ORIGINAL ARTICLE

The effect of Aerobic Exercise on Metabolic Syndrome Markers in Middle-Aged Women

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ABSTRACT

Introduction: Metabolic syndrome (MetS) refers to a group of risk factors linked to central obesity, dyslipidemia, hypertension and glucose intolerance. Aerobic exercise as part of lifestyle changes can reduce calorie consumption and enhance metabolic markers. This study aims to determine the effect of aerobic exercise has on MetS markers in middle-aged women. **Methods:** The study employed a pre-experimental design featuring a single group with pretest and posttest. The participants in this research consisted of 24 middle-aged women, and the sampling method employed was convenience sampling. Independent variable is aerobic exercise equivalent to 150 min/week throughout 4 weeks. Dependent variables are MetS markers, which include waist circumferences (WC), Triglyceride (TG) levels, High-Density Lipoprotein Cholesterol (HDL-C) levels, blood glucose levels, and blood pressure (BP). Data was examined through univariable and bivariable analyses, with the risk factor magnitude assessed using the odds ratio (OR) and a 95% Confidence Interval (CI). **Results:** Providing aerobic exercise reduced the incidence of MetS by 33.3%. Aerobic exercise intervention was significant difference in average WC (p-value= 0.003, 95%CI= 1.18-5.15), HDL-C (p-value= 0.001, 95%CI= -30.50- (-17.66), Systolic BP (p-value= 0.001, 95%CI= 13.88-26.94), blood glucose (p-value= 0.001, 95%CI= 13.07-30.61). **Conclusion:** Aerobic exercise for middle-aged women can reduce WC, BP, blood glucose, increase HDL-C and improve MetS markers.
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INTRODUCTION

Prevalence MetS at the adult population in the world is assessed at 20-25% (1), in the middle-age and elderly population was 37.1% (3) while among sedentary adults with obesity it is 80% (2). Metabolic syndrome is defined by central obesity, impaired blood glucose and insulin resistance, high blood pressure, decreased HDL-C levels and elevated triglycerides (4–6). Individuals with MetS have twice the risk of mortality and three times more likely to experience a cardiovascular disease (CVD) like a heart attack or stroke compared to those without MetS (7). Metabolic syndrome consists of a group of risk factors for CVD and indicated a fivefold elevation in the risk factor for type 2 diabetes mellitus (T2DM) (8,9).

Based on Global Consensus the International Diabetes Federation (IDF), MetS identified central obesity (using race and gender-specific waist circumferences cut-offs) as an essential component, along with any two of the following factors: elevated Triglycerides ≥150 mg/dl or a history of treatment for this lipid issue, lowered HDL-C <50 mg/dl in females or a history of treatment for this lipid condition, elevates blood pressure: systolic BP ≥130 mm Hg or diastolic BP ≥85 mm Hg or on treatment for previously diagnosed hypertension, and increasing fasting plasma glucose ≥100 mg/dl or previously diagnosed T2DM (10).

Family history of T2DM and obesity or being overweight are independent predictors of incidence of MetS in both genders with all components of MetS (11). Conversely, MetS among individuals under 50 years old was somewhat more prevalent in men, but after 50, it was more common in women due to hormonal changes and biological processes in women post-menopause (3). One of the interventions that can reduce the incidence of MetS in women is by doing physical activities such as aerobic exercise. The clinical aspect of MetS can be modified with physical activity, which include: raising energy expenditure, promoting dilatation of current

vessels and enhancing insulin sensitivity (12). This study aims to assess the impact of aerobic exercise on MetS markers in middle-aged women.

MATERIALS AND METHODS

Study design

This study was a pre-experimental design featuring a single group with pretest and posttest design. This study only involved an experimental group without a control group in the study.

Participants and setting

The participants in this research are middle-aged women at District Utama, South Cimahi, and the total number of participants was 24 people. The criteria for inclusion in these studies are women aged 40 to 65, homemakers, and who lack regular exercise routines. During the intervention period, all participants were encouraged to keep their usual diet and exercise routine. The sampling technique used is convenience sampling. This research took place between March-December 2023.

Ethical considerations

The Ethics Committee at Fakultas Ilmu dan Teknologi Kesehatan Universitas Jenderal Achmad Yani Cimahi approved this research, registered under number: 05/KEPK/FITKes-UNJANI/III/2023.

Variable and data collection

Independent variable is aerobic exercise performed two to three times a week with duration of 50-75 minutes, or equivalent to 150 minutes/week throughout 4 weeks. This exercise is divided into warm-up movements for ten minutes, core exercise for thirty to fifthe minutes and cool-down exercise for ten to fifteen minutes. Aerobic exercise intensity categorized as moderate with maximum heart rate (MHR) is 50-70% and METS (Metabolic Equivalents) moderate are 3.0-5.9 METs. The entire supervised aerobic training program was performed under professional observation. A trainer or therapist guides sessions, monitors progress (heart rate, effort), adjusts intensity, and ensures safety. The exercise all performed with popular music, which makes the respondents excited with this intervention.

Dependent variables include markers of MetS, which are: central obesity measured by waist circumferences, level of Triglyceride (TG), High-Density Lipoprotein Cholesterol (HDL-C), blood glucose levels, and blood pressure (BP). Metabolic syndrome was characterized by individuals possessing central obesity along with at least two of the following conditions: dyslipidemia indicated by hypertriglyceridemia and low HDL-C levels, impaired fasting glucose, and hypertension (4,10) Metabolic syndrome markers examined with anthropometry and biochemical measurement. The examination markers of MetS were carried out before and after the implementation of the intervention. Anthropometry measurement to determine central obesity with waist circumference (WC), it was measured halfway between the top of hip bone and the bottom of the rib. Cut off point WC at women for MetS are 80 cm or higher (10). Biochemical analysis utilized to assess lipid profiles including TG level, HDL-C, and blood glucose concentration from blood vessels following a twelve-hour overnight fast. Venous blood samples (5 ml) were collected in tube from each participant. The Glucose Oxidase-Peroxidase aminoantipyrine (GOD-PAP) was used to estimate the blood glucose level. Colorimetric enzymatic test using glycerol-3-phosphate-oxidase (GPO) method and precipitant reagent for in vitro determination of high-density lipoprotein cholesterol (HDL-C) according to the CHOD-PAP-method on photometric systems method were used to estimate triglycerides and HDL cholesterol. Increased TG is indicated when the level exceeds 150 mg/dL, lower HDL-C occurs if the level drops below 50 mg/dL, and hyperglycemia is present when fasting glucose is greater than 100 mg/dL. Blood pressure was taken using a sphygmomanometer, a high BP is identified if the systolic is 130 or above or the diastolic is 85 mmHg or above (10).

Data analysis

The analysis employed univariable methods to examine each variable individually, while bivariable analysis utilized the dependent t-test. The important test employed a p-value with a significant threshold (alpha) of 0.05. The size of the risk factor for MetS is established by the Odds Ratio (OR) and the 95% Confidence Interval (CI).

RESULTS

Metabolic Syndrome are persons as having central obesity along with any two of the following four characteristics: elevated TG, decrease HDL-C, increases BP and elevated fasting plasma glucose levels. In this research, the prevalence of MetS among middle-aged women before the intervention was 66.7% and after intervention, it was 33.3%. MetS markers among middle-aged women showed that participants who were overweight experienced, from 16.7% to 12.5%, and so did central obesity decreased after being given intervention from 79.2% to 75%. In this study shows that the research result are different, where elevated TG increses, participants with higher TG levels before intervention are 29.2% and after intervention are 37.5%, Participants with reducing low HDL-C from 79.2% to 12.5%, with hyperglycemia after intervention decreased significantly, from 33.3% to 4.2% and raised BP before intervention are 75% and after intervention are 54.2% (Table I).

As shown in table II, providing aerobic exercise intervention to middle-aged women can decrease of WC, with the average before intervention are 91.62±11.56

Table I: Frequency distribution Metabolic Syndrome Marker of respondents (n= 24)

Component of Mets	Before intervention	After intervention
Obesity		
Obese	16 (66.7%)	16 (66.7%)
Overweight	4 (16.7%)	3 (12.5%)
Normal	4 (16.7%)	5 (20.8%)
Central Obesity		
Increased WC	19 (79.2%)	18 (75%)
Normal WC	5 (20.8%)	6 (25%)
Triglyceride (TG)		
Elevated TG	7 (29.2%)	9 (37.5%)
Normal TG	17 (70.8%)	15 (62.5%)
High-Density Lipoprotein Cholesterol (HDL-C)		
Low HDL-C	19 (79.2%)	3 (12.5%)
Normal HDL-C	5 (20.8%)	21 (87.5%)
Hyperglicemia		
Yes	8 (33.3%)	1 (4.2%)
No	16 (66.7%)	23 (95.8%)
Blood Pressure (BP)		
Raised BP	18 75%)	13 (54.2%)
Normal BP	6 (25%)	11 (45.8%)
Metabolic syndrome (MetS)		
Yes	16 66.7%)	8 (33.3%)
No	8 (33.3)	16 (66.7%)

cm and after intervention are 88.46±9.54 cm, there was a significant difference in the WC with p-value= 0.003, (95% CI= 1.18-5.15). In this research, aerobic exercise intervention was significant difference in average HDL-C level (from 43.42±11.01 mg/dL to 67.54±20.83 mg/dL) with p-value= 0.001, (95% CI= -30.50 to (-17.66). Systolic BP was significant before and after intervention (from 138.75±22.71 mmHg to 118.33±16.33) with p-value= 0.001, (95%CI= 13.88-26.94), before intervention average of SBP are 138.75±22.71 mmHg and after intervention are 118.33±16.33 mmHg. Blood glucose level decreased before and after intervention with aerobic exercise (p-value= 0.001, 95%CI= 13.07-30.61), average before intervention is 96.33±23.75 mg/dL and after intervention is 74.49±8.48 mg/dL.

DISCUSSION

Metabolic syndrome is a clustering of metabolic alters and is related with obesity, especially central obesity, dyslipidemia, hypertension, insulin resistance or glucose intolerance (4,11,13). Metabolic syndrome can increase the risk of non-communicable disease such as: hypertension, T2DM, and developing atherosclerotic CVD (11,13). This research found that participants suffering from MetS decrease after intervention with aerobic exercise (from 66.7% to 33.3%). Prevalence of MetS is associated with physical activities and sedentary lifestyle. Decreasing level of aerobic exercise was associated with increasing level of risk factor for MetS (14). Research by Chou et al (2023) found that females mature with aged 40-64 years old with no exercise, increased the risk factor for MetS with p-value < 0.0001 and Adjusted Odd Ratio (AOR)= 2.01 (95%CI=1.37-3.02) (15).

This research found that aerobic intervention can reduce WC, HDL-C, SBP and blood glucose. Research by Kudo et al (2021), women with daily physical activity had significantly higher risk factors for MetS: BMI, WC, SBP, LDD-C and HbA1c (16). According to a systematic review by Ostman et al (2017), found that, exercise training can be reducing WC with p-value<0.001; mean difference (MD)- 1.37 cm (95%CI= -202, -0.71), reduce SBP with p value<0.001, MD= -2.54 mmHg (95%CI= -4,34, 0.75) and reduce fasting blood glucose with p-value<0.001, MD= -0.16 mg/dL (95%CI= -0.32, -0.01) (17). According the research by Chou et al (2023), found that participants aged between 40-64 years old with exercise ≥ 150 min/week significant with

Table II: Paired t-test analysis the effect of aerobic exercise in middle-aged women

Variable	Min	Max	mean±SD	Delta	p-value	95%CI	
						Lower	Upper
WC (cm)							
Before	72	119	91.62±11.56	3.16±4.69	0.003	1.18	5.15
After	71	104	88.46±9.54				
Triglyceride (mg/dL)							
Before	56	460	131.58±83.04	-10.66±51.71	0.323	-32.50	11.17
After	71	384	142.25±73.53				
HDL-Cholesterol (mg/dL)							
Before	30	84	43.42±11.01	-24.12±15.30	0.001	-30.05	-17.66
After	34	118	67.54±20.83				
SBP (mmHg)							
Before	100	180	138.75±22.71	20.41±15.45	0.001	13.88	26.94
After	100	160	118.33±16.33				
DBP (mmHg)							
Before	60	100	86.25±9.23	2.08±11.78	0.396	-2.98	7.06
After	60	100	84.17±10.59				
Blood Glucose (mg/dL)							
Before	72	150	96.33±23.75	21.84±20.77	0.001	13.07	30.61
After	71	104	74.49±8.48				

the risk of MetS (p-value= 0.017, Adjusted odd Ratio= 0.62, 95%CI= 0.41-0.91), it means that exercise can be protecting factor for suffering MetS (15).

Obesity is the most important risk factor for MetS (19), whereas excessive fat in and around the abdomen is more associated with occurrence of MetS (20). So that the abdominal or visceral obesity is a marker and has a central role in the development of MetS (18). Central obesity is a major risk factor for metabolic charge such as insulin resistance, hyperlipidaemia, and several CVD (18). In this study, it was found that providing intervention with aerobic exercise in middle-aged women can reduce and control markers related to MetS. The limitation of this study is that there was no information about medication history and did not calculate food consumption, especially carbohydrates, where a low-carbohydrate diet is significantly related to controlling MetS markers (19).

Aerobic exercise is one of the most effective interventions for controlling MetS. It causes energy expenditure for aerobic exercise and can reduce body weight and reduce abdominal fat deposits significantly (12,18). Aerobic exercise is a lifestyle intervention for controlling and decreasing in hypertensive patients, it can be lowering SBP by 8-12 mmHg dan DBP by 5-6 mmHg. Aerobic treatment can effect change for blood parameters such as total cholesterol (TC), TG, DHL-C, and LDL-C. Aerobic exercise is more effective to increase HDL-C, and lowering levels of TC and TG. Physical activity is more recommended for patients with T2DM, when muscles contractions during aerobic exercise, this will increase glucose uptake in skeletal muscle so that blood sugar levels will be controlled (12).

Several limitations must be acknowledged when interpreting the findings of this study. First, the use of a pre-experimental, single-group pretest–posttest design lacks a control group, which restricts the ability to draw definitive causal inferences and limits the generalizability of the results to the wider population. Second, the study did not measure or account for potential confounding variables, such as the participants' baseline diet, concurrent medications, or external physical activity outside of the formal intervention. Finally, the relatively short intervention period—consisting of only four weeks of therapy sessions—may have been insufficient to yield or observe optimal therapeutic outcomes

CONCLUSION

According to this study, provision of aerobic exercise intervention in middle-aged women can be decreasing the percentage of participants who have experienced MetS, central obesity, hypertension, hyperglycemia, and increasing HDL-C. Lifestyle intervention for middle-age women with aerobic exercise can reduced visceral fat and lead to improved MetS markers, it can decrease WC, SBP, DBP, blood glucose level, and increase HDL-C.

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