Short-term Effects of a Physical Activity Intervention on Obesity and Aerobic Fitness of Adolescent Girls

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Original Article

ABSTRACT

Background: In the past two decades, physical activity has decreased during both childhood and adolescence, and particularly adolescence. It seems that schools are attractive settings in which to implement interventions designed in order to promote physical activity 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 aerobic fitness in 12–14 years aged girls.

Methods: This is a study with single group pretest and posttest design, in which 129 middle school girls in city of Isfahan were assessed based on preventive plan of inactivity in children at the Provincial Health Office. Variables, including weight, height, body mass index (BMI), waist-hip ratio (WHR), body fat percentage and aerobic power of subjects were measured using valid tests.

Results: This study showed that subjects' body fat percentage changed about 3.6% (37.74% pretest vs. 36.39% posttest), VO_2 max changed 7.43% (29.72 pretest vs. 31.93 posttest), WHR changed 1.12% (0.89 pretest vs. 0.88 posttest), whereas BMI was changed 1.65% (27.80 pretest vs. 27.34 posttest). Findings also revealed that there were significant differences between fat percent, ($P = 0.001$) and VO_2 max ($P = 0.001$) of subjects, but there was no difference between BMI of them in pre- and post-tests ($P = 0.361$).

Conclusions: These results suggest that even a short-term exercise intervention may lead to positive changes in body fat percentage, WHR and aerobic fitness of overweight children. Therefore, school-based physical activity interventions can be an effective preventive strategy to control obesity and overweight in students.

Keywords: Intervention, middle school, obesity, physical activity, students

INTRODUCTION

Incidence of obesity and overweight in children of numerous societies has increased dramatically, and that is one

of main factors seems related to development of obesity, type 2 diabetes, hypercholesterolemia, hypertension, metabolic syndrome, cardiovascular diseases, and all-cause mortality in both adults and children.[1-3] Overweight and obesity are determined by combination of factors such as genetics, nutritional, metabolic, behavioral, environmental, cultural and socioeconomic influences.[4] However, overweight and obesity in most individuals result from excessive energy consumption and/or inadequate physical activity.[5]

Previous studies in this area showed that one in four children aged 6–14 years is presently overweight in developed and developing countries,[5] which ranges from 11% to 39%.[4] The prevalence of overweight and obesity was found similar in boys and girls,[6,7] or significantly different between genders, with difference found in studies that reported higher prevalence of overweight and obesity in either girls, or boys.[6,8] 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.[9] Based on published data in this regards prevalence rates of overweight and obesity for Iranian school children is 13.8%.[10]

Suggested public health strategies to prevent childhood obesity are promoting breastfeeding, limiting watching television, encouraging physical activity, increasing fruit and vegetable intake, controlling serving size and limiting soft drink consumption.[8] 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/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%.[11-14]

Schools are identified as a key setting for public health strategies to decrease or prevent the prevalence of overweight and obesity, and to the best of our knowledge, only a few data is 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. Furthermore, few studies have examined the effectiveness or impact of school-based interventions on aerobic fitness and body compositions of female aged 12–14 years students. Therefore, this study was carried out to determine the effects of a selected short-term physical activity intervention on obesity and aerobic power of middle school girl students in Isfahan city.

METHODS

Subjects

This is a semi-practical study, conducted among middle school girl students (aged 12–14 years) from city of Isfahan, who based on preliminary assessments during February–May 2011, have been determined as overweight or obese, a number of 129 middle school girl students, with written consent of their parents or guardians volunteered to take part in this study and selected as subjects. 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 and their parents/guardians were informed that they could withdraw from the study at any time.

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, subscapular, and medial calf) were obtained using a caliper. The landmarks were identified and measured according to Lohman and Timothy procedure,[14] 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 ∑ SF + 9.7 females;

and if triceps and sub-scapular <35 mm; %fat = 1.33 [∑SF] − 0.013[∑SF] ^{2} + 2.5 females.[14]

Heights were measured by a stadiometer (Novin, Iran) to the nearest 0.5 cm while body weight was obtained to the nearest 0.2 kg by a calibrated balance beam scale (Novin, Iran). Body mass index (BMI) was calculated as weight (kg)/height (m) ^{2}.

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 of buttocks.[14]

Cardiovascular or aerobic fitness of subjects was determined using pacer 20 m shuttle-run test.[15] 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 a 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 VO_2 max of children.[15]

Intervention

Numerous meetings were designed for the teachers and parents and held at each intervention school to inform and encourage the efforts launched since the teachers were key persons to implement the interventions. Physical education teachers received guidelines regarding the training programs, healthy nutrition and energy balance for the students.

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. Also, the intervention schools received some exercising equipment (such as balls, jump ropes, etc.) to promote physical activity during exercise intervention. Intervention program consisted of adding two 90-min sessions of physical education courses for selected students for 2 days/week in their free time. 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 such as soccer, volleyball, basketball and badminton, playing some sports 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 the inactive girl students.

Statistical analysis

Descriptive statistics were run on all the variables. We used paired *t*-test to determine statistical differences between means 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

The descriptive data of the measured variables including height, weight, waist-hip ratio (WHR), BMI, body-fat percentage and aerobic fitness are shown in Table 1. (Mean ± standard deviation). The results of statistical analysis and comparison of measured variables are shown in Table 2 and Figures 1-3. As shown in Table 1, pretest and posttest mean results for body fat percentage were 21.12% and 19.32%; WHR

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

Variables	Mean±SD	
	Pre-test	Post-test
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 power (ml/kg/min)	29.72±5.39	31.93±4.89

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

Table 2: Results of dependent *t*-test and comparison of variables in girl students (*n*=129)

Variables	*t*	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**
Aerobic power: 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

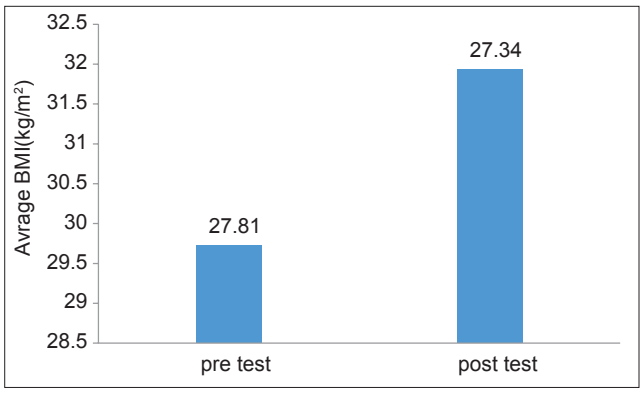

Figure 1: Comparison of pre- and post-tests body mass index of girl students

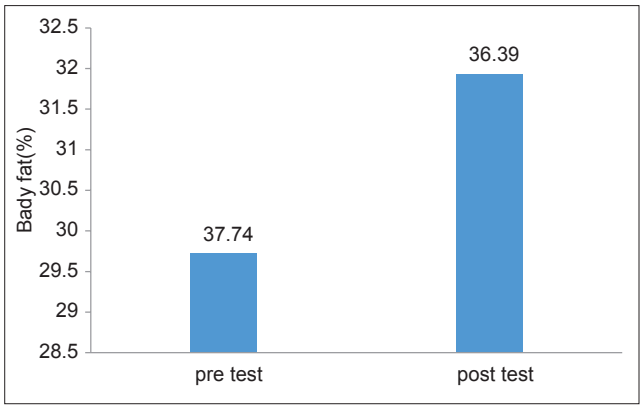

Figure 2: Comparison of pre- and post-tests fat percentage of girl students

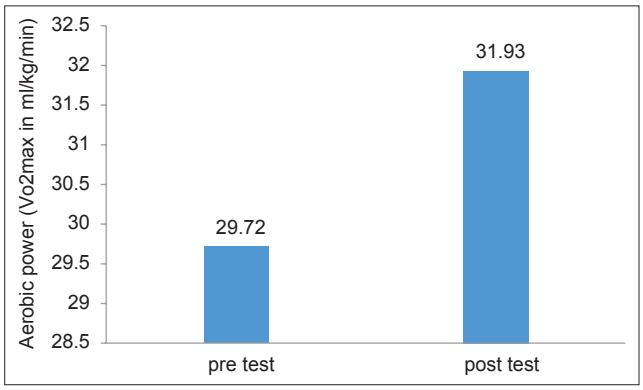

Figure 3: Comparison of pre- and post-tests aerobic power of girl students

were 0.89 and 0.88 cm. and VO_2 max were 29.72 and 31.93 ml/kg/min, respectively. Table 2 shows that there were statistically significant differences between pre and posttest means of some measured variables including body-fat percentage, WHR and VO_2 max ($P < 0.001$); but in statistical analysis, we did not find significant difference between pre and posttest BMI values of subjects ($P = 0.361$).

DISCUSSION

The efforts of the present study were targeted to promote students' participation in regular physical activities and to reduce sedentary behavior during a selected 6 weeks intervention period. 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. The interventional strategies were aimed to increase the total physical activity level of all participants in general and specifically overweight/obese inactive girl students. The findings of study revealed that improvements in some measured variables such as VO_2 max and body composition indexes are consistent with some studies and inconsistent with other findings in this regards.[14] Inactivity is only one of the factors interconnected with obesity, and perhaps it is one of the easiest to modify.[15] Guidelines for physical activity in children and youth recommend involvement in moderate to vigorous physical activities for at least 60 min a day for health promotion and from a weight-control perspective.[14-16]

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, that were to increase the fitness levels of students.[17,18] Also, 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.[18-20] 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 in term of physical activity, although body fat percent of subjects decreased, but no significant differences were found.[18,21,22]

In some studies, it has been reported that multi-component school based intervention can affect physical activity patterns in adolescents by increasing overall physical activity.[21,23,24] 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.[24] The findings of some of above mentioned studies 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.

The data of this study demonstrated that although duration of school-based program of this study was short, there were significant differences between body fat percentage, BMI, WHR and aerobic fitness of the participants prior and after the test.

Limitations

We believe that more accurate measurement methods of physical activity 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

Our results suggest that aerobic fitness as an indicator of physical activity is linked to the 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/ 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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