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RELATIONSHIP BETWEEN METABOLIC SYNDROMES WITH ANTHROPOMETRY MEASUREMENTS IN THE ELDERLY

Prijo Sudibjo[*1], Cerika Rismayanthi[2], Krisnanda Dwi Apriyanto[3], Satya Perdana[4] & Yulvia Miftachurochmah[5]
[*1,2,3&4]Department of Sports Science, Faculty of Sports Science, Yogyakarta State University, Indonesia
[5]Department of Sport Coaching Education, Faculty of Sports Science, Yogyakarta State University, Indonesia

ABSTRACT

This study aims to determine the relationship between (1) metabolic syndrome with BMI, (2) metabolic syndrome with waist circumference, (3) metabolic syndrome with hip circumference, and (4) metabolic syndrome with waist-to-hip circumference ratio. This research is an analytical observational study conducted with a cross-sectional approach. Sampling was done by consecutive sampling technique. The instruments used to collect data are scales to measure body weight, a stadiometer to measure height, BMI, waist circumference, and hip circumference measured using a measuring tape. Metabolic syndrome includes blood pressure, abdominal circumference, triglycerides, HDL, and fasting blood glucose. Data analysis techniques include normality tests and correlation tests. This study shows a significant relationship between metabolic syndrome and anthropometric status. The strength of the coefficient parameters is seen in the correlation coefficient. It shows a positive correlation on all research variables with moderate correlation strength on the waist circumference variable (r = 0.476), weak correlation strength on the hip circumference variable (r = 0.331), moderate correlation strength on the RLPP variable (r = 0.416) and the strength of the correlation is weak on the BMI variable (r = 0.363). Based on the results of this study, it can be concluded that the elderly need to do physical activity as an alternative solution to prevent the occurrence of metabolic syndrome.

Keywords: metabolic syndrome, anthropometry, body mass index, waist and hip circumference ratio, elderly.

1. INTRODUCTION

Increasing age in the elderly will bring various compensations for decreased function and physical changes. Physical changes in the elderly include wrinkled skin, hair loss turning white, muscle volume shrink, heart size shrink, so that blood pumping power decreases, atherosclerosis, osteoporosis,, and decreased flexibility. There is an increase in the prevalence of degenerative diseases in the elderly. Hypertension is a form of degenerative disease that often occurs in the elderly. Hypertension is the silent killer because it is an important cardiovascular factor in the elderly. Hypertension in the elderly is at risk of causing stroke, coronary heart disease, kidney failure, and heart failure [1]. Diabetes mellitus, central obesity, dyslipidemia, and hypertension are components of the metabolic syndrome, so an increase in prevalence will affect increasing the incidence of metabolic syndrome. Metabolic syndrome consists of a set of symptoms including increased waist circumference, increased blood triglyceride levels, decreased levels of high-density lipoprotein (HDL)-blood cholesterol, high blood pressure, and glucose intolerance [2,3]. The World Health Organization (WHO) states that an individual who has 3 of these 5 symptoms can be declared to have metabolic syndrome. The prevalence of metabolic syndrome in the United States reaches 25% [4]. In Indonesia, in the elderly group, the prevalence of the metabolic syndrome is 14.9% [5]. Metabolic syndrome criteria based on the modified National Cholesterol Education Program for the Asian region states. That a person is declared to have metabolic syndrome if he has 3 of 5 conditions such as 2 increases in waist circumference (> 90 cm for men and > 80 cm for women), increased levels of blood triglycerides (>150 mg/dl), low levels of HDL cholesterol (men 110 mg/dl) [6].

Anthropometry is one method to measure the nutritional status of the community. Apart from measuring nutritional status, anthropometry can also be used as a screening for obesity. Some anthropometric indices include Body Mass Index (BMI), bodyweight for age, height for age, weight for height, upper arm circumference, subcutaneous fat thickness according to age, and Waist to Hip Ratio (RLPP) [7,8]. Body Mass Index (BMI) is the most recommended measurement for evaluating obesity and overweight in children and adults. Apart from being easy and inexpensive, BMI levels are associated with body fat and risk factors for type II diabetes [9,10]. In addition to BMI, anthropometric measurements that can be used for obesity screening are RLPP [11,12]. Central obesity is an important risk factor for cardiovascular diseases, such as hypertension and coronary heart disease, kidney disease, metabolic syndrome, and the inflammatory response in which obesity has a strong relationship with hypertension [13,14].

An anthropometric index can be used to detect 3 central obesity, one of which is the waist-to-hip ratio (RLPP). The anthropometric index is a measurement that is easy, fast, inexpensive, non-invasive, and quite accurate in predicting visceral body fat, which is closely correlated with metabolic syndrome [15]. Central obesity can also be measured by knowing the waist circumference,> 102 cm for men and > 88 cm for women [16,17]. Anthropometric measurements of central obesity are generally carried out to see predictions of metabolic disorders. Various studies have reported that anthropometric indicators of central obesity, such as waist-to-hip ratio and waist circumference, are associated with metabolic syndrome, but several studies have shown inconsistent results. A strong correlation between anthropometric measurements and metabolic disorders in a person is also influenced by a person's metabolism, such as age, gender, race, ethnicity, religion, genetics, and others. Anthropometric measurements, both BMI and RLPP, can be used as an initial screening to predict the incidence of metabolic syndrome. This prompted researchers to further study the relationship between metabolic syndrome and anthropometric measurements in the elderly.

2. METHODS

This research is an analytical observational study conducted with a cross-sectional approach, namely the type of research that emphasizes the measurement time or data observation one time at a time which is carried out on the dependent and independent variables. Analytical observational research was carried out by making observations without any treatment from the researcher.

Population and Research Sample

Sampling was done by consecutive sampling technique; samples were taken from all subjects who came and met the selection criteria until the number of subjects was met. This type of research is a correlation. Nogotirto Lotus Elderly Group, Nogotirto Village, Gamping Sleman District. These elderly are elderly assisted by the Indonesian Doctors Association (IDI) and the Indonesian Doctor's Wives Association (IIDI) Yogyakarta, total sampling 111 people.

Research Instruments

The instruments used to collect anthropometric status data is a scales to measure body weight a stadiometer to measure BMI. Waist circumference and hip circumference were measured using a measuring tape. The metabolic syndrome included blood pressure, abdominal circumference, triglycerides, HDL, and fasting blood glucose.

Analysis Techniques

The data were evaluated with SPSS 25. Firstly, the data evaluated normality test using normal distribution analysis Kolmogorov-Smirnov test. As the data were normally distributed, the correlation Spearman test was used.

3. RESULTS

The sample in this study was the Nogotirto Lotus Elderly Group. 111 seniors participated in the series of activities required in this study, consisting of 31 men and 80 women.

Table 1. Number of Research Samples by Gender

No	Gender	Total	Percentage
1.	Man	31	27,93%
2.	Women	80	72,07%
Total		111	100%

A total of 111 samples have been measured to determine the risk of metabolic syndrome and anthropometric status. The measurement of metabolic syndrome showed that as many as 31 elderlies consisting of 6 men and 25 women, had metabolic syndrome. At the same time, some 80 elderly consisting of 25 men and 55 women were not at risk of developing metabolic syndrome. Data related to the results of measuring the risk of metabolic syndrome are shown in table 2 below:

Table 2. Number of Seniors at Risk for SM by Gender

No	Status	Gender		Total
		Man	Women	
1.	Metabolic syndrome	6	25	31
2.	Non metabolic syndrome	25	55	80
Total		31	80	111

Waist circumference Central obesity is a state of excess adiposity tissue that collects in the abdominal area (intra-abdominal fat), which can be determined through abdominal circumference measurements with positive results for men more than 90 cm and women more than 80 cm. This cut of the point is used as a reference in this study. From a total of 111 samples, measurements were taken to determine the risk of metabolic syndrome and also anthropometric status. There were 77 elderly who had central obesity consisting of 14 older men and 63 older women. At the same time, 34 elderly did not have central obesity 17 consisting of 17 older men and 17 older women. Data regarding the waist circumference of the elderly can be seen in Table 3 below:

Table 3. Number of Elderly Who Has Central Obesity Measured at Waist Circumference

No	Status	Gender		Total
		Man	Women	
1.	Central Obesity	14	63	77
2.	Non Central Obesity	17	17	34
Total		31	80	111

The following data describes a description of the number of older adults who have or do not have metabolic syndrome combined with data on the number of older adults whose waist circumference has been measured, which is then categorized as having central obesity or not, which can be seen in Table 4 below:

Table 4. Data on the Number of Elderly Based on Metabolic Syndrome Status and Waist Circumference

Status		Waist Circumference		Total
		Not Obese	Obesity	
Metabolic Syndrome	No	33	47	80
	Yes	1	30	31
Total		34	77	111

Classification of patients based on the cut of point RLPP from WHO for the Asian population, namely RLPP values > 0.95 for men and > 0.80 for women, indicate abdominal obesity. This cut of the point is used as a reference in this study. Measurement of abdominal obesity with RLPP in 111 elderly, data obtained that there are 78 elderly who experience abdominal obesity consisting of 5 older men and 73 older women. In comparison, 33 elderly did not experience abdominal obesity consisting of 26 older men and 7 older women. Data regarding the elderly RLPP can be seen in the table below:

Table 5. Number of Elderly Who Has Central Obesity Measured by RLPP

No	Status	Gender		Total
		Man	Women	
1.	Abdominal obesity	5	73	78
2.	Non abdominal obesity	26	7	33
Total		31	80	111

Table 6. Data on the Number of Elderly Based on Metabolic Syndrome Status and RLPP

Status		RLPP		Total
		Not Obese	Obesity	
Metabolic Syndrome	No	30	50	80
	Yes	3	28	31
Total		33	78	111

Table 7. Classification of BMI in Asian Adults [18]

No.	Classification	BMI (kg/m^2)
1.	Underweight	< 18,5
2.	Normal	18,5 – 22,9
3.	Overweight:	≥ 23
	Risky	23,0 -24,9
	Obese I	25,0 – 29,9
	Obese II	≥ 30,0

The BMI classification in this study is based on the Asian adult population following the WHO norms. Data on the classification of BMI, gender, and the number of elderly can be seen in the following table:

Table 8. Classification of BMI, Gender, and Number of Elderly

No.	Classification	Gender		Total
		Man	Women	
1.	Underweight	1	4	5
2.	Normal	9	19	28
3.	Overweight:			
	Risky	8	18	26
	Obese I	9	27	36
	Obese II	4	12	16
Total		31	80	111

Table 9. Data on the Number of Elderly Based on Metabolic Syndrome Status and BMI

Status		BMI					Total
		Underweight	Normal	Risky	Obese I	Obese II	
Metabolic Syndrome	**No**	4	25	20	25	6	80
	Yes	1	3	6	11	10	31
Total		5	28	26	36	16	111

Normality test is carried out using the One-Sample Kolmogorov-Smirnov Test. The data is normally distributed if p> 0.05. The following are the results of the Kolmogorov Smirnov normality test, which includes waist circumference, hip circumference, RLPP, and BMI.

Table 10. Normality Test of Research Variables

		Waist circumference	Hip circumference	RLPP	BMI
N		111	111	111	111
Normal Parameters[a,b]	Mean	88.9459	97.8333	.9085	25.4519
	Std. Deviation	11.66782	10.07480	.06302	4.62788
Most Extreme Differences	Absolute	.062	.110	.079	.095
	Positive	.059	.110	.045	.095
	Negative	-.062	-.078	-.079	-.045
Test Statistic		.062	.110	.079	.095
Asymp. Sig. (2-tailed)		.200[c,d]	.002[c]	.082[c]	.015[c]

In the hip circumference and BMI data, the data are not normally distributed. Because the data is not normal, the Pearson parametric test cannot be performed. The test that can be performed on data that is not normally distributed is Spearman's non-parametric test. The following are the results of Spearman's non-parametric correlation test.

Table 11. Spearman Non-Parametric Correlation Test Results

			Variables of Research			
			Waist circumference	Hip circumference	RLPP	BMI
Spearman's rho	Metabolic Syndrome	Correlation Coefficient	.476**	.331**	.416**	.363**
		Sig. (2-tailed)	.000	.000	.000	.000
		N	111	111	111	111

The significance value of p<0.05 indicates a significant correlation between metabolic syndrome and waist circumference, hip circumference, RLPP, and BMI. From the data above, it can be read that all research variables, including waist circumference, hip circumference, RLPP, and BMI have a value of p = 0.000 (p <0.05). The strength of the coefficient parameters is seen in the correlation coefficient, showing a positive correlation on all research variables with moderate correlation strength on the waist circumference variable (r = 0.476), weak correlation strength on the hip circumference variable (r = 0.331), moderate correlation strength on the RLPP variable (r = 0.416) and the strength of the correlation is weak on the BMI variable (r = 0.363). The strength of the correlation refers to the following table:

Table 12. Interpretation of Correlation Strength (Dahlan, 2011: 169)

Parameter	Value	Interpretation
Correlation Strength	0,0 - < 0,2	Very Weak
	0,2 - < 0,4	Weak
	0,4 - < 0,6	Medium
	0,6 - < 0,8	Strong
	0,8 - < 1	Very Strong

4. DISCUSSION

The results in this study indicate a significant relationship between metabolic syndrome and anthropometric status. The significance value of p<0.05 indicates a significant correlation between metabolic syndrome and waist circumference, hip circumference, RLPP, and BMI. The data found that all research variables, including waist circumference, hip circumference, RLPP, and BMI, had a p-value = 0.000 (p <0.05). The strength of the coefficient parameters is seen in the correlation coefficient, showing a positive correlation on all research variables with moderate correlation strength on the waist circumference variable (r = 0.476), weak correlation strength on the hip circumference variable (r = 0.331), moderate correlation strength on the RLPP variable (r = 0.416) and the strength of the correlation is weak on the BMI variable (r = 0.363). Waist circumference is one of the tools used to assess excess fat in the abdomen, which is often referred to as central obesity [20,21]. Central obesity is excess fat in the abdomen associated with blood lipid abnormalities, increasing the risk of coronary heart disease and metabolic disease [22–24].

The results of waist circumference measurements showed that 77 (69.37%) subjects from 111 elderly had central obesity. The results of this study are greater than the central obesity rate based on Tzotzas et al., (2011), this research is study cross-sectional epidemiological survey conducted in Greece, showed that the overall prevalence of abdominal obesity using the index Waist Circumference was 12.5% and 14.2% in boys and girls, while using the index WHtR, it was 25.6% and 20.0% respectively. This study's high rate of central obesity may be due to lifestyle changes, namely the consumption of energy-dense foods that are high in carbohydrates, fat, cholesterol, low in fiber, and physical activity. It is recommended that the subject's cholesterol intake is less than 300 mg/day and fiber between 25-30 g/day [26–28]. Energy-dense food accompanied by a lack of physical activity is thought to result in weight gain. Most of the excess energy will be stored as fat, and this accumulation of fat causes obesity [29,30]. Accumulation of fat in the abdomen will increase the release of free fatty acids into the blood circulation to increase the synthesis of triglycerides. This increase is thought to cause hypertriglyceridemia, lower HDL cholesterol, and increased LDL cholesterol [31,32].

Metabolic syndrome is also influenced by obesity which can be measured using nutritional status, namely body mass index. Based on the results of this study, data were obtained that some 26 older adults had a nutritional risk status, 36 elderly were in the obese category I, and 16 older adults were obese II. Being overweight or obese is a risk factor for various degenerative diseases, one of which is diabetes mellitus. Obesity is caused by excessive insulin retention by pancreatic beta cells in the blood (hyperinsulinemia). Insulin is needed by fat to be stored and managed into body cells. If insulin cannot convert fat into an energy source for the body's cells, fat will accumulate, which can cause blood sugar levels to rise [33–35].

Body Mass Index (BMI) is closely related to the degree of fat tissue [36,37]. To measure the fat tissue, waist circumference measurements can be carried out because fat accumulation is around the pelvis and waist, which indicates central obesity. Along with the increasing problem of obesity, a known metabolic syndrome consists of central obesity, insulin resistance, hypertension, and dyslipidemia. Men and women who are obese impact high systolic and diastolic blood pressure, total cholesterol, LDL cholesterol, and triacylglycerol, but low HDL cholesterol levels. The waist-to-hip ratio is a measurement method that can be used to determine body fat distribution, describe central obesity, and predict the risk of cardiovascular disease than BMI [38]. The results showed a significant relationship between metabolic syndrome and RLPP (p=0.000) with moderate correlation strength (r=0.416). The risk of cardio-metabolic disease related to central obesity is associated with increased visceral adipocyte tissue (VAT) [39]. Obesity is characterized by the occurrence of adipose tissue hyperplasia and adiposity hypertrophy [40].

5. CONCLUSION

Based on the implementation of the research activities that have been carried out, the following conclusions can be drawn: The study results show that as many as 31 older adults have metabolic syndrome. A total of 111 people had complete data for correlation analysis. The results in this study indicate a significant relationship between metabolic syndrome and anthropometric status. The greater the waist circumference, hip

circumference, RLPP, and BMI are, the greater the risk of metabolic syndrome. Therefore, the elderly need to do physical activity as an alternative solution to prevent the occurrence of metabolic syndrome.

Suggestion

Based on some of the conclusions above, it is recommended to all members of the Elderly Group. To continue to carry out health checks routinely and routinely carry out physical activities that follow each characteristic of the elderly. It is recommended that the elderly maintain their health and fitness status. So that is expected to avoid the symptoms of metabolic syndrome.

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