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Effect of cycle ergometer training using different intensities in increasing catecholamine hormone of overweight females

Efecto del entrenamiento en bicicleta ergométrica utilizando diferentes intensidades en el aumento de la hormona catecolamina en mujeres con sobrepeso

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Abstract The main purpose of this study was to compare cycle ergometer training using low intensity and moderate intensity in increasing the catecholamine hormone of overweight females. This study was conducted on 50 overweight females with mean age of 22.44±2.97 years old and body mass index between 25 kgm^{-2} to 30 kgm^{-2}. Treatment was given 4 times per week during 5 weeks periods in Group 1 with low intensity cycle ergometer continuous training (60%-70% HRmax), and Group 2 with moderate intensity cycle ergometer continuous training (70%-80% HRmax). Heart rate was monitored using polar heart rate monitor H10. Pre-test was taken before giving treatment and post-test after giving a treatment by taking blood a day after doing exercise and fasting at night and the blood samples obtained are taken to the laboratory for serum sample analysis. Data were analyzed using paired t-test. The result found that there was an increase in catecholamine hormone in both groups with a p-value of <0.05. It can be concluded that cycle ergometer training using low and moderate-intensity improved catecholamine hormone for overweight females.
Keywords: Aerobic training, low intensity, moderate intensity, sports health

Resumen El propósito principal de este estudio fue comparar el entrenamiento en bicicleta ergométrica usando baja intensidad e intensidad moderada para aumentar la hormona catecolamina de mujeres con sobrepeso. Este estudio se realizó en 50 mujeres con sobrepeso con edad promedio de 22,44±2,97 años e índice de masa corporal entre 25 kg.m.2 a 30 kg.m.2. El tratamiento se administró 4 veces por semana durante períodos de 5 semanas en el Grupo 1 con entrenamiento continuo en cicloergómetro de baja intensidad (60%-70% FCmáx), y el Grupo 2 con entrenamiento continuo en cicloergómetro de intensidad moderada (70%-80% FCmáx). La frecuencia cardíaca se controló utilizando un monitor de frecuencia cardíaca polar H10. Se toma pre-test antes de dar el tratamiento y post-test después de dar un tratamiento tomando sangre al día siguiente de hacer ejercicio y en ayunas por la noche y las muestras de sangre obtenidas son llevadas al laboratorio para análisis de muestra de suero. Los datos se analizaron utilizando la prueba t pareada. El resultado encontró que hubo un aumento en la hormona catecolamina en ambos grupos con un valor de p <0,05. Se puede concluir que el entrenamiento en bicicleta ergométrica de intensidad baja y moderada mejoró la hormona catecolamina en mujeres con sobrepeso.
Palabras clave: Entrenamiento aeróbico; baja intensidad; intensidad moderada; salud deportiva.

Introduction

Overweight is a health disorder that in almost all countries has increased (Gbary et al. 2014). Overweight causes many health problems, which will cause a high risk of dangerous diseases. Overweight is caused by several factors such as genetic factors, individual behavior, physical activity, sedentary behavior and socioeconomic factors (Adela Hruby et al. 2015). One of the prevention and treatment for the overweight is to do exercise. Health problems experienced by overweight people namely disorders in metabolism, and cardiovascular disorders, until the emergence of cancer caused by an imbalance in the body's need to excrete calories due to the accumulation of fat in the body. Fat in the body can be reduced by doing sports activities that are aerobic or sustainable (Gbary et al. 2014).

Overweight occurs because of the accumulation of fat that is not used or could not be converted into energy. There are many things to reduce fat, and one of them is aerobic or prolonged exercise. Aerobic exercise will help in the process of converting fat into energy. Aerobic exercise done with low intensity will stimulate lipolysis of fat in the body both visceral and subcutaneous. Fat in the body is called triglycerides (TG). Triglycerides can be broken down when performing physical activities with low intensity which will cause triglycerides to break down into free fatty acids and glycerol. Free fatty acids are the biggest energy providers during physical activity (Brandou et al. 2005). Free fatty acids cannot be used immediately, but need gradual physical activity and require a long duration and an increase in fat oxidation (Alkahtani 2014).

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Aerobic exercise can reduce body fat and improve metabolism. Provision of fat that is intramuscularly split during aerobic exercise (Muscella et al. 2020). Aerobic exercise can be interpreted as physical exercise that increases heart rate and breathing volume to provide oxygen for muscle activation. In this regard, one of the aerobic exercises that can be used is cycle ergometer training. Cycle ergometer training is a component of a strength training program that has the potential to increase aerobic capacity and cardiovascular health (Bouaziz et al. 2015).

The process of decreasing body fat levels is assisted with several other activities on the body physiologically. The physiological activity can be in the form of hormones which are known to be very much helpful in the process of fat metabolism. One of the hormones that help the process of fat metabolism is the catecholamine hormone. The catecholamine hormone lipolysis fat during exercise with aerobic or sustainable sports (Hargreaves and Spriet 2020).

The process of the catecholamine hormone can also increase lipolysis in triglycerides. The catecholamine hormone (especially epinephrine) increases during physical exercise. Ongoing physical exercise will provide physical stress (Novadri Ayubi et al., n.d.; N Ayubi et al. 2022). The stress received will stimulate the adrenal medulla and stimulate the secretion of the catecholamine hormone (epinephrine and norepinephrine). The supply of catecholamines is in the chromaffin granule which resembles a transmitter in the pathway of the sympathetic nerve and is secreted through the blood. When the sympathetic nerve is activated under conditions of fear or stress (Sherwood 2016). Epinephrine increases blood glucose and fatty acids through a variety of metabolic effects and contributes to homeostasis indirectly by preparing the body in response to a period of physical peak in critical conditions. Epinephrine increases plasma concentrations of glucose and fatty acids into normal conditions which provide additional energy availability in increasing physical activity (Sherwood 2019).

Evidence in a study of the role of hormones in sports reported that the catecholamine hormone stimulates the occurrence of lipolysis by stimulating β-adrenal receptors which occur when exercising physical activity (Frye and Chittur 2020). In connection with the above, other researchers also found that the results of aerobic exercise have an effect on fat by stimulating the hormones that play an important role in reducing fat. Endurance training by stimulating catecholamine can reduce fat in adipocyte tissue (Berends et al. 2019). Researchers have also conducted preliminary research on overweight women with aerobic exercise with the result that there is no difference between low and moderate intensity exercise on body fat and free fatty acids, but there is an influence of both exercises on these variables (Dyaksa, Liben, and Mintarto 2021).

Based on some findings of the researchers previously, therefore the purpose of this study was to compare the effect of cycle ergometer training using low intensity and moderate intensity in increasing catecholamine hormone of young overweight females.

Methods

Participants

The participants of this study were 50 females with body mass index between 25 kg×m^2 to 30 kg×m^2, healthy body, and no metabolic diseases and heart problems. The participants were voluntarily to participate in the study. All participants were divided into two groups, Group 1 and Group 2. Group 1 was given treatment cycle ergometer continuous training with low intensity and Group 2 cycle ergometer continuous training with moderate intensity.

Measures

The pre-test was taken by taking blood before giving a treatment by fasting at night and taking blood in the morning after fasting. Post-test by taking blood a day after doing treatment and fasting at night and the blood samples obtained, it was taken to the laboratory for serum sample analysis. Blood was taken from the arm (median cubital vein) which was then examined in the laboratory using ELISA (pg/mL) for catecholamines hormones.

Procedure

Treatment was given using a cycle ergometer continuous training 4 times per week during 5 weeks periods. Warming up was given for about 5 minutes before doing exercise, then it was continued with 30 minutes of cycle ergometer continuous training and 5 minutes cooling down after training. The intensity of exercise for low intensity was 60% -70% HR max and for moderate-intensity 70% -80 HR max. Heart rate and intensity of training were monitored by using polar heart rate monitor H10.

Statistical analysis

Data were analyzed using paired t-tests obtained using the help of SPSS. Data was presented mean, standard deviation, minimum, and maximum

Results

This study found that there was a decrease in mean Body Mass Index from 27,64±0,93 kgm^2 with a range of 26,03 kgm^2 to 29,52 kgm^2 during pre-test become 26,57±0,71 kgm^2 with a range of 25,37 kgm^2 to 27,-93 kgm^2 during post-test.

The result of the catecholamine hormone increased after being given aerobic training in all samples. It increased from 217.38±53.48 pg/mL with a range of 132.22 pg/mL to 338.54 pg/mL during pre-test, it became 266.78±67.08 pg/mL with a range of 159 ,33 pg/mL to 401.10 pg/mL during post-test. The result of the pre-test and post-test of the catecholamine hormone is presented in Table 1.

Table 1.
Pre-test and Post-test of Catecholamine Hormone all Participants

Data	n	Catecholamine Hormone levels (pg/mL)		
		Min	Max	x±SD
Pre-test	50	132,22	338,54	217,38±53,48
Post-test	50	159,33	401,10	266,78±67,08

As can be seen from Table 1, it is indicated that there was an increase of catecholamine hormone after being given aerobic training in all samples using low intensity as well as moderate intensity. It increased by approximately 49 pg/mL.

This study found that there was an increase of catecholamine hormone after being given continuous cycle ergometer with low intensity with a mean of 229.81±57.79 pg/mL with a range of 140.56 pg/mL to 338.54 pg/ mL during the pre-test, it became 354.45±24.89 pg/mL with a range of 3012.10 pg/mL to 391.91 pg/mL during posttest. The result of the pre-test and post-test of the catecholamine hormone in the low-intensity group is presented in Table 2.

Table 2.
Catecholamine Hormone for Aerobic Training using Low Intensity

Data	n	Catecholamine Hormone levels (pg/mL)		
		Min	Max	x±SD
Pre-test	25	140,56	338,54	229,81±57,79
Post-test	25	3012,10	391,91	354,45±24,89

As can be seen in Table 2, it showed that catecholamine hormone increased approximately 124.64 pg/mL after being given aerobic training using low intensity.

This study also found that catecholamine hormone increased after being given continuous cycle ergometer using moderate intensity with a mean of 212.15±35.99 pg/ mL with a range of 162.22 pg/mL to 279.45 pg/mL during pre-test , it became 315.51±50.55 pg/mL with a range of 241.66 pg/mL to 396.08 pg/mL during post-test. The result of the pre-test and post-test of the catecholamine hormone at the moderate intensity group is presented in Table 3.

Table 3.
Catecholamine Hormone for Aerobic Training using Moderate Intensity

Data	n	Catecholamine Hormone levels (pg/mL)		
		Min	Max	x±SD
Pre-test	25	162,22	279,45	212,15±35,99
Post-test	25	241,66	396,08	315,51±50,55

As can be seen in Table 3, it showed that catecholamine hormone increased approximately 103.36 pg/mL after being given aerobic training using moderate intensity.

Table 4.
The result of paired t-test for catecholamine hormone

Data	x±SD	P
Pre-test and post-test catecholamine hormone	-114±59,42	0,00

Table 4 showed that between pre-test and post-test of catecholamine hormone it increased significantly with p-value <0.05.

Discussion

The main purpose of this study was to compare cycle ergometer training with low intensity and medium intensity.

The results of this study prove that cycle ergometer training with low intensity can increase catecholamine hormones. Likewise, cycle ergometer training with moderate intensity is also able to increase catecholamine hormones. Although research on exercise and catecholamines is very scarce, a literature review study that supports the results of this study was conducted by (Zouhal et al. 2008) reporting that the highest concentrations of catecholamine hormones were achieved by middle-distance runners and long-distance runners. In addition, the study also reported that the catecholamine hormone response was also influenced by gender.

The catecholamine hormone plays a role in the lipolysis of free fatty acids (FFA). This hormone works when the body is stressed or exercised. The stress caused by this exercise will stimulate the adrenal medulla to secrete catecholamine hormones (epinephrine and norepinephrine). Epinephrine will maintain arterial blood pressure, increase blood glucose and blood fatty acids (Lakshmipathy 2019). The implementation of fat metabolism in the blood not only requires catecholamine hormones but also requires several other hormones to help fat metabolism. These hormones together stimulate gluconeogenesis (amino acids into glucose) and glycogenolysis (glycogen into glucose) which makes glucose converted into energy, so that energy needs are still met (Fahami, Ramli, and Latif 2018). This hormone also metabolizes the fat in adipose tissue with an increase in free fatty acids for sufficient energy to be used by cells (Fahami, Ramli, and Latif 2018). In this regard, a study (Johnson et al. 2010) reported that a 12-week ergometer training cycle was able to reduce free fatty acid levels in postmenopausal women.

Furthermore, the increase in the rate of lipolysis is also one of the causes of catecholamine hormones, especially epinephrine, which has a higher binding to adrenoreceptors which results in increased fat breakdown. Increased levels of catecholamines stimulated by exercise and decreased insulin concentrations result in increased lipolysis and FFA release (Boukerb et al. 2021).

Increased blood flow will release catecholamines, especially epinephrine in large quantities to prepare the body for physical exercise to be strong. Strong physical exercise will increase the workload of the heart, skeletal muscles, large blood flow to meet the body's metabolic needs (Steiner et al. 2021).

In addition, (Liu et al. 2020) reported that prolonged exercise increased the mobilization and oxidation of FFA as an energy source. The release of catecholamines can stimulate increased fat metabolism. The study (Muscella et al. 2020) also reported that during endurance exercise there was a release of free fatty acids and glycerol from triglycerides in the tissues. A gradual increase in exercise intensity will increase the plasma concentrations of these hormones individually. Norepinephrine plasma concentrations will increase when VO2max is above 50% and epinephrine will increase when exercise intensity exceeds 70% of VO2max (Wilhelm et al. 2016).

Thus, aerobic exercise activities such as cycle ergometer training with low or moderate-intensity have the potential to increase catecholamine hormones which play an important role for someone who is overweight.

Conclusion

It can be concluded that there was an increase in catecholamine hormones after being given aerobic exercise using a cycle ergometer training with low intensity and moderate intensity. Therefore, continuous cycle ergometer training can be used as an alternative method to increase catecholamine hormone for overweight young women.

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