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Effect of Moderate Intensity Combination Exercise on Reducing Inflammation in Obese Women

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ABSTRACT

High inflammation in obesity is a serious problem for improving the quality of human resources. High inflammation in obesity conditions will interfere with health metabolism, thus having an impact on the occurrence of complications in obesity. Regular physical exercise is believed to be a strategic method for individuals who are obese. The purpose of this study is to prove the combination exercise on reducing inflammation in obesity. A total of 20 obese women with a BMI of ≥25 kg/m2 were divided into 2 groups, namely the control group (K1; n = 10), the combination exercise intervention group (K2; n = 10). Exercise is done at moderate intensity (aerobic exercise 60-70% HRmax and strength training 60-70% 1-RM), on aerobic exercise for 40 minutes and strength training as many as 4-6 sets, 10-15 reps, with a frequency of 5x/week, for 4 weeks. Inflammatory levels use the biomarker IL-1β. Inflammatory levels were measured at the time of pretest and posttest using the ELIS method. The Paired Sample T-Test showed no difference in the average inflammatory level between the pretest and the posttest in K1 (22.45 ± 7.15 vs 22.72 ± 6.87 ng/mL; p= 0.867), and in K2 there was a significant difference (23.86 ± 10.18 vs 16.27 ± 3.60 ng/mL; p= 0.037). It can be concluded that with 4 weeks of moderate-intensity combination exercise, it is proven to reduce inflammation levels in obese women.

Keywords: women, obesity, IL-10, physical exercise, inflammation

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Introduction

High inflammation in obesity is a serious problem for improving the quality of human resources. High inflammation causes metabolic dysfunction, reduces motivation to be active, so the less movement is done, the higher the occurrence of obesity (Ghaderi et al., 2021). However, until now, handling obesity, especially in reducing inflammation rates, has not received serious attention. Inflammation is a risk factor that can cause a decline in metabolic health, thus impacting on a decrease in life expectancy (Collins et al., 2018).

Amin et al., (2019) showed that increased levels of inflammation in obesity lead to the development of various types of inflammatory disorders including type 2 diabetes mellitus. H. Wu & Ballantyne, (2020) also stated in their research that increased inflammation in obesity can reduce insulin resistance which will have an impact on increasing metabolic disorders, the occurrence of type 2 diabetes mellitus (T2DM), and cardiovascular disease.

Obesity is characterized by high fat mass accumulation, which can reduce muscle mass and increase the risk of injury to loaded muscles. Therefore, one approach to reducing inflammation is to increase muscle mass and decrease fat mass. According to Collao et al., (2020), increasing muscle mass and decreasing fat mass can be achieved through exercise. However, exercise for obese individuals requires special attention because they tend to have low levels of

physical fitness, so exercise intensity is an important factor (Chin et al., 2016).

Aerobic exercise is highly recommended for obese groups because it can improve heart, lung, and metabolic function (Oppert et al., 2021). However, aerobic exercise alone is considered less effective in developing muscle mass significantly (van Baak et al., 2021). In this case, weight training also needs to be applied because it can increase muscle strength. Therefore, combining aerobic exercise and weight training with an intensity appropriate for obese individuals will make a real contribution to reducing inflammation (Yousefabadi et al., 2021). Based on this, this study will combine aerobic and strength training sessions carried out at one time with an intensity of 60%-70% to reduce inflammation using the IL-1β biomarker.

Methodology

This research method is a true experimental with a research design in the form of the randomized pretest-posttest control group design. The study was conducted for 4 weeks using 3 places, namely: 1) Sport Science Laboratory, Faculty of Sport Science, State University of Malang; 2) Atlas Sport Club Malang; and 3) Physiology Laboratory, Faculty of Medicine, Brawijaya University. The subjects in this study used 20 obese women as research subjects selected based on the following criteria: age 20-30 years, body mass index (BMI) ≥25 kg/m^2, blood pressure (systolic 110/120 mmHg and diastolic 70/80 mmHg), resting heart rate 60-80 bpm, oxygen saturation 96-100%, not actively exercising, non-smokers, and non-drinkers of alcohol. The research subjects were divided into 2 groups, namely the control group (K1; n = 10) and those given combination training (K2; n = 10).

The combination exercise in this study used aerobic exercise and resistance exercise. Aerobic exercise used a treadmill for 40 minutes. Resistance exercise used 6 gym equipment with the Cybex and Life Fitness brands which were divided into 2 muscle parts, namely the lower body and upper body. The upper body part used a chest press machine, shoulder press machine, and lat pull down machine, then the lower body part used a leg press machine, leg extension machine and hip abduction machine. The intensity of the exercise in this study used moderate intensity (aerobic exercise 60-70% HRmax and resistance exercise 60-70% 1-RM), which was done in 4 sets, 10 repetitions, with a frequency of 5x/week, within 4 weeks. Throughout the combination exercise, heart rate was monitored with POLAR H10. Furthermore, blood samples taken through the cubital vein were ±4 ml during the pretest (before the exercise intervention) and posttest (after 4 weeks of the combination exercise intervention). Blood samples will be centrifuged for 15 minutes at a speed of 3000 rpm then separate and store the serum at a temperature of -800C for analysis of IL-1β levels the next day using the Enxymelinked Immunosorbent Assay (ELISA) kit method (Cat.No.: E-EL-H0149; Elabscience, Inc., USA) with a sensitivity level of 4.96 pg/mL and a detection range of 7.81-500 pg/mL.

Data analysis in this study was conducted after the pretest and posttest were collected. Furthermore, the data that had been obtained were analyzed using the Statistical Package for the Social Science (SPSS) application with version 21.0. The normality test was conducted through the Saphiro-Wilk test with a significant level ($p>0.05$). The difference in IL-1β levels from the pretest to the posttest in each group was analyzed using the paired sample t-test, then the difference in IL-1β levels from the pretest to the posttest between groups using the independent sample t-test with a significant level ($p<0.05$).

Result

The results of the analysis of the characteristics of the research subjects including age, height (TB), weight (BB), Body Mass Index (BMI), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Resting Heart Rate (RHR), Oxygen Saturation (SpO2), Body Temperature (ST), Fasting Blood Sugar (FBS), Hemoglobin (HB) in the control group (K1) and the combination exercise group (K2) did not show any significant differences as can be seen in Table 1.

Table 1. Characteristics of Research Subjects in Both Groups

Variable	n	K1		K2		
		Mean	SD	Mean	SD	*P-Value*
Age (year)	10	23.40	1.58	23.60	1.64	0.785
TB (m)	10	1.54	0.068	1.56	0.039	0.582
BB (kg)	10	72.91	7.63	74.70	5.89	0.564
IMT (kg/m^2)	10	30.41	2.68	30.65	1.92	0.821
TDS (mmHg)	10	122.60	7.53	120.50	10.69	0.618
TDD (mmHg)	10	72.00	6.61	74.70	5.71	0.342
DJI (bpm)	10	85.40	9.15	86.50	8.00	0.778
SpO^2 (%)	10	98.20	0.789	98.60	0.516	0.196
ST (°C)	10	35.30	1.06	35.78	0.590	0.229
GDP (mg/dL)	10	98.40	13.26	97.80	4.70	0.894
HB (g/dL)	10	13.94	1.87	14.00	1.48	0.938

Description: K1: Control group; K2: Combined Exercise Group; SBP: Systolic blood pressure; SBP: Diastolic blood pressure; DJI: Resting heart rate; SpO^2: Oxygen saturation; ST: Body temperature; GDP: Fasting blood sugar; HB: Hemoglobin; TB: Height; BB: Weight; BMI: Body mass index.

Based on the results of descriptive analysis, it shows that the characteristics of the subjects in each group are not significantly different. The results of the Independent Samples T Test show that there is no significant difference in the average data on the characteristics of the research subjects in both groups ($p>0.05$). The results of further analysis on the levels of inflammation between the pretest and posttest in both groups are presented in table 2 below.

Table 2. Results of Analysis of IL-1β Levels Pretest and Posttest in Both Groups

Groups	Observation	n	Mean (ng/mL)	SD	Normality	*p-value*
K1	*Pretest*	10	22.45	7.15	0.201	0.867
	Posttest	10	22.72	6.87	0.788	
K2	*Pretest*	10	23.86	10.18	0.163	0.037*
	Posttest	10	16.27	3.60	0.115	

Description: K1: Control group; K2: Combination Exercise Group. (*) Indicates significant value with level ($p<0.05$)

Based on the results of descriptive analysis, it shows that there is a decrease in the average level of inflammation between pretest and posttest in group K2 and an increase in K1. The results of the normality test show that the distribution of the average data on the level of inflammation between pretest and posttest in each group is normal ($p>0.05$). The results of the Paired Sample T-Test show that there is a significant decrease in the average level of inflammation between pretest and posttest in K2 ($p=0.037$; $p<0.05$).

Based on the results of the study, there was a difference in the average IL-10 levels in both groups between pretest and posttest. However, in the control group (K1) the difference in inflammatory levels was not significant compared to the combination exercise group (K2) (Table 2.).

Dicussion

Based on the results of the study, there was a significant change in inflammation reduction between the combination exercise groups (K2) carried out for 4 weeks. In this study, the reduction in inflammation was greater in the combination exercise group. There was a difference in K1 which was inversely proportional to K2 in terms of reducing inflammation levels. The results of the analysis revealed that the greatest reduction occurred in K2 in terms of inflammation levels before and after combination exercise. This is in accordance with previous research by Pranoto et al., (2023)which stated that the combination exercise group with moderate intensity of 50-70% HRmax for 4 weeks in obese women

resulted in a more effective reduction in pro-inflammatory cytokine levels than the control group. Combination exercise is considered a more effective exercise because it has the greatest anti-inflammatory effect compared to aerobic exercise and strength training (Kargarfard et al., 2017). The results of this study reported that combination exercise is more effective in reducing pro-inflammatory cytokines than aerobic exercise and strength training separately.

Combination training performed for 4 weeks reduces inflammation levels. During physical exercise, there is an increase in the activation of T cells and macrophages, which play a role in the inflammatory response (Rosa-Neto et al., 2022). During exercise, there is a release of anti-inflammatory cytokines such as IL-10 and TGF-β1 which help neutralize the pro-inflammatory effects of cytokines such as IL-1β (Steen et al., 2020). During exercise, there is an increase in mitochondrial function in muscle cells, which plays a role in energy metabolism and reduces the accumulation of waste products that can trigger inflammation (Magherini et al., 2019). In addition, exercise affects hormone regulation, increasing levels of anti-inflammatory hormones and decreasing levels of stress hormones such as cortisol (Athanasiou et al., 2023). Combination training can reduce body fat, especially visceral fat, which is the main source of pro-inflammatory cytokines. By reducing body fat, the production of other pro-inflammatory cytokines can be suppressed.

The decrease in inflammation levels is also due to a decrease in adipose tissue due to physical exercise. Research conducted by Calcaterra et al., (2022) found that intense physical exercise can contribute significantly to helping reduce adipose tissue, which functions as an endocrine and paracrine organ, and is also responsible for stimulating a decrease in inflammatory mediators. This is supported by research conducted by Metsios et al., (2020) which shows that inflammatory mediators come from macrophages in adipose tissue in obese people. Hypertrophy and hyperplasia in obese women cause stress and macrophage activation.

Research conducted by Pranoto et al. (2023) stated that combination training is considered the best exercise because it has the greatest effect compared to aerobic exercise and resistance training. Aerobic exercise increases blood flow and oxygen to muscle tissue, while strength training builds muscle mass (Liang et al., 2021). The decrease in inflammation levels after a 4-week combination exercise intervention was followed by metabolic processes that occur during exercise, such as increased oxygen consumption and antioxidant production. This process is also supported by increased blood flow and nutrient transport to the muscles, which can help reduce inflammation (Handajani et al., 2015). Muscle contractions and the use of fat stores as an energy source cause a decrease in muscle mass and an increase in adipose tissue (Kusuma et al., 2023). This is due to the intervention of moderate-intensity combination exercise recommended in the fat mass reduction program. During combination exercise, IL-6 produced by muscles can reduce the secretion of IL-1β and TNF-α (Alvarez et al., 2020). In this study, a significant decrease in inflammation levels was found in the combined exercise intervention group (K2). These changes lead to the conclusion that the greatest changes in inflammation levels occurred in subjects who did the exercise.

Conclusions

Based on the research results, it can be concluded that a combination of aerobic exercise and moderate intensity strength training carried out for 4 weeks reduces inflammatory cytokine levels in obese women

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