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The Effect of Cardiovascular Exercises on Body Fat Percentage and Body Mass Index Among Overweight Youth

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***Abstract*—**Non-excessive overweight represents a critical physiological stage requiring preventive interventions to avoid clinical obesity. This study aimed to investigate the effect of a proposed training program based on cardio (aerobic) exercises in reducing body fat percentage and Body Mass Index (BMI) among youth. The study adopted an experimental approach using a one-group pre-test/post-test design. The sample consisted of 12 young men (mean age 26.50 ± 3.97 years) purposively selected from Souk Ahras province, controlling for extraneous variables and ensuring homogeneity in anthropometric characteristics. The sample underwent an 8-week aerobic training program (24 training sessions). Statistical treatments using the paired samples T-test revealed statistically significant differences (at the 0.05 significance level) in favor of the post-test across all variables. Total weight decreased by an average of 5.93 kg, BMI dropped from 27.50 to 25.63, and body fat percentage significantly decreased from 32.31% to 25.35%. The study concluded that the scientific regulation of cardiovascular exercise loads contributes highly effectively to fat oxidation and the improvement of body composition, recommending its adoption as a safe and essential protocol for obesity prevention and weight management.

***Keywords*—**Cardiovascular exercises; Body composition; Fat oxidation; Body Mass Index; Exercise physiology.

1. Introduction

The modern era is witnessing radical demographic and technological transformations that have reshaped daily lifestyle patterns, as automation and the changing nature of professions have led to a noticeable decline in daily physical activity levels, resulting in the widespread phenomenon of physical inactivity, considered the fourth leading cause of mortality globally (Corbin et al., 2000; World Health Organization [WHO], 2020).

This reality has produced complex health and metabolic challenges, primarily the issue of positive energy imbalance, which inevitably leads to weight gain and the accumulation of body fat. Recent epidemiological reports by the World Health Organization indicate an alarming and rapid rise in the rates of individuals whose Body Mass Index (BMI) exceeds normal limits, turning weight gain from a mere aesthetic symptom into a health and economic burden that threatens quality of life (Al-Amin & Nabia, 2010).

Amidst this health crisis, the category of youth with "non-excessive overweight" (BMI between 25 and 29.9 kg/m²) emerges as a highly important segment from a preventive perspective. This physiological stage represents a critical turning point preceding the entry into the dark tunnel of clinical obesity and its associated serious metabolic risks known as Metabolic Syndrome, such as arterial hypertension, dyslipidemia, and insulin resistance, which is the primary precursor to type 2 diabetes (Kammash & Bashir, 2011; Alberti et al., 2009).

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To address these metabolic issues, exercise physiology research has shifted towards designing and implementing effective kinetic strategies aimed at restructuring body composition in safe and sustainable ways. In this context, "Cardiovascular Exercises" stand out as one of the most important scientific interventions, defined by the American College of Sports Medicine as any continuous rhythmic physical activity that engages large muscle groups for prolonged periods and relies primarily on aerobic energy production pathways (American College of Sports Medicine [ACSM], 2018).

These exercises are considered the cornerstone of weight management programs due to their superior ability to increase daily caloric expenditure and adjust the thermal balance in favor of fat burning (McArdle, Katch, & Katch, 2015). From a precise physiological and biochemical standpoint, the effectiveness of cardio exercises lies in inducing deep and long-term central and peripheral functional adaptations. Regular and regulated practice improves mitochondrial density and volume (Mitochondrial Biogenesis) within muscle fibers, and increases the activity of oxidative enzymes responsible for fatty acid oxidation (Beta-oxidation), which raises the body's efficiency in relying on Fat Oxidation as a primary source for Adenosine Triphosphate (ATP) production during moderate and sub-maximal aerobic effort (El-Sayed, 2017).

Furthermore, recent physiological studies have proven that varying the intensity of cardio exercises, especially when incorporating high-intensity intervals, induces a significant physiological phenomenon known as Excess Post-exercise Oxygen Consumption (EPOC), which keeps basal metabolic rates elevated for long hours after the training session ends, thereby doubling the volume of fat mass consumed during rest periods (Boutcher, 2011). Despite these established scientific facts, the sports field still lacks the precise application of cardio training loads specifically directed at the non-excessive overweight youth category. This study adopts two main hypotheses: The first hypothesis states that there are statistically significant differences between the pre- and post-measurements in favor of the post-measurement in the body fat percentage variable due to the cardio program. The second assumes statistically significant differences in favor of the post-measurement in Body Mass Index (BMI) and total weight reduction.

2. Methods

2.1 Study Methodology and Sample:

The study relied on the experimental method using a quasi-experimental one-group design with pre- and post-measurements, due to its absolute suitability for the nature of the research problem (Zerouati, 2007). The study sample was purposively selected and consisted of 12 young men from Souk Ahras province, aged between 25 and 29 years (mean age 26.50 ± 3.97 years, height 1.78 ± 0.06 meters, weight 87.15 ± 4.73 kg). Sample homogeneity was ensured based on skewness coefficients confined between (±3), with the condition that participants did not engage in any regular sports activities parallel to the experimental program.

2.2 Measurement Tools and Data Collection:

Accurate scientific measuring devices were used to ensure data validity and reliability, employing a stadiometer for total height and an electronic medical Body Composition Scale for total weight and body fat percentage, automatically extracting BMI based on the formula (weight in kg / height in meters squared). Implementation tools also included resistance bands, light free weights, medicine balls, and stationary bicycles.

2.3 Training Program and Statistical Analysis:

The proposed program was built upon modern sports training foundations and lasted for eight weeks with three sessions per week (totaling 24 sessions), averaging 45 to 60 minutes per session. The program targeted the activation of aerobic energy systems by regulating intensity between moderate and sub-maximal (Ben Goua, 2012). For results analysis, SPSS was used, relying on central tendency measures and the paired samples T-test to determine the significance of differences at the (0.05) level.

3. Results

Statistical analysis showed substantial improvement and statistically significant differences in all studied anthropometric variables between the pre- and post-measurements in favor of the post-measurement. Regarding total weight, the sample recorded a clear decline from a pre-test mean of 87.15 kg to a post-test mean of 81.22 kg, achieving a positive difference of 5.93 kg, with a calculated T-value of 6.841, which exceeds the critical value (2.201) at 11 degrees of freedom and a 0.05 significance level. Consequently, BMI experienced a statistically significant decline from a pre-test mean of 27.50 to 25.63 post-test, with a T-value of 2.364. As for the most

physiologically important variable, body fat percentage, statistical treatments proved a notable decrease from 32.31% to 25.35%, a difference of nearly 7%, with a statistically significant T-value of 5.518, confirming the significance of the differences and the acceptance of the hypotheses.

Table 1. Significance of differences between pre- and post-measurements in study variables (N=12)

Variable	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Positive Difference	Calculated t-value	Statistical Significance
Body Weight (kg)	87.15 ± 4.73	81.22 ± 2.93	5.93	6.841	Statistically significant
Body Mass Index (BMI; kg/m²)	27.50 ± 2.33	25.63 ± 2.11	1.87	2.364	Statistically significant
Body Fat Percentage (%)	32.31 ± 2.86	25.35 ± 3.13	6.96	5.518	Statistically significant

Note. Mean ± SD = mean ± standard deviation. The tabulated critical t-value at the 0.05 significance level, with 11 degrees of freedom, is 2.201. All calculated t-values exceed the critical value, indicating statistically significant differences between pre-test and post-test measurements.

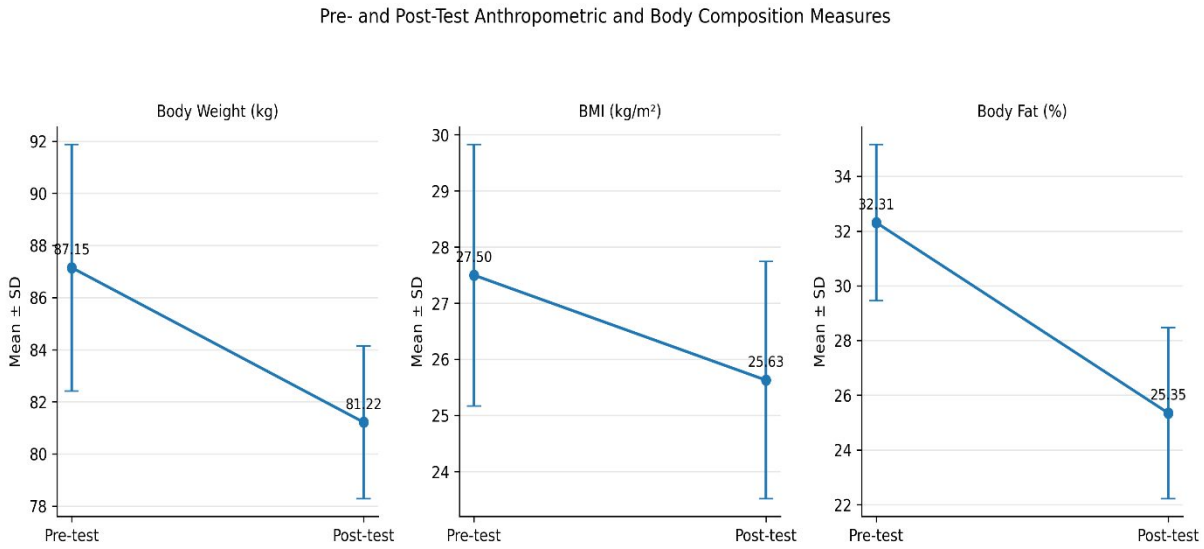


Figure 1. Pre- and post-test comparisons of body weight, body mass index, and body fat percentage (mean ± SD).

Note. Data are presented as mean ± standard deviation (SD). Error bars represent ±1 SD.

4. Discussion

The statistical analysis demonstrates the significant efficacy of the structured cardiovascular intervention, producing profound physiological, biochemical, and structural adaptations in overweight young adults.

The marked reduction in body fat percentage—decreasing from a pre-intervention mean of 32.31% ± 2.86% to a post-intervention mean of 25.35% ± 3.13% ($t=5.518, p<0.05$)—reflects well-documented neuroendocrine and metabolic adaptations to sustained aerobic loading. Sustained moderate-to-vigorous aerobic exercise depletes intramuscular and hepatic glycogen reserves, stimulating the sympathetic-adrenal system to elevate circulating catecholamines, specifically epinephrine and norepinephrine (Brooks et al., 2019; Powers & Howley, 2021). Catecholamines bind to β-adrenergic receptors on adipocytes, activating the cyclic adenosine monophosphate (cAMP) and protein kinase A (PKA) signaling cascades. This pathway phosphorylates perilipin A and hormone-sensitive lipase (HSL), mobilizing triacylglycerols from adipose tissue into free fatty acids (FFAs) and glycerol (Kammash & Bashir, 2011; Jeukendrup & Gleeson, 2018).

Once released into systemic circulation, FFAs are bound to plasma albumin, transported to skeletal muscle myocytes, and shuttled across the mitochondrial membrane via the carnitine palmitoyltransferase (CPT-1) enzyme complex for mitochondrial β-oxidation (McArdle et al., 2015). Over the eight-week intervention (24 structured sessions), repeated aerobic stimulation enhanced mitochondrial density and biogenesis through peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1α) pathways, while simultaneously elevating oxidative enzyme kinetics, notably citrate synthase and 3-hydroxyacyl-CoA dehydrogenase (HAD) (Egan & Zierath, 2013; Hargreaves & Spriet, 2020).

These physiological findings align with extensive exercise physiology literature. Donnelly et al. (2009) established in the ACSM Position Stand that structured aerobic exercise exceeding 150–250 minutes per week produces significant fat mass reduction in overweight adults without dietary restriction. Similarly, Willis et al. (2012), in the STRRIDE AT/RT trial, demonstrated that aerobic training protocol execution produces significantly greater body fat and visceral fat reduction compared to resistance training alone. Furthermore, the inclusion of variable-intensity interval cardiovascular bouts induced significant Excess Post-Exercise Oxygen Consumption (EPOC). This elevated post-exercise metabolic state reflects the energy cost of ATP-PCr resynthesis, lactate clearance, core temperature regulation, and sustained neuroendocrine signaling, which extends lipid oxidation well into the post-exercise recovery window (Boutcher, 2011; LaForgia et al., 2006).

The statistically significant reduction in total body weight (from 87.15 ± 4.73 kg to 81.22 ± 2.93 kg,$t=6.841,p<0.05$) and the corresponding decline in BMI (from 27.50 ± 2.33 kg/m^2 to 25.63 ± 2.11 kg/m^2,$t=2.364,p<0.05$) confirm the thermodynamic principle of energy balance (Hall et al., 2012). The structured cardiovascular training increased daily Total Energy Expenditure (TEE) beyond Resting Metabolic Rate (RMR) and the thermic effect of food, inducing a cumulative negative energy deficit that forced the mobilization of endogenous lipid stores (Thomas et al., 2012).

From a clinical and epidemiological perspective, transitioning the cohort's mean BMI from 27.50 kg/m^2 toward the upper boundary of normal weight (24.9 kg/m^2) represents a critical preventive health outcome. Non-excessive overweight (BMI 25.0--29.9 kg/m^2) is a pivotal pathophysiological window characterized by subclinical systemic inflammation, adipose tissue hypoxia, and altered adipokine secretion, including elevated leptin and suppressed adiponectin (Alberti et al., 2009; World Health Organization, 2020). Left unaddressed, this state accelerates systemic insulin resistance, endothelial dysfunction, and dyslipidemia, laying the groundwork for Metabolic Syndrome, Type 2 Diabetes Mellitus, and premature Cardiovascular Disease (CVD) (Al-Amin & Nabia, 2010; Grundy et al., 2004).

Our findings corroborate clinical intervention trials by Swift et al. (2014) and Thorogood et al. (2011), which demonstrated that aerobic exercise programs lasting 8–12 weeks induce clinically meaningful weight loss (>3%--5%) and substantial improvements in cardiometabolic risk markers among overweight young adults. By stabilizing body mass and reducing central adiposity during this developmental age (25–29 years), structured cardiovascular exercise provides a potent non-pharmacological therapy that restores cardiometabolic health and prevents the progression toward clinical obesity.

5. Conclusions

An eight-week structured cardiovascular training program, consisting of three sessions per week lasting 45–60 minutes per session, was associated with statistically significant reductions in body fat percentage, total body mass, and body mass index (BMI) among overweight young adults. These findings highlight the potential effectiveness of regular, appropriately prescribed cardiovascular exercise in improving body composition and supporting weight management. However, the magnitude and clinical relevance of these changes should be interpreted in relation to the participants' baseline characteristics and the outcomes measured.

Cardiovascular training performed at appropriate aerobic intensities may promote fat oxidation and induce metabolic adaptations that contribute to improved body composition. These adaptations may involve changes in mitochondrial function, oxidative enzyme activity, and the capacity of skeletal muscles to utilize fatty acids as an energy source. Nevertheless, the extent of these physiological responses depends on several factors, including exercise intensity, training duration, individual fitness level, and nutritional status.

Cardiometabolic Disease Prevention: Lowering BMI from 27.50 kg/m^2 to 25.63 kg/m^2 effectively reverses the early metabolic derangements associated with non-excessive overweight, providing a safe, accessible, and non-pharmacological strategy to prevent clinical obesity and Metabolic Syndrome.

Exercise physiologists and fitness professionals are encouraged to implement structured, individualized cardiovascular training programs for overweight individuals seeking to improve body composition and manage body weight. These programs should incorporate appropriate aerobic exercise intensities, progressive adjustments to training volume, and systematic monitoring of exercise intensity, including heart rate when suitable. Depending on participants' physical fitness, health status, and exercise tolerance, a combination of continuous moderate-intensity aerobic exercise and high-intensity interval training may be considered. Training prescriptions should be individualized to ensure safety, adherence, and sustainable long-term benefits.

From a public health perspective, healthcare professionals, educational institutions, and sports organizations should promote regular aerobic physical activity among young adults to counteract sedentary lifestyles and reduce cardiometabolic risk. Exercise recommendations should be consistent with established public health guidelines, taking into account individual health conditions and physical capabilities. In addition, combining regular physical activity with balanced nutrition and appropriate lifestyle modifications may support more sustainable improvements in body composition and metabolic health.

Finally, future research should investigate the long-term effects of structured cardiovascular training programs using larger and more diverse samples. Researchers should consider including additional indicators, such as waist circumference, blood pressure, blood glucose, and blood lipid profiles, to provide a more comprehensive assessment of cardiometabolic health. Comparisons between different training intensities and exercise modalities would also help identify the most effective and practical approaches for improving body composition among overweight young adults.

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