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Treadmill has a more beneficial effect than cycling on fat loss through myokines secretion in obese women

La cinta de correr tiene un efecto más beneficioso que el ciclismo en la pérdida de grasa mediante la secreción de miocinas en mujeres obesas

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Abstract. Obesity is a condition characterized by the excessive accumulation of body fat beyond normal limits. Irisin and IL-6 are myokines that have a function to convert white adipose tissue into brown adipose tissue, resulting in thermogenesis that induces energy expenditure and has implications for reducing excess fat accumulation. This study aims to demonstrate the response of moderate-intensity treadmill and ergo cycle exercise on fat loss and increasing myokines secretion in obese adolescent females. A total of 30 obese women met the criteria with body mass index (BMI) of 30.02±2.97 kg/m², age 21.27±1.31 years were recruited into the study and given single session of aerobic ergo cycle exercise (AEEG) and aerobic treadmill exercise (ATEG) during 45 min. Measurement of myokines, i.e., irisin and IL-6, using Enzyme-Linked Immunosorbent Assay (ELISA) on all samples. Statistical analysis was performed using a one-way ANOVA test and Tukey's HSD post hoc test with significance at the 5% level. The results showed that the average levels of irisin post-exercise were 72.82±42.96 ng/mL at CTLG, 282.50±75.96 ng/mL at AEEG, 488.14±61.30 ng/mL at ATEG, and p = 0.000. Average levels of IL-6 post-exercise were 51.09±15.68 pg/mL at CTLG, 58.94±3.62 pg/mL at AEEG, 129.29±52.65 pg/mL at ATEG, and p = 0.000. Average Δ FAT were -0.02±0.34 % at CTLG, -0.35±0.19 % at AEEG, -0.46±0.18 pg/mL at ATEG, and p = 0.002. Both intervention of exercise consistently increased irisin levels, while IL-6 levels were found to increase only with aerobic treadmill exercise. Likewise, body fat only decreased after one session of treadmill aerobic exercise compared to ergo cycle aerobic exercise.
Keywords: Aerobic exercise, interleukin 6, irisin, obesity, metabolism

Resumen. La obesidad es una condición caracterizada por la acumulación excesiva de grasa corporal más allá de los límites normales. La irisina y la IL-6 son mioquinas que tienen la función de convertir el tejido adiposo blanco en tejido adiposo marrón, lo que resulta en una termogénesis que induce el gasto de energía y tiene implicaciones para reducir la acumulación excesiva de grasa. Este estudio tiene como objetivo demostrar la respuesta del ejercicio en cinta rodante y bicicleta ergonómica de intensidad moderada sobre la pérdida de grasa y el aumento de la secreción de mioquinas en mujeres adolescentes obesas. Un total de 30 mujeres obesas cumplieron los criterios con un índice de masa corporal (IMC) de 30,02 ± 2,97 kg/m2 y una edad de 21,27 ± 1,31 años. Fueron reclutadas para el estudio y se les administró una única sesión de ejercicio aeróbico en bicicleta ergométrica (AEEG) y ejercicio aeróbico en cinta rodante. (ATEG) durante 45 min. Medición de miocinas, es decir, irisina e IL-6, mediante un ensayo de inmunoabsorción ligado a enzimas (ELISA) en todas las muestras. El análisis estadístico se realizó mediante una prueba ANOVA unidireccional y la prueba post hoc HSD de Tukey con significancia al nivel del 5%. Los resultados mostraron que los niveles promedio de irisina post-ejercicio fueron 72,82±42,96 ng/mL en CTLG, 282,50±75,96 ng/mL en AEEG, 488,14±61,30 ng/mL en ATEG y p = 0,000. Los niveles promedio de IL-6 post-ejercicio fueron 51,09±15,68 pg/mL en CTLG, 58,94±3,62 pg/mL en AEEG, 129,29±52,65 pg/mL en ATEG y p = 0,000. Los Δ FAT promedio fueron -0,02 ± 0,34 % en CTLG, -0,35 ± 0,19 % en AEEG, -0,46 ± 0,18 pg/mL en ATEG y p = 0,002. Ambas intervenciones de ejercicio aumentaron consistentemente los niveles de irisina, mientras que se encontró que los niveles de IL-6 aumentaron solo con el ejercicio aeróbico en cinta rodante. Del mismo modo, la grasa corporal solo disminuyó después de una sesión de ejercicio aeróbico en cinta rodante en comparación con el ejercicio aeróbico en bicicleta ergonómica.
Palabras clave: Ejercicio aeróbico, interleucina 6, irisina, obesidad, metabolismo

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Introduction

Obesity is a condition characterized by the excessive accumulation of body fat beyond normal limits and can be associated with intense persistence of hyperplasia and hypertrophy of fat cells in adipose tissue (Vekic et al., 2019). In the 20th century, obesity was recognized as an epidemic and has now been classified as a pandemic (Windarti et al., 2019). In 2012, the World Health Organization (WHO) issued a global action plan to address the alarming prevalence of obesity (WHO, 2012). An estimated 1.9 billion adults over the age of 18 are overweight, while 650 million of them are obese, comprising 11% of men and 15% of women (WHO, 2016). Obesity in Asia has increased from 4.2% in 2014 (WHO, 2016) to 6.2% in 2015 (Chooi et al., 2019). In Indonesia, obesity has also increased since 2013, from 14.8% to 21.8% in 2018 (Basic Health Research, 2018). The increasing prevalence of obesity worldwide is a problem that needs to be addressed urgently, but the issue of obesity has not been adequately resolved until now.

Obesity is a risk factor for several noncommunicable diseases (NCDs) that can cause mortality (Hawley & McGarvey, 2015), such as type 2 diabetes mellitus, hypertension, dyslipidemia, heart disease, osteoarthritis, and several types of cancer (Hruby & Hu, 2015). A sedentary lifestyle is one of the most contributing factors to the development of obesity (Yaya & Ghose, 2019). Lifestyle modification is recommended as one of the cornerstones in obesity management (Gadde et al., 2018). Moreover, previous studies have highlighted the existence of irisin, a muscle-secreted compound (myokine), which plays a beneficial role in addressing obesity-related problems (Boström et al., 2012). Irisin is a myokine that was discovered in 2012 (Boström et al., 2012) and has a function to convert white adipose tissue into brown adipose tissue, resulting in thermogenesis that induces energy expenditure (Boström et al., 2012; Merawati et al., 2023) and has implications for reducing excess fat accumulation (Arias-Loste et al., 2014). Exercise can increase the expression of irisin and enhance its beneficial effects on metabolism and health by promoting mitochondrial biogenesis and function in skeletal muscle (Gan et al., 2018, Galgani et al., 2012). In addition, other cytokines also contribute to fat metabolism (Wedell-Neergaard et al., 2019) and maintaining glucose homeostasis (Lang Lehrskov et al., 2018) in obesity, including interleukin 6 (IL-6) (Pranoto et al., 2023a). IL-6 is a cytokine that plays a role in the inflammatory response and induces the process of glycogenolysis and lipolysis to release energy reserves (Lin et al., 2023). Myokines, including IL-6, released by muscles in response to physical exercise, have anti-inflammatory properties (Severinsen & Pedersen, 2020). Conversely, IL-6, primarily released by macrophages and mononuclear cells, has a pro-inflammatory effect and is abundantly produced in white adipose tissue in obese conditions (Francisco et al., 2018).

Exercise is considered one of the effective and efficient methods to prevent the increasing prevalence of obesity (Rejeki et al., 2021; Pranoto et al., 2023b; Merawati et al., 2023), through the mediation of irisin in the process of increasing energy expenditure, glucose, and lipid metabolism (Perakakis et al., 2017). The increase in irisin levels during exercise is a result of increased muscle contraction, which activates peroxisome proliferator-activated receptor gamma coactivator-1-alpha (PGC1-α) to stimulate fibronectin type III domain-containing protein 5 (FNDC5) secretion and proteolytic cleavage of FNDC-5 membrane protein in skeletal muscle, resulting in the release of irisin into the bloodstream (Costello et al., 2018; Rejeki et al., 2021). In addition, exercise can also increase IL-6 levels in both plasma (Deveci & Şanlıer, 2018; Cullen et al., 2015) and blood serum (Briken et al., 2016; Luna et al., 2011), which will play a role in the regulation of glucose and lipid metabolism (Lehrskov & Christensen, 2019).

However, some studies still report controversial results. For instance, Rejeki et al. (2021) observed an increase in irisin levels in obese women after treadmill exercise at an intensity of 60-70% HRmax. In contrast, Huh et al. (2014) found insignificant differences in irisin levels before and after a treadmill running exercise intervention. Similarly, Tsuchiya et al. (2015) also reported insignificant differences in irisin levels before and after endurance exercise on an ergocycle. A study conducted by Archundia-Herrer et al. (2017) also indicated no significant increase in irisin expression in skeletal muscle after aerobic exercise using an ergocycle. Conversely, IL-6 levels increased between 6 and 24 hours after ergocycle exercise training (Hojman et al., 2019). Treadmill exercise at 65% VO2max intensity was also reported to significantly increase IL-6 levels (Newlin et al., 2012). However, the results of a study by Salamat et al. (2016) reported that moderate-intensity treadmill exercise decreased IL-6 levels. Research by Pranoto et al. (2023b) reported that IL-6 levels decreased after 24 hours of moderate-intensity treadmill exercise in obese women. However, the effect of exercise models in obesity on irisin and IL-6 parameters has not been investigated.

This study aims to compare the response of moderate-intensity treadmill and ergo cycle exercise on fat loss and increasing myokines secretion in obese adolescent females. The urgency of this study is that the increase in the obese population and life expectancy requires efforts to reduce the impact of morbidity and mortality and improve quality of life. The results of this research will help determine the optimal exercise dose for managing obesity in society.

Materials and Methods

Study designs in research

This study was true-experimental with a randomized pretest-posttest control group design. This study has followed the principles of the Declaration of Helsinki and was approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Airlangga (No. 192/EC/KEPK/FKUA/2021).

A total of 40 participants of Javanese ethnicity underwent anthropometric and body composition measurements; 10 participants did not meet the inclusion criteria. A total of 30 obese women (based on Asia-Pacific BMI classification) met the inclusion criteria with body mass index (BMI) of 30.02±2.97 kg/m^2, age 21.27±1.31 years, blood pressure (systolic: 111.13±3.98 mmHg; diastolic: 74.97±4.49 mmHg), resting heart rate 74.93±5. 59 bpm, body temperature 36.00±0.56 °C, oxygen saturation 97.57±1.22%, fasting blood glucose 93.57±3.80 mg/dL, and hemoglobin 15.04±1.21 g/dL were recruited into the study, and blood samples were collected. All participants were given clear verbal and written information about the study, and then participants consciously completed and signed the informed consent form. All selected participants had no history of smoking, alcohol consumption, and chronic diseases.

The participants were randomly divided into three groups: CTLG (n = 10; control group), AEEG (n = 10; aerobic ergo cycle exercise group), and ATEG (n = 10; aerobic treadmill exercise group). Exercise was performed once at an intensity of 60-70% HRmax for 45 minutes. This study's dropout rate was 0%, and the attendance rate was 100%. After the intervention program, anthropometric and body composition measurements and blood samples were taken.

It can be seen in the research flow chart (Figure 1) for further explanation.

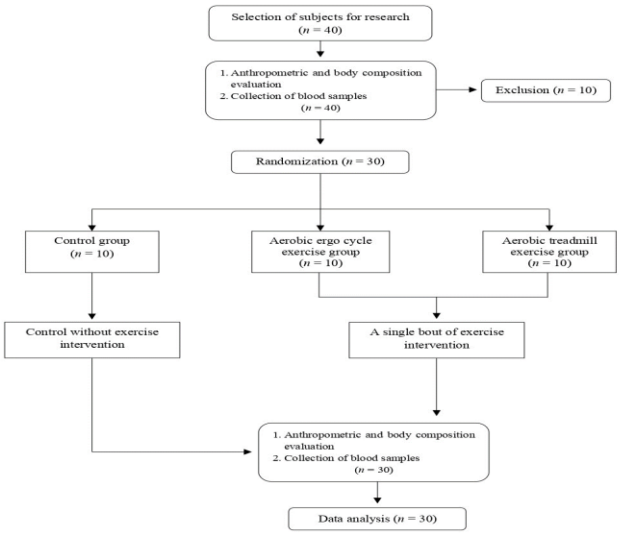

Figure 1. Study design flowchart

Exercise protocol programs for obese

The training program was implemented and supervised by personal trainers from Atlas Sports Club Malang, East Java 65146, Indonesia, to ensure that the exercises were performed correctly and to prevent the risk of injury. The intervention was carried out in only one exercise (acute exercise), which was carried out in mid-August (summer). The exercise program was applied from 08.00-10.00 AM or for 2 hours. The research environment had a humidity level of 50-70% with a room temperature of 26 ± 1°C. Geographically, the research site was located at 7.06°—8.02° South Latitude (LS) and 112.06°—112.07° East Longitude (BT) and has an altitude of between 440 – 667 meters above sea level. A Polar H10 heart rate monitor was used to monitor heart rate during exercise. Details of the exercise program are shown in Table 1.

Table 1.
Exercise program details

Group	Frequency	Intensity	Type	Time	Tools
Control group (CTRL)	Without intervention exercise				
Aerobic ergo cycle exercise group (AEEG)	One time exercise	60-70% HR_{max}	Continuous	45 min (5 min of warm-up, 35 min of core exercise, and 5 min of cool-down)	Ergo cycle (Monark 828 E, Version 1010 Art. No: 7950-296, Vansbro, Sweden)
Aerobic treadmill exercise group (ATEG)	One time exercise	60-70% HR_{max}	Continuous	45 min (5 min of warm-up, 35 min of core exercise, and 5 min of cool-down)	Treadmill (Pulsar 4.0 HP Cosmos Sports and Medical, Nussdorf-Traunstein, Germany)

Blood sample collection and blood analysis

Blood was collected from the cubital vein up to 4 ml after the subject had fasted overnight for 10-12 hours. Blood was collected twice, 30 minutes before exercise and 10 minutes after exercise. Blood was centrifuged at 3000 rpm for 15 minutes, then serum was separated and immediately analyzed for irisin and IL-6 levels. Analysis of irisin levels was performed using the enzyme-linked immunosorbent assay (ELISA) kit (code EK-067-29; Phoenix Pharmaceuticals, Inc., USA) with a standard curve range of 1.9 ng/mL-1000 ng/mL and a sensitivity of 1.9 ng/mL. IL-6 levels were measured using the ELISA kit method (Cat. No.: E-EL-H6156; Elabscience, Inc., USA) with a standard curve range of 1.56-100 pg/mL and a sensitivity level of 0.94 pg/mL. The accuracy of the ELISA kit used has been validated by previous studies (Rejeki et al., 2021; Pranoto et al., 2023a).

Statistical analysis

Statistical analysis was performed using GraphPad Prism 9 (GraphPad Software for Windows, San Diego, California USA). Data were first analyzed using descriptive tests to determine the size of the distribution and the centering of the data. Normality test was applied using Shapiro-Wilk, while homogeneity test was applied using Levene's test. Paired sample t-test was used to test the pre-exercise and post-exercise data in each group. One-way ANOVA test and Tukey's HSD post-hoc test were applied to test the data among the three groups (CTRL vs. AEEG vs. ATEG) at pre-exercise, post-exercise, and delta. Data are presented as mean ± standard deviation (SD). All data were significant at the 5% level.

Results

The baseline characteristics of all participants showed no significant differences, as shown in Table 2. This indicates that all groups were at the same baseline. The results of the analysis of myokine levels and body fat between pre-exercise and post-exercise in the three groups (CTRL, AEEG, and ATEG) are shown in Table 3. The results of the analysis of myokine levels and body fat between CTRL vs. AEEG vs. ATEG at pre-exercise, post-exercise, and delta are shown in Table 3, while the correlation analysis between myokine levels and body fat is shown in Table 4.

Table 2.
A baseline of characteristics across all participants

Variable	CTLG (n = 10)	AEEG (n = 10)	ATEG (n = 10)	p-Value
Age (yrs)	21.50±1.43	21.30±1.42	21.00±1.16	0.707
Weight (kg)	73.17±8.47	80.76±10.81	72.07±7.58	0.083
Height (m)	1.58±0.04	1.60±0.05	1.58±0.05	0.427
Body mass index (kg/m^2)	29.50±3.16	31.60±3.25	28.95±1.85	0.106
Systolic blood pressure (mmHg)	110.40±3.24	109.70±4.24	113.30±3.80	0.097
Diastolic blood pressure (mmHg)	76.10±5.82	73.10±2.96	75.70±4.08	0.278

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Resting heart rate (bpm)	74.90±4.38	73.30±4.67	76.60±7.34	0.434
Body temperature (°C)	36.10±0.39	35.98±0.66	35.92±0.64	0.777
Oxygen saturation (%)	97.90±0.99	97.40±1.43	97.40±1.27	0.589
Fasting blood glucose (mg/dL)	92.60±2.59	95.50±2.88	92.60±5.04	0.144
Hemoglobin (g/dL)	15.10±1.32	15.27±1.19	14.74±1.18	0.624
Baseline FAT (%)	44.82±4.11	46.64±3.19	43.44±2.67	0.124
Baseline FM (kg)	33.06±6.55	37.93±7.33	31.45±4.67	0.073
Baseline FFM (kg)	40.09±2.67	43.22±3.53	40.67±3.64	0.098
Baseline irisin (ng/mL)	87.43±44.28	121.13±55.77	91.00±42.87	0.244
Baseline IL-6 (ng/mL)	52.55±9.01	56.53±6.99	57.01±11.62	0.517

FFM: Free fat Mass; FM: Fat Mass; IL-6: Interleukin 6; AEEG: Aerobic ergo cycle exercise group; CTLG: Control group; ATEG: Aerobic treadmill exercise group. Data are presented as mean ± standard deviation. A one-way ANOVA test obtained the p-value.

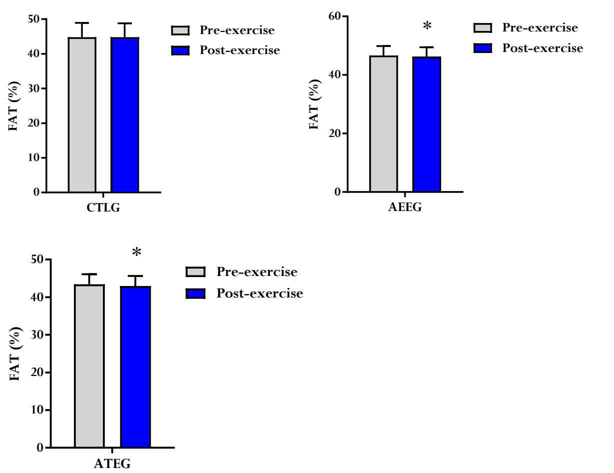

Figure 2. The FAT (%) analysis in the three groups (CTLG, AEEG, and ATEG). Data are presented as mean ± standard deviation. P-value was obtained by paired sample t-test. (*)Significant vs. pre-exercise ($p \leq 0.05$).

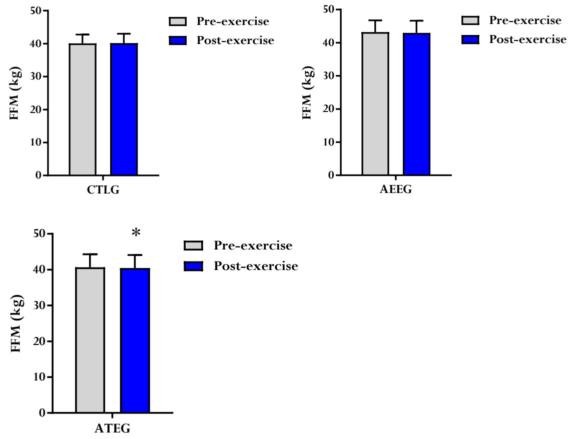

Figure 4. The FFM (kg) analysis in the three groups (CTLG, AEEG, and ATEG). Data are presented as mean ± standard deviation. P-value was obtained by paired sample t-test. (*)Significant vs. pre-exercise ($p \leq 0.05$).

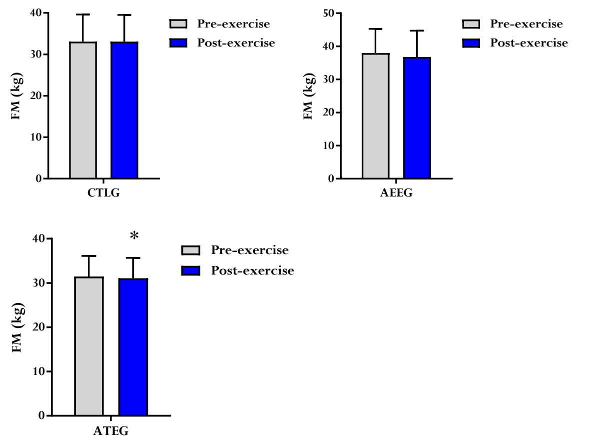

Figure 3. The FM (kg) analysis in the three groups (CTLG, AEEG, and ATEG). Data are presented as mean ± standard deviation. P-value was obtained by paired sample t-test. (*)Significant vs. pre-exercise ($p \leq 0.05$).

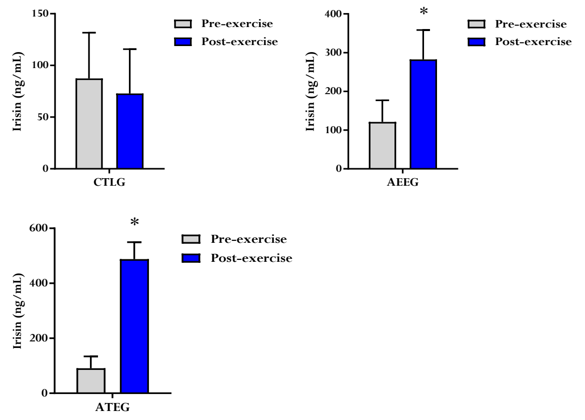

Figure 5. The analysis of Irisin (ng/mL) in the three groups (CTLG, AEEG, and ATEG). Data are presented as mean ± standard deviation. P-value was obtained by paired sample t-test. (*)Significant vs. pre-exercise ($p \leq 0.05$).

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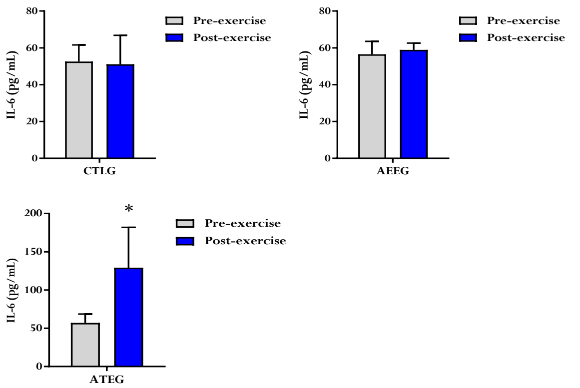

Figure 6. The analysis of IL-6 (pg/mL) in the three groups (CTLG, AEEG, and ATEG). Data are presented as mean ± standard deviation. P-value was obtained by paired sample t-test. (*)Significant vs. pre-exercise ($p \leq 0.05$).

Table 3.
The analysis of myokine levels and fat in all participants

Assessment	CTLG (n = 10)	AEEG (n = 10)	ATEG (n = 10)	p-value
		FAT (%)		
Pre-exercise	44.82±4.11	46.64±3.19	43.44±2.67	0.124
Post-exercise	44.80±3.99	46.29±3.17	42.98±2.64	0.101
Δ Post – Pre	-0.02±0.34	-0.35±0.19*	-0.46±0.18*	0.002
		Fat Mass (kg)		
Pre-exercise	33.06±6.55	37.93±7.33	31.45±4.67	0.073
Post-exercise	33.06±6.45	36.80±7.93	31.07±4.60	0.152
Δ Post – Pre	0.00±0.24	-1.13±2.53	-0.38±0.15	0.233
		Free Fat Mass (kg)		
Pre-exercise	40.09±2.67	43.22±3.53	40.67±3.64	0.098
Post-exercise	40.18±2.84	42.98±3.66	40.46±3.65	0.148
Δ Post – Pre	0.09±0.26	-0.24±0.49	-0.21±0.07	0.059
		Irisin (ng/mL)		
Pre-exercise	87.43±44.28	121.13±55.77	91.00±42.87	0.244
Post-exercise	72.82±42.96	282.50±75.96**	488.14±61.30**††	0.000
Δ Post – Pre	-14.61±50.64	161.37±91.92**	397.14±64.06**††	0.000
		IL-6 (pg/mL)		
Pre-exercise	52.55±9.01	56.53±6.99	57.01±11.62	0.517
Post-exercise	51.09±15.68	58.94±3.62	129.29±52.65**††	0.000
Δ Post – Pre	-1.46±13.99	2.41±8.76	72.29±54.91**††	0.000

(*) Significant vs. CTLG ($p \leq 0.05$). (**) Significant vs. CTLG ($p \leq 0.001$). (†) Significant vs. AEEG ($p \leq 0.05$). (††) Significant vs. AEEG ($p \leq 0.001$). Data are presented as mean ± standard deviation. P-value was obtained by one-way ANOVA and Tukey's HSD post hoc test.

Table 4.
Univariate correlations with Δ myokine levels and Δ fat in all participants

Variable	Δ Irisin Levels (ng/mL)		Δ IL-6 Levels (pg/mL)	
	r	*p*-value	*r*	*p*-value
Δ FAT (%)	-0.715**	$p \leq 0.001$	-0.460*	0.011
Δ Fat Mass (kg)	-0.679**	$p \leq 0.001$	-0.402*	0.028
Δ Free Fat Mass (kg)	-0.723**	$p \leq 0.001$	-0.368*	0.045
Δ IL-6 Levels (pg/mL)	0.626**	$p \leq 0.001$	–	–
Δ Irisin Levels (ng/mL)	–	–	0.626**	$p \leq 0.001$

(*) Significant with $p \leq 0.05$ by Spearman correlation test. (**) Significant with $p \leq 0.001$ by Spearman correlation test. (–) No analysis was performed.

Discussion

This study aimed to analyze the response of moderate-intensity treadmill and ergocycle exercise on irisin and IL-6 levels in obese women. The main finding of this study was that the treadmill has a more beneficial effect on fat loss through myokine secretion in obese women than cycling. Treadmill exercise was more effective than ergocycle exercise in increasing irisin and IL-6 levels in obese women (Table 3). Myokines, such as irisin and IL-6, are markers of increased energy expenditure as an effect of moderate-intensity aerobic exercise. Li et al. (2022) showed that treadmill exercise intervention can significantly increase irisin levels. Irisin is an adipo-myokine secreted mainly by myocytes after skeletal muscle contraction (Waseem et al., 2022; Colpitts et al., 2022). Muscle contraction leads to activation of peroxisome proliferator-activated receptor-gamma coactivator (PGC-1α), which in turn increases fibronectin type III domain-containing protein 5 (FNDC5) gene expression (Sari et al., 2024). The cleavage of this polypeptide protein at the N-terminus is known as irisin hormone (Boström et al., 2012). This hormone plays a vital role in energy metabolism by converting white fat to brown fat, thereby increasing thermogenesis (van der Vaart et al., 2021). Research findings by Chireh et al. (2018) showed that exercise using an ergocycle significantly increased irisin levels in healthy men. Jürimäe et al. (2022) also showed an increase in irisin levels after aerobic exercise using an ergocycle. The bicycle ergometer offers the advantages of a minor space requirement, less noise, convenient quantification of workload, less interference with the ECG, and avoidance of physical injury that may be caused by unstable standing (Ren et al., 2022). This results in differences in the frequency of muscle contractions during exercise. Treadmill exercise tends to involve more muscle contractions than ergocycle exercise. In addition to the major muscles used for exercise, the muscles, tendons, and ligaments used to maintain posture are also activated when exercising on a treadmill. The difference in muscle contraction between these two instruments used for exercise may affect the differences in myokine secretion levels, such as irisin and IL-6 (Leal et al., 2018).

IL-6 is synthesized and released in large amounts by skeletal muscle during exercise and is classified as a myokine (Balakrishnan & Thurmond, 2022). Exercise involves skeletal muscle contraction, which produces active substances such as myokines (Kwon et al., 2020; Nishii et al., 2023). It has been reported that several hundred myokines are secreted during exercise (Huh, 2018). The increase in IL-6 during exercise is due to an increase in muscle contraction, which causes an increase in calcium (Ca^{2+}), which activates the p38 mitogen-activated protein kinase (p38-MAPK) signaling pathway to activate IL-6 production (Nara & Watanabe, 2021). IL-6 is one of the most essential myokines, and evidence suggests that the function of muscle-derived IL-6 is not pro-inflammatory but related to glucose and lipid metabolism (Kistner et al., 2022). Physical activity reduces the risk of disease so that exercise can be prescribed as a remedy for sedentary lifestyle-related diseases such as obesity, type 2 diabetes, dementia, cardiovascular disease, and cancer (Rejeki et al., 2023; Severinsen and Pedersen et al., 2020). It has been reported that increased irisin levels in response to exercise can reduce body weight in individuals with obesity and insulin resistance in patients with diabetes (Dianatinasab et al., 2020; Kim et al., 2016; Whillier, 2020).

Obesity is characterized by excessive fat accumulation in the body and has become one of the major growing health problems (Soujanya & Jayadeep, 2022). The condition of obesity is associated with increased levels of body fat, oxidative stress, and expression of inflammatory markers (Ellulu et al., 2017). A 5-10% reduction in body weight is the recommended treatment target and a realistic goal for obese patients (Bongartz et al., 2022). This modest weight loss significantly reduces most comorbidity risks (Durrer Schutz et al., 2019; Powell-Wiley et al., 2021). Based on the results of this study, moderate-intensity aerobic exercise using either a treadmill or an ergo cycle significantly reduced body fat in obese women (Table 3). These findings are consistent with the results of a study by Park and Nickerson (2022), which showed that moderate-intensity aerobic exercise may contribute to reducing inflammation and oxidative stress independent of the effects of reducing body fat mass.

Research by Zhu et al. (2022) also reported that the percentage of total body fat was reduced with all types of exercise. Recent research from Pranoto et al. (2024) also reported the existence of reduced body fat in obese after long-term combination training.

Conclusion

The main finding of this study was that both intervention of exercise consistently increased irisin levels, while IL-6 levels were found to increase only with aerobic treadmill exercise. Likewise, body fat only decreased after one session of treadmill aerobic exercise compared to ergo cycle aerobic exercise. These results suggest that aerobic treadmill exercise may significantly affect metabolic and inflammatory markers more than aerobic ergo cycle exercise. However, this study had limitations, such as a small sample size, a short duration, and a lack of a control group. Therefore, further studies are needed to verify the effects of different types of exercise on obesity and related outcomes.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgments

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