-P1)+P2(1-P2)}\right]^2}{(P1-P2)^2}$$ Formula 1

$$p_1 = \frac{OR}{(OR+1)} \qquad p_2 = \frac{P1}{OR\,(1-P1)+P1}$$ Formula 2

To calculate the p-value, it is used the results of previous studies which is done based on the OR value (2.41) (13). The following is the calculation process of the sample:

$$p_1 = \frac{OR}{(OR+1)} \qquad p_2 = \frac{P1}{OR\,(1-P1)+P1}$$

$$= \frac{2.41}{(2.41+1)} = \frac{2.41}{(3.41)} = 0.707 \qquad = \frac{0.707}{2.41(1-0.707)+0.707} = \frac{0.707}{(1.41313)} = 0.5$$

$$n = \frac{\left[Z_{1-\alpha/2}\cdot\sqrt{2.P2(1-P2)}+Z_{1-\beta}\sqrt{P1(1-P1)+P2(1-P2)}\right]^2}{(P1-P2)^2}$$

$$n = \frac{[1{,}96\,.\sqrt{2.0.5(1-0{,}5)}\;+0.84\,.\sqrt{0.707(1-0.707)+0{,}5(1-0.5)}]^2}{(0.707-0.5)^2}$$

$$n = \frac{1.869}{0.042849}$$

$n = 43.6182875 \approx 44$

After calculating, it is derived the sample size of 44 subjects for the case group and 44 subjects for the control group.

Statistics analysis

The independent variables in this study were abdominal obesity and body mass index, and the dependent variable was the ischemic stroke. Univariate analysis for ischemic and non-ischemic stroke was presented in the form of frequency distribution tables. After conducting the normality test with the Kolmogorov-Smirnov test with p-value 0.754 (normal distribution), then the bivariate analysis was performed. It is a statistical method used to analyze and understand the significant relationship between disease and the factors that contribute to ischemic stroke using the analytical statistics test by using the Pearson parametric test.

Multivariable analysis was used to determine the relationship and the magnitude of the influence of independent and dependent variables, in this test using a simple logistic regression statistical test (12). If the multivariable logistic regression analysis on the results of the bivariate test shows p <0.25, the variable can be included in the multivariate model. All of the variables tested must have a significant value of (p <0.25). Eligible variables are included in the equation model to assess the risk of ischemic stroke, so it can calculate the probability value (the percentage chance of ischemic stroke).

RESULTS

The Differences of Obesity Assessment in BMI and Waist Circumference Techniques

This study showed the differences in determining someone's obesity status using the technique of calculating BMI and waist circumference. Based on the measurement results, from 88 patients which consisted of 44 patients in case group (patients with ischemic stroke diagnose) and 44 in control groups (patients with non-ischemic stroke diagnose) (Table I).The assessment of obesity using waist circumference showed that most of the cases in the group had waist circumference ≥90 cm (cut off for male) and 40 patients had ≥80 cm (cut off for female) valued at 45.5% and there were 4 patients (4.5%) who did not have a waist size beyond normal. While in the control group, there were 15 patients (17%) who had the abdominal circumference exceeding the normal limit and 29 patients (33%) did not have measurements of waist circumference exceeding the normal limit. The obesity measurement using BMI technique showed that there were 42 patients (47.7%) who had body mass index <29.9kg/m^2 (not obese) and 2 (2.3%) patients who had BMI measurements> 30 kg/m^2. Whereas in the control group, patients who had BMI < 29, 9kg/m^2 (Not obese) were as many as 43 patients (48.9%) and there was 1 (1.1%) who had a BMI> 30 kg/m^2.

Based on the assessment of obesity status in all patients (subjects), from 88 patients taking the measurements (Table II), patients who were considered obese by using a waist circumference measurement technique but were considered not obese if measured by using the body mass index (BMI) were accounted for 48 patients (54.5%). Patients who were not obese measured by 2 measurement techniques were 32 patients (37.5%).

Based on the results of the assessment, it showed that there is a considerable difference in identifying nutritional status (obesity) between waist circumference technique and body mass index measurements. Therefore to prevent early risk of stroke, it can be measured using waist circumference.

Probability in Identifying Obesity with Body Mass Index and Waist Circumference Techniques to the Ischemic Stroke

Before calculating the probability of each variable, it must have a significant p-value <0,25. Therefore, before the probability calculation, there must be bivariate analysis to see the significant value (p <0.25) then followed by multivariable testing. The results of the bivariate analysis using the Pearson correlation test showed that waist circumference and BMI variables had p <0.25 (Table II), which meant that the two variables in this study were eligible to be included in the multivariable statistical analysis test.

Table I: Relationship between Abdominal Obesity and Respondent Body Mass Index with Ischemic Stroke

Variable	Ischemic stroke Incidence				Total		p-value
	Case		Control				
	n	%	n	%	n	%	
Abdominal Obesity							
Yes	40	45.5	15	17.0	55	62.5	0.0000
No	4	4.5	29	33.0	33	37.5	
Total	44	50	44	50	88	100	
Body Mass Index							
Yes (>30 kg/m^2)	2	2.3	1	1.1	3	3.4	0.0260
No (<29,9 kg/m^2)	42	47.7	43	48.9	85	96.6	
Total	44	50	44	50	88	100	

Table II. Abdominal Obesity Incidence and Body Mass Index of Research Respondents

Variable		Body Mass Index		Total
		Yes (>30 kg/m^2)	No (<29.9 kg/m^2)	
Abdominal Obesity	Yes	7 (8.0%)	48 (54.5%)	55 (62.5%)
	No	1 (1.1%)	32 (36.4%)	33 (37.5%)
Total		8 (9.1%)	80 (90.9%)	88 (100%)

Multivariable analysis was used to see the effect of independent variables and the dependent variable. After confirming the variable tested to have significance of p <0.25, variable of waist circumference and BMI were analyzed and then incorporated into the model equations and p value that was not significantly removed from the model. Here is the model of the equation that is produced if someone has abdominal obesity at the risk of ischemic stroke (Table III):

Y = 1.723 + 0.027 (Abdominal Obesity)
= 1.75

If someone has abdominal obesity, they have a risk of 1.75 times to experience an ischemic stroke compared to someone who does not have abdominal obesity. It indicates that abdominal obesity is a risk factor for the occurrence of ischemic stroke. The model equation for variable of body mass index to the occurrence of ischemic stroke in BMI is described below:

Y = 0.742 + 0.052 (BMI)
= 0.794

After calculating using the equation model, the result is 0.794. This showed that if the subject is included in the obesity category in calculating peripheral obesity (BMI), then the subject would be at 0.794 times risky

Table III: Results of Multivariate Analysis that Mean Statistically

Model	B	S.E	Wald	Sig.	Exp (B)
(Constant)	1.723	0.410	4.197	0.000	0.125
Abdominal Obesity	0.027	0.624	5.450	0.000	18.385
(Constant)	0.743	0.503	1.478	0.000	0.138
Body Mass Index	0.052	1.261	2.173	0.140	6.412

of ischemic stroke (protective factor) compared to those who are not included in the BMI category> 30 kg/m^2.

Based on the analysis results, the probability of abdominal obesity of the patients to experience an ischemic stroke can be calculated using the probability formula formed as follows:

$$P = \frac{1}{(1+e^{-}(1.723+0.027(1))}$$

$$P = \frac{1}{(1+0.174)} = 0.8517 \ (85\%).$$

The probability to experience an ischemic stroke caused by abdominal obesity was 85%, while 15% of which can be affected by other factors that cannot be measured. Other cases occurred after calculating the individual's body weight compared to height with the results of> 30 kg/m^2 (obesity), the ischemic stroke can likely be seen as follows:

$$P = \frac{1}{(1+e^{-}(1.723+0.052(1))}$$

$$P = \frac{1}{(1+2.214)} = 0.3111 \ (31.1\%).$$

Based on the calculations, it can be seen that the probability of a person having an ischemic stroke caused by body mass index is 31 %, while 69 % of them is caused by other factors that are unmeasured.

DISCUSSION

Measurements using Waist Circumference and Body Mass Index Techniques with Ischemic Stroke Incidence

Assessing the level of abdominal fat using the waist measurement technique can show the level of abdominal obesity. Assessing the fat levels in the body using waist circumference measurements is the best predictor for assessing the risk of degenerative diseases like stroke (13). Abdominal obesity would trigger the process of atherosclerosis associated with the occurrence of hypertension, diabetes mellitus, and *hyperlipidemia*. Some studies show that obese people will increase their risk of developing the ischemic stroke. Every person with 10 cm waist size or more has a stroke risk of 10% (14). Several studies have shown that obese people will have a higher risk of having an ischemic stroke (8).

One method used to determine the nutritional status and the percentage of fat in the body of an adult is to use body mass index measurements (15).BMI is now frequently used, although there are some opinions stating that BMI is not an accurate method of measuring fat levels in the body (16). Measurement of body mass index is a simple indicator that can be used to determine a person's risk of cardiovascular disease (17). Respondents were categorized as obese if they have a BMI> 30 cm kg/m^2 and were categorized as non-obese if they have a BMI <29, 9 kg/m^2. In this study, the group of cases that were considered obese were less than those who were not obese (Table II).

In other hand, the patients were obese with a calculation of waist circumference but were considered not obese if calculated by using BMI (Table 1). The results of this analysis indicated that to determine obesity status, it would be more appropriate to use waist circumference measurements compared to BMI measurements. Based on these results, it can be concluded that the assessment of abdominal fat is a good predictor of the risk of vascular disease compared to measurements of whole body fat in Asian races and in Japanese women (18,19).

Assessment of nutritional status against the risk of health problems is more appropriate if the measurement uses waist circumference measurements (abdominal obesity) compared with the BMI method (peripheral obesity).This happens because the cells around the stomach will be better prepared to release fat into the bloodstream when compared to other body parts of fat. If the fat has entered the blood vessels, it will cause blockages in the arteries which will cause hypertension, diabetes mellitus, stroke and cancer (20,21) .

Relationship between Abdominal Obesity and Body Mass Index with Ischemic Stroke Incidence

In the case group, Obese patients are more compared to non-obese patients (Table II), it was indicated that the assessment of obesity using measurements of abdominal obesity is precise and sensitive measurement to assess the risk of degenerative diseases. After the normality test using the Kolmogorov-Smirnov test, then Person test was indicating a significant relationship between abdominal obesity and the incidence of ischemic stroke (Table II). Abdominal obesity is associated with hypertension and diabetes mellitus which are the risk factors for stroke. In addition, these are also a risk factor for the metabolic syndrome that contributes to stroke (8).If the size of the waist circumference increases, it will increase the risk factors for Coronary Heart Disease (CHD), stroke, diabetes mellitus, and mortality due to the cardiovascular disease (22). Abdominal obesity is a risk factor for stroke, and there were approximately 85% of cases of ischemic stroke are the effects of obesity. Therefore, requires a lot of attention because people should know that obesity is associated with many degenerative diseases (23).

The results of the analysis using the Pearson test obtained indicating that there was a significant relationship between the measurements of obesity using BMI for the incidence of ischemic stroke (Table II). This results was supported by previous studies that obesity (BMI> 30kg/m^2) was associated with the risk of ischemic stroke with a p-value of 0.01(OR 1.57, CI=1.28-1.94)(24). If someone has a BMI above normal (obesity), it can trigger *dyslipidemia*, resulting in changes in blood vessel structure, especially in endothelial cells (17).Endothelial

cells will be released when damaged, because it will cause blockages in the arteries and cause the ischemic stroke (2).

The Effects of Abdominal Obesity and Body Mass Index with Ischemic Stroke Incidence

People with abdominal obesity have a risk of having ischemic stroke 1,75 times greater than those who do not have abdominal obesity. In addition, the probability of an abdominal obesity person will have 85% experiencing an ischemic stroke, while someone with peripheral obesity (BMI) will have a risk of having an ischemic stroke of 0.794 times compared to those who do not have a BMI beyond the normal limit. People with peripheral obesity have the possibility to experience ischemic strokes as big as 31%. This shows that abdominal obesity can be used for predictive factors for the risk of having an ischemic stroke, according to the results of a study on abdominal adiposities which showed a very strong significant relationship to the occurrence of stroke (2). The limitation of this study is that sampling uses a purposive sampling method, so there is a lack of variation in data from the sample. In addition, errors in anthropometric measurements also affected the results.

CONCLUSION

In accordance with the analysis results, the incidence of ischemic stroke was greater in patients with abdominal obesity that reached as many as 40 people (45.5%) compared to patients with peripheral obesity (BMI). The best method for identifying the risk of degenerative diseases is measuring the waist circumference. According to the equation model calculation, abdominal obesity has a risk for having an ischemic stroke 1,75 times greater than those who do not have abdominal obesity. In addition, the probability of abdominal obese people experiencing ischemic stroke is around 85% greater than those without visceral obesity.

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