

Effect Of Interval Exercise Versus Continuous Exercise On Increases Energy Expenditure On A Treadmill

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ABSTRACT

Obesity is a condition of abnormal fat accumulation in adipose tissue. The cause of obesity is multi-factorial, but a common factor that contributes to weight gain is an imbalance between energy intake and energy expenditure. Doing exercise is considered as one of the most effective and efficient methods in preventing the increasing prevalence of obesity. This is because the exercise causes an increase in energy expenditure. This study aims to analyze the effect of interval exercise versus continuous exercise on increasing energy expenditure on a treadmill. This study is a pre-experiment with a posttest-only design research design using 16 obese women aged 19-23 years old, body mass index (BMI) 25-35 kg/m², percentage body fat (PBF) above 30% and fasting blood glucose (FBG) below 100 mg/dL, normal hemoglobin (Hb), normal systolic and diastolic blood pressure, normal resting heart rate, VO_{2max} 25-30 mL/kg/min and randomly divided into two groups, namely IE (n=8, interval exercise) and CE (n=8, continuous exercise). Interval exercise and continuous exercise interventions were carried out at 08.00 a.m. for 40-45 minutes using a treadmill. The measurement of energy expenditure was using OMRON Caloriscan HJA-306-EW. Data analysis techniques used the Independent-Samples T Test with the Statistical Package for Social Science (SPSS). The results obtained mean energy expenditure on IE (251.750±19.775) kcal and CE (278.750±23.334) kcal (p=0.026). Based on the results of the study concluded that continuous exercise increases energy expenditure compared to interval exercise in obese women.

Keyword : Interval Exercise, Continuous Exercise, Energy Expenditure, Obese Women

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BACKGROUND

Obesity is a multi-factorial disease that develops due to a long-term imbalance between energy intake and energy expenditure (Rambhojan *et al.*, 2015), thus causing an increase in abnormal fat accumulation in adipose tissue (Sofa, 2018). Obesity is a very serious threat to health in the world (Marie *et al.*, 2014; Peterson *et al.*, 2014) with a prevalence rate that continues to increase from year to year (Chooi *et al.*, 2019). According to the World Health Organization (WHO) (2015) obesity became a global epidemic with the prevalence of being overweight and obesity estimated at 39% of the world's population. In 1980 and 2013 showed that the prevalence of obesity in men and women showed an increase, from 28.8% up to 36.9% in men, while in women showed an increase from 29.8% to 38.0% (Ng *et al.*, 2014). The increasing prevalence of obesity requires special efforts in overcoming the problem of obesity (Carneiro *et al.*, 2016).

Obesity is a global health problem that must be considered because obesity increases the risk of various chronic diseases such as type-2 diabetes mellitus (T2DM), hypertension and cardiovascular disease (CVD) (Gadde *et al.*, 2018). In addition, obesity also causes dyslipidemia, arterial hypertension, ischemic heart disease, non-alcoholic fatty liver disease and several types of cancer (Moreno-Navarrete and Fernandez-Real, 2019). The causes of obesity are multi-factorial including lifestyle changes such as consumption of high alcoholic drinks, smoking habits and consumption of high-fat foods and lack of physical activity (Azkia and Wahyono, 2018). However, a common factor that contributes to weight gain is an imbalance between energy intake and energy expenditure (Norheim *et al.*, 2014; Delany *et al.*, 2013). Lifestyle modification is recommended to be one of the foundations to manage obesity (Gadde *et al.*, 2018). Controlling energy intake and energy expenditure is one of the main mechanisms in regulating energy balance (Gadde *et al.*, 2018).

The relation between energy expenditure and obesity has been studied for years, but the mechanism of energy expenditure still remains unclear (Delany *et al.*, 2013). Energy expenditure is one of the basic components of energy balance that can help develop strategies to reduce obesity (Hill *et al.*, 2012). Energy expenditure is considered as an energy production process from energy substrates (carbohydrates, lipids, proteins) and alcohol, where there is oxygen consumption (O₂) and carbon dioxide (CO₂) production (Volp *et al.*, 2011). Individuals with obesity have lower energy expenditure levels compared to people who are not getting obese (normal and overweight). This kind of thing in the long run will contribute to weight gain (Carneiro *et al.*, 2016). According to Taylor *et al.* (2018) explained that exercise is the right strategy in increasing energy expenditure (Hill *et al.*, 2012). Research conducted by Grieve (2018) concluded that aerobic continuous, high intensity interval training, strength endurance, traditional resistance and high intensity resistance increase energy expenditure. According to Schaun *et al.* (2018) explained that continuous training has higher energy expenditure than high intensity interval training. Jung *et al.* (2019) explain that interval exercise and continuous exercise are appropriate recommendations for weight loss. Continuous exercise is an alternative on increasing fat distribution in overweight/obesity (Keating *et al.*, 2014). However, the increase in energy expenditure with interval exercise and continuous exercise in obese women is still unclear. Based on the background above, the purpose of this study aims to analyze the effect of interval exercise with continuous exercise on increasing energy expenditure on the treadmill.

METHOD

This study is a pre-experiment with a posttest-only design research design using 16 obese women aged 19-23 years old, body mass index (BMI) 25-35 kg/m², percentage body fat (PBF) above 30% and fasting blood glucose (FBG) below 100 mg/dL, normal hemoglobin (Hb), normal systolic and diastolic blood pressure, normal resting heart rate, VO₂max 25-35 mL/kg/min and randomly divided into two groups, namely IE (n=8, interval exercise) and CE (n=8, continuous exercise). All of these research procedures were approved by the Health Research Ethics Commission of the Faculty of Medicine, Airlangga University, Surabaya number 309/EC/KEPK/FKUA/2019.

Intervention interval exercise (IE) was done by running on a treadmill with an intensity of 60-70% HR_{max} for 45 minutes with details of 5 minutes warming up (50-60% HR_{max}), 35 minutes core (5 minutes working (60-70% HR_{max}) interspersed with active recovery on the treadmill for 2.5 minutes (50-60% HR_{max}) performed 5 repetitions) and 5 minutes of cooling (50-60% HR_{max}). Intervention of continuous exercise (CE) was done by running on a treadmill with an intensity of 60-70% HR_{max} for 40 minutes with details of 5 minutes warming (50-60% HR_{max}), 30 minutes of the core being carried out continuously (60-70% HR_{max}) and 5 minutes of cooling (50-60% HR_{max}). The intervention was carried out at 08.00 a.m. using a treadmill (Richter Treadmill Semi-Commercial Evolution (4.0 hp DC)).

Height measurement (TB) was using a stadiometer (SECA, Chino, CA). Measurement of body composition consists of body weight (BMI) body mass index (BMI), percentage body fat (PBF) using TANITA (Body Composition Analyzer DC3607601 (2) -1604 FA, TANITA Corporation of America, Inc.). Blood pressure measurement was using a digital omron blood pressure monitor HEM-7130L (OMRON Model HEM-7130 L, Omron Co.). FBG measurements was using ACCU-CHEK (ACCU-CHEK® Performance, Mannheim, Germany), while Hb measurements was using Easy Touch (Easy Touch GCHb, Taiwan). Energy expenditure measurement was using OMRON Caloriscan HJA-306-EW.

VO₂max measurement was using the Astrand 6-minute cycle test method and used an ergocycle (Monark 828 E, Version 1010 Art. No: 7950-296, Vansbro, Sweden). Heart rate monitoring to control exercise intensity was using Polar (Polar H10 Heart Rate Sensor, USA, Inc.).

Data analysis techniques was using statistical packet for social science (SPSS) software version 21 (Chicago, IL, USA). The normality test uses the Shapiro-Wilk test. Data that normally distributed were tested using the Independent-Samples T Test with a significant level ($p < 0.05$). All data are displayed with mean±SD.

RESULT

The results of descriptive analysis of the research subject's characteristics in each group can be seen in table 1.

Table 1. Research Subject's Characteristics

Variable	n	IE	CE	Independent-Samples T Test <i>p-value</i>
		Mean±SD	Mean±SD	
Age (year)	8	21.000±1.603	20.750±0.707	0.693
Height (m)	8	1.587±0.062	1.572±0.051	0.863
Weight (kg)	8	72.637±8.364	71.937±7.540	0.609
BMI (kg/m ²)	8	28.825±1.758	28.937±1.448	0.891
PBF (%)	8	42.800±3.584	44.150±2.507	0.397
SBP (mmHg)	8	112.500±4.629	111.250±3.535	0.554
DBP (mmHg)	8	75.000±5.345	75.000±5.345	1.000

RHR (bpm)	8	81.375±14.686	78.375±8.450	0.624
VO _{2max} (ml/kg/min)	8	26.195±0.968	28.533±3.130	0.063
FBG (mg/dL)	8	89.375±5.705	89.625±7.558	0.942
Hb (g/dL)	8	15.075±1.012	14.525±1.030	0.300

Based on Table 1, the Independent-Samples T Test shows that there are no significant differences in the mean data characteristics of research subjects in each group. The results of the energy expenditure analysis in each group can be seen in table 2.

Table 2. Energy Expenditure Statistics Analysis Result in Each Group

Variable	n	IE	CE	Independent-Samples T Test <i>p</i> -value
		Mean±SD	Mean±SD	
Energy expenditure (kcal)	8	251.750±19.775	278.750±23.334	0.026*

Based on Table 2, the Independent-Samples T Test shows that there is a significant difference in the average energy expenditure ($p < 0.05$).

DISCUSSION

Based on Table 2, it shows that there are significant differences in the average energy expenditure. The results showed that continuous exercise had higher average energy expenditure than exercise intervals. These results are in line with the results of a study conducted by Schaun *et al.* (2018) concluded that continuous training has a higher energy expenditure than high intensity interval training. This is due to differences in the type of exercise performed; interval training and continuous exercise. Interval exercise is a form of exercise that is carried out alternately between doing training activities (work intervals) with periods of low intensity activity (interrupted periods) in a training phase (Yunus, 2017), while continuous exercise is a form of exercise with speed and the distance specified, without a break until the entire distance traveled (Busyairi and Ray, 2018). Therefore, in the interval exercise there is an interrupted period in this study, namely active rest and in continuous exercise, so the work done is higher, certainly causing energy expenditure on continuous exercise to be higher. Higher work requires more energy to supply energy requirements for muscle contraction during exercise, so energy expenditure is also greater in continuous exercise.

Exercises that involve body activities require energy so that muscles can contract. The needed energy comes from food that consumed and provided from various chemical reactions in the body. The fastest energy source available for muscle contraction is adenosine triphosphate (ATP). ATP is a source of energy found in muscle fibers as a source of sudden energy for muscle contraction. This potential energy has two high-energy phosphate bonds that are converted into kinetic energy. In our body, there are chemical compounds in the form of ATP. During exercise, this compound is converted to adenosine diphosphate (ADP) and produces energy for muscle contraction. The energy used for muscle contraction is called energy expenditure (Sandi, 2019). According to Jung *et al.* (2019) said that continuous exercise provides a positive effect with an increase in the use of fat as an energy source. The increase in fat certainly has a positive effect on the condition of obesity. Continuous exercise is also effective for weight loss. This is because with continuous exercise an increase in energy consumption can increase energy expenditure. In addition, continuous exercise also has a positive effect by increasing levels of epinephrine, norepinephrine and growth hormone in the blood, insulin secretion and cortisol. Therefore, continuous exercise in obesity is a logical alternative to improve the condition of obesity, so as to improve the health.

CONCLUSION

Based on the results of the study, it is concluded that one continuous exercise session carried out for 40 minutes using a treadmill significantly increases energy expenditure compared to exercise intervals in obese women.

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