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Effect of endurance and resistance training on C-reactive protein in obese children

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ABSTRACT

The aim of this study was the effect of 12 weeks endurance and resistance training on C - reactive protein in obese children. For this purpose 16 obese children (BMI> 28, age= 11-13 year old) were voluntarily participated in this study. Obese children were randomly divided into two groups: experimental (n= 8), and control (n= 8). Blood sample were taken in two stages (before and after completion of 12 weeks) as well as 12-14 hours after fasting. Serum was kept at -80°c until C-reactive protein analysis. Experimental groups received 12 weeks endurance and resistance trainings (3 sessions per week). Intensity of the resistant training was based on previously maximum repeated exercises. Intensity of theEndurance training was based on the maximum heart rate (HR_{max}) estimated by: 220 – age (at 12th week heart rate increased up to 80% - 85% of HR_{max}). Results showed that 12 weeks endurance and resistance training caused to significant decrease of the C-reactive protein levels,body fat mass, and body mass index in experimental group compared to the control group ($p<0.05$). It is suggested that regular participation in endurance and resistance training program can be associated with decreased future cardiovascular risk inthe obese children, as well as it is a goalfor behavior change in both prevention and treatment of childhood obesity.

Keywords: training, C-reactive protein, body fat mass, obese children.

INTRODUCTION

Increasing prevalence of obesity in children and adolescents is particularly alarming [12]. Children who are obese tend to become obese adults. Obese children and adults face health and psychological challenges related to their obesity compared with their leaner counterparts [28]. There are many possible etiologies of obesity as the adipose tissue playing a significant, complex role in the physiology of fuel metabolism and hormone regulation. The development of obesity represents a pathophysiologic increase in fat mass in which multiple metabolic pathways are

deranged [7]. Excessive body fat evolves from a complex interaction of physiologic, metabolic, behavior, and social factors [11]. There is a close link between obesity and increased cardiovascular risk (CVR) [1, 2, 9, 20, 21, and 24] in children and adolescent.

The correlation of circulating C- reactive protein (CRP), inflammatory cytokines and complications of obesity has been studied in obese children with mixed results. Analysis of the database from the National Health and Nutrition Examination Survey showed that BMI is the best predictor of elevated CRP in children,crossing all ages, genders and ethnic groups[24].It was observed that higher adiposity indicates higher CRP levels in children. A strong relation between elevated CRP levels and cardiovascular risk factors, fibrinogen, and HDL has been noted, suggesting a role for inflammation throughout life in the development of atherosclerosis and cardiovascular disease [28].

Lack of physical activity is a significant contributor to obesity [11].Obesity treatment has increasingly focused on the therapeutic qualities of exercise [23]. Some evidence has demonstrated the association between regular participation in physical activity and physical fitness which benefits in physical and mental health, including reduction in cardiovascular risk [1, 4, 16, and 22] as well as body fat mass(BFM)[14, 19].

The results of some researches demonstrated regular participation in exercise training program causes the lower levels of CRP [10]. On the other hand, some studies reported no change in CRP [3, 8, 17, and 29] after completion of an exercise training program in obese children and adolescent.

Studies have often in failed to provide adequate information regarding important elements of the exercise program for obese children and adolescent such as: volume of training [1, 8, and 10] intensity and monitor of training [1, 10] as well as verity of exercise [3].In some studies intensity, volume, and duration of training were not gradually and progressively increased [8, 29, and 15].

Data on the effect of endurance and resistance training on health obese children are limited. We evaluated exercise training program variables and then design endurance and resistance training program based on it. On the basis of latter were defined the volume, intensity, duration, monitoring of intensity and verity of exercises and etc. Given the negative short- and long-term impact of obesity on children, careful attention should be paid to the unique health issues of this “at-risk” population with both prevention and early intervention strategies [11].

We designed endurance and resistance training program with performance ability at school. Intensity, duration and volume of endurance and resistance training were gradually and progressively increased on the basis of children tolerance, supervised and encouraged by physical education teacher. Therefore the purpose of this study was the effect of 12 weeks (3days/week) endurance and resistance training on C- reactive protein in obese children without dietary intervention.

MATERIALS AND METHODS

This study was semi- experimental. One of the local schools (Taleb- Amoli) locating in Amol city, Iran was randomly selected for the study. The height and the weight of 430 students (age=11-13 years) were measured with a Seca 220 (22089 Hamburg, Germany), body mass index (BMI) was calculated as weight in kilograms divided by height in square meters (kg/m^2)

[15]. Body fat mass was analyzed by Body Composition Analyzer (Inbody220) Then, 16 healthy students with BMI>28 voluntarily participated in the study. The students did not have any previous exercise, and participation in any weight loss programs (at least during last 3 month), as well as have not any history of cardiovascular disease, diabetes, and other medical problems. Besides, the subjects did not smoke, and use any medication. Obesity was defined according to the suggestion of Cole and co-authors [27].

After collecting blood sample, were realized within the first week prior to the commencement of the 12 week's exercise training program, then obese children were randomly divided into two experimental(n=8), and control(n=8) groups. Before training, the obesity students' parents were invited to get all information about the study and to give their consent. The obese children were requested to avoid doing any exercise other than requires the study.

Blood sampling

For assessment of biochemical index, blood samples were gathered in two stages (before, and after 12 week's endurance and resistance training) as well as 12-14 hours after fasting. The obese children did not do any exercise for 48 hours before the first blood sampling. 48 hours after last training session, the blood samples gathering of experimental and control groups were repeated. The centrifuged blood serum was kept at -80 ^{o}C until analysis. CRP levels were measured by mean of ELISA kits. After collecting the blood samples the exercise training program variables were evaluated and on the basis of it the endurance and resistance training program was designed

Method of endurance and resistance Training

Intensity of the resistant training was based on previously maximum repeated exercises. Endurance training intensity was based on the maximum heart rate (HR_{max}) estimated by: 220 – age. These trainings started with 50% to 60% of HR_{max}, in the first 2 weeks of the program to ensure that participants developed a sense of success and positive self-esteem early in the program [17].Then intensity of endurance training increased by 5% every 2 weeks and as a result at 12th week heart rate (HR) increased up to 80% - 85% of HR_{max}. During the endurance training sessions, HR continuously was measured with HR monitor (Polar, RS100th cardio running). For every session the target HR zone was defined by physical education teacher. Also by help of target zone alarm subjects can be sure that their exercises have correct intensity. When the target zone of heart rate limits is activated, the wrist unit sounds an alarm when there are above or below their limits. The subjects were instructed on the use of the polar watches during the exercise training session.

The training intensity, volume, and duration were gradually and progressively increased on the basis of children tolerance throughout the course of the 12 weeks training. This helped to ensure that all subjects in the experimental group received adequate physiological overload benefits.

Volume of resistance training estimated by number sets×repetition×weight of the subjects. For the first two weeks running time was 10 min, and then was increased by 2min weekly, thus at 12thweek the running time reached 30min. In first four weeks, the time for claiming up and down the stair was 6min (2sets×3min=6min), for the second four weeks one min to each set (2sets×4min=8min) and for the last four weeks one more set(3sets×4min=12min) were added.

Statistical analysis

Frequencies, means, and standard deviations were calculated for each variable. The Independent-sample T test was used for definition of differences between both control and experimental groups, whereas differences between pre- and post training were assessed using the Pair- Sample

T test. The level of significance was set at p< %5. All the statistics was performed using SPSS version 11/00 software.

RESULTS

In this study we demonstrated that 12 weeks regular endurance and resistance training decrease the significance of the body fat mass (BFM), body mass index (BMI) and CRPin experimental obese children group. BFM, BMI and CRP before and after the endurance and resistance training program are shown in Tables 1.There were no baseline difference between the experimental and control groups for any of the measured descriptive variable (Table 1).

Table 1. BFM, BMI and CRP data in the experimental (n=8) and control (n=8) groups beforeand after 12 weeks endurance and resistance training

Variable	Experimental group		Control group	
	Before	After	Before	After
Weight(kg)	69.88± 3.01	72± 3.7 * □	73.82± 5.3	79.57± 8.4 +
BMI(kg/m^2)	28.85± 1	27.63± 1.1 *	29.77± .81	30.45± 2.08
BFM(kg)	29.8± 4.2	26.93± 3.08*□	31.72± 2.89	33.27± 5.06
CRP (µ/g/ml)	4.96 ± .3	4.66±.29*□	5.05± .24	5.12±.16

Data were presented as the mean± SD.
** P<.05 before training vs after training in experimental group by Paired- Sample T Test.*
+ p<.05 before training vs after training in control group by Paired- Sample T Test.
□ p<.05 after training in experimental group vs after training in control group by Independent- sample T Test.

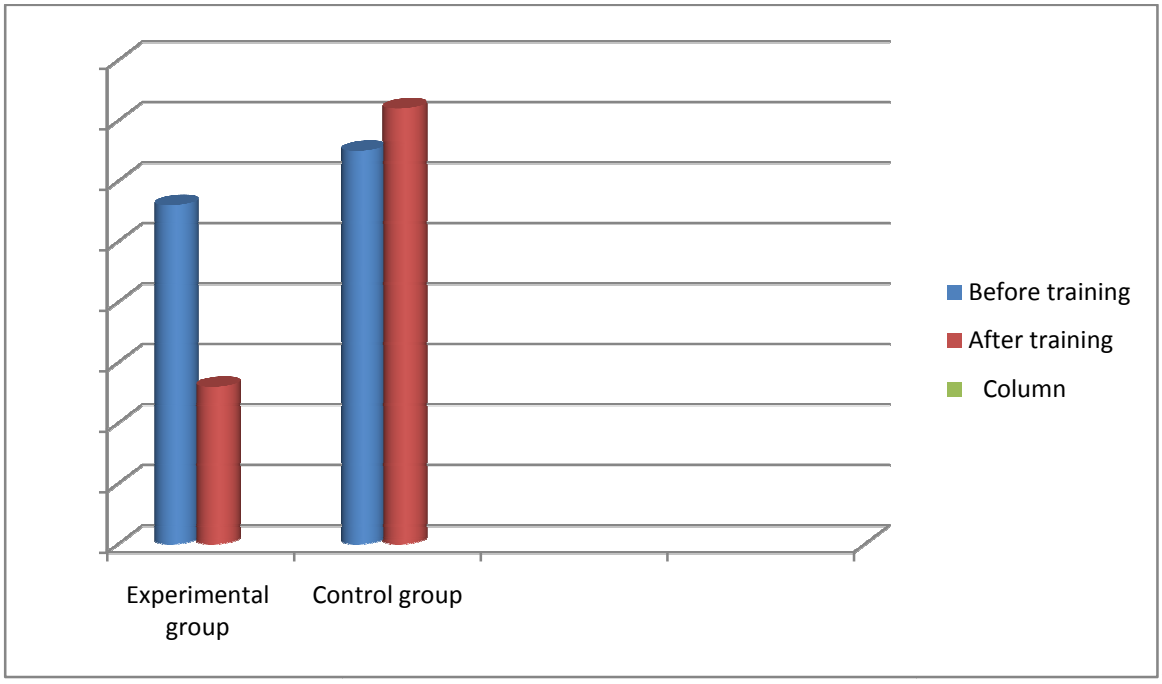

Figure 1. CRP data in the experimental (n=8) and control (n=8) groups beforeand after 12 weeks endurance and resistance training

Effect of endurance and resistance training on BFM, BMI and CRP

As shown in table 1, BFM (29.85 ± 4.2vs 26.93± 3.8 kg), BMI (28.85 ± 1 vs 27.63 ± 1.01 kg/m^2) and CRP (4.96 ± .3 vs 4.66 ±.29 µ/g/ml) (figure 1) were decreased significantly after completion of the endurance and resistance training in experimental group, while in control group BFM (31.72 ±2.89 vs 33.27 ± 5.06 kg), BMI(29.77 ± .81 vs 30.45 ±2.08 kg/m^2) were increased

significantly, and CRP concentration (5.05 ± .24 vs 5.12 ±.16 µ/g/ml) was no significant change in control group

It was demonstrated that BFM (26.93± 3.8 vs 33.27 ± 5.06 kg), weight (72.o± 3.7 vs 79.57± 8.4) ,BMI (27.63 ± 1.01 vs 30.45 ±2.08 kg/m2), and CRP (4.66 ± .29 vs 5.12 ± .16 µ/g/ml)were significantly decreased in the experimental group compared to control group after 12 weeks endurance and resistance trainings.

DISCUSSION

The study involved 16 obese children with BMI>28 (kg/m2), and age from 11 to 13 years. The subjects were randomly divided into two groups: experimental group (n=8) and control group (n=8), without dietary intervention.

The problem of childhood obesity is accelerating throughout the world [5].Long-term health complications in overweight children after 40 years follow-up include significantly increased rates of cardiovascular diseases and digestive diseases but also increased mortality [5].

Obese children of all ages have evidence of a low-grade chronic inflammatory state. In this sense, even the very youngest obese children do not differ from obese adults. In some cases, the degree of inflammation, as measured by circulating acute-phase reactants and cytokines**[**24**]** Acute- phase reactants are serum proteins that increase during inflammation and are keys to restoring homeostasis. The most commonly measured acute- phase reactant is CRP, which plays a dominant role in amplifying the inflammatory response[24]. Enhanced levels of CRP can be used as a marker of inflammation [28].CRP secreted by the liver in response to a variety of inflammatory cytokines, increases rapidly in response to trauma, inflammation, and infection and decreases just as rapidly with the resolution of the condition, thus the measurement of CRP can be used to monitor inflammatory states [28]. CRP has a pro-inflammatory effect and has been well established as a risk factor for cardiovascular disease, hypertension and stroke[25].

CRP is reported to be a stronger predictor of cardiovascular events than low- density lipoproteinand has been utilized extensively as a risk marker in epidemiological research[13]. There is evidence that decreased physical activity is associated with obesity, whereas physically active children may have lower risks of chronic diseases than physically inactive children [18].

Aerobic exercise has been reported to be associated with lower risk of cardiovascular mortality. Cardiovascular disease often has its origins in childhood and because several risk factors for cardiovascular disease progress from childhood to adulthood, understanding the distribution and implications of risk factors such as hs-CRP among children is of considerable interest [29**]**.

The benefits of increased physical activity and fitness are significant in obesity prevention and treatment. A meta- analysis of exercise treatments of obese children aged 4-17 has shown that exercise treatment decreased percent body fat in obese children [23].

How exercise training reduces inflammation and suppresses CRP levels is not well defined. It is likely that exercise training reduces CRP both directly by reducing cytokine production in fat, muscle, and mononuclear cells and indirectly by increasing insulin sensitivity, improving endothelial function, and reducing body weight [6]. Sae Young Jae et al showed that lifestyle modification emphasizing regular exercise training significantly decreased hs-CRP, also they

showed that Nicklas et al and Marcell et al reported that exercise training did not have a significant effect on hs-CRP[26].

Data regard the effect of endurance and resistance training on obese children is limited. The main finding of this study was that after 12 weeks endurance and resistance training BFM, BMI, and CRP concentrations in experimental group were significantly reduced. The results are in agreement with previous study showing regular participation in exercise training program, decrease the concentration of CRP in obese children and adolescent [10]. On the other hand, some studies reported no change in CRP [3, 8, 17, 29, and] after completion of exercise training program in obese children and adolescent.

Difference in the results research may be due to insufficient intensity, volume, duration of the training or unsupervised physical education teacher.

We designed endurance and resistance training program with performance ability at school. Intensity, duration and volume of concurrent training were gradually and progressively increased on the basis of children tolerance, supervised and encouraged by physical education teacher.

The current study has some limitations, the sample size may have been too small, the effects of age, growth, maturation, attention, and seasonal variations on the dependent variables were not assessed and dietary monitoring. Despite these limitations, shown that BFM, BMI and CRP were significant decreased after completion endurance and resistance training in experimental group, while none achieved in control group.

CONCLUSION

It was demonstrated that regular participation in endurance and resistance training program caused to significant decrease of the C-reactive protein levels, body fat mass, and body mass index in experimental group compared to the control group (p<%5) as well as can be associated with decreased future cardiovascular risk in the obese children.Regular participation in endurance and resistance training program is a goal for behavior change in both prevention and treatment of childhood obesity.

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