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Single Bout High Intensity Interval Exercise (HIIE) Prevents Adiponectin Reduction in Sedentary Overweight Women

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Abstract

This study aimed to analyze the effect of a single bout of high-intensity intermittent exercise (HIIE) on serum adiponectin levels in sedentary overweight young adult women. A total of 22 overweight adult obesity women with a BMI of 23-24.9 m2/kg were enrolled in this study. Subjects were divided into 2 groups, control and HIIE. The exercise was static cycling for a total of 25 minutes (3 minutes warming up, 20 minutes HIIE, and 2 minutes cooling down). The HIIE was held 10 sets intermittently with the ratio 1:1, 1 minute cycling in 80-90% HRmax, 1 minute active resting with 40 rpm cycling. The data in this study were taken before and 1 hour after the HIIE. The adiponectin level was measured using a human ELISA kit. The adiponectin level in the control group reduced significantly ($p<0.05$), however, the HIIE group reduced insignificantly. A single bout of HIIE in sedentary overweight young adult women can maintain the adiponectin level. Therefore, it may have a positive contribution to women's health. However, further research needs to be conducted to uncover the underlying mechanism.

Keywords: *HIIE, adiponectin, overweight, sedentary, women, healthy lifestyle*

Introduction

Obesity is a condition of being overweight. Obesity occurs due to an increase in the number of adipocytes and adipose tissue infiltration (Versini, Jeandel, Rosenthal, & Shoenfeld, 2014). Adipose tissue has a function as an energy store, in overcoming excess energy, adipose tissue expands with increasing size and number of adipocytes. A lifestyle characterized by physical activity is one of the causes of being overweight and the main risk of global death (Martins, Lopes, Diniz, & Guedes, 2021). Overweight controls with a higher risk of syndrome diseases such as chronic and progressive disease, increase the risk of morbidity and mortality, risk of developing diabetes, and worsening glycemic index (Kim & Lim, 2017). Apart from being an organ that is active in metabolism, adipose is also capable of secreting several adipokines. Response signals received as a result of endocrine processes, one of the endocrine peptide hormones secreted is adiponectin, which acts in adipose tissue. Increased BMI, overweight, high inflammation, syndrome metabolism, and diabetes correlate with adiponectin (Sirico et al., 2018; Zaidi et al., 2021). This relationship proves that the occurrence of endocrine dysfunction in overweight individuals (Gilbertson et al., 2019). In addition to increasing insulin sensitivity, adiponectin can also mediate anti-inflammatory effects, decreasing adiponectin level results in a balance of homeostasis and disturbances (Zaidi et al., 2021). Thus, it is very important to explore strategies to enhance metabolic processes (Nieste et al., 2021).

The development of overweight is estimated at 23% of peo-

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ple in adults and 81% of adolescents (11-17 years) who do not meet the physical activity recommendations set by WHO. In Indonesia, the increase of overweight in adolescence continues to increase (Rachmi & Baur, 2017). This finding concludes that adults will experience weight gain, which develops more rapidly. The WHO recommendations for physical activity are 150 minutes of moderate-intensity aerobic physical activity or at least 75 minutes of high-intensity aerobic physical activity per week. Therefore, the alternative offered by WHO related to maintaining body homeostasis is through physical exercise, as described above.

Exercise/physically active intervention has been shown to provide physiological changes in adipose tissue, signaling that it can modify adipokine production to prevent long-term chronic disease associated with overweight. Pro-inflammation that occurs in overweight can be minimized through weight loss due to exercise (Rossi et al., 2017). Recently, it has been shown that high-intensity interval training is more beneficial in improving cardiometabolic activity than long-term exercise (Racil et al., 2016). Adiponectin was found to increase through exercise in childhood (García-Hermoso et al., 2016) and adulthood (Simpson & Singh, 2007). However, high-intensity acute aerobic exercise has not found consistent results and very few have studied the adipose tissue, increase factor in response to high-intensity acute exercise.

This study aimed to analyze the effect of acute high-intensity intermittent exercise (HIIE) on serum adiponectin levels in overweight young adult women with a sedentary lifestyle.

Material and Methods

Study Design

This study used a pre and post-control group design. The taking of research subjects was carried out by purposive sampling and then the subjects were divided into 2 groups. Group 1 (CG) was the control group (without any treatment), and Group 2 (EG) conducted the high-intensity intermittent exercise treatment (HIIE).

Subjects

22 overweight adult women participated in the study. The subjects of this study were divided into two groups, namely (CG) with control without treatment, and (EG) with high-intensity intermittent exercise (HIIE) treatment (CG age 22.73±2.05, body weight 60.33±5.28 kg, height 158±6.40 cm, BMI 23.96±0.64; EG age 24.55±1.50, body weight 58.99±4.75 kg, height 156±5.38 cm, BMI 24.16±0.59). Exclusion criteria in this study were under 18 years old, were experiencing pain, infection, or inflammation of canker sores in the week prior to the study did not take drugs in the last 3 days (antibiotics, anti-inflammatory, amphetamines, and vitamins), do strenuous physical exercise 24 hours before the intervention, consuming weight loss supplements since 30 days before the intervention, and consume fruits, oils, tea, and coffee.

Blood Collection and Exercise

Before taking the initial blood sample, the respondent first fasted from the night or 12 hours before the blood sample was taken. Then the blood sample is taken again (1 hour after exercise). The acute HIIE exercise method is performed using an ergocycle. High-intensity physical exercise using active rest intervals. Heating was carried out for 3 minutes at 40 rpm (increased). The HIIE session consists of 10 X 1 minute (80%-90%) HRmax, interspersed with a break of 1 minute at 40 rpm. Cooling for 2 minutes (lower slowly) (Heydari, Freund, & Boutcher, 2012; de Souza et al., 2018).

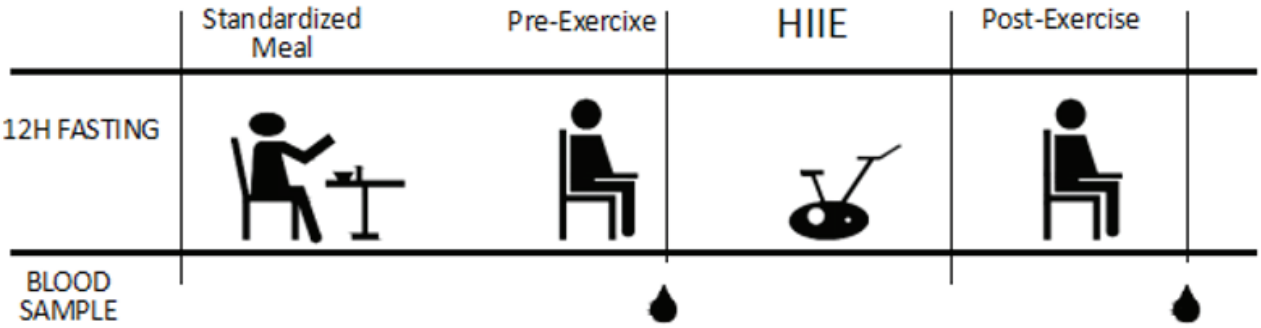

FIGURE 1. Blood Sampling and Intervention Schemes

Statistics

The data obtained were tested using the Shapiro-Wilk method to determine the normality of the data distribution. Data that is normally distributed, that different tests will be carried out with Paired t-test and Independent t-test. For all statistical analyses, significance was accepted at $p<0.05$. Data processing was performed using the statistical program SPSS v23.0 (SPSS Inc., Chicago, IL, USA).

Ethics

This research protocol has been declared to be ethically appropriate in accordance to 7 (seven) WHO 2011 standards, namely 1) Social values, 2) Scientific values, 3) Equitable assessment and benefits, 4) Risks, 5) Persuasion/Exploitation, 6) Confidentiality and privacy 7) Informed Consent, referring to the 2016 CIOMS guidelines. This is shown by the fulfillment of indicators for each standard. The Declaration of ethics was approved by the Health Research Ethics Committee of the Faculty of Medicine, Airlangga University. No ethics that is 248/EC/KEPK/FKUA/2021.

Results

Table 1. Shows the basic characteristics of all participants who are included. Anthropometric indices and metabolic factors did not differ significantly between the two groups, except for a difference in age between the control group and the HIIE group.

Table 1. Characteristics of Research Subjects

Characteristics	Group	n	$\bar{\chi}$±SD	Shapiro-Wilk	p-Value
Weight	Control	11	60.355 ± 5.28	0.718	0.532
	HIIE	11	58.991 ± 4.75	0.545	
Height	Control	11	158 ± 6.40	0.620	0.437
	HIIE	11	156 ± 5.38	0.461	
Age	Control	11	22.73 ± 2.05	0.243	0.028
	HIIE	11	24.55 ± 1.50	0.023	
BMI	Control	11	23.964 ± 0.64	0.334	0.458
	HIIE	11	24.164 ± 0.59	0.266	
Systolic	Control	11	112.18 ± 12.78	0.637	0.530
	HIIE	11	109.18 ± 8.89	0.021	
Diastolic	Control	11	75.36 ± 5.81	0.778	0.868
	HIIE	11	75.91 ± 9.02	0.123	
Body Fat	Control	11	31.827 ± 5.36	0.043	0.286
	HIIE	11	33.745 ± 1.93	0.816	
TBW	Control	11	46.227 ± 2.48	0.959	0.483
	HIIE	11	46.945 ± 2.21	0.971	
Muscle Mass	Control	11	39.191 ± 5.04	0.315	0.097
	HIIE	11	36.109 ± 2.99	0.810	
Bone Mass	Control	11	2.291 ±0.43	0.969	0.491
	HIIE	11	2.182 ± 0.27	0.405	
BMR	Control	11	1255.82 ± 149.79	0.657	0.388
	HIIE	11	1207.18 ± 105.00	0.807	
Viseral Fat	Control	11	4.964 ± 0.80	0.304	0.629
	HIIE	11	4.81 ± 0.56	0.135	
Right ARM	Control	11	1.655 ± 0.27	0.315	0.504
	HIIE	11	1.718 ± 0.14	0.118	
Left ARM	Control	11	1.591 ± 0.28	0.154	0.799
	HIIE	11	1.564 ± 0.20	0.376	
Right LEG	Control	11	6.182 ± 0.71	0.326	0.624
	HIIE	11	6.318 ± 0.55	0.193	
Left LEG	Control	11	6.136 ±0.72	0.275	0.804
	HIIE	11	6.029 ± 0.62	0.435	
Physique Rating	Control	11	3.18 ± 1.47	0.000	0.099
	HIIE	11	4.27 ± 1.48	0.000	

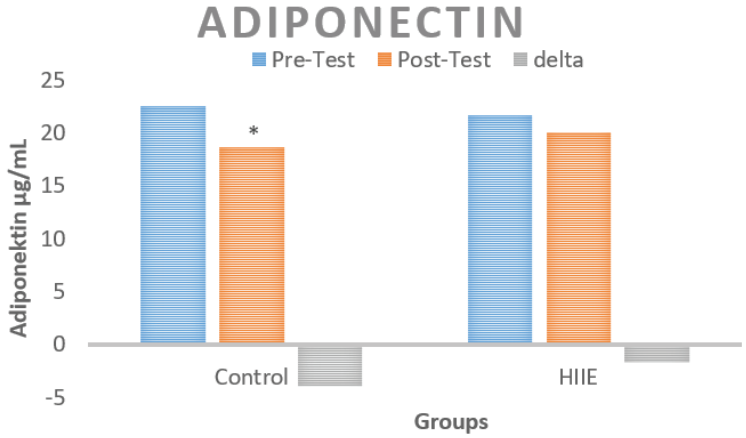

FIGURE 2. The average of adiponectin before and after HIIE in each group.
*Adiponectin decreased significantly ($p<0.05$) in the control group between pre and post HIIE.

Table 2. Mean and Standard Deviation of Adiponectin Serum in Both Groups

Data	Group	n	Adiponectin Levels (ng/mL)		
			(Pre-test)	(Post-test)	(Delta)
			χ±SD	χ±SD	χ±SD
Adiponectin	Control	11	22.571 ± 0.90	18.695 ± 0.70	-3.876 ± 1.20
	HIIE	11	21.659 ± 2.756	20.041 ± 1.05	-1.618 ± 2.53

Table 3. Result of the Normality Test for Adiponectin

Data	Group	n	Shapiro-Wilk
Adiponectin (Pre-test)	Control	11	0.233
	HIIE	11	0.578
Adiponectin (Post-test)	Control	11	0.524
	HIIE	11	0.764
Adiponectin (Delta)	Control	11	0.861
	HIIE	11	0.675

Table 4. Result Test of Adiponectin

Data	Test Method	Group	p
Adiponectin	Paired t-test	Control (pre-test & post-test)	0.000*
		HIIE (pre-test & post-test)	0.061
	Independent t-test	Delta control (CG) & HIIE (EG)	0.068

* there is a difference between the pre-post test (p<0.05)

Discussion

These findings support our initial hypothesis and suggest that acute attacks of high-intensity aerobics (HIIE) successfully maintain serum adiponectin levels in overweight adult women. One session of acute HIIE exercise was sufficient to maintain adiponectin levels compared with no exercise which experienced a greater decrease in serum adiponectin levels. One recent study also found unchanged adiponectin levels in overweight individuals after high-intensity exercise (Kao et al., 2021). However, in our study, it should be noted that adiponectin levels were able to be maintained without any differences in the anthropometric and metabolic characteristics of the respondents. Therefore, these findings add to the list of evidence showing that acute exercise has health benefits in individuals regardless of weight change and a sedentary lifestyle.

Relatively short training sessions have shown some benefit in improving the health status of sedentary adults. The beneficial effect of high-intensity aerobic exercise on adipokine profile has been suggested for overweight/obesity (Vardar et al., 2018). The current findings are supported by previous findings that have reported that acute high-intensity aerobic exercise has little effect on adiponectin levels and is significantly reduced at rest and can regulate short-term adiponectin secretion (Hojbjerre, Rosenzweig, Dela, Bruun, & Stallknecht 2007; Pop et al., 2010). In contrast to the research findings mentioned above, short-term acute aerobic exercise in sedentary men (abdominal fat) using a treadmill increased adiponectin levels after high-intensity intervention and remained elevated after rest (Saunders et al., 2012). A recent meta-analysis of 14 randomized controlled trials conducted among 347 youths revealed that exercise was associated with a significant increase in adiponectin; exercise intensity, changes in body fat, total duration of exercise, and duration of training sessions, were all found to significantly influence the effect of exercise on adiponectin (García-Hermoso et al., 2016). The investigators, therefore, concluded that exercise appears to be able to maintain adiponectin levels in overweight individuals.

Two intermittent exercise studies also found conflicting results: Varady, Bhutani, Church, & Phillips (2010) found an increase in adiponectin levels after one resistance training exercise in trained weightlifters and in individuals who combined weightlifting with running, in this study increased adiponectin levels. In response to acute exercise. In contrast, the findings of Mansouri et al. (2011) did not find changes in adiponectin levels after one exercise. On the other hand, the researchers occupied the differences in the two studies above where the researchers found a decrease in adiponectin levels in each group, but an insignificant decrease was found only in the post-exercise group.

Adiponectin strongly influences insulin resistance and inflammation (Otu & Otu, 2021). Exercise has been shown to increase insulin sensitivity, which is mediated through an increase in the hormone to adiponectin receptors (Cho et al., 2015), and inflammation found in research shows that inflammatory biomarkers are lower in people who engage in frequent and intense physical activity, decreased inflammation coincided with increased levels of inflammation. The anti-inflammatory agent whose secretion can be increased in the presence of adiponectin (de Lemos, Oliveira, Páscoa-Pinheiro, & Reis, 2012). Adiponectin reduces inflammation by inhibiting macrophage differentiation, changing the macrophage phenotype to anti-inflammatory (Fang & Judd, 2018). Similar results to previous studies using the HIIE protocol (de Souza et al., 2018) giving a single high-intensity exercise (HIIE) session increased good anti-inflammatory response through lipolysis and fat-free mass. Lipolysis of adipocytes results in a reduction in post-aerobic exercise, resulting in beneficial changes in adipokine secretion (Kelly et al., 2014).

In addition, the correlation of adiponectin changes was significant with a decrease in body fat mass (r=7.06) to (r=6.31) (Cipryan, Dostal, Plews, Hofmann, & Laursen, 2021). Pressure on the body indicates the body needs energy, fatty acids are released from adipose tissue and mobilized for use, reactions in cells activate lipases that hydrolyze triglycerides in fat droplets and produce free fatty acids that are ready to be released through the blood circulation and sent to organs, muscles. And other body tissues. Increased levels of adiponectin in muscles have a beneficial effect on glucose absorption and fatty acid oxidation (de Farias Lelis, de Freitas, Machado, Crespo, & Santos 2019) resulting in an increase in whole-body energy (Homeostasis). Findings (Heydari, Freund, & Boutcher, 2012) showed that 20-minute aerobic exercise bouts of HIIE were shown to decrease adipose tissue, which was associated with increased glucose and lipid metabolism (Okauchi et al., 2007). The found adipose tissue reduction was associated with decreased atherosclerosis. HIIE has been shown to show a significant increase in fatty acid oxidation throughout the body and skeletal muscle so that the response to catecholamines also increases slightly (Heydari et al., 2012). Catecholamines have been shown to promote lipolysis and are responsible for the release of fat from fat stores. Also, significant -adrenergic receptors were also found, adding to the evidence that HIIE has a greater potential for fat loss and increased fat oxidation. Since the HIIE exercise program requires a minimal time commitment, impacting subject compliance, physical activity requiring minimal effort still results in optimal fat loss.

The main finding in this study was that high-intensity aerobic exercise through acute HIIE using ergocycle had little effect in maintaining adiponectin levels expressed in adipose tissue 1-hour post-intervention. The authors found that the results obtained were influenced by time, where adiponectin had a relatively long half-life in serum (2.5 hours - 6 hours) and serum adiponectin was found to be high during the day (Fang & Judd, 2018).

Conclusions

The effect of acute HIIE using ergocycle has been shown to maintain serum adiponectin in overweight adult women with a sedentary lifestyle. This is due to the pressure received by the body, resulting in an increase in energy requirements, catecholamines, and the process of lipolysis. However, further research is needed regarding exercise, age, and timing of research on the mechanisms of other pro-inflammatory and anti-inflammatory mediators.

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Conflicts of Interest

No potential conflicts of interest relevant to this article could be reported.

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