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Investigating changes in body composition and cardiovascular risk factorsin in obese children by basic gymnastics exercise

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Abstract

Background: Obesity could be a major wellbeing concern within the world since it is related with numerous maladies. It has been appeared that basic gymnastics exercise viably avoid and treat this issue. In this manner, the shows consider examined the impact of 12 weeks of basic gymnastics exercise on body composition and cardiovascular risk factors in obese children.

Method: In this quasi-experimental research, with a plan pre-test-post-test and a control group, 30 obese children with BMI at or over the 95th percentile and the average age=9.4, were chosen purposefully and were divided into 2 groups (Basic gymnastics exercise, and control) randomly. The exercise protocol was executed for 12 weeks, three times a week, and 45 minutes for each session incrementally. Body composition and lipid profile files were measured in two stages: pre-test and post-test. In arrange to analyze the information, multivariate covariance tests were utilized.

Results: The findings of the research showed that the exercise intervention significantly reduced the fat percentage and BMI in obese children ($p \leq 0.001$). Moreover, a significant decrease in total cholesterol (TC), triglyceride (TG), and LDL and a significant increase in HDL were observed ($p \leq 0.002$).

Conclusion: These results indicate the beneficial effects of basic gymnastics exercise on body composition and cardiovascular risk factors in obese children. Therefore, the use of basic gymnastics exercise is recommended to improve these variables.

Keywords: Body composition, Basic gymnastics eexercise, Risk factors, Obese cchildren

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Introduction

Obesity in childhood is one of the foremost critical open wellbeing issues around the world. It is evaluated that more than 330 million children aged 5-19 a long time endure from serious lack of healthy sustenance (1). According to the Center for Disease Control and Prevention (CDC), 4 out of 10 Americans are currently obese. Furthermore, the World Obesity Federation predicts that by 2030, one in five women and one in seven men will be obese (2). Specifically, 12.7% of 2- to 5-year-olds, 20.7% of 6- to 11-year-olds, and 22.2% of 12- to 19-year-olds in the United States are obese, and wordwide, more than 340 million children and teenagers between the ages of 5 to 19 years old are obese and 39 million children under 5 years old are obese (3).

In Iran, a study was conducted to examine the prevalence of obesity in children with a meta-analysis approach from January 2000 to January 2021. 2,637,912 children and teenagers aged 2 to 15 years were examined. According to this meta-analysis, the overall prevalence of obesity was reported as 11.4% (95% confidence interval: 9.4-13.7%) (4). Moreover, the occurrence of non-communicable chronic diseases such as; Dyslipidemia, hypertension, nonalcoholic fatty liver disease, obstructive sleep apnea, type 2 diabetes, some types of cancer, heart disease, and psychosocial disorders are increasing at younger ages (5). According to the report of the World Health Organization (WHO), four million people die annually as a result of obesity (6).

Furthermore, obesity in childhood and adolescence is harmful to metabolism in the future and can reduce a person's life expectancy by many years. Increasing childhood obesity is a result of several factors including; Genetics, hormonal, metabolic, behavioral, nutritional factors, and ultimately imbalance in energy intake and consumption and reduction in physical activity occur (7). The development and persistence of obesity is largely driven by a biosocial framework, whereby biological predisposition, socioeconomic, and environmental factors interact in adipose tissue proliferation and obesity. First-line therapeutic approaches include family-based obesity-effective behavioral change interventions that address diet, physical activity, avoidance of sedentary behaviors, and sleep quality. However, evidence for intensive nutritional (supplementary) approaches, pharmacotherapy, and metabolic surgery as adjunctive therapies is emerging. However, these treatments are not accessible in most communities (6).

It is important to treat childhood obesity early on, so that it can be managed before complications begin. Diet modification, exercise therapy, behavior modification and preventive activities are the basic principles of treatment. However, children with obesity are experiencing an increasingly limited access to effective treatments compared to adults, because studies of drugs and other treatment options often exclude children. Furthermore, families and medical providers are often reluctant to implement these interventions in children due to the potential

risks or side effects of drug and medical treatments (5). Based on this, it seems that the first line of prevention and treatment of overweight and obesity is the implementation of physical and sports activities. Total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, and triglycerides are among the most important components of blood lipids related to health. The results of many studies have shown that exercise interventions reduce body fat content and improve cardiovascular risk factors, thereby reducing the risk of cardiovascular diseases (8). Moreover, aerobic physical activity reduces the level of total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) (9).

One of the dynamic and very attractive sports that can affect body composition and cardiovascular risk factors is gymnastics. Gymnastics consists of movements that require cardio-respiratory endurance, flexibility, muscle strength, agility, explosive power, muscular endurance and body muscle coordination (10). Therefore, this exercise can be an important way to improve blood lipoprotein levels. Anwar et al. (2023) reported that gymnastics reduces BMI and increases physical fitness in obese children (11). In addition, it has been observed that 6 months of mini-trampoline and treadmill exercise has a significant effect on weight loss in obese children (12).

In a study, Shakib et al. (2022) also reported a notable decrease in miR-128-1, HDL-C, LDL-C, triglyceride (TG) and TC indices following simultaneous aerobic and strength exercise in obese subjects (13). However, the effectiveness of this type of exercise has not been fully determined on the body's physiological indicators. In addition, exercise programs to reduce weight, improve body composition and cardiovascular risk factors of overweight and obese children have mainly focused on aerobic exercises (14). However, it seems that using exercise programs with combined exercises such as gymnastics can also be beneficial.

Considering the importance of obesity in children and the limitations of studies on basic gymnastics exserces in obese children, this study aims to answer the question whether basic gymnastics exercise is effective on improving body composition and cardiovascular risk factors in obese children.

Materials and methods:

This study is a type of quasi-experimental and applied research conducted in a pre-test and post-test format with a control group. The statistical population included obese girls aged 7 to 11 years with a BMI equal to or greater than the 95th percentile in Isfahan. 30 of them were

selected according to specific goals and randomly divided into 2 exercise groups (EG, n = 15) and a control group (CG, n = 15).

Based on G* Power software (G* Power version 3, 1, 9, 2), the minimum sample size of 24 people (12 people in each group) was obtained with alpha of 5%, beta of 80% and effect size of 0.30, but with considering the drop of samples in different stages of the research, the number of 15 people in each group was considered.

Entry criteria for this study were limited to girls aged 7 to 11 years who were obese and had a BMI at or above the 95th percentile.They should not have participated in weight-loss exercises within the past year, been taking any medications or supplements, not been using tobacco, or had a history of illness or infection that affects immune factors. Additionally, they had not had an acute lower extremity injury in the past 6 months or had pain in the trunk or lower extremities. Exclusion criteria included failure to attend two consecutive exercise sessions, lack of appropriate cooperation to perform the intervention, and presence of injury. One week before starting the exercise protocol, all the programs, possible benefits, and risks, as well as the correct method of performing basic gymnastics exercises, were explained to the participants. Additionally, all subjects were provided with appropriate forms so that they could voluntarily and consciously declare their willingness to participate in the study.Then the subjects were divided into two basic gymnastics exercise groups and a control group.The exercise protocol was carried out over 12 weeks and three sessions per week. During this time, the control group had their usual daily schedule. Also, body composition and cardiovascular risk factors were measured in two phases: pretests and posttests.

The method of measuring height, weight and body mass index (BMI)

To measure the height, a German caliper, SECA show 210, with an exactness of 3 mm was utilized. In this way, the subject was set with his uncovered feet behind the height measuring tape that was connected to the divider, so that to begin with his body weight is similarly disseminated on both legs, besides, his head, middle, and legs are within the same line, and the back of the legs, hips and head of the individual touch the divider. At that point, employing a ruler that was set on the subject's head, the height was measured and recorded in centimeters whereas breathing out. In expansion, an advanced scale, KEEP FIT showing 6657 made in China, was utilized to measure weight. Subjects were put on a therapeutic scale with light clothing and no shoes so that their weight was disseminated on both feet. At that point body weight was recorded with an exactness of 0.1 kg. Moreover, the BMI was based on height and weight estimations and the equation BMI=kg/m2 was utilized to calculate BMI.

Fat% measurement method

The Fat% was measured using a 10gms/mm2 Lafayette caliper, Lafayette Inc, USA, using the method of measuring fat% (two points) and Slater's (1988) equation, which was rewritten by Lohmann (1992) (15).

Blood sampling method

In arrange to assess the biochemical factors, the subjects' blood tests were collected in two stages: pre-test and post-test. During the pre-test, one day befor the beginning of the workout program and after 12 hours of fasting, a blood test was taken from the Anticubital vein of the cleared-out hand in a sitting position, between 8 and 10 am by a laboratory technician, with a volume of 10 cc. Moreover, within the post-test, in arrange to avoid the intense impact of working out on the studied factors, after 24 hours of the final workout session, just like the pre-test, blood was taken after 12 hours of fasting within the same time from 8 to 10 am.

Cardiovascular risk factorsin measurement method

Fasting TC, HDL-C, LDL-C and TG were measured by enzymatic colorimetric method using Roche Diagnostics D2400 kit (Basel, Switzerland) (16).

Exercise protocol

Exercise protocol was performed over 12 weeks and 3 sessions per week of 45 minutes.This program is carried out by dividing the basic movements of gymnastics into 3 parts: movements, rotation, and balance, while observing the order of difficulty of the equipment and the principle of overload (17) (Table 1).The program starts with about 15 minutes of warm-up and 10 minutes of coll down with stretching and gentle movements. All exercises are performed under the supervision of a trainer to ensure that all athletic movements are performed correctly. Exercise intensity was estimated from heart rate based on the predicted heart rate ratio with the Karonen equation equal to 50–75% of heart rate reserve. The intensity of the exercises is controlled by the Polar Beat Meter (CE 0537, N2965, Polar Beat T31, made in Finland) within the mentioned range and if it is necessary to increase or decrease the intensity, it will respond with the necessary information to the subjects.

Table1: Basic gymnastics exercise program

Exercise	Time/Repetition	Week
Worming- up	15 minutes	1-12
Front balance	10-15 second/3	1-12
Side balance	10-15 second/3	1-12

Arabesque balance	10-15 second/3	1-12
Walking on the line	10 minutes	1-6
Walking on the balance beam	5 minutes	6-12
cradle movement	10 R	1-6
Types of walking	10-15 minutes	1-6
jumping	2-3 Time/medium distance	6-12
Forward Roll	10 R	6-12

To analyze the data, descriptive statistical methods were used to calculate centrality and dispersion indices and data were reported based on mean and standard deviation.The Shapiro-Wilk test was used to test the normality of the data and the Levine test. was used to test the equality of variances of the variables. Furthermore, to test the significance of group mean differences (pre- and post-test), the statistical method of multivariate analysis of covariance was used using SPSS26 software at a significance level of 0.05.

Results:

The characteristics of research subject are presented in figure 1.

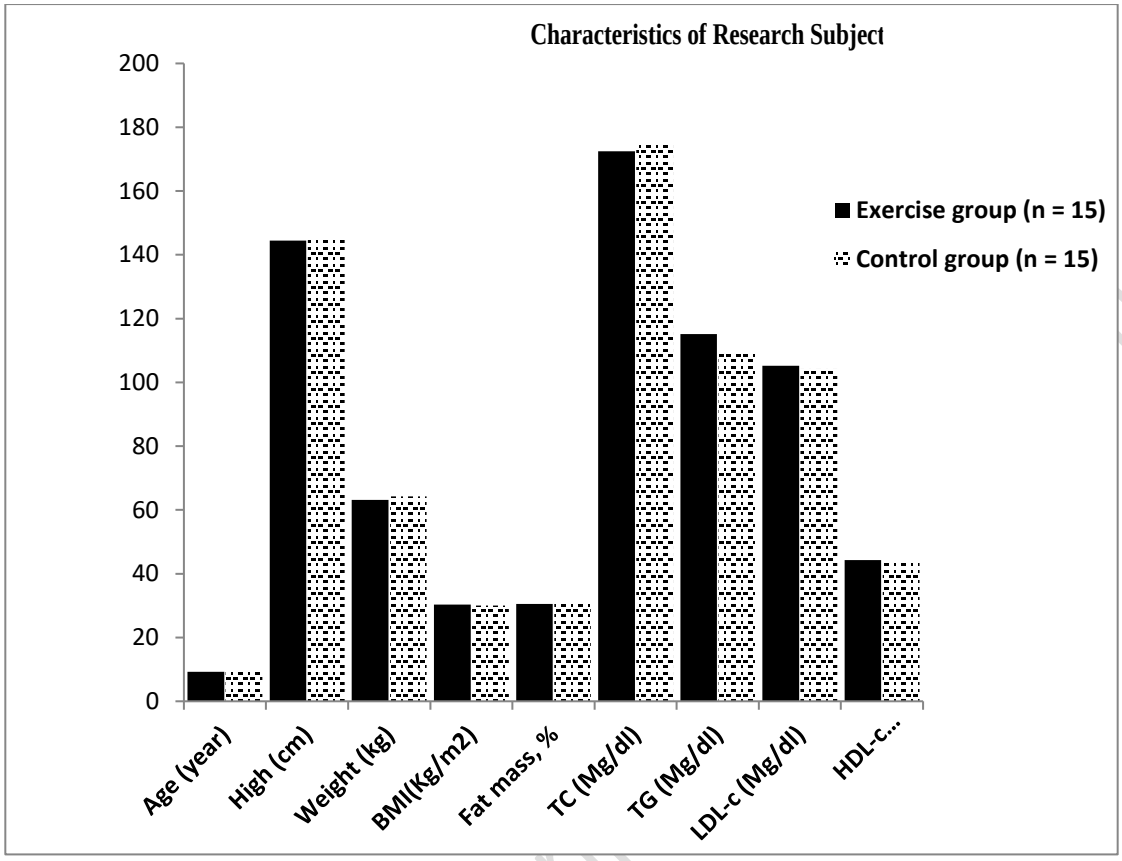

Figure 1: The characteristics of research subject

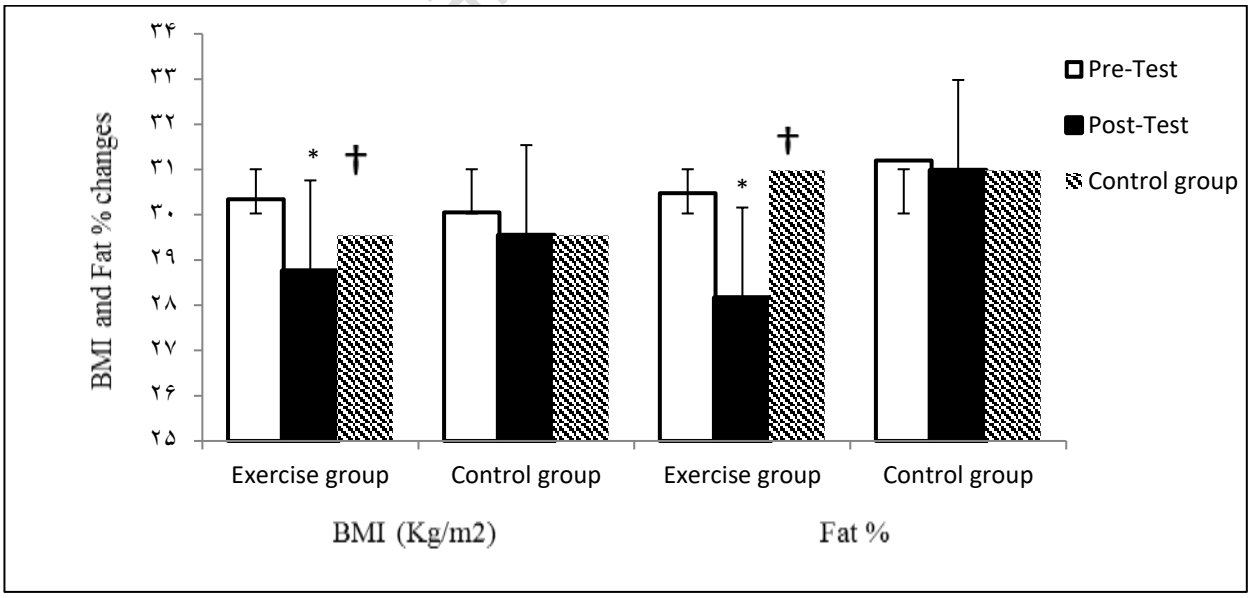

Figure 2: Comparison of of BMI and Fat % for exercise and control groups between pre and post test in obese children.

* Significant differences from pre-test to post-test; † Significant difference with the control group (P≤0.05).

Figure 2 shows that after the implementation of the intervention, body mass index (BMI) and fat percentage decreased significantly in the exercise group (P=0.001).

Table 2: Comparison of cardiovascular risk factors for exercise and control groups between pre and post test in obese children

Variable	Groups	Pre-Test	Post-Test	P-value (Between groups)
TC (Mg/dl)	Exercise group	172.15 ± 45.1	149.06 ± 38.17	*0.001
	Control group	184.3 ± 79.17	176.2 ± 45.17	
TG (Mg/dl)	Exercise group	106.3 ± 07.10	84.2 ± 16.11	*0.001
	Control group	107.02 ± 89.19	74.2 ± 99.10	
LDL-c (Mg/dl)	Exercise group	105.3 ± 7.97	73.1 ± 20.10	*0.002
	Control group	105.04 ± 21.01	104.3 ± 2.10	
HDL-c (Mg/dl)	Exercise group	44.3 ± 9.46	17.2 ± 3.44	*0.001
	Control group	43.04 ± 21.01	43.5 ± 82.9	

ʌ: significant differences from pre-test to post-test; *: significant difference between two groups.

TC, Total cholesterol; TG, Triglyceride; LDL-c, Low-density lipoprotein cholesterol; HDL-c, High-density lipoprotein cholesterol; Values are expressed as mean_SD unless otherwise indicated. Significant difference at P≤0.05

Table 3 shows that after the implementation of the intervention, in the exercise group the amount of CT, TC, and LDL decreased and the HDL values increased significantly (p≤0.05).

Discussion:

The aim of this study was investigating the effect of basic gymnastics exercises on body composition and cardiovascular risk factors in obese girls. The results showed that the exercise intervention significantly reduced fat% and BMI in obese girls (P=0.001). Further, a significant decrease in TC, TG, and LDL and a significant increase in HDL were observed in experimental

group ($p \leq 0.002$). In line with the results of the present study, Iriyani et al. (2023) in a study investigating the effect of gymnastics on changing the nutritional status and fitness level of overweight and obese adolescents reported that exercise intervention has an effect on changes in body weight and BMI of overweight and obese adolescents (18). Bellicha et al. (2021) in a meta-analysis study with the aim of summarizing the effects of exercise programs on weight loss, body composition changes and weight maintenance, showed that exercise leads to significant weight loss, fat reduction and visceral fat reduction (19). In agreement with these studies, Razavi et al (۲۰۱۹) also observed a significant reduction in BMI in the physical activity and diet group in a study titled The Impact of Changing Dietary Habits and Physical Activity in the Treatment of Overweight and Obesity in Children (20). Additionally, Hajinia et al. (2019) studied the effects of a period of interval training and high-intensity resistance exercise on lipid profiles and body composition in overweight and obese subjects, showing that weight and body fat percentage were significantly reduced in the exercise groups (21).

In a similar study conducted on obese adolescent girls, these results were confirmed (22). To explain these results, it can be said that aerobic exercise such as some basic gymnastics exercises in obese people increases mitochondrial function, mitochondrial mass, protein turnover, changes in skeletal muscle metabolic enzymes, the relationship between the capillary network and muscle fibers, and insulin sensitivity (23). Also, due to the high energy cost and the activation of the AMPK signaling pathway that increases fat oxidation, exercise can reduce body fat percentage (24). Another important mechanism in the reduction of body fat and BMI after exercise is the increased production of PGC-1α, which is an important factor in controlling metabolism and increasing fat oxidation, and preventing obesity (25). In summary, performing basic gymnastics exercise for 12 weeks through the mentioned mechanisms can affect the use of body fat as an energy substrate and ultimately reduce body fat percentage, weight and improve body composition.

Another result of this study was a reduction in TC, TG, LDL and an increase in HDL levels after performing 12 weeks of baseline exercise. Previous studies aimed at investigating the effects of exercise on blood lipids have reported conflicting results. Despite this issue, most published information suggests a strong relationship between lipid profile status and physical activity. In agreement with the results of the present study, Shakib et al. (2022) in a study examining changes in miR-128-1 and several blood lipoproteins after 12 weeks of concurrent aerobic and strength exercise reported that miR-128-1, HDL- C, LDL-C, TG and TC were significantly reduced (13). Additionally, Hajinia et al. (2019) studied the effects of a period of

interval training and high-intensity resistance exercise on lipid profile and body composition in overweight and obese subjects.They reported weight loss, body fat percentage, serum triglyceride levels, and LDL levels in the exercise groups (21). Furthermore, Ramezani et al. (2015) in a study investigated changes in cardiovascular metabolic risk factors after 8 weeks of endurance, resistance, and combined exercise training in inactive obese children. The results showed that after performing the exercise, BMI, total cholesterol, triglyceride, LDL, and VLDL as well as insulin resistance all decreased in the test groups (26). In a similar study, Rahmati et al. (2014) examined changes in serum levels of leptin, insulin, lipids, and body mass index after a period of intermittent speed training in obese children. The results of this study show that interval speed training has a significant effect on leptin, insulin, and cholesterol levels in obese children and that these exercises improve body mass index in these individuals (27). Souri et al. (2014) also reported that HIT exercises have the potential to reduce serum Leptin levels and increase Adiponectin in obese children by reducing fat mass (28). In this regard, Miller et al. (2014) studied the effects of a short-term, high-intensity training program on the work capacity, body composition, and blood characteristics of sedentary obese men. Data analyses showed significant improvements in body fat (3.6%), cholesterol (13%), triacylglycerol (37%), and insulin levels (18%) from pre- to post-program HICT (29). Paoli et al. (2013) also showed that high-intensity interval exercise resulted in significant reductions in body weight, fat mass, total cholesterol, low-density lipoprotein, and apolipoprotein B.

However, although most studies reported results consistent with the findings of this study, there were differences in timing, size, population, and exercise interventions used. Many factors such as: Different duration, intensity, and duration of exercise will lead to different results on the impact of exercise on lipoprotein levels. Nevertheless, although the mechanism of exercise-induced lipoprotein changes is unclear, it is likely that exercise increases lipid utilization in the blood, leading to reduced lipid levels (30).

The results of many studies show the beneficial effects of exercise on lipoprotein levels. It has been found that physical activity is generally associated with an increase in HDL cholesterol and a decrease in LDL cholesterol and triglycerides. In addition to causing changes in serum lipid levels, exercise also has beneficial effects on the growth, composition, and function of HDL particles. Regular exercise has been reported to increase serum HDL-C and apoA-I, increase HDL quality and function, increase antioxidant capacity, and reduce TG and its products Oxidized in LDL and HDL.Therefore, through regular exercise with appropriate intensity, lipoproteins acquire more anti-atherosclerotic properties (31). Aerobic exercise, like some physical activities, has been shown to influence blood lipid metabolism. By increasing

lipoprotein lipase (LPL) levels and skeletal muscle activity, it increases HDL-C. Furthermore, such activities accelerate lipid transport, degradation, and excretion, and reduce fasting or postprandial TG (32). In addition to the changes mentioned, aerobic physical activity also reduces total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) levels (9).

Based on the results of the above studies, basic gymnastics exercise helps improve body composition and lipid levels in obese children. Gymnastics is a combination of endurance, flexibility, strength, agility, power and explosive movements.Therefore, this exercise can be a great strategy to lose weight and improve fitness for obese children. It appears that exercise promotes fat oxidation with significant changes in free fatty acids, triglycerides and lactic acid and may be an important factor in preventing overweight and obesity.

In summary, regular gymnastic exercise leads to the consumption of TG by muscle tissue and increases LPL (lipoprotein lipase), leading to increased TG hydrolysis. It also improves the efficiency of the PCSK9 enzyme (low-density lipoprotein receptor enzyme), reduces LDL uptake and increases its excretion from the liver, and finally, increases LXR (liver X receptor) processing and ABCA1 (membrane transport protein) expression in macrophages and promotes RCT (reverse cholesterol transport) (33). It is worth mentioning that the subjects of the study were obese children who sat at their desks and did not exercise much. To cultivate the ability to move and be physically active for these children, gymnastics is an interesting sport that they can pursue with pleasure and enthusiasm and achieve optimal fitness and physical fitness. This study also has limitations that should be taken into account when generalizing the results. The present study was conducted on obese girls; therefore, caution is needed before generalizing our findings to gender and other conditions. Additionally, the sample size in this study was 15 people per group; it is likely that a larger sample and a wider geographical area would allow the results to be generalized to a wider society.

Conclusion:

The results of this study showed a significant improvement in body composition and cardiovascular risk factors after 12 weeks of baseline gymnastic exercise in obese children. Therefore, performing basic gymnastic training is recommended for obese children, parents, sports coaches and medical centers as a suitable strategy to prevent overweight and obesity.

There is not conflict of interest.

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