

Original Article

The effect of regular physical activity on exercise tolerance: a school-based intervention

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Abstract

Objectives: The main purpose of this study was to assess the effects of daily physical activity on exercise tolerance ability using the six minute walk test in healthy female students.

Methods: The participants in this field study were 252 healthy girls, 9-12 years old, studying in an elementary school in Tehran from March to June 2011. A three months daily physical activity protocol, with 15 minutes exercise per day, was designed as a curricular-based exercise intervention program. The six minute walk test was used as a tool to measure exercise tolerance ability before and after the intervention. Paired t-test, ANOVA and correlation tests were used when appropriate.

Results: The participants, with mean age of 10.6 (SD = 1.1), formed different body mass index groups known as underweight, normal, at risk and overweight with 8.3, 60.7, 18.7, and 12.3% respectively. The mean of the distances moved along in a six minute walk test, before and after the intervention, increased from 833.4 meter to 923.3 meter, indicating 10% increase and the difference was found to be statistically significant ($P < 0.001$). However, analysis of mean differences of the walked distances, before and after the intervention, showed no statistically significant difference for the body mass index groups ($P > 0.05$).

Conclusion: A 15-minutes daily physical activity could enhance the exercise tolerance of school-age girls; the activity, as an easy and inexpensive form of intervention, is recommended to students.

Key Words: Female, Intervention Studies, Motor Activity, 6-Minute Walk Test; Students

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Introduction

Physical activity has proven to be associated with healthy lifestyle, which could prevent lifestyle-related diseases. A number of studies on children's health have indicated a strong tendency among children to become

more inactive, gain more weight and get more exposed to conditions such as type2 diabetes, coronary artery diseases, cancer and osteoporosis¹⁻⁴. According to numerous pieces of evidence, overweight and sedentary behaviors are more common among children in the recent years, with negative implications for the subsequent ages^{1,2}. Given that healthy children turn to

be healthy adults, promotion of healthy activities among children proves to be a must³.

Many studies admit that children with less than one hour physical activity in a day may be more liable to cardiovascular risk factors than those who are more active⁴. Additionally regular physical activity in children would affect their adulthood lifestyle. Kraut et al. predicted that children's participation in organized school-age sporting activities could increase the amount of leisure time they would allocate to physical activity in adulthood⁵.

The ability to walk for a distance is a quick, easy, and inexpensive way to assess the physical function of an individual⁶. The 6-minute walk test (6MWT) has been frequently used in the last decade to evaluate the sub-maximal effort of an adult individual, representing his general capacity for exercise. Recent analyses suggest that this test is administered easily and tolerated better while reflecting the activities of daily life more closely^{7,8}.

Previous findings have shown that, in children and adolescents, the distance walked in 6MWT could be influenced by variables such as age, height and weight. This test can also cause a difference in heart rate before and after the test^{2,9}; in a number of studies, the association between anthropometric variables and 6MWT in healthy children has been discussed, as mentioned above, but the effect of regular physical activity on exercise tolerance in school-aged children is an important subject that has been left unattended. In this concern, the current study is to identify the effects of daily regular physical activities on school girls aged 9 to 12 for three months. The participants taking part in the 6-minute walk test are expected to gradually enhance the distance they could walk in the upcoming weeks by pursuing a 15-minutes exercise per day.

Methods

This research was a school-based field trial study. The data collection procedure lasted from March to June 2011. A list of all schools located in the Second District of the Municipality of Tehran was obtained from the relevant authorities. Then one of the schools was randomly selected from the list. Nearly all the students of the selected school aged 9-12 years

participated in the study, except those who did not have the inclusion criteria. The inclusion criteria dealt with the selection of healthy students whose parents agreed with their participation in the exercise and accordingly signed the informed consent. The exclusion criteria, on the other hand, included underlying discomforts, such as cardiovascular, respiratory or neuromuscular diseases or the history of an acute illness, two weeks before the selection date; added to these were the impact of a special treatment that could influence the walk test and failure to obtain the informed consent.

With these criteria at work, a total of 252 healthy girls from grades three to five of the primary school were asked to participate in this study. The data collection forms, consisting of questions such as date of birth, underlying diseases, long-term medications, nutrition, physical activity and physical training hours were filled in by the researchers. A medical doctor examined the selected children and confirmed their health status.

The Six-Minute Walk Test

The 6-minute walk test was used as a tool to assess one's exercise tolerance. It is a test of relatively low complexity that measures the distance that a person can quickly walk in a 30-meter (100-foot) hallway repeatedly during 6 minutes, referred to as the 6-min walk distance¹⁰.

Despite its frequent use in adults, with beneficial results, the 6MWT has not been widely used in the pediatric population, mainly because of lack of standardized protocols. The study of Li et al. was the first to assess the reliability and validity of the 6MWT, involving normal healthy children¹¹.

Before performing the test, the researchers had to verify children's anthropometric data to measure issues such as age (years), height (m), weight (kg) and body mass index (BMI). To prevent bias, only one person measured all anthropometric data and a standard calibrated scale was used to measure the subject body weight and height.

The test was administered according to a standardized protocol¹² at a suitable location on the school ground with a 100-foot (30.5 meter) distance, marked by a colored tape at the starting line and intervals of one meter in length.

The participants were told that the purpose of the test was to find out how far they could get in 6 minutes by just walking fast, without running, skipping or hopping; they were also told that they might walk more slowly if they were very tired, or even stop walking if they were exhausted. The participants were advised to wear comfortable clothes and appropriate shoes and to avoid severe exercise for at least two hours before the test. No warm-up period, before the test was allowed, but they could consume a light meal before the test. The participants had to relax at least 10 minutes before performing the test in a chair, near the starting line. The test was self-paced.

During the walk, the participants were encouraged verbally by the researchers. At the end of the sixth minute, the participants were advised to stop. The technician used an electronic chronometer with a buzzer that ringed in 6 minutes after the walk started and the distance covered in six minutes was recorded in meters.

Intervention

In the next step the school based intervention was performed. A protocol for 15 minutes physical activity per day in a school was designed and implemented every morning for three successive months; the exercise was monitored by a physical training teacher. The protocol was equally composed of butterfly movement of the legs and hands, skipping in four directions, scissoring motion, turning around and running. The intensity of the exercise was in moderate level. At the end of the third month, the 6 minute walk test was repeated using the same protocol and the second round of data were recorded.

The participants' age ranged from 9 to 12 which fall within the BMI category for participants under twenty years of age. BMI of students was adjusted for age with the help of "BMI-for-age percentiles chart" which is a tool used for 2 to 20 years old individuals¹³. In CDC Chart, the BMI-for-age cutoff points are defined as underweight for under 5th percentile, normal for the 5th to under 85th percentile, overweight risk for 85th to under 95th percentile and overweight for 95th percentile and more. BMI was sorted according to "BMI-for-age percentiles chart" from the 2000 CDC Growth Chart.

STATISTICAL ANALYSIS

In order to assess changes in walked distances, observed in the test to retest phases, a paired t-test was performed. The mean differences between the distances walked before and after intervention among the BMI groups were analyzed using One-Way ANOVA test. The correlation of BMI and the distances walked before and after intervention were examined by the correlation coefficient test. In all cases the results were statistically significant when p-values reported less than 0.05 ($P < 0.05$). The analysis was conducted using the Statistical Package for Social Sciences (SPSS), version 17.

Results

A total of 252 girls, 9-12 years old, with the mean age of 10.6 (SD = 1.1), participated in this study. The data obtained was subjected to a number of descriptive statistics, table 1 below. The mean difference of the distances walked in 6MWT before and after the intervention was statistically significant ($p < 0.001$). The characteristics of the 6 minute walk test and retest are available in table 2.

Table1. Characteristics of the girls, aged 9-12 years, from an elementary school randomly selected from the 2nd district of the Municipality of Tehran

	N	Mean (S.D)	Median
Age (years)	252	10.62(1.1)	11.00
Weight (Kg)	252	40.55(8.9)	39.00
Height (Cm)	252	144.24(6.3)	144.00
BMI	252	19.36(3.4)	18.90

Table2. Characteristics of 6MWT test and retest for girls, aged 9-12 years, from an elementary school randomly selected from the 2nd district of the Municipality of Tehran

	N	Mean(S.D)*	Median
6minute walk test, pre exercise (meter)	252	833.4 (135.5)	832.5
6minute walk test, post exercise (meter)	252	923.3 (161.6)	910.0
Difference (meter)	252	89.9(99.63)	70.0

* P-Value for mean differences < 0.001

Table 3. 6MWT results based on classification of BMI in girls aged 9-12 years from an elementary school randomly selected from the 2nd district of the Municipality of Tehran.

BMI for age	Difference in the walked distance		
	Number (Percent)	Mean (S.D) ^{*†}	Median [†]
underweight	21 (8.3%)	110.0(130.7)	80.00
normal	153 (60.7%)	86.50(99.7)	70.00
at risk	47 (18.7%)	87.55(92.4)	65.00
overweight	31 (12.3%)	97.26(88.1)	70.00
total	252 (100%)	89.98	70.00

* P-Value for mean differences >0.05

† based on Meters

In the next step, the differences between groups of BMI and the distances walked before and after intervention were examined. Compared to the initial test, the mean difference in the retest showed different amounts of increase in the “normal”, “at risk” and “overweight” groups as follows, 86.5 (S.D= 99.7), 87.5 (S.D=92.4), 97.2 (S.D= 88.1). In the “underweight” group, however, this pattern was not observed. According to One-Way ANOVA, there were not any statistically significant differences between the means based on BMI ($P>0.05$).

The correlation coefficient of BMI and walked distances, before and after the intervention, as measured by Pearson Correlation formula, was -0.006 , which was not statistically significant ($P>0.05$). Table 3, below, presents the 6MWT results based on classification of BMI.

Discussion

The purpose of the study was to examine the effects of regular physical activity on exercise tolerance ability of healthy children. According to the results, a 15-minutes regular physical activity carried out for three months increased the distance walked in six minutes. The results are in line with the systematic review of William et al. indicating beneficial effects of daily physical activities carried out by students at schools¹. A noticeable point in such studies, including the current work, is that they serve as short-term interventions while the effect of long-term intervention on children's physical activity has not been well substantiated yet¹⁴. This study also adopted a short-term scheme on practical grounds as the intervention

would lead to summer holidays when the schools would close, with no students around, for nearly three months.

Because the participants' age ranged from 9 to 12, their BMI was adjusted with “BMI-for-age percentile chart” which is a tool used for 2 to 20 year-old children¹³. The selection of a chart comparable to children's age is important in that the concept of BMI in children is not the same as adults since children's BMI changes as they grow.

The current study also examined the possibility of a significant correlation between walked distances and BMI. The results, however, did not show any significant correlation for the distances walked in test and retest exams regarding BMI, but in terms of weight size, the increasing patterns of walked distances and BMI indicated physical activity's greater effect on “at risk” and “overweight” groups than those in “normal” and “underweight”; this could be considered as effect size that may be clinically considerable and need to be more investigated. Additionally, despite statistically different means of the distance walked in six minutes, period of intervention was not long enough to affect BMI, so the result, in this concern, may not be sound enough to warrant discussion.

Our findings support those of Roush et al. in terms of BMI and 6MWT in American children¹⁵ but are at odd with those of Lammers et al. according to which the distance walked in 6MWT may be related to age, weight and height¹⁰. Also, unlike this study, in Geiger et al. the 6MWT increased during the weight reduction program in overweight children¹⁶. The results of the current study indicate the significance of designing a comprehensive exercise program with clear targets for children at primary-school age.

As indicated earlier, the results did not manifest any significant correlation between the distance walked in six minutes and BMI. Increasing BMI in children is a complicated process requiring long-term investigations with nutritionally controlled physical activities; hence, short time interventions aiming to change energy expenditure without improving the habitual diet could hardly entail any noticeable effects. Future studies are recommended to consider and control nutritional factors while assessing physical activities; the studies could be carried out in schools with

nutrition and physical activity programs lasting for longer time.

There were some limitations in this study; Implementation of the intervention required strong cooperation between school officials and investigators for every single day of the three months while the study was being performed; such cooperation was not so easy to achieve. It would be difficult to monitor the continuous presence of children in the physical activities every day for three successive months while the intervention was going on; additionally, the intervention, lasting for three months, was not long enough to reach some valid conclusions on the effect of 6-MWT on children's BMI. Maturation is a potential threat based on the 9-12 year old range of the participants, but three months period of follow-up is unlikely to be affected by this. Future studies need to consider and plan for such problems if they are to make the experiments more enjoyable and the results more authentic. This study designed as a before-after intervention; we recommend designing other studies as concurrent external control group and more follow-up period to modify the effect of probable confounders.

In conclusion only a very simple intervention can affect exercise tolerance test of students in only 3 months. It is recommended to implement these simple exercise programs in routine daily program of the primary schools. It can be a cost effective way to reduce burden of chronic diseases.

Conclusions

Psychological problems and specially depression and anxiety disorders account as serious problems, in haemodialysis patients, which can put their health in jeopardy. Therefore, it is suggested that for early diagnosis and treatment of depression, HD patients be psychologically examined periodically. In conclusion, stressor factors must be assessed in haemodialysis patients and intervention methods must be presented for improving patients' life skills in order to prevent psychological and social stress factors.

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