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Original Article

The Effects of Twelve-Weeks of Aerobic Exercise on Body Composition, Physical Fitness and Happiness among Obese Adolescents

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Abstract

Introduction: Although the effects of participating in aerobic exercise on physical and psychological indicators of children and adolescents has been investigated, its effect on obese adolescents has been less noticed.
Objective: This study was designed to investigate the effects of twelve-weeks of aerobic exercise on body composition, physical fitness and happiness among obese adolescents.
Methods: The present study utilized a semi-experimental approach with an applied purpose, employing a pre-test and post-test design along with a control group. 48 obese students with a BMI in the 95th percentile and higher and aged 12 to 15 years old were selected from middle schools as participants and randomly assigned into experimental (n=18) and control (n=17) groups. Body composition, physical fitness and happiness were measured using standard tests. Data was analyzed using independent sample t test and ANCOVA.
Results: The findings indicate a significant reduction in weight, BMI, BF%, and WHR among the aerobic subjects during the post-intervention period ($p<0.05$). Also, a significant improvement was observed in flexibility, abdominal muscle endurance, upper body strength and endurance, agility and happiness among the aerobic subjects during the post-intervention period ($p<0.05$).
Conclusion: Aerobic exercise program recommended in this study was successful in reducing body fat indices, physical fitness components and happiness in obese adolescents. Hence, participating in regular sport and exercises such as aerobic can be strongly recommended as an effective strategy to enhance psychological indicators such as happiness in obese adolescents.

Keywords: Exercise, Aerobic, Adiposity, Fitness, Adolescents

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1. Introduction

In the past few decades, significant changes have occurred in the dietary habits and lifestyles of human societies due to economic, social, and health advancements, as well as the rise of urbanization and industrialization (1). Adolescence, being a period of intense physical and psychological growth, plays a crucial role in shaping behaviors related to physical activity and nutrition, potentially leading to an increased risk of obesity (2). Obesity is a complex issue that arises from a combination of various factors, such as genetics and lifestyle choices, particularly physical activity and dietary habits, which are influenced by social, cultural, and environmental elements (3,4). Referred to as the epidemic of the 21st century, the origins of obesity as a health concern are believed to lie in adolescence, a critical period for the development of obesity and overweight, leading to the onset of obesity and other non-communicable diseases in adulthood. Childhood and adolescent obesity are linked to a higher likelihood of developing type 2 diabetes, hypertension, dyslipidemia, and cancer later in life. Furthermore, adolescent obesity not only impacts teenagers' self-esteem and can lead to symptoms of depression, but it also incurs significant health costs (5-7). The prevalence of obesity in children and adolescents in developing countries has more than doubled and quadrupled, respectively, over the past three decades. The World Health Organization has predicted that by 2030, approximately 60 million children will be obese, with higher rates in Middle Eastern nations compared to other developing regions. Research indicates that 70% of obese children will continue to struggle with obesity into adulthood (8,9). The rapid rise in overweight rates among young individuals should serve as a warning sign, as adolescent obesity remains a prevalent health issue in the country.

The rise in adolescent obesity can be attributed to an imbalance between energy intake and expenditure. In the last twenty years, there has been a decrease in energy expenditure among children, coupled with changes in physical activity patterns, such as increased screen time and reduced time spent on physical activities in schools and communities (10-12). Research indicates that the reduction in physical activity has a greater impact on obesity in children and adolescents compared to dietary habits. Given the influence of

adolescent years on adult nutritional behaviors and physical activity, promoting a healthy lifestyle during this period can have a positive impact on health. Generally, an excess of body fat is the result of a prolonged imbalance between energy intake and energy expenditure (10,13,14). The formation of fat cells occurs during childhood and adolescence, and being overweight during this time leads to an increase in the size of fat cells and their multiplication. Therefore, it is crucial to address childhood and adolescence obesity in order to prevent adult obesity (13). The optimal age to prevent childhood and adolescence overweight from progressing into adult obesity is during school years, specifically between the ages of 6 and 15 (15,16). The decrease in physical activity and increased sedentary lifestyle in today's society has significantly impacted body composition, physical fitness, and organ function, particularly during growth and development. There are various methods proposed to address obesity in children and adolescents, with physical activity being one of the most cost-effective and straightforward strategies to control overweight and obesity by increasing metabolism and utilizing fats as an energy source (16-18).

Engaging in regular physical activity is crucial for maintaining good health and has been identified as a key aspect in promoting healthier behaviors to enhance overall well-being (19,20). It is particularly important for children and adolescents to engage in adequate physical activity to support their physical growth and cognitive development. Physical activity habits are typically established early in life and tend to remain consistent until around the age of eighteen, carrying on into adulthood (19-21). Therefore, it is advisable to adopt healthy lifestyle practices early on to prevent difficulties in changing established habits later. Unfortunately, there is a lack of inclination towards increasing physical activity among teenagers, with overall activity levels being notably low, especially among girls (19,20,22-24). The contemporary sedentary lifestyle driven by technology has contributed to the decline in physical activity levels, particularly among this age group, whereas just two decades ago, teenagers were actively engaged in various physical activities such as games, walking, cycling, and regular sports. The findings of research indicate that there exists an inverse correlation between physical activity and body mass index (BMI) in children (22,24,25). Those with high levels of physical activity tend to have a normal weight compared to those with low activity levels. Any decrease in sedentary behavior, such as watching TV and playing computer games, and any increase in physical activity, to any degree, can contribute to achieving a healthy weight (25,26). However, engaging in activities that elevate heart rate is particularly beneficial. Generally, activities like walking, swimming, cycling, volleyball, and basketball are recommended. Additionally, exercises like sit-ups can help target localized obesity, especially in the abdominal area. It is crucial that the chosen physical activity is enjoyable for the child or teenager, and that its duration and intensity gradually increase to maintain interest and prevent boredom (22,24-26). Furthermore, the ease and accessibility of the exercise are important for sustainability. Regular exercise also helps reduce appetite and plays a role in controlling body composition by promoting the release of corticotropin-releasing factor and increasing fat oxidation (19, 25,26).

Physical fitness encompasses the overall health and capabilities of the body, which includes various elements such as muscle strength, muscle endurance, aerobic endurance, flexibility, and body composition (27). Studies have indicated a correlation between obesity and physical fitness components, revealing that obese or overweight children tend to exhibit lower levels of endurance, muscle strength, flexibility, and cardiovascular fitness (28-30). Additionally, excess fat mass can hinder movement speed and the ability to adjust body posture, with individuals of average height and muscle mass typically excelling in agility tasks (28,29). Gender disparities have also been observed, with boys generally displaying superior cardio-respiratory fitness, muscular endurance, and agility compared to girls, while girls tend to outperform boys in terms of flexibility (29-31). Boys also tend to fare better than girls in sitting and running assessments. On the other hand, it has been shown that engaging in physical activity can enhance physical fitness such as endurance and strength, leading to improved physical function and overall quality of life (29,32). Research focusing on enhancing balance, strength, endurance, and functional mobility has demonstrated a positive association between physical activity and functional health (28-32). Hence, it can be assumed that participating in physical activities can lead to better physical functionality and fitness among obese children and adolescents.

Furthermore, childhood obesity and being overweight can lead to psychological issues. For instance, recent research indicates that depression can both contribute to and result from obesity (33-35). Moreover, obese adolescents in clinical studies were found to have higher rates of anxiety disorders compared to their normal weight counterparts (33,34). When it comes to the impact of obesity on psychological well-being, some studies have revealed that obese children tend to have lower self-esteem than those with normal weight. Additionally, certain studies have found that there is not a direct correlation between body dissatisfaction and body mass index in girls, while in boys, this relationship follows a U-shaped pattern (33-36). These studies suggest that boys with very low or very high BMIs tend to experience higher levels of body dissatisfaction. On a positive note, research has shown that regular physical activity can improve psychological well-being, such as happiness, in children and adolescents (36-39). Happiness plays a crucial role in two key aspects: firstly, it involves experiencing positive emotions such as satisfaction and victory, and secondly, it entails an individual's enthusiasm to engage in social interactions. Feeling happy enables individuals to feel secure and composed, make sound decisions, actively participate in social events, and consequently, experience greater joy. Happiness stands as a fundamental element of life quality across all age groups, especially teenagers (37,38). Happy teenagers exhibit enhanced concentration levels, problem-solving abilities with minimal effort, reduced confusion, and distress. Research indicates that individuals who are happy tend to achieve success in various facets of life. Given the significance of happiness among adolescents, it is imperative to explore ways to enhance it, especially among obese adolescents (37-39).

Aerobics is currently a popular form of physical activity, with research showing its positive effects on different organs in the body and its effectiveness in

managing weight (40-42). Aerobic exercise is defined as "with oxygen," indicating that any activity or sport that utilizes oxygen falls under this category. During aerobic activities, both breathing and heart rates increase. Engaging in aerobic exercise contributes positively to the health of the heart, lungs, and circulatory system. Various sports, including swimming, walking, and running, are recognized as forms of aerobic exercise. However, aerobics is distinguished as a separate category within fitness sports. This form of physical activity involves the use of large muscle groups and encompasses a variety of exercises characterized by rhythmic and aerobic movements, often combined with strength and stretching exercises. Typically, these activities are performed in a group setting and accompanied by music, making aerobics a comprehensive series of balanced exercises within the realm of aerobic sports. Past studies have shown that participating in aerobic training sessions leads to a decrease in body fat percentage and an increase in fat-free mass (41,43,44). Moreover, engaging in aerobic exercises has been associated with significant reductions in overall weight and body fat percentage (45,46). In addition, aerobics improves breathing depth and respiratory system efficiency by increasing oxygen supply to the respiratory system (47,48). While the impact of aerobic exercise on the physical and psychological well-being of children and adolescents has been explored, its influence on obese adolescents has received comparatively less attention. To the best of our knowledge, there is a lack of research focused on the effects of consistent aerobic exercise on the body composition and mental health of this specific group. Consequently, it is essential to create and evaluate new and innovative intervention strategies aimed at improving exercise adherence and reducing dropout rates within this high-risk population. Hence, this study was designed to investigate the effects of twelve-weeks of aerobic exercise on body composition, physical fitness and happiness among obese adolescents.

2. Methods

2.1. Participants

The present study utilized a semi-experimental approach with an applied purpose, employing a pre-test and post-test design along with a control group. The research focused on obese male students aged 12 to 15 years old. After screening eligible students, four schools were randomly chosen, and 48 obese students with a BMI in the 95th percentile and higher were selected as participants. According to definition of obesity, children aged 2-20 years can be classified as obese as BMI ≥95th percentile for age and sex (1,3,6). The research samples were then divided into two groups, namely the experimental and control groups, each consisting of 24 students. The sample size was determined using G*Power software with an effect size of 0.95, a test power of 0.90, and α=0.05 (17). It is important to note that during the research process, the number of subjects in the groups decreased due to lack of motivation, emigration, and irregular participation in training sessions. As a result, the number of final samples whose data was analyzed decreased to 35 people, with 18 participants in the experimental group and 17 participants in the control group. Prior to commencing the research implementation stages, the purpose and method of the research were explained to the participants and their parents. Discussions were held regarding the complications and problems of obesity in children, emphasizing the importance of parental involvement in controlling it, and written consent was obtained from the parents of the students. Subsequently, the students underwent a health examination by a specialist doctor and received a certificate of health, along with a doctor's approval for physical activity. During the initial evaluation, the requirements for participating in the study were: 1) students who are obese with a BMI at or above the 95th percentile, 2) not taking any nutritional supplements, 3) not adhering to a specific diet, 4) free from injury and illness, 5) not restricted from engaging in physical activity. If any of these conditions are not met, the individual is excluded from the research study.

2.2. Measures

2.2.1. Body Composition

The anthropometric measurements and body composition of participants, such as height, weight, BMI, body fat percentage (BF%) and waist-to-hip ratio (WHR) were assessed in two phases - pre-test and post-test - for both groups. The procedure for measuring these variables is outlined below:

a) Height: In order to accurately measure height, the individual should stand barefoot with their feet flat on the ground and together. Knees should be straight, palms close to the sides, and shoulders at the same level. The subject's head, shoulders, and heels should touch the wall, while a flat object is placed on top of their head against the wall at a 90-degree angle for measurement. The wall serves as a reference point.

b) Weight: The individual removed his shoes and bulky clothing before stepping onto the digital scale to have the weight of his feet accurately measured and recorded to the nearest tenth of a decimal.

c) BMI: BMI was calculated by dividing weight by the square of height (in meters). After measuring the height and weight of the participants in that sequence, the body mass index was determined and documented in both the pre-test and post-test.

d) BF%: BF% can be calculated by measuring subcutaneous fat in specific areas such as the biceps brachii, triceps brachialis, subscapularis, and supraclavicular areas using calipers. The formula derived from these measurements can then determine the subjects' body fat percentage.

(e) WHR: The most straightforward method for measuring fat distribution is by using WHR. This measurement is closely linked to the development of cardiovascular diseases. The largest circumference, from the top of the pelvis to the point where the legs meet the torso, was measured while standing with a tape measure, with an accuracy of approximately 0.1 cm.

2.2.2. Physical Fitness

All participants underwent five health-related physical fitness assessments, which included tests for flexibility (forward bending), abdominal muscle endurance (modified sit-ups in 60 seconds), upper body strength and endurance (modified pull-up), and agility (4x9m run).

a) Flexibility: To start the test, the subject sits barefoot on the floor in front of the flexibility box with his legs stretched forward. The knees should be straight and stretched and the distance between the feet should be 10 cm. The soles of the feet should also be flat and the heels should stick to the box. To perform the test, the hands are brought straight forward, and then the subject bends forward and pushes the box forward as far as possible with the tips of the index fingers. The subject has the right to bend and straighten his body a maximum of 4 times, and in the last time, he must hold his position at the maximum stretch for 1 to 2 seconds. The subject's score is the farthest point that was obtained in the last time of elongation in centimeters.

b) Modified sit-ups: The individual is positioned on their back with knees bent, ensuring that the soles of their feet are touching the ground. The distance between the heels should measure approximately 30 to 40 cm. Each hand is placed in a crossed position on the opposite shoulder. Another person must secure the feet to the ground. Throughout the test, the individual's hands must remain in contact with the chest, and their buttocks must remain on the mat. The subject's score is determined by the number of correct sit-ups completed within one minute.

c) Modified pull-up: The test is conducted while lying on the back, where a portion of the body weight is supported by the heels. To execute this test, the individual lies on their back beneath the pull-up, aligning their shoulders with the bar. Next, the individual grasps the bar and lifts their body and legs off the ground. Only the heels remain in contact with the ground, ensuring that the body maintains a straight and parallel position without bending at the knees or hips. The individual then proceeds with the pull-up stretch, repeating the process as many times as possible, with the total number of repetitions being recorded.

d) 4x9m run: To execute this test, two parallel lines 9 meters apart were drawn. Two pieces of wood or a similar object are positioned behind the second line. The student takes his place behind the first line. Upon the signal of a whistle or the command "go", he must sprint to the opposite lane, pick up a stick, return to the starting point, then retrieve the second stick and return to the starting point. The student completes this 9-meter course 4 times, and his time is recorded.

2.2.3. Happiness

The Oxford Happiness Questionnaire (49) was used to measure happiness. It contains 29 four-choice questions, whose options are scored from zero to three, and thus, the sum of the scores of the 29 items forms the total score of the scale. The total score of the subjects fluctuates from zero to 87. The validity of this questionnaire was confirmed here by nine experts with a CVI of 0.94 and a CVR of 0.92. The reliability of this questionnaire has approved in this study where its Cronbach's alpha was 0.90.

2.3. Procedure

The research commenced with the necessary coordination with the Education Department, followed by obtaining permission to proceed. Subsequently, a briefing session was conducted to introduce the research objectives, methodologies, and intervention implementation to the students and their parents. Written consent was then acquired from the parents, and the pre-test encompassed body composition, physical fitness, and a happiness questionnaire. The experimental group underwent an aerobic training program consisting of stretching, jogging, and aerobic exercises at 40 to 50% of the maximum heart rate for 12 weeks (three sessions per week, totaling 36 sessions). Each session involved a 5-minute warm-up, 50 minutes of walking at 40 to 50% of the maximum heart rate, followed by a cool-down period, and a 5-minute stretching routine in an outdoor setting. The research involved obese teenagers, which resulted in a training intensity maintained throughout the entire year, without taking into account any overload principle in each session. This program was consistently implemented from the first to the twelfth week. A post-test was conducted under the same conditions as the pre-test to compare the intervention's effects, with results analyzed between the groups. The control group did not engage in any sports activities throughout this period.

2.4. Statistical Analysis

In this research, mean and standard deviation were used for describing the research variables. in order to check the normality of the data distribution, Shapiro-Wilk test was used. In to compare the intra-group pre-test and post-test of each group, a dependent t-test was used. Also, to compare the data of two groups, an independent t test was used. A significant level of 0.05 was used. SPSS version 26 was used for data analysis.

3. Results

3.1. Body Composition

Table 1 displays the anthropometric parameters and body composition before and after the intervention for both the experiment and control groups. The findings indicate a significant reduction in weight, BMI, BF%, and WHR among the aerobic subjects during the post-intervention period (all $p<0.05$).

Table 1. Pre- and Post-Intervention Body Composition Parameters in the Experimental and Control Groups.

Variables	Phase	Group		P-Value (Inter-Group Comparisons)
		Aerobic	Control	
		M±SD	M±SD	
Height (Cm)	Pre-test	155.83±5.03	156.78±4.21	0.550
	Post-test	-	-	-
	P-Value (Intra-Group Comparisons)	-	-	
Weight (kg)	Pre-test	73.97±4.74	72.45±4.00	0.315
	Post-test	68.91±4.37	72.26±3.72	0.021
	P-Value (Intra-Group Comparisons)	<0.001	0.475	
BMI (Kg/m²)	Pre-test	30.49±2.76	29.50±2.68	0.288
	Post-test	28.71±2.54	29.42±2.57	0.421
	P-Value (Intra-Group Comparisons)	<0.001	0.474	
BF%	Pre-test	32.07±2.25	31.48±2.37	0.456
	Post-test	29.75±2.19	31.36±2.24	0.039
	P-Value (Intra-Group Comparisons)	<0.001	0.176	
WHR	Pre-test	0.93±0.02	0.92±0.02	0.629
	Post-test	0.89±0.02	0.93±0.02	0.021
	P-Value (Intra-Group Comparisons)	<0.001	0.896	

3.2. Physical Fitness

Table 2 displays the physical fitness components before and after the intervention for both the experiment and control groups. The findings indicate a significant improvement in flexibility (forward bending), abdominal muscle endurance (modified sit-ups in 60 seconds), upper body strength and endurance (modified pull-up) and agility (4x9m run) among the aerobic subjects during the post-intervention period (all p<0.05).

Table 2. Pre- and Post-Intervention Physical Fitness Components in the Experimental and Control Groups.

Variables	Phase	Group		P-Value (Inter-Group Comparisons)
		Aerobic	Control	
		M±SD	M±SD	
Flexibility	Pre-test	13.11±2.29	13.38±4.17	0.810
	Post-test	14.57±1.89	13.49±3.84	0.296
	P-Value (Intra-Group Comparisons)	<0.001	0.726	
Sit-Ups	Pre-test	2.72±1.77	2.70±1.57	0.977
	Post-test	4.27±1.84	2.76±1.25	0.008
	P-Value (Intra-Group Comparisons)	<0.001	0.718	
Pull-Up	Pre-test	1.61±0.77	1.64±1.16	0.915
	Post-test	2.55±0.92	1.70±1.10	0.019
	P-Value (Intra-Group Comparisons)	<0.001	0.791	
4x9m run	Pre-test	14.53±2.06	14.44±2.20	0.906
	Post-test	13.14±2.14	14.73±2.17	0.037
	P-Value (Intra-Group Comparisons)	<0.001	0.297	

3.3. Happiness

Table 3 displays the happiness scores before and after the intervention for both the experiment and control groups. The findings indicate a significant enhancement in happiness among the aerobic subjects during the post-intervention period (all p<0.05).

Table 3. Pre- and Post-Intervention Happiness Scores in the Experimental and Control Groups.

Variable	Phase	Group		P-Value (Inter-Group Comparisons)
		Aerobic	Control	
		M±SD	M±SD	
Happiness	Pre-test	42.88±14.72	42.64±15.81	0.963
	Post-test	53.38±13.55	42.52±15.63	0.035
	P-Value (Intra-Group Comparisons)	<0.001	0.822	

4. Discussion

Although the effects of participating in aerobic exercise on physical and psychological indicators of children and adolescents has been investigated, its effect on obese adolescents has been less noticed. Therefore, this study was designed to investigate the effects of twelve-weeks of aerobic exercise on body composition, physical fitness and happiness among obese adolescents.

The findings indicate a significant reduction in weight, BMI, BF%, and WHR among the aerobic subjects during the post-intervention period. These findings are in line with those of previous studies (11,12,14,16,18,40,42,44-47), indicating that participating in aerobic exercise may reduce body fat indices in obese adolescents. The findings show that the exercise training outlined in this research resulted in decreases in BMI and BF%, indicating that engaging in aerobic exercise can facilitate favorable alterations in body composition without the need for calorie limitations. This outcome could be attributed to the elevated levels of free fatty acids (↑FFA) present in individuals with surplus adiposity, which can be readily utilized during

exercise (18,41,42). Consequently, a 12-week aerobic exercise plan for those who are overweight is likely to be effective and can influence the utilization of body fat as an energy source, leading to reductions in both BMI and BF%. To interpret these findings, it can be stated that engaging in sports boosts lipolysis in adipose tissue, enhances the capacity to extract and oxidize fat in trained muscles, and increases the utilization of fat reserves (41,43). Furthermore, deep and diaphragmatic breathing during exercise elevates energy expenditure, leading to higher energy consumption by both active and respiratory muscles. This type of breathing also enhances oxygen delivery to active muscles and promotes fat oxidation in the body (43-45). The combination of these physiological effects during physical activity results in decreased overall body weight, reduced fat percentage, lower body mass index, and improved body composition.

Moreover, the findings of this study indicate a significant improvement in physical fitness components such as flexibility, abdominal muscle endurance, upper body strength and endurance and agility among the aerobic subjects during the post-intervention period. These results are consistent with previous research results (28-30,41,43,46,48). An increase in cardiac output, an increase in the oxygen difference between venous and arterial blood in the muscles, an increase in muscle capillary density and mitochondrial density after exercise intervention is probably the reason for the improvement of aerobic capacity, and it seems that with the improvement of aerobic capacity, muscular endurance also increases, because muscle endurance It depends a lot on the ability of the heart and blood circulation of the muscles (29,41,43). Also, the increase in anaerobic power and speed performance is probably related to the increase in the involvement of motor units, increase in lactate threshold, fatigue tolerance and increase in neuromuscular coordination. Also, the improvement of body composition in the present study may be one of the reasons for the improvement of sports performance in the subjects of the present study (30,31).

The results of this study indicated that the happiness of obese adolescents increased after participating in 12 weeks of aerobic exercises. A comparison of happiness levels before and after the training revealed that the average happiness of obese teenagers increased after 12 weeks compared to before the training. These findings are in line with those of previous studies (37,38,40-42). To interpret these findings, it can be stated that physical exercises are a significant source of happiness, as several studies suggest that exercise and physical exercises can elevate plasma endorphins and are linked to feelings of happiness. Endorphins act as natural pain relievers, leading to pleasurable sensations. Furthermore, exercise boosts the hormone serotonin, which plays a crucial role in regulating mood. Given that the pursuit of peace, vitality, and freshness is a key indicator of human mental health, the role of regular and consistent physical exercises and sports in enhancing lifestyle and promoting mental freshness and health is evident (38,41,42). Athletes tend to exhibit high emotional stability and self-confidence, as well as positive self-perceptions and outlooks on life, with significant development in their personality traits.

A notable aspect of the present study is the selection of obese adolescents as subjects, a demographic that has received limited attention in prior research. The study was also constrained by certain limitations as it focused solely on obese male adolescents. Consequently, the findings cannot be extrapolated to obese female adolescents. Hence, it is recommended that future research endeavors address these constraints and explore the impact of engaging in aerobic exercises on the body composition, physical fitness, and overall well-being of obese teenage girls.

4.1. Conclusion

Based on the results of this study, it can be concluded that the aerobic exercise program recommended in this study was successful in reducing body fat indices in obese adolescents and potentially lowering the risk of additional complications related to excess body fat in this population. In addition, the decreases in percentage of body fat and fat mass observed in our study as a result of aerobic exercise training suggest that this intervention could potentially offer health benefits by aiding in fat reduction and promoting a healthy body weight. Further investigation with a longer training period, such as 6-12 months, may be required to confirm these findings. In terms of physical fitness, it can be inferred that consistent aerobic exercise can enhance the physical fitness of obese adolescents. Nevertheless, it is advisable to implement a longer aerobic exercise program with an exceeding 40 to 50% of the maximum heart rate with considering the overload principle for more significant improvements in physical indicators among obese adolescents. As practical implications, it can be sated that, due to the fact that, happiness score among the statistical population in this study was in an average level, participating in regular sport and exercises such as aerobic can be strongly recommended as an effective strategy to enhance psychological indicators such as happiness in obese adolescents. In addition, physical education teachers may use aerobic exercises in the physical education lesson to improve the physical and mental health of obese students.

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Footnotes

Authors' Contribution: This study was carried out solely by the corresponding author.

Conflicts of Interest

Non to declare.

Data Availability: The data that support the findings of this study are openly available upon request from the corresponding author.

Ethical Approval: Approval for this study was obtained from the university. The author confirms that all steps . The requirements of this study comply with ethical guidelines. Participants were informed about the characteristics of the study and gave written informed consent.

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