

Short-term Effects of a Physical Activity Intervention on Obesity and Cardiovascular Fitness of 12-14-year-old Boy Students

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ABSTRACT

Background: Some local governments have implemented strategies to increase physical activity as a way to control obesity in children, but in Iranian students few studies have evaluated the effects of such interventions on overweight and obese children. The aim of this study was to evaluate the effects of a short-term school-based physical activity on obesity and cardiovascular fitness in 12-14-year-old boy students.

Methods: This study showed an intervention effect on some health-related fitness factors in students. A number of 127 boy students aged 12–14 years, in the city of Isfahan, based on preventive plan of inactivity in children at the provincial Health office selected randomly as subjects. Measurement variables include; weight, height, body mass index (BMI), waist-hip ratio (WHR), body-fat percent and aerobic power of subjects measured by valid tests.

Results: This study revealed that body-fat percentage of this students changed near to 17.84% (42.25% pretest vs. 34.71% posttest), WHR 0.44%, (0.915 pretest vs. 0.911 posttest), VO₂ max changed 8.54% (27.84 pretest vs. 30.22 posttest) whereas BMI was changed 2.61% (26.81 pretest vs. 26.03 posttest). Results also revealed that there were significant differences between fat percent, ($P = 0.001$) and VO₂ max ($P = 0.001$), but there was no difference between BMI of subjects in pre and posttests ($P = 0.452$).

Conclusions: Findings of this study signify that an implementation of short-term intervention components in the school system may have a beneficial effect on body-fat percentage and cardiovascular fitness of overweight/obese children.

Keywords: Cardiovascular fitness, middle school, obesity, students

INTRODUCTION

It is well-established that obesity is associated with a substantial burden of illness and health care costs. Obesity is associated with an increased risk of hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease and many

other noncontiguous diseases. The economic costs associated with the management of obesity and obesity-related diseases are remarkable.^[1,2] Overweight and obesity are determined by combination of factors such as; genetic, nutritional, metabolic, behavioral, environmental, cultural and socioeconomic influences.^[3] However, overweight and obesity in most individuals result from excessive energy consumption and/or inadequate physical activity.^[2]

Previous studies in this area showed that one in four children aged 6–14 years is presently overweight in developed and developing countries,^[2] which ranges from 11% to 39%.^[3] The prevalence of overweight and obesity was found similar in boys and girls,^[4] or significantly different between genders, with difference found in studies that reported higher prevalence of overweight and obesity in either girls^[4] or boys.^[4] The level of prevalence in European school children is reported to be as high as 27.7% and 28% for boys and girls of the eastern region, respectively.^[1,4] Based on published data in this regards prevalence rates of overweight and obesity for Iranian school children is 13.8%.^[5]

Physical factors such as an increase in sedentary lifestyles and the availability and marketing of foods, an increase in the use of computers and television viewing, greater dependence on vehicles for transportation, and decreases in physical activity in schools are considered major determinants of obesity.^[5]

Some international surveys suggest that the proportion of students who did not participate in at least 20 min of regular physical activity on 3 or more of the past 7 days and did not do at least 30 min of moderate physical activity on 5 or more of the past 7 days was 33.4%. The percentage of students who participated in no vigorous or moderate physical activity during the past 7 days was 11.5%, the percentage of students who attended physical education class daily was only 28.4%, the percentage of students who watched 3 or more hours of TV/day on an average school day was 38.2%, the percentage of students who ate five or more servings of fruits and vegetables per day during the past 7 days was 22%, the percentage of students who were at risk for becoming overweight was 15.4%, while the percentage of students who were overweight was 13.5%.^[6-9]

To the best of our knowledge, only a few data are available about the effects of school-based physical activity programs on overweight and obese students in the city of Isfahan and even in our country, Iran. Therefore, this study was carried out to determine the effects of a short-term physical activity intervention on obesity and cardiovascular fitness of middle school boy students in the city of Isfahan.

METHODS

Subjects

To examine the efficacy of a selected short-term exercise program for improving aerobic fitness and body composition of children, this semi-practical study has been conducted. A number of 127 middle school boy students, with written consent of their parents or guardians, volunteered to take part in this study and selected as subjects. Subjects selected from a different area of the city of Isfahan, who based on preliminary assessments during February to May 2011, have been determined as overweight or obese. For the entry conditions, participants were in good health, free from musculoskeletal dysfunctions, and metabolic and heart diseases. None of the subjects was on medication at the time of the study.

All of the subjects were informed that they could withdraw from the study at any time. Participants were in good health, free from musculoskeletal dysfunctions, and metabolic and heart diseases. None of the subjects was on medication at the time of the study.

Measurements

Subjects completed a physical activity and medical history questionnaire as each subject underwent 1-day testing session. During this session, anthropometric assessments and physical fitness tests were carried out.

Skin folds at three sites (triceps, sub-scapular, and medial calf) were obtained using a caliper. The landmarks were identified and measured according to Lohman and Timothy procedure,^[10] and the mean of three measurements was used for representing skinfold thickness. Body-fat percentage was determined according to gender-specific equations as following: If triceps and sub-scapular skin

folds >35 mm; %fat = 0.546 \sum SF + 9.7 females; and if triceps and sub-scapular <35 mm; %fat = 1.33 [\sum SF] – 0.013 [\sum SF]² + 2.5 females.^[10] Standard calibrated scales and stadiometers were used to determine the height, weight, and body mass index (BMI) of students. Heights were measured by a stadiometer (Novin, Iran) to the nearest 0.5 cm, while body mass were obtained to the nearest 0.2 kg using a calibrated balance beam scale (Novin, Iran). BMI was calculated as weight (kg)/height (m²).

Children's waist-circumference was measured using a flexible tape at the level of the narrowest point between the lower costal border and the iliac crest, and Hip circumference was measured at the widest region.^[10]

Cardiovascular or aerobic fitness of subjects was determined using pacer 20 m shuttle-run test.^[11] Subjects were required to run back and forth on a 20 m course and be on the 20 m line at the same time a beep is emitted from tape. The frequency of sound-signals increased in such a way that running speed started at 8.5 km/h and was increased by 0.5 km/h each minute. When the subjects could no longer follow the pace, the stage the subjects were able to run for was recorded and used for calculating the aerobic power or VO₂ max in children.^[11]

Intervention

All intervention subjects participated in a twice-weekly training program. The selected 6 weeks intervention program consisted of adding two 90 min sessions of physical education courses for selected students in their leisure time. With collaboration of school principals, teachers, school health services and parental committees, our physical activity intervention was programmed to increase participants' physical activity during both school hours and their leisure time, for 6 weeks intervention period.

In addition, we prepared physical activity and nutritional fact sheets for parents (including student-parent tasks), and hence that they were informed of the program they had to follow in holidays. Furthermore, the intervention schools received some exercising equipment (such as balls, jump ropes, etc.) to promote physical activity during exercise intervention time period. The physical activity intervention program included

10 min of warm up, performing push-ups, curl-ups, 20 m shuttle-run tests in groups, practicing some basic sport skills like soccer, volleyball, basketball and badminton, playing one of the mentioned sports for 20–30 min and finally 5 min cool down activities. The intervention strategies were aimed to increase the total physical activity level of all participants in general and specifically overweight or obese boy students.

Statistical analysis

Descriptive statistics was run on all the variables. We used paired *t*-test to determine differences between results of pre and posttests in measured variables, with *P* < 0.05 considered as statistically significant. Data were analyzed using the SPSS-PC software (version 20.0, IBM SPSS inc. USA).

RESULTS

Subject characteristics including height, weight, waist-hip ratio (WHR), BMI, body-fat percentage and cardiovascular fitness are summarized in Table 1. The results of statistical analysis and comparison of measured variables are shown

Table 1: Descriptive data related to measured variables in girl students (*n*=129)

Variables	Mean±SD	
	Pretest	Posttest
Height (cm)	159.09±7.21	159.09±7.21
Weight (kg)	70.11±8.12	68.95±8.14
WHR	0.88±0.93	0.88±0.91
BMI (kg/m ²)	27.81±3.61	27.34±3.61
Body fat (%)	37.74±6.62	36.39±6.67
Aerobic fitness (ml/kg/min)	29.72±5.39	31.93±4.89

SD=Standard deviation, BMI=Body mass index, WHR=Waist-hip ratio

Table 2: Dependent *t*-test and comparison of variables in subjects (*n*=129)

Variables	<i>t</i>	df	Significant
Weight: Pre and posttest	-6.493	128	0.001**
WHR: Pre and posttest	1.318	128	0.001**
BMI: Pre and posttest	-0.911	128	0.361
Body fat: Pre and posttest	14.781	128	0.001**
VO ₂ max: Pre and posttest	-7.719	126	0.001**

***P*<0.01. df=Degrees of freedom, *t*=Critical *t*. BMI=Body mass index, WHR=Waist-hip ratio

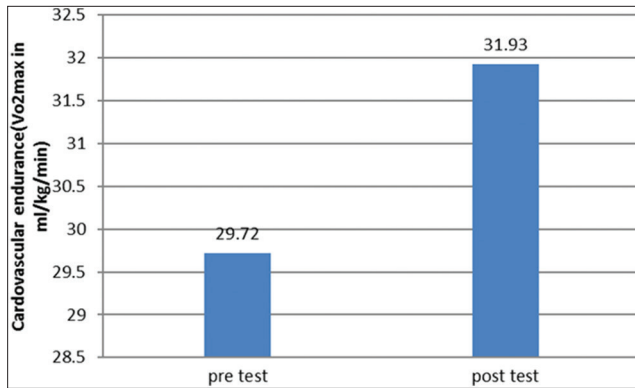


Figure 1: Comparison of pre posttests cardiovascular fitness of boy students

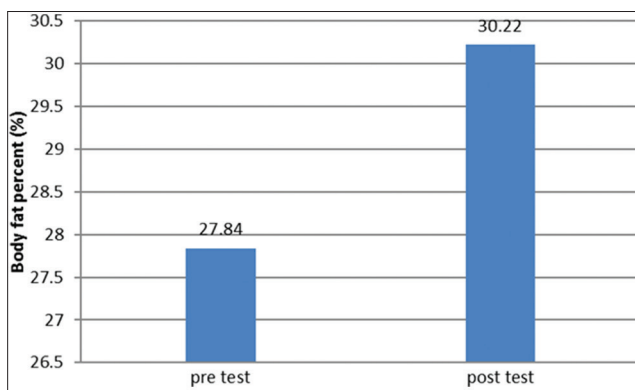


Figure 2: Comparison of pre posttests fat percent of boy students

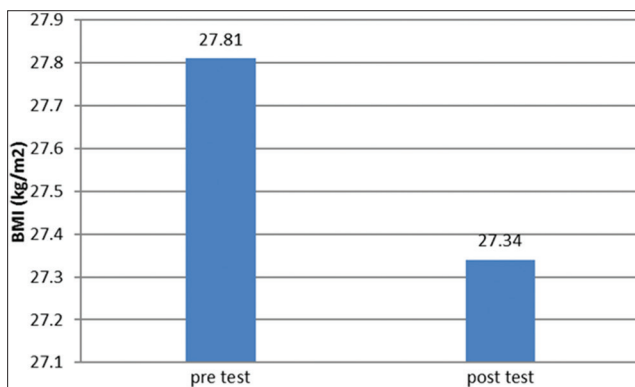


Figure 3: Comparison of pre posttests body mass index of boy students

in Table 2 and Figures 1-3. This study showed that subjects' body-fat percentage changed of 17.84% (42.25% pretest vs. 34.71% posttest), WHR levels changed 0.44%, (0.915 pretest vs. 0.911 posttest), VO₂ max changed 8.54% (27.84 pretest vs. 30.22 posttest), while BMI was changed 2.61% (26.81 pretest vs. 26.03 posttest). Results

also revealed that there was a greater decrease in fat percent and increase in cardiovascular fitness levels among the intervention participants, and this difference between fat percent, ($P = 0.001$) and VO₂ max of subjects were significant ($P = 0.001$). On the other hand, although BMI levels of students decreased from pre and posttests, but this difference did not reach statistical significance ($P = 0.452$).

DISCUSSION

The interventional strategies in this study were aimed to increase the total physical activity level of all participants in general and specifically obese or overweight boys. Our intervention was associated with significant weight loss, reduced BMI, reduced body-fat percentage, and increased cardiovascular fitness, however we believed that duration of intervention was too short and many factors we have to control in this regards. Preventive or treatment programs for childhood obesity require a multidisciplinary approach and should include dietary modifications, nutritional education, changes in life style, behavioral modification, and parental involvement.

In a school-based intervention that was held in Britain and implemented in 10 primary schools with 634 children, it was found that the program resulted in remarkable improvements to achieve aims of the study.^[7,12] Furthermore, in an intervention in Britain, with the aim of reducing consumption of carbonated drinks to prevent excessive weight gain in children, consumption of carbonated drinks was decreased (0.6 glasses with average glass size of 250 mL.) in the intervention group, whereas it increased in the control group; which in 12 months resulted in a decrease in the percentage of overweight and obese children in the intervention group, while it increased in the control group.^[13,14] In a study carried out on American-Indian students aged 8–11 years old, the purpose of the study was to evaluate the effectiveness of a school-based multi-component intervention for reducing body-fat percentage in different states, it consisted of four components: Classroom curriculum, food service modifications, physical activity and family involvement. It has been reported that, the body-fat percentage levels of subjects decreased in terms of physical activity implementation but, significant differences were

not found.^[14,15,16] In some studies, it has been reported that a multi-component school-based intervention can affect physical activity patterns in adolescents by increasing overall physical activity.^[17,18,19] Effects of this intervention seemed to be more profound in girls than boys, low-active adolescents compared with high-active adolescents, participants with normal weight compared with overweight, and for participants with parents having middle education level as opposed to high and low education levels, respectively.^[20] The findings above mentioned researches revealed that implementation of interventional strategies in the school system may have a beneficial effect on public health by increasing overall physical activity among adolescents and possibly among children, and low-active adolescents in particular.^[19] However, as we mentioned in some literatures in this regard, comparison studies of different kinds of school-based interventions are necessary to distinguish the most effective strategies to prevent obesity or improvements of health status of children.

Limitations

We believe that more accurate measurement methods of physical activity and multidisciplinary approaches are required to determine the effects of school-based physical activity interventions in children. Moreover, it is better to have control groups to modify and control other covariates. Hence it is regrettable to express that the present study lacks this feature. Finally, it can be said that unfortunately duration of intervention in this study was short due to inadequate facilities and other problems.

CONCLUSIONS

The data of this study demonstrated that although duration of school-based program of this study was short, but intervention resulted in significant positive effects on body-fat percentage, BMI, WHR and aerobic fitness of the participants. Our results suggest that aerobic fitness as an indicator of physical activity is linked to decreased level of adiposity in children. According to the results of the present study and the fact that Iranian academic curriculum includes only 90 min physical activity per week, initiatives should be put forward

to promote physical activity in Iranian children in both school and out-of-school environments.

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