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The Effect of 12-Week Endurance Training on Lipid Profiles and Fat Percentage of Overweight Girls

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Abstract

Background and Purpose: Overweight and obesity in childhood are associated with the potential risk of cardiovascular disease and metabolic syndrome in adulthood. The purpose of this study was to investigate the effect of 12 weeks of moderate endurance training on lipid profile and body composition of overweight girls. **Method:** The present study was semi-experimental with pre-test and post-test design, in which 19 overweight girls aged 8 to 12 were randomly selected. Before and after intervention, body composition of subjects was measured under fasting conditions by BODY LOGIC BODY FAT ANALYZER and biochemical indices were measured and recorded by enzyme-calorimetric method. **Results:** Statistical analysis showed that 12 weeks of endurance training resulted in a significant reduction in triglycerides levels ($p<0.025$) and body fat percentage ($p<0.002$), while no significant change was found in cholesterol serum levels and body mass index. **Conclusions:** The findings of this study suggested that moderate intensity endurance training lead to improvement of body composition and biochemical parameters related to obesity in overweight girls, which reflected the vital role of these training in preventing obesity and related cardiovascular diseases among children and adolescents.

Keywords: Aerobic, Children, Obesity, Triglycerides, Fat

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INTRODUCTION

Overweight and obesity are two of the most important health problems in our modern world, which its prevalence have been increasing dramatically among children and adolescents. According to the World Health Organization (WHO), the worldwide prevalence of obesity almost tripled ("Obesity and overweight,"). Studies show that the prevalence of obesity among children in Middle East countries is higher than other developing countries (Mirmiran, Sherafat Kazemzadeh, Jalali Farahani, & Azizi, 2010). However, Iran is one of the seven countries where the prevalence of obesity has been highlighted among children. Also, in a systematic review and meta-analysis study, the prevalence of obesity has been reported 5.82% among Iranian students aged 6 to 18 years (Khazaei et al., 2017). The most important risk for obese children is, to increase their chances of becoming obese adults; as more than half of the overweight adults were overweight in their childhood (Biro & Wien, 2010). Research has shown that the increase in adipocyte due to overweight and obesity in children leads to changes in lipid profiles and the prevalence of metabolic and cardiovascular diseases. In other words, overweight and obesity are associated strongly with the risk factors such as hypertension and hyperlipidemia. Researchers have reported that low levels of high density lipoprotein (HDL), low density lipoprotein (LDL), and triglyceride (TG) levels which are observed in obese subjects are associated with myocardial infarction, cardiac and cerebral ischemia. Also, a mean increase in triglyceride concentration (2-10 mg/L), accompanied by its accumulation in the vascular wall, which increases the risk of atherosclerosis (Wang & Xu, 2017). In addition, elevated serum levels of triglyceride leads to lipolysis increment in hepatocyte, results in increase of plasma free fatty acids concentration, which increases the risk of non-alcoholic fatty liver (Fabbrini, Sullivan, & Klein, 2010). Several studies have suggested the relationship between body fat percentage, waist circumference and BMI with HDL, LDL, and TG (Oda, 2018). Moreover, Jeong et al. (2018) study showed that the total increase of cholesterol is significantly associated with higher risk of cardiovascular disease (Jeong et al., 2018).

Recent research suggests that body fat percentage is a more appropriate indices than body weight to detect unfavorable lipid profiles in children and adolescents (Oliosa, Zaniqueli, Alvim, Barbosa, & Mill,

2019). Horri et al. (2006) reported that obesity is associated with changes in levels of lipid profile in children and adolescents, leading to an increase in left ventricular mass (Horri & Vakili, 2006). Also, recent studies on obese children aged 13 to 15 years suggests a direct relationship between fat percentage with TG, TC, LDL and LDL/HDL ratios (Juliaty, Arief, Lisal, & Daud, 2018). Similarly, Meral, Uslu, Yozgatli, & Akçay (2015) showed that children with high body mass index, would have higher LDL, TC, and TG in comparison with children with normal BMI (Meral et al., 2015). Physical activity and proper diet are considered as cost-effective and non-pharmacological approaches for the treatment and prevention of obesity. The role of exercise and physical activity has been well documented in improving the body composition and mental health of children and adolescents at the age of school. Accordingly, the common guideline for children and adolescents at the school age is 60 minutes of moderate to vigorous daily activity (Pate, Flynn, & Dowda, 2016). In this regard, Minasian, Marandi, Kelishadi, and Abolhassani (2014) reported an inverse correlation between fat percentage and physical fitness in children ("Global Strategy on Diet, Physical Activity and Health.,"; Minasian et al., 2014). Also in another study, Zorba, Cengiz, & Karacabey (2011) showed the role of exercise in cardiovascular disease prevention by reducing blood lipids and insulin resistance in obese children (Zorba et al., 2011).

According to the prevalence of overweight and obesity in children, and its role in development of various diseases and high therapeutic costs, obesity prevention is a necessary measure. In Iran, we are faced with obesity and overwight phenonemon, especially in children due to the lack of proper nutrition knowledge and insufficient public awareness about the role of exercise training and physical activities as fundamental factors to improve health. However, few studies have examined physiological needs of children and to the best of my knowledge, there has been no study to evaluate body fat percentage, BMI and lipid profile changes follwoing endurance exercise training among iranian girls aged 8-12 years. Therefore, regarding to the previous literature, we assumed that endurance training would improve the lipid profile and body composition of overweight children. Therefore, the purpose of this study was to investigate the effect of 12 weeks of endurance training on lipid profiles and body composition of overweight girls.

METHOD

Subjects

The present study was a semi-experimental with pre-test and post-test design. The study population consisted of overweight girls aged 8 to 12 years old. Research aims were presented for subjects who had participated in the study. Finally, 20 people were randomly selected according to inclusion criteria. The inclusion criteria were having body mass index more than 27 kg/m 2, lack of history and absence of diseases such as cardiovascular disease, diabetes and any conditions that prevents the subject from continuing the research. Subjects were excluded if their menstrual cycles had started. The subjects' health was examined by a specialist physician and the consent form was completed by parents, one of the subjects was excluded from the research because of the lack of participation conditions in sports activities.

Anthropometric measurements

The body height was measured using a stadiometer and digital weight scale was used to measure weight (SECA, Germany). The body mass index and body fat percentage were measured using Body Logic Body Fat Analyzer (603, Korea). Blood pressure and heart rate were measured by a digital barometer (OMRON, Finland). Also, brief-type self-administered diet history questionnaire (BDHQ) was used to assess subjects' nutritional status.

Training protocol

The progressive training program was conducted for 12 weeks, 3 sessions per week, at 55-70% of maximum heart rate and certain rest intervals in the afternoon. Each training session consisted of three parts: warm up, endurance training and cool down. The warm up section was 15 minutes and included jogging and dynamic stretching. The main body of training started with 30 minutes of moderate intensity endurance training, which increased to 65 minutes at the end of the training period. Subjects were encouraged to continue throughout the training. Then participants conducted ten minutes gradual cool down (Faigenbaum, 2015). The maximum heart rate was calculated by Miller, Wallace, and Eggert (1993) Formula (r = 0.71) for obese people (Miller et al., 1993). In order to monitor the training intensity throughout the sessions, Polar pacemaker was used (Pacer, Finland).

Biochemical measurements

To evaluate serum cholesterol and triglyceride levels, 3 milliliter of blood from the brachial vein was collected at fasting state in the morning (9:00 AM) before and after 12 weeks of endurance training. Then blood samples were placed at room temperature for 10 minutes and after clotting, were centrifuged for 10 minutes at a speed of 2500 rpm to separate the serum from the clot; then it was kept at -20 ° C. The enzymatic-calorimetric method (GPO-PAP) was used to measure serum levels of triglyceride and total cholesterol (RA-100).

Statistic analyzer

All the information of subjects was evaluated using SPSS software version 22. Data were analyzed by descriptive statistics, paired t-test and regression analysis at a significant level ($p < 0.05$).

RESULTS

Table 1 shows the general and physiological characteristics of subjects before and after training intervention (Table 1). Also, the mean concentration of triglycerides, cholesterol, body fat percentage and BMI after 12 weeks of aerobic training in overweight girls is shown in Table 2 (Table 2). Statistical analysis showed a significant reduction of triglyceride (0.025) and body fat (0.002). On the other hand, serum cholesterol levels (0.478) and body mass index (0.115) did not show significant changes.

Table 1: general and physiological characteristics of subjects

variables	Mean ± SD	
	Pre-test	**Post-test**
Age(yrs)	9.8±1.5	
Weight(Kg)	49.4±11.6	45.6±11.1
Height(Cm)	140.3±7.7	142.1±8.2
Systolic blood pressure(mm Hg)	120.8±	112.6±13.2
Diastolic blood pressure(mm Hg)	65.8±10.7	61.8±11.8
Heart rate(bpm)	89.7±12.4	80±9.7

Table 2: Biochemical and body composition changes after 12 weeks of moderate intensity endurance training

Variables	Pre-test	Post-test	SIG
Cholesterol(mg/100ml)	182.3±29.8	179.8±14.4	0.487
Triglyceride (mg/100ml)	178.5±84.2	142.1±52.1	0.025*
Body fat (%)	34.2±5.3	29.4±4.4	0.002*
BMI (kg/m^2)	27.2±4	24.8±3.8	0.115

(*) indicates $p<0.05$

DISCUSSION

Overweight and obesity in childhood are an important concern for public health which influence various biological systems and increase the risk of developing a variety of chronic diseases in adulthood (Umer et al., 2017). The purpose of this study was to investigate the effect of 12 weeks endurance training on lipid profile and body composition of overweight girls. The results indicated a significant reduction of triglyceride (0.025) and body fat (0.002) after 12 weeks of endurance training. On the other hand, serum cholesterol levels (0.478) and body mass index (0.115) did not show significant changes.

In the present study, serum triglyceride levels decreased significantly after 12 weeks of moderate-intensity endurance training ($p <0.025$). The result was consistent with the Meta-analysis of Kelley and Kelley and Calcaterra et al.'s study on the reduction of triglyceride levels in obese and overweight children and adolescents (Calcaterra et al., 2013; Kelley & Kelley, 2007). Also, the results of Chang, Liu, Zhao, Li, and Yu (2008) study indicated that serum triglyceride levels decreased in children puberty periods (Chang et al., 2008). One of the possible mechanisms for reduction of triglyceride levels is the increase of lipase enzyme activity that break down triglyceride into free fatty acids. It has been well documented that endurance training increases the metabolism of fat by increasing mitochondrial numbers and lipase enzyme activity (Lee, 2011). On the other hand, it has been proven that exercise training can mostly decrease plasma lipid levels by increasing the ability of skeletal muscles to use lipids in comparison with glycogen as fuel. Following endurance training, the serum levels of lecithin-cholesterol acyltrans (LACT) —the enzyme responsible for ester transfer to HDL

cholesterol, are increased, while the serum levels of cholesterol ester transfer protein (CEPT)—the enzyme responsible for transfer of HDL cholesterol to other lipoproteins, are decreased. Therefore, this increased enzymatic activity rises the ability of muscles to oxidize fatty acids come from plasma, VLDL cholesterol or triglycerides (Mann, Beedie, & Jimenez, 2014).

In the present study, the percentage of fat was significantly decreased after 12 weeks of moderate intensity endurance training in overweight girls (p 0.002). This finding was corroborated by the studies of Narayani & Sudhan and Owens et al. (Narayani & Sudhan, 2010; Owens et al., 1999). The increase of fatty acids oxidation due to the increase oxygen consumption to produce energy in moderate intensity endurance training play a significant role in the body composition and health of individuals. On the other hand, the released catecholamines by the endurance training stimulate beta-adrenergic receptors and increase lipolysis of adipose tissue, which ultimately leads to an increase in serum levels of free fatty acids. In addition, it has been reported that during the endurance training, about half of the required fatty acids are supplied from subcutaneous adipose tissue (Mehdizadeh & Khosravi, 2015). Therefore, according to the previous research and the results of this study, subcutaneous fat tissue can play an important role in energy production of moderate intensity endurance training, which can be considered as a non-pharmacological and safe intervention for body composition improvement in children and adolescent.

In the present study, total serum cholesterol levels did not change significantly after 12 weeks of endurance training ($p < 0.478$).

The finding was supporetd by preious studies (Kelley & Kelley, 2007; Tolfrey, Campbell, & Batterham, 1998). The lack of significant changes in serum cholesterol levels in children was probably due to the lack of nutritional intervention in the study, so the subjects followed their normal (high fat) diet during the training protocol. According to the results of the present study and the findings of Yalin, Gök, & Toksöz (2001), it could be stated that in order to reduce serum cholesterol significantly, one should use nutritional intervention or control its diet along with the exercise protocol (Yalın et al., 2001).

In the present study, BMI did not change significantly after 12 weeks of endurance training ($p < 0.15$). This finding was in agreemnet with the

results of Silva, Petroski, and Pelegrini in 2014 (Silva, et al., 2014). Since the changes of body mass index are associated with growth and muscle mass, BMI alone is not the best way to assess the body composition changes after an intervention in children. On the other hand, the results of this study showed that there was a significant reduction in body fat percentage and no significant changes in body mass index after 12 weeks of moderate-intensity endurance training, suggesting the benefits of such exercise training in improving the body composition of overweight children.

CONCLUSIONS

Considering the results, moderate-endurance training was able to have a beneficial effect on body composition and subsequently lipid profile without any changes in body mass index and weight. This indicates the benefits of such exercise training in prevention and treatment of obesity, metabolic and cardiovascular diseases.

Declaration of Interest

The authors declare that there is no conflict of interest.

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