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The Effects of Eight-week Aerobic Exercises on Body Composition and Maximal Oxygen Consumption in 10-12 Year Old Overweight Girls

M. Derakhshan Nejad, A.H. Habibi and M. Ghanbarzadeh
Department of Sport Physiology, University of Shahidchamran, Ahvaz, Iran

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Corresponding Author:
M. Derakhshan Nejad
Department of Sport Physiology, University of Shahidchamran, Ahvaz, Iran

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Abstract: Cardiovascular diseases are considered as one of threats to human health, especially in individuals with overweight. The aim of this study was to investigate the effects of eight-week Aerobic exercises on lipid profile in 10-12 years old overweight girls. In this study 27 overweight 10-12 year old female students were selected and randomly divided into two groups; a) training group (n = 17) and b) control group (n = 10). Training group were participated into the Aerobic training for 8 weeks, at the intensity of 70-85% of maximal heart rate, meeting 3 times a week that lasted 60 min per session. The variables included TG, TC, LDL-C, VLDL-C, HDL-C and TC/HDL-C ratio were measured in two groups before and after the training period. Co variance and T-test were utilized to analyze the data. The findings showed that after eight weeks of training, the average variables such as BF (p = 0.00), BMI (p = 0.00) and VO_{2max} (p = 0.00) has significantly changed compared with before the training while there was no significant change in the value of WHR (p = 0.066). There was also a significant change in the variables BF (p = 0.001) and VO_{2max} (p = 0.024) between experimental and control group after eight weeks of training. However, a significant difference was not observed in the variables WHR (p = 0.83) and BMI (p = 0.64). According to these results, Aerobic exercise in overweight 10-12 year old girls can have beneficial effects on some cardiovascular risk factors.

INTRODUCTION

Increasing prevalence of overweight in children is one of the most important public health problems in developed and developing countries that results in various side effects in childhood and adolescence[1, 2]. Physically and psychologically negative effects in the child is one of its consequences and particularly increase the possibility of obesity in adolescence leading to increase in the incidence of cardiovascular disease, diabetes, hypertension and even cancer[2]. Increase in obesity and overweight among children in developing countries derives from change in people's lifestyle which somehow is related with urban modern lifestyle such as sending an

enormous amount of daily life on watching TV and playing computer games. Fatty diets and inactiveness are the factors accelerating this issue. Studies done in developed countries, particularly in the Middle East and some Asian countries indicate the prevalence of overweight and obesity in children in two decades. Unfortunately, there isn't enough information on the prevalence of obesity and overweight in children. Some studies indicate that its prevalence has increased in the late two decades to the extent that in a survey of primary school students in Tehran, the prevalence of overweight and obesity was 7.7% and 3/13, respectively[3].

it has recently been clear that although symptoms of some diseases such as coronary obstruction appears in adulthood, the disease starts from adolescence and young ages[4]. There are many contributing factors to the increase of cardiovascular disease among which unhealthy nutritional habits, sedentary, low aerobic fitness, obesity, overweight, high blood pressure and unfavorable conditions of lipid profiles can be noted[5]. Some of these factors such as increasing prevalence of overweight in adolescents which is associated with reduced physical activity have been known as the main cause of cardiovascular disorders[6]. It is alleged that for every unit increase in body mass index, the risk of cardiovascular disease increases by 8% and in turn by increasing physical activity of a MET, the risk of cardiovascular fitness reduces by 8% that emphasizes the importance of physical activity and being in shape[7].

Aerobic activities are one of the ways to lose weight and body fat that can improve cardiovascular endurance, abdominal muscle endurance, flexibility and lower subcutaneous fat thickness[8]. Researchers have suggested that adolescents should participate in varied and enjoyable physical activities ranging from moderate to strenuous at least 60 min or more. Regular physical activity is not only essential for normal growth and development of adolescents but also leads to an active lifestyles in childhood and adolescence years that results in reducing the risks associated with chronic diseases in later years[9].

Aerobic exercise is an aerobic activity through which an individual can consume a lot of energy. Aerobic exercises include various movements in which speed and flexibility are of particular importance. As it's accompanied by music, it would be very fun and exciting increasing calorie burning and has a particular appeal among girls. Regarding to this fact, the effect of exercise on improving fitness and reducing body fat percentage can increase adolescent girl's interest in participating in physical activity. Aerobic exercise and variables of Body Fat (BF), Body Mass Index (BMI), Waist-to-Hip Ratio (WHR) and maximal oxygen uptake (Vo_{2max}) have sporadically been studied in various internal and external research. Lai *et al*.[10] in their study examined the effect of aerobic exercise on heart rate at rest, the percentage of fat and people obesity aged 10-16 (48 boys and 40 girls) and concluded that aerobic exercise reduces relaxed heart rate, glucose, fat levels and obesity in these individuals[10]. Lee *et al*.[11] studied the effect of aerobic and resistance exercises on abdominal fat, liver fat and insulin sensitivity in 45 boys aged 12-16 for three months. The results showed that both types of exercise reduce abdominal fat and liver but only resistance training improves insulin sensitivity[12]. Davis *et al*.[12] examined the effect of aerobic exercise on BMI and body fat percentage of girls and boys age range of 9 and 10 years and concluded that aerobic exercise decreased body fat percentage and BMI in these children. Osanloo *et al*.[13] investigated the effect of Combined Aerobic Dance, Aerobics Step-platforms and resistance training on some cardiovascular risk factors and highlighted that aerobic exercise decreases body fat percentage, body mass index and an increases maximal oxygen consumption in healthy middle-aged women with low mobility[12]. Jyvant[14] in their study investigated dance aerobic's impact on fat distribution and Vo_{2max} and concluded that there are no significant differences in fat distribution in Vo_{2max} and haunch between middle-aged women who have exercised for six months and those who haven't. Review of literature points out to the fact that less study has been done on the effect of a period of 8 week exercise on variables such as body fat percentage, Body Mass Index (BMI), waist-to-hip ratio and maximal oxygen consumption (Vo_{2max}) in girls who are overweight with the age range of 10-12 years. As mentioned earlier, childhood and adolescence are of particular importance in the prevention of cardiovascular disease and obesity and by changing lifestyle and increasing physical activity in this period, people can experience a better and healthier adult hood. Therefore, the selection of appropriate age to participate actively in sports and the kind of physical activity is also important because the optional selection of sports and its popularity can be effective to participate in exercises[15]. Therefore, the aim of this study is to examine the effect of eight week aerobic exercise on body composition and Vo_{2max} factors in overweight girls aged 10-12 years.

MATERIALS AND METHODS

This study wasa quasi-experimental and applied research aiming to analyze changes in the dependent variables (body fat percentage, waist-to-hip ratio, BMI and VO_{2max}) in overweight girls age10-12 years by using dependent variable(aerobics exercises).

The aim of this study was to investigate the effect of 8 week aerobic exercise on body composition and VO_{2max} in overweight girls aged 10-12 in Ahvaz. This research included 10-12-year-old girls in elementary schools in Ahvaz. Three elementary schools were randomized to determine a statistical sample. In each school, the third,

fourth and fifth grade students with an age range of 10-12 years were selected and their weight (average 19/68) and height (average 96/156) were measured.

Their body mass index was calculated by the formula (body mass index = (weight (kg))/(height (m)^2)). Participants with the body mass index of 25-30 were selected and divided randomly into two experimental group (n = 17) and control group (n = 10) providing necessary information about research and training situations and completing the consent form.

The dependent variables of the study in both pre-test and post-test were measured in the same conditions. Waist Circumference around the waist in the middle of the last rib and the upper edge of the iliac crest and hip circumference at the largest circumference between the waist and knees with non-elastic tape was measured with an accuracy of 5.0 and the ratio of waist to hip (WHR) was calculated by dividing the waist circumference by hip circumference[16]. Subcutaneous fat was measured using calipers (Trademark Harpenden). Method of measuring body fat percentage is based on Jackson and Pollock method that is calculated by subcutaneous fat using three parts of arm, above the iliac and femoral front through the following equation[17].

$$BF\% = 495/(1.089733-(0.0009245\times s)+(0.0000025\times s\times s)-(0.0000979\times a))-450$$

Measuring VO_{2max} using the formula Queen's College was carried out, the test was 3 minutes and the participant had to climb up a 30-50 cm stair (height of the step depended on the height participant, the step height should be in such a way that when the participant places foot on the stairs, hip flexion angle is 70° in the case) at a rate of 26 time per minute. After the test, participants sit immediately and test taker measures heart rate in a minute after 5 sec and it is calculated using the following formula, i.e, VO_{2max} which is for women[18].

$$VO_{2Max} = 65/81-(\text{Heart Rate}\times 0/1847)$$

The experimental group was supposed to do aerobic exercises with the intensity of 85-70% of maximum heart rate in 24 sessions over 8 weeks (3 sessions per week). Each run consisted of three parts: warm-up, main stage and cool-down . Stretching, exercising and jogging for 10 min was done in warm-up. The main stage included exercisess of 20 min aerobic movements in the first sessions that lasted 40 min at the end of this run. Cooling phase included 10 min of both stretching and calisthenics. Main aerobics excersises included hamonic movements of hands and feet that provided in the form of blocks. Each block is composed of 32 moves. In this study, 16 beat blocks including moves and 4 beats suitable for beginners have been used at the first and second weeks. A 32 beat block was prepared by a combination of the blocks of the first 2 weeks was to increase the duration and intensity of exercise in the third week and 32 beat blocks were used by the end of the exercise. The intensity of exercise was calculated based on each person's maximum heart rate using the formula Karonenand heart rate was being monitored at each session. It was necessary to ensure that participants in each session did the exercises about target heart rate determined based on 85-70% maximum heart rate. During this period, the control group performed their normal activities. In this study, descriptive statistics to describe the characteristics of the subjects and inferential statistics to analyze the data were utilized. In descriptive statistics, mean and standard deviation were used as measures of central tendency and dispersion, respectively. In the inferential statistics, after giving aShapyr and Wilke's test to assume normal distribution of data and equality of variances by the Levene test, analysis of covariance was used to compare the difference in values between the groups and dependent t test to compare pre-test and post-test. Statistical analysis was conducted at the significant level of $p \leq 0/05$.

RESULTS

Subject's charectrisics of both groups in Table 1 and BF, WHR, BMI and VO_{2max} of experimental group in pre-test and post-test using a dependent t-test in Table 2 were compared. In Table 3, variables, BF, WHR, BMI and VO_{2max} at post-test experimental and control groups using analysis of covariance were compared with each other.

As it is clear from Table 2, after eight weeks of training, the average of variables such as BF (p = 0.00), BMI (p = 0.00) and VO_{2max} (p = 0.00) has significantly changed compared with before but WHR (p = 0.066) has not significantly changed.

Table 1: Distribution of age, height, weight and body mass index of participants

Group	Control	Experimental	Total
Age (year)	11./81	11/05±./99	11/02±./9
Height (cm)	1/45±4/34	1/45±10/84	11/45±7/59
Weight (kg)	57/80±9/38	57/20±10/09	57/50±10/11
Mass body index (kg/m^2)	27/04±1/82	26/66±1/68	26/85±1/57

Table 2: Comparison of BF, WHR, BMI and VO_{2max} changes in experimental group in pretest and post test

Significance level	f value	SD	Mean	Test stage	Dependent variable test
00/0	13/92	1/66	33/99	Pre-test	BF
		1/89	30/95	Post-test	
0./066	1/97	0/06	0/82	Pre-test	WHR
		1/06	0/81	Post-test	
0/00	8/33	1/68	26/66	Pre-test	BMI
		1/39	25/57	Post-test	
0/00	-7/87	2/27	38/70	Pre-test	$VO2_{max}$
		2/24	40/82	Post-test	

Table 3: Comparison of BF, WHR, BMI, and VO_{2max} changes in control and experimental group after training period

Significance level	t-value	SD	Mean	Group	Test lipid profile
./001	-3/79	1/94	30/95	Experimental	BF
		1/33	33/6	Control	
./83	-0/21	0/06	0/81	Experimental	WHR
		0/06	0/82	Control	
./06	-1/92	1/44	25/57	Experimental	BMI
		1/6	26/72	Control	
/024	2/4	2/31	40/81	Experimental	VO_{2max}
		1/89	38/74	Control	

By comparing the results in Table 3 related with two groups post-tests, it becomes clear that there is a significant difference in the variables BF ($p = 0.001$) and VO_{2max} ($p = 0.024$) between the experimental group and the control group after eight weeks of training but there is no significant difference between these two variables WHR ($p = 0.83$) and BMI ($p = 0.64$) .

RESULTS AND DISCUSSION

This study aimed at investigating the effect of aerobic exercise on body composition and VO_{2max} during 8 weeks among overweight girls with an age range of 12-10 years old. The results of the study showed that eight weeks of aerobic training can significantly increase the mean of variables such as BF and VO_{2max} compared to before training in the experimental group but the training had no significant effect on the variable WHR. Also in the tests, two experimental and control groups showed significant differences in the values of variables such as BF and VO_{2max} in which body fat percentage reduced in the experimental group and VO_{2max} values was significantly higher for them. However, thre was no significant difference in WHR and BMI between the experimental and control groups after 8 weeks of aerobic training.

It is clear from evidence that in recent decades in most countries, the daily physical activity among different age groups including children, adolescents and youth have declined, so the increased prevalence of obesity may be a direct result of the decline in their physical activity. Most studies have shown that physical exercise and sport regardless of their type, can reduce body fat and improve body composition of children's.

People who exercise regularly have a higher percentage of lean body mass than sedentary individuals. A person with a good level of physical fitness has lean body mass with low body fat percentage, sufficient muscle mass, strong and flexible tendons and bones with sufficient mineral content[19]. Exercise, especially aerobic exercises has a positive effect on human health. Aerobic exercises increase cardiovascular endurance and this proper preparation of cardio-vascular protects people against diseases and deaths from cardiovascular disease[20].

The results showed that 8 weeks of aerobic exercise decreased body fat in overweight girls with an age range of 10-12 years . This finding is consistent with results of Lai *et al*.[10], Davis *et al*.[12], Lee *et al*.[11] and Osanloo[13]. All the researchers examined the effect of aerobic exercise on body fat percentage and concluded aerobic exercise has a positive effect on reducing body fat percentage. But Jyvant[14] in his research did not see any significant effect of aerobic exercise on reducing fat percentage and the reason for this paradox can be explained by different age groups of participants (senior women), fat changes checkpoints (lower body) and the type of aerobic exercise which have been done.

Another finding of this study is a significant and positive impact of aerobic exercise on participant's VO_{2max} that was consistent with results of Tahqyqly and colleagues, Osanloo[13]. But, Jyvant[14] in his study did not observe any significant effect of aerobic excercise on improving VO_{2max} and the reason for this paradox can be explained by different age groups of participants (middle-aged women) and the type of aerobic exercise that has been done.In this study, although Body Mass Index (BMI) in experimental group was significantly reduced, there was no significant difference between post tests of experimental and control groups; therefore, it can not be said that aerobic excercise has an effect on reducing BMI.

This finding was not in line with Davis *et al*.[12] and Osanloo[13]. This contradiction could be due to differences in the age and gender of participants, type of aerobic exercise or exercise period.

waist-to-hip ratio was the last variable examined in this study that the results showed that 8 week aerobic exercise has no significant effect on reducing this ratio in overweight girls aged 10-12 years old. the length of training period or type of training done in this study may also be another reason why no significant changes occured in these variables. One of its reasons may be the replacement of muscle tissue for fat tissue in both the lumbar and hip due to exercises that caused the waist-to-hip ratio did not changed significantly.

CONCLUSION

Based on the results of this study that has examined the effect of 8 weeks aerobic exercise on body fat percentage, body mass index, waist-to-hip ratio and maximum oxygen consumption in overweight girls with an age range of 12-10 years can suggest to overweight girls aged 10-12 years reducing body fat percentage and improving aerobic capacity and their cardiovascular endurance through 8 week aerobic exercise.

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