



Original article. Effect of high intensity interval training on lipid profile and body composition in adolescents with obesity. Vol. 12, n.º 3; p. 1-15, July 2026. <https://doi.org/10.55040/gjgale43>

Effect of high intensity interval training on lipid profile and body composition in adolescents with obesity

Efecto del entrenamiento por intervalos de alta intensidad sobre el perfil lipídico y la composición corporal en adolescentes con obesidad

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Abstract

This study aims to investigate the effects of High-Intensity Interval Training (HIIT) program on lipid profiles, LDL (low-density lipoprotein), HDL (high-density lipoprotein), and triglycerides (TG). This study is a quasi-experiment with a one-group pretest-posttest design. Sixteen obese adolescent males participated in the study. The HIIT intervention used 85% of maximum heart rate. A treadmill was used for the HIIT treatment at 50% of baseline, and the exercise was conducted for 6 weeks. LDL, HDL, and triglyceride levels were measured using the LYSUN Blood Lipid, glucose was measured using the Blood Glucose 25T AGM-4000, and body composition was measured using the Omron HBF-702T. Data analysis was performed using the T-paired Test. Result Glucose ($p=0.000$), LDL ($p=0.011$), HDL protein ($p=0.002$), TG ($p=0.000$), BMI ($p=0.012$) showed significant differences after the 6-week HIIT intervention, with different results for Waist Circumference ($p=0.226$), which showed no significant difference despite a decrease each week. The intervention improved cardiometabolic markers (glucose, LDL, HDL, triglycerides, BMI), but waist circumference showed minimal change, indicating internal metabolic adaptations occurred faster than external body measurements.

Keywords: HIIT, obesity, HDL, LDL, TG

Resumen

El objetivo de este estudio es investigar los efectos del programa de entrenamiento por intervalos de alta intensidad (HIIT) sobre los perfiles lipídicos, el LDL (lipoproteína de baja densidad), el HDL (lipoproteína de alta densidad) y los triglicéridos (TG). Este estudio es un cuasi-experimento con un diseño de pretest-posttest de un solo grupo. En el estudio participaron dieciséis adolescentes varones obesos. La intervención HIIT utilizó el 85 % de la frecuencia cardíaca máxima. Se utilizó una cinta de correr para el tratamiento HIIT al 50 % del valor basal, y el ejercicio se llevó a cabo durante 6 semanas. Los niveles de LDL, HDL y triglicéridos se midieron con el LYSUN Blood Lipid, la glucosa se midió con el Blood Glucose 25T AGM-4000 y la composición corporal se midió con el Omron HBF-702T. El análisis de los datos se realizó mediante la prueba T pareada. Resultado La glucosa ($p=0,000$), LDL ($p=0,011$), proteína HDL ($p=0,002$), TG ($p=0,000$), IMC ($p=0,012$) mostraron diferencias significativas tras la intervención HIIT de 6 semanas, con resultados diferentes para la circunferencia de la cintura ($p=0,226$), que no mostró diferencias significativas a pesar de una disminución cada semana. La intervención mejoró los marcadores cardiometabólicos (glucosa, LDL, HDL, triglicéridos, IMC), pero la circunferencia de la cintura mostró un cambio mínimo, lo que indica que las adaptaciones metabólicas internas se produjeron más rápidamente que las mediciones corporales externas.

Palabra Clave: HIIT, obesidad, HDL, LDL, TG.

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Introduction

One of the key clinical consequences of obesity is the development of metabolic syndrome, a cluster of interrelated cardiometabolic risk factors that includes abdominal obesity, insulin resistance (Paulino da Silva Bento et al., 2021), dyslipidemia (elevated triglycerides and reduced HDL-C), and elevated blood pressure (Ahmad et al., 2023). The pathophysiological basis of metabolic syndrome lies in adipose tissue dysfunction (Banihashemi et al., 2022), chronic low-grade inflammation, and impaired insulin signaling—mechanisms strongly linked to excess visceral fat (Lopez-Jimenez et al., 2022). Individuals with metabolic syndrome are at substantially increased risk of developing atherosclerosis, myocardial infarction, stroke, and type 2 diabetes mellitus (Jaakonmäki et al., 2022). Obesity is far more than a cosmetic issue—it is a complex, chronic disease marked by excessive fat accumulation that disrupts normal metabolic processes and significantly increases the risk of non-communicable diseases (NCDs), particularly cardiovascular diseases (CVDs), type 2 diabetes mellitus, certain types of cancer, and chronic kidney disease (Gawel et al., 2024). The rising prevalence of obesity worldwide has thus led to a parallel increase in metabolic syndrome, making it a major target for preventive and therapeutic interventions in modern healthcare.

From a biomedical perspective, the link between lipid profile and health is mediated by several interrelated cellular and molecular mechanisms (Hung et al., 2025). In obese individuals, adipose tissue undergoes hypertrophy and hyperplasia, resulting in altered adipokine secretion and chronic low-grade inflammation (Powell-Wiley et al., 2021). Adipocytes and infiltrating macrophages produce pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF- α) (Kawinchothpisan et al., 2025), interleukin-6 (IL-6), and monocyte chemoattractant protein-1 (MCP-1), which contribute to systemic inflammation and insulin resistance (El Meouchy et al., 2022; Hadiono et al., 2023). Insulin resistance, in turn, disrupts normal lipid homeostasis by increasing hepatic lipogenesis and decreasing lipoprotein lipase (LPL) activity, leading to elevated circulating VLDL and TG levels (Nedunchezhiyan et al., 2022).

These complex interactions among lipid metabolism, inflammation, and vascular pathology underscore the need for targeted interventions aimed at improving lipid profiles as a means to reduce cardiometabolic risk (Feng et al., 2024). While dietary modification

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and pharmacotherapy remain primary strategies, physical activity is increasingly recognized as a powerful modulator of lipid metabolism (Ouerghi et al., 2022). Among various exercise modalities, High-Intensity Interval Training (HIIT) has garnered attention due to its efficiency and ability to induce profound metabolic adaptations in a relatively short time frame (Liu et al., 2022). HIIT, which involves alternating periods of vigorous activity and recovery, has demonstrated promising effects on cardiovascular function, insulin sensitivity, and body composition (Gaweł et al., 2024; Zhu et al., 2021). Recent studies suggest that HIIT may also exert favorable effects on lipid profiles by enhancing mitochondrial biogenesis, upregulating fatty acid oxidation, and improving the expression of lipid-regulating enzymes such as lipoprotein lipase and hepatic lipase (Bacchetti et al., 2024). Furthermore, HIIT may influence the expression of key genes involved in cholesterol transport and inflammation, such as peroxisome proliferator-activated receptor gamma (PPAR γ), AMP-activated protein kinase (AMPK), and nuclear factor-kappa B (NF- κ B) (El Meouchy et al., 2022).

Study reported significant improvements in HDL-C and reductions in LDL-C following a 16-week HIIT intervention in individuals with metabolic syndrome (Alarcón-Gómez et al., 2021). Similarly, Studied found that HIIT led to greater reductions in total cholesterol and triglycerides compared to moderate-intensity continuous training (MICT) in overweight young men (Monica & Hendrianingtyas, 2022). In contrast, observed minimal changes in lipid profiles following 12 weeks of HIIT in sedentary adults, suggesting that baseline metabolic status and training duration may influence outcomes. Moreover, in a systematic review and meta-analysis, concluded that while HIIT is effective for improving insulin sensitivity and cardiorespiratory fitness, its impact on lipid profiles is inconsistent and often not significantly different from MICT (Murillo et al., 2022). These discrepancies highlight the need for further investigation using standardized HIIT protocols and larger, diverse sample populations to determine the specific conditions under which HIIT most effectively modulates lipid metabolism.

Therefore, the present study aims to investigate the effect of a 6-week High-Intensity Interval Training (HIIT) program on lipid profile parameters in obese adolescents. The research question addressed in this study is: “Does a 6-week HIIT intervention significantly improve lipid profile markers in obese adolescents?” The

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objective of this study is to evaluate the effectiveness of HIIT in improving HDL-C, LDL-C, triglycerides, and other lipid-related metabolic indicators as a strategy to reduce cardiometabolic risk in obese adolescents

Methodology

Subjects

This study employed a quantitative experimental research design using a one-group pretest–posttest longitudinal approach to examine the physiological effects of a 6-week High-Intensity Interval Training (HIIT) intervention in adolescents with obesity. The study focused on evaluating changes in glucose levels, lipid profile parameters (LDL, HDL, and triglycerides), and body composition indicators (BMI and waist circumference) before and after the intervention period. Participants in this study consisted of 16 adolescents with obesity (BMI >30 kg/m²). Participants were recruited using a purposive sampling technique from local communities and schools in Madiun, Indonesia. Inclusion criteria included adolescents aged 15–18 years with obesity classification based on BMI, who were physically able to participate in exercise training. Exclusion criteria included a history of cardiovascular disease, musculoskeletal injury, trauma, or other medical conditions that could interfere with exercise participation.

Prior to participation, all respondents and their parents/guardians received a detailed explanation regarding the study procedures, benefits, and potential risks. Written informed consent was obtained from parents/guardians, and assent was obtained from all adolescent participants before data collection began.

Ethical clearance was obtained from the Research Ethics Committee of Universitas PGRI Madiun, Indonesia, which approved all research procedures (No: 003305/Komite Etik Penelitian Universitas PGRI Madiun/2025).

The training in this study used the HIIT training method. HIIT uses 60% of the total maximum speed (treadmill speed). The HIIT interval is 2 minutes of activity: 2 minutes of rest, for a maximum of 20 minutes per session. The training frequency is 3 times per week for 6 weeks. 6-week HIIT intervention can improve physiological responses in adolescents with obesity because repeated high-intensity exercise stimulates mitochondrial biogenesis, enhances antioxidant enzyme activity, and reduces oxidative



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stress, thereby improving skeletal muscle metabolic efficiency and energy utilization (Mukai et al., 2026). In addition, short-term HIIT has been shown to improve cardiorespiratory fitness and metabolic flexibility by increasing oxygen consumption efficiency and carbohydrate oxidation in obese adolescents, which contributes to better glucose regulation and insulin sensitivity (Manescu, 2025). Regular HIIT performed for six weeks also promotes favorable adaptations in endothelial function, lipid metabolism, and inflammatory regulation, which are important mechanisms for reducing cardiometabolic risk in obesity (Stankovic et al., 2025). Furthermore, exercise-induced physiological adaptations during a 6-week training period may occur because repeated muscular contractions activate AMP-activated protein kinase (AMPK) and peroxisome proliferator-activated receptor gamma coactivator-1 alpha (PGC-1 α), leading to improved fat oxidation and metabolic homeostasis in adolescents with obesity (Cheng et al., 2026).

Glucose, Lipid Profile, Body Composition

The lipid profile included Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), and Triglycerides. All variables were measured using the the LYSUN Blood Lipid Analysis Meter, operated by a certified pharmaceutical expert. Blood glucose test using Gluco Dr. Auto Blood Glucose Monitor + 25T AGM-4000. Body composition measured was BMI and waist circumference using the Omron HBF-702T Body Composition Monitor. Initial data analysis was performed using descriptive statistics to summarize the mean values of each variable. T-Paired Test was performed using SPSS version 26 for Windows. A significance level of 0.05 was applied in this study.

Results

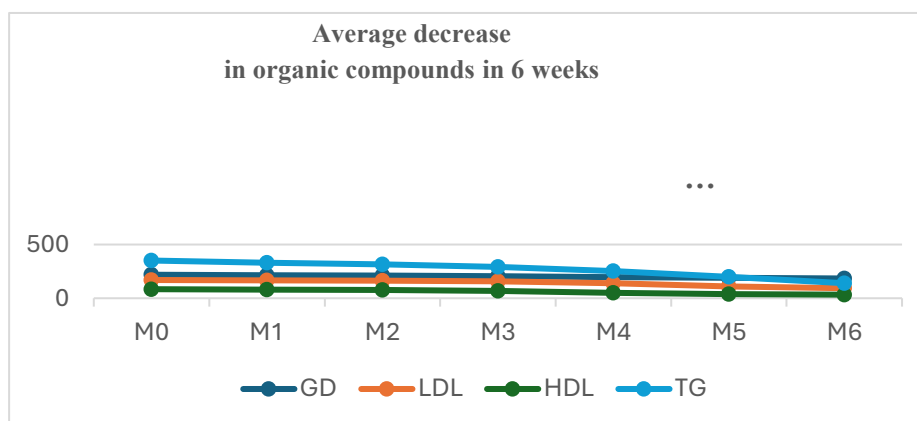
Table 1 Average per week

	GD	LDL	HDL	TG	BMI	Waist (LP)
W1	222 $\pm$ 814	179 $\pm$ 3.5	86.1 $\pm$ 3.5	350.3 $\pm$ 6.1	33.3 $\pm$ 0.7	87.0 $\pm$ 1.9
W2	220.7 $\pm$ 5.18	178.2 $\pm$ 3.9	85.1 $\pm$ 1.8	346.7 $\pm$ 6.7	33.3 $\pm$ 0.7	87.0 $\pm$ 1.5
W3	217.8 $\pm$ 4.5	178.5 $\pm$ 3.5	84.2 $\pm$ 2.1	345.5 $\pm$ 5.6	32.9 $\pm$ 1.00	87.9 $\pm$ 1.4
W4	211.3 $\pm$ 3.8	178.1 $\pm$ 6.1	84.2 $\pm$ 1.6	342.9 $\pm$ 5.2	32.7 $\pm$ 0.5	86.9 $\pm$ 0.9
W5	204.8 $\pm$ 6.5	176.8 $\pm$ 5.0	83.1 $\pm$ 3.5	339.1 $\pm$ 5.2	32.9 $\pm$ 0.3	86.9 $\pm$ 1.0
W6	200.4 $\pm$ 5.3	175.2 $\pm$ 4.5	82.4 $\pm$ 1.8	337.2 $\pm$ 4.8	32.9 $\pm$ 0.06	85.7 $\pm$ 1.3

*Glucose (GD), Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), Triglycerid (TG), Body Mass Index (BMI), Waist (LP)



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Graphics 1 Average Per Week

The table 1 and Figure 1 shows a consistent downward trend in metabolic biomarkers over 6 weeks. Blood glucose (BG) decreased steadily from 222 to 200, followed by LDL from 179 to 175, and HDL from 86.1 to 82.4, indicating metabolic changes due to the intervention. Triglycerides (TG) also decreased gradually from 350.3 to 337.2, showing a positive response to the exercise or program. BMI values decreased slightly in weeks 3 and 4 but tended to stabilize thereafter in the range of 32.7–32.9. Waist circumference (LP) showed a slight fluctuation from 87.0 to 85.7, indicating slower anthropometric changes compared to internal biomarker parameters. Overall, physiological adaptation was more pronounced in metabolic indicators than in external body composition over a relatively short period of time.

Table 2. Data Analysis

	GD	LDL	HDL	TG	BMI	Waist
Pre	220±6.08*	169.1±6.9*	84.4±2.92*	351.1±6.9*	34.3±0.4*	90.4±2.0
Post	184±3.3*	93.0±4.1*	33.3±2.7*	140.1±2.2*	30.5±0.15*	80.03±0.09

* Significantly different; Glucose ($p=0.000$), Low Density Lipoprotein ($p=0.011$), High Density Lipoprotein ($p=0.002$), Triglycerides ($p=0.000$), Body Mass Index ($p=0.012$). Waist ($p=0.226$)

The table shows that the intervention resulted in significant physiological changes in most cardiometabolic parameters. There was a significant decrease in glucose levels ($p=0.000$), LDL ($p=0.011$), HDL ($p=0.002$), triglycerides ($p=0.000$), and BMI ($p=0.012$) from pre- to post-intervention conditions, indicating an overall improvement in the participants'



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metabolic profile. However, although waist circumference experienced an absolute decrease, the change was not statistically significant ($p=0.226$), indicating that adaptation to the intervention was more dominant in internal metabolic parameters than in peripheral anthropometric indicators during the study period.

Discussion

The results of statistical analysis on the Waist Circumference (WC) variable showed a p-value of 0.226, which was above the significance threshold of 0.05. This finding indicates that the decrease in waist circumference after six weeks of HIIT exercise intervention in 16 obese adolescents did not show a statistically significant change. Although there was a descriptive trend toward a decrease, the change was not large enough to produce a meaningful effect. Thus, it can be concluded that six weeks of HIIT training did not have a significant effect on waist circumference in this study.

This insignificance is in line with several previous studies. Research conducted on obese adolescents showed that eight weeks of HIIT intervention did not result in a significant reduction in waist circumference, despite an increase in cardiometabolic capacity (Stankovic et al., 2025). A study also reported that six weeks of HIIT training in young obese women did not result in significant changes in waist circumference (Powell-Wiley et al., 2021). Similar findings were reported that despite metabolic improvements in the form of decreased blood glucose, LDL, and triglycerides, changes in waist circumference after six weeks of HIIT intervention were still minimal and insignificant (Jaakonmäki et al., 2022). These three studies show a pattern that relatively short exercise duration is insufficient to influence anthropometric changes, particularly waist circumference.

Decreased of waist circumference may also be associated with hormonal regulation and systemic inflammatory status associated with abdominal fat (Kong et al., 2022). Accumulation of central fat is closely correlated with increased cortisol secretion, both due to psychological stress and physiological responses to high-intensity exercise (Obradovic et al., 2021). Cortisol has a selective lipogenic effect on the abdominal region through increased lipoprotein lipase activity (Dote-Montero et al., 2021), thereby potentially inhibiting waist circumference reduction despite increased energy expenditure

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(Çiçek & Ozdurak Singin, 2023). Moreover, visceral adipose tissue is a source of proinflammatory cytokines such as TNF- α and IL-6, which can impair insulin sensitivity (Wueest, 2025). Impaired insulin sensitivity has implications for the body's ability to shift energy substrates from glucose to fat oxidation during and after exercise (Hung et al., 2025). Therefore, although HIIT is theoretically effective in increasing fat metabolism, hormonal and inflammatory conditions that are not fully resolved within six weeks may be the main limiting factors in producing statistically significant changes in waist circumference.

Limitations of HIIT on abdominal circumference reduction can be explained by disruption of the lipolysis-fat oxidation pathway in visceral adipocytes mediated by hormone regulation and intracellular signaling (Paucar-Urbe et al., 2026). In the physiological context, HIIT does increase the release of catecholamines (Xu et al., 2024) that bind to β_1 and β_2 -adrenergic receptors (Jakobsen et al., 2024) on adipocytes to activate adenylate cyclase and increase cAMP concentration (Iliuta et al., 2022), which in turn activates protein kinase A (PKA) and hormone-sensitive lipase (Obradovic et al., 2021). However in visceral abdominal fat, the expression of α_2 -adrenergic receptors which are antilipolytic tends to be more dominant, thereby inhibiting the cAMP-PKA pathway and decreasing the efficiency of free fatty acid mobilization (Izzicupo et al., 2021). Moreover, increased cortisol due to metabolic stress from HIIT (Iliuta et al., 2022) activates glucocorticoid receptors in visceral adipocytes (Koskinas et al., 2024), which transcriptionally increases lipoprotein lipase (LPL) activity and facilitates fatty acid re-esterification (Weiskirchen, 2024), so that most of the fatty acids resulting from lipolysis do not enter the mitochondrial β -oxidation pathway (Vatovec et al., 2024). On the mitochondrial level, insulin resistance and low adiponectin inhibit the activation of AMP-activated protein kinase (AMPK) (Öniz et al., 2024), which plays a crucial role in increasing fatty acid transport to mitochondria via carnitine palmitoyltransferase-1 (CPT-1) (Wang et al., 2026). As a result, despite an acute increase in triglyceride breakdown, the capacity for visceral fat oxidation remains limited, so that there is not a large enough deficit in abdominal fat to produce a statistically significant change in waist circumference over a six-week period.



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Conclusion

Overall, the insignificance of the waist circumference variable in this study is consistent with most short-term HIIT studies and can be explained by physiological mechanisms that require more time to produce meaningful anthropometric changes. These results emphasize that a longer intervention period and stricter dietary control may be necessary to achieve significant waist circumference reduction in obese adolescents.

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References

- Ahmad, A. M., Mahmoud, A. M., Serry, Z. H., Mohamed, M. M., & Abd Elghaffar, H. A. (2023). Effects of low-versus high-volume high-intensity interval training on glycemic control and quality of life in obese women with type 2 diabetes. A randomized controlled trial. *Journal of Exercise Science and Fitness*, 21(4), 395–404. <https://doi.org/10.1016/j.jesf.2023.08.003>
- Alarcón-Gómez, J., Calatayud, J., Chulvi-Medrano, I., & Martín-Rivera, F. (2021). Effects of a HIIT protocol on cardiovascular risk factors in a type 1 diabetes mellitus population. *International Journal of Environmental Research and Public Health*, 18(3), 1–12. <https://doi.org/10.3390/ijerph18031262>
- Bacchetti, T., Morresi, C., Simonetti, O., & Ferretti, G. (2024). Effect of Diet on HDL in Obesity. *Molecules*, 29(24), 1–17. <https://doi.org/10.3390/molecules29245955>
- Banihashemi, M., Yazdkhasti, E., Haghshenas, M. M., & Rostamkhani, F. (2022). *Journal of Exercise & Organ Cross Talk*. 2(2), 47–53. <https://doi.org/10.22034/jeoct.2022.347878.1041>
- Cheng, H., Song, S., Shu, H., Li, H., Tao, M., & Liu, B. (2026). The effects of HIIT and MICT on body fat composition and cardiopulmonary fitness in adults: a meta-analysis of randomized controlled trials. *BMC Sports Science, Medicine and Rehabilitation*, 18(1). <https://doi.org/10.1186/s13102-025-01519-2>



Original article. Effect of high intensity interval training on lipid profile and body composition in adolescents with obesity. Vol. 12, n. ° 3; p. 1-15, July 2026. <https://doi.org/10.55040/gjgale43>

- Çiçek, G., & Ozdurak Singin, R. H. (2023). Effect of aerobic and resistance exercises on body composition and quality of life in overweight and obese women: a randomized control trial. *Universa Medicina*, 42(1), 70–83. <https://doi.org/10.18051/univmed.2023.v42.70-83>
- Dote-Montero, M., Carneiro-Barrera, A., Martinez-Vizcaino, V., Ruiz, J. R., & Amaro-Gahete, F. J. (2021). Acute effect of HIIT on testosterone and cortisol levels in healthy individuals: A systematic review and meta-analysis. In *Scandinavian Journal of Medicine and Science in Sports* (Vol. 31, Number 9, pp. 1722–1744). John Wiley and Sons Inc. <https://doi.org/10.1111/sms.13999>
- El Meouchy, P., Wahoud, M., Allam, S., Chedid, R., Karam, W., & Karam, S. (2022). Hypertension Related to Obesity: Pathogenesis, Characteristics and Factors for Control. *International Journal of Molecular Sciences*, 23(20). <https://doi.org/10.3390/ijms232012305>
- Feng, J., Zhang, Q., Chen, B., Chen, J., Wang, W., Hu, Y., Yu, J., & Huang, H. (2024). Effects of high-intensity intermittent exercise on glucose and lipid metabolism in type 2 diabetes patients: a systematic review and meta-analysis. *Frontiers in Endocrinology*, 15(June). <https://doi.org/10.3389/fendo.2024.1360998>
- Gaweł, E., Hall, B., Siatkowski, S., Grabowska, A., & Zwierzchowska, A. (2024). The Combined Effects of High-Intensity Interval Exercise Training and Dietary Supplementation on Reduction of Body Fat in Adults with Overweight and Obesity: A Systematic Review. *Nutrients*, 16(3). <https://doi.org/10.3390/nu16030355>
- Hadiono, Kustiawan, A. A., Alexander, B., & Khoirunnisa, A. N. (2023). Effect of HIIT and MIT on TNF α levels and blood profile for obesity therapy. In *Fizjoterapia Polska* (Vol. 23, Number 2, pp. 158–161). <https://doi.org/10.56984/8ZG0DF1BA>
- Hung, C. H., Su, C. H., & Wang, D. (2025). The Role of High-Intensity Interval Training (HIIT) in Neuromuscular Adaptations: Implications for Strength and Power Development—A Review. In *Life* (Vol. 15, Number 4). Multidisciplinary Digital Publishing Institute (MDPI). <https://doi.org/10.3390/life15040657>

Original article. Effect of high intensity interval training on lipid profile and body composition in adolescents with obesity. Vol. 12, n. ° 3; p. 1-15, July 2026. <https://doi.org/10.55040/gjgale43>

- Iliuta, I., Song, X., Pickel, L., Haghighi, A., Retnakaran, R., Scholey, J., Sung, H., Steinberg, G. R., & Pei, Y. (2022). *Shared pathobiology identifies AMPK as a therapeutic target for obesity and autosomal dominant polycystic kidney disease*. (August), 1–14. <https://doi.org/10.3389/fmolb.2022.962933>
- Izzicupo, P., Blasio, A. Di, Credico, A. Di, Ghinassi, B., Capranica, L., Napolitano, G., Baldassarre, A. Di, Modestini, E., & Pietro, M. Di. (2021). *Objectively Measured Physical Activity Increases Only in Males During a Summer Camp for Obese Children*. 3(March), 1–8. <https://doi.org/10.3389/fspor.2021.624449>
- Jaakonmäki, N., Zedde, M., Sarkanen, T., Martinez-Majander, N., Tuohinen, S., Sinisalo, J., Ryödi, E., Autere, J., Hedman, M., Junttola, U., Huhtakangas, J. K., Grimaldi, T., Pascarella, R., Nordanstig, A., Bech-Hanssen, O., Holbe, C., Busch, R., Fromm, A., Ylikotila, P., ... Putaala, J. (2022). Obesity and the Risk of Cryptogenic Ischemic Stroke in Young Adults. *Journal of Stroke and Cerebrovascular Diseases*, 31(5), 1–9. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2022.106380>
- Jakobsen, D. D., Brader, L., & Bruun, J. M. (2024). Effect of a higher protein diet and lifestyle camp intervention on childhood obesity (The COPE study): results from a nonrandomized controlled trail with 52 - weeks follow - up. *European Journal of Nutrition*, 63(6), 2173–2184. <https://doi.org/10.1007/s00394-024-03420-z>
- Kawinotchpaisan, K., Segsarnviriyaya, C., & Norchai, P. (2025). The Effects of High-Intensity Interval Training (HIIT) on Sleep Quality in Obese Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. In *Obesities* (Vol. 5, Number 2). Multidisciplinary Digital Publishing Institute (MDPI). <https://doi.org/10.3390/obesities5020032>
- Kong, M., Xu, M., Zhou, Y., Geng, N., Lin, N., Song, W., Li, S., Piao, Y., Han, Z., Guo, R., Yang, C., Luo, N., Wang, Z., Ma, L., Xu, Q., Wang, L., Qiu, W., Li, J., Shi, D., ... Duan, Z. (2022). Assessing Visceral Obesity and Abdominal Adipose Tissue Distribution in Healthy Populations Based on Computed Tomography: A Large Multicenter Cross-Sectional Study. *Frontiers in Nutrition*, 9(April), 1–9. <https://doi.org/10.3389/fnut.2022.871697>



Original article. Effect of high intensity interval training on lipid profile and body composition in adolescents with obesity. Vol. 12, n. ° 3; p. 1-15, July 2026. <https://doi.org/10.55040/gigale43>

- Koskinas, K. C., Van Craenenbroeck, E. M., Antoniadou, C., Blüher, M., Gorter, T. M., Hanssen, H., Marx, N., McDonagh, T. A., Mingrone, G., Rosengren, A., Prescott, E. B., Aboyans, V., Blomstrom-Lundqvist, C., Nielsen, J. C., Donal, E., Döhner, W., Ferrini, M., Halvorsen, S., Hassager, C., ... Zeppenfeld, K. (2024). Obesity and cardiovascular disease: an ESC clinical consensus statement. *European Heart Journal*, 45(38), 4063–4098. <https://doi.org/10.1093/eurheartj/ehae508>
- Liu, Y., Li, Y., Cheng, B., Feng, S., Zhu, X., Chen, W., & Zhang, H. (2022). *Comparison of visceral fat lipolysis adaptation to high - intensity interval training in obesity - prone and obesity - resistant rats*. 9, 1–14. <https://doi.org/10.1186/s13098-022-00834-9>
- Lopez-Jimenez, F., Almahmeed, W., Bays, H., Cuevas, A., Di Angelantonio, E., le Roux, C. W., Sattar, N., Sun, M. C., Wittert, G., Pinto, F. J., & Wilding, J. P. H. (2022). Obesity and cardiovascular disease: mechanistic insights and management strategies. A joint position paper by the World Heart Federation and World Obesity Federation. *European Journal of Preventive Cardiology*, 29(17), 2218–2237. <https://doi.org/10.1093/eurjpc/zwac187>
- Manescu, D. (2025). *Physiological and Performance Effects of a High-Intensity Interval Training in University Students*. <https://doi.org/10.20944/preprints202507.0801.v1>
- Monica, & Hendrianingtyas, M. (2022). Correlation of Triglyceride/HDL-Cholesterol Ratio and Visceral Adiposity Index with 25(OH)D in Obese Female. *Indonesian Journal of Clinical Pathology and Medical Laboratory*, 29(1), 59–63. <https://doi.org/10.24293/ijcpml.v29i1.1923>
- Mukai, K., Takahashi, Y., Ebisuda, Y., Sugiyama, F., Yoshida, T., & Miyata, H. (2026). Physiological adaptations to 6 weeks of high-intensity interval and moderate-intensity continuous training in horses: A randomized crossover study. *Physiological Reports*, 14(4), e70785. <https://doi.org/10.14814/phy2.70785>
- Murillo, S., Brugnara, L., Servitja, J. M., & Novials, A. (2022). High Intensity Interval Training reduces hypoglycemic events compared with continuous aerobic training in individuals with type 1 diabetes: HIIT and hypoglycemia in type 1



Original article. Effect of high intensity interval training on lipid profile and body composition in adolescents with obesity. Vol. 12, n. ° 3; p. 1-15, July 2026. <https://doi.org/10.55040/gjgale43>

diabetes. *Diabetes and Metabolism*, 48(6).

<https://doi.org/10.1016/j.diabet.2022.101361>

Nedunchezhiyan, U., Varughese, I., Sun, A. R. J., Wu, X., Crawford, R., & Prasad, I. (2022). Obesity, Inflammation, and Immune System in Osteoarthritis. *Frontiers in Immunology*, 13(July), 1–19. <https://doi.org/10.3389/fimmu.2022.907750>

Obradovic, M., Sudar-Milovanovic, E., Soskic, S., Essack, M., Arya, S., Stewart, A. J., Gojobori, T., & Isenovic, E. R. (2021). Leptin and Obesity: Role and Clinical Implication. *Frontiers in Endocrinology*, 12(May), 1–14. <https://doi.org/10.3389/fendo.2021.585887>

Öniz, M., Sarıtaş, N., & Şentürk, M. (2024). Effects of short-term high-intensity interval training on growth hormone , cortisol , and leptin levels. <https://doi.org/10.22514/jomh.2023.124>

Ouerghi, N., Fradj, M. K. Ben, Duclos, M., Bouassida, A., Feki, M., Weiss, K., & Knechtle, B. (2022). Effects of High-Intensity Interval Training on Selected Adipokines and Cardiometabolic Risk Markers in Normal-Weight and Overweight/Obese Young Males. A Pre-Post Test Trial. *Biology*, 11(6). <https://doi.org/10.3390/biology11060853>

Paulino da Silva Bento, A. F., Páez, L. C., & Manuel de Mendonça Raimundo, A. (2021). High-intensity interval training in high-school physical education classes: Study protocol for a randomized controlled trial. *Contemporary Clinical Trials Communications*, 24. <https://doi.org/10.1016/j.conctc.2021.100867>

Powell-Wiley, T. M., Poirier, P., Burke, L. E., Després, J. P., Gordon-Larsen, P., Lavie, C. J., Lear, S. A., Ndumele, C. E., Neeland, I. J., Sanders, P., & St-Onge, M. P. (2021). Obesity and Cardiovascular Disease A Scientific Statement From the American Heart Association. *Circulation*, 143(21), E984–E1010. <https://doi.org/10.1161/CIR.0000000000000973>

Stankovic, M., Čaprić, I., Pezelj, L., Biševac, E., Mekić, R., Zećirović, A., Salihagić, Z., Ajdinović, A., & Jelaska, I. (2025). High-Intensity Interval Training (HIIT): Impact of Duration on Body Composition, Cardiometabolic Health, and Aerobic Capacity in Adolescent Women. *Metabolites*, 15(9). <https://doi.org/10.3390/metabo15090623>



Original article. Effect of high intensity interval training on lipid profile and body composition in adolescents with obesity. Vol. 12, n. ° 3; p. 1-15, July 2026. <https://doi.org/10.55040/gjgale43>

- Vatovec, T. P., Jakus, T., Pucer, P., Franeti, B. P., & Stubelj, M. (2024). *The Results Of The “ My Challenge ” Camp In Addressing Childhood Obesity Rezultati Tabora » Moj Izziv « Pri Obravnavi*. 63(4), 172–179. <https://doi.org/10.2478/sjph-2024-0023.THE>
- Wang, C., Hu, Y., Chen, J., & Wu, Y. (2026). High-intensity intermittent training promotes adipose tissue browning via the IL-27/p38 MAPK–PGC-1 α signaling pathway in diet-induced obese rats. *Frontiers in Physiology*, 17. <https://doi.org/10.3389/fphys.2026.1745363>
- Weiskirchen, R. (2024). *The signaling pathways in obesity - related complications*. (January), 1–20. <https://doi.org/10.1002/ccs3.12039>
- Wueest, S. (2025). *MINI-REVIEW | Immunometabolic Cross-Talk and Regulation of Endocrine and Metabolic Functions The controversial role of IL-6 in adipose tissue on obesity-induced dysregulation of glucose metabolism*. (17), 607–613. <https://doi.org/10.1152/ajpendo.00306.2020>
- Xu, Y., Li, Y., Wang, C., Han, T., Wu, Y., Wang, S., & Wei, J. (2024). Clinical value and mechanistic analysis of HIIT on modulating risk and symptoms of depression: A systematic review. *International Journal of Clinical and Health Psychology*, 24(1). <https://doi.org/10.1016/j.ijchp.2023.100433>
- Zhu, Y., Nan, N., Wei, L., Li, T., Gao, X., & Lu, D. (2021). The effect and safety of high-intensity interval training in the treatment of adolescent obesity: A meta-analysis. *Annals of Palliative Medicine*, 10(8), 8596–8606. <https://doi.org/10.21037/apm-21-757>