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The Effect of a Selective Exercise Program on Motor Competence and Pulmonary Function of Asthmatic Children: A Randomized Clinical Trial

Ezzat Khodashenas[1], Elham Bakhtiari[2], Mehdi Sohrabi[3], Ali Mozayani[1], Manijheh Arabi[3], Vahideh Velayati Haghighi[3], Nasrinsadat Motevalli Haghi[1], *Hamid Ahanchian[4]

[1]Department of Pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.
[2]Research Center for Patient Safety, Mashhad University of Medical Sciences, Mashhad, Iran.
[3]Department of Motor Behaviors, Faculty of Sport Sciences, Ferdowsi University of Mashhad, Mashhad, Iran.
[4]Department of Pediatric Allergy and Immunology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

Abstract

Background

Physical activity in asthmatic children may be useful. But there is not adequate knowledge about it. In present study the effect of selective exercise on motor competency and pulmonary function in asthmatic pediatrics was evaluated.

Materials and Methods

In a randomized clinical trial study, fifteen asthmatic children aged 6 to 18 years were included. Patients were randomly divided into the experimental or control group. There was no difference in the routine pharmacotherapy. The aerobic group had an exercise program consisting of 45-minute sessions three times per week for 8 weeks. The outcome measures were the difference between the pre- and post-exercise program and also the experimental and control groups. Spirometry parameters (such as FEV1and FVC) were measured. Motor competency was measured by the Ozeretski test. Quality of life was evaluated by St. George's questionnaire. The data were analyzed using SPSS software (version 16.0).

Results: A significant effect was observed for spirometry parameters, quality of life and the Ozeretski test in two studied groups. Aerobic exercise had a significant effect in improving FEF 25-75%, quality of life and the fine and gross motor performance in the experimental group ($P< 0.05$). A significant difference was observed between two groups for FEF, FEF25-75% and quality of life ($P< 0.05$).

Conclusion

Regular exercise improves the spirometric parameters and quality of life in studied asthmatic children. In present study, aerobic exercise and strength training were useful complementary means for the treatment of asthmatic children.

Key Words: Asthma, Child, Selective exercise program, Spirometry, Quality of life.

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Corresponding Author:

Hamid Ahanchian (M.D), Department of Pediatric Allergy and Immunology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

Email: ahanchianh@mums.ac.ir

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1- INTRODUCTION

Asthma is a reversible airway disease that decreases the airway cross-section due to the parasympathetic nervous activity of the smooth muscles of the respiratory airway. It is one of the most common chronic respiratory diseases affecting 14-16% of children worldwide which even leads to hospitalization in certain cases (1). Asthma has a negative effect on growth, development, mental and physical health and other dimensions of life (2, 3). Today, the importance of exercise in health and quality of life improvement is an obvious fact. On the other hand, exercise can induce asthmatic attacks in a small percent of children; this is recognized as exercise induced asthma (EIA). Because of the risk of EIA, especially in allergic children, some people consider exercise as injurious for asthmatic children (4-6).

In contrast with this general belief, several studies have reported the effectiveness of regular exercises in the reduction of asthma symptoms. Multiple mechanisms are involved in this process; regular exercise leads to an increase in respiratory muscles strength, reduction in the need for bronchodilators and eventually more effective treatment for asthmatic patients (1, 7, 8). Today, the type of exercise which is most beneficial to asthmatic patients is the main concern. Most studies have reported aerobic exercise as the physical activity of choice. It has been suggested that about 8 to 12 weeks of aerobic exercise is efficient in controlling asthma symptoms and improving their quality of life (1, 9). Most researches on asthmatic patients have just focused on increment of the respiratory muscles strength and change in the respiration pattern (10, 11), while increasing the strength and tolerance of other muscles such as the diaphragm, trunk and upper limbs can also be beneficial to these patients (12). The change in the respiratory pattern can also increase the strength and tolerance of the respiratory muscles, but this requires training. Also, since it requires the conscious attention of the individual, it is not always practiced (12). Spirometry parameters such as forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio (FEV1%), forced expiratory flow (FEF), and FEF25-75% are used to measure the progress in asthmatic patients. In asthma as a obstructive disease, both values of FEV1 and FVC are decreased (1). Aerobic exercise, alone (13) or with strength training (9) raises spirometry parameters. It has been reported that exercise improves the pulmonary performance and decreases symptoms such as wheezing, coughing, chest tightness and shortness of breath in asthmatic kids (14). The present study aimed to determine the effect of a selective exercise program on spirometry parameters and quality of life in Iranian asthmatic children.

2- MATERIALS AND METHODS

2-1. Study design

This randomized clinical trial study (ID-code: IRCT2016062028546N1), was performed in allergy clinic at Qaem hospital, affiliated to Mashhad University of Medical Sciences, Mashhad, Iran, from 2015 to 2016. The study participants were 20 children aged between 6 and 18 years with documented asthma. The asthmatic children were randomly divided into the experimental and control groups. Randomization was performed by an expert who was not involved in evaluation and data analysis. Because the intervention was a physical exercise, blinding was not possible. Out of the 20 consecutive volunteers, 15 patients completed the experiment (9 patients in experimental group and 6 controls), and one patient in experimental group and four patients in control group withdrew during the study. Flow diagram of patient's involvement is presented in **Figure.1**. All patients

participated in the pre- and post-test. The experimental and control groups received routine medications whereas the experimental group also contributed in selective exercise programs. Selective exercise programs were supervised and included aerobic exercise and strength training as 45-min sessions three times per week, being continued for 8 weeks. The study protocol was described to all patients and their parent/guardian and an informed consent was obtained from them prior to study entrance.

2-2. Selection criteria

Children aged 6 to18 years with intermittent to mild asthma receiving inhaled corticosteroid for at least one year visiting the Respiratory Clinic were included. Patients who experienced major changes in routine medications during the study course were excluded from the trial.

2-3. Selective Exercise Program

The exercise testing guidelines (published by the American College of Sports Medicine) were studied in our patients (15). Before the experiment, each patient was familiarized with the testing procedures. In the experimental group, every exercise session consisted of three parts: 5-10 min of warm-up exercises, 20-30 of the main exercises including aerobic and strength exercises, and 5-10 min of cool down exercises.

2-4. Measurements

All participants performed a spirometry test, including FEV1, FVC, FEV1%, FEF, and FEF25-75% parameters before and after the intervention. Motor competency was measured by the Ozeretski test (16). Weight was measured by digital scales (Seca, Germany, precision 5 gr) in stand position and height was measured in stand position by the same person. Spirometry (Cosmed, Italy) was measured by the same person for all patients. Body Mass Index (BMI) is a person's weight in kilograms divided by the square of height in meters. Children's body lipid profile changes over the years and in girls and boys as they grow. This is why BMI for children is gender and age specific. BMI-for-age is planned on gender specific growth charts. These growth charts are used for children and adolescents 2-20 years of age. Using the growth charts, comparing body size with the suitable age and gender growth chart enables healthcare providers to monitor growth and recognize health or nutrition-related problems (17).

2-4-1. St. George's respiratory questionnaire

The St. George's respiratory questionnaire (SGRQ- 2009) includes questions on physical activity, daily diet, and socioeconomic status, history of asthma in the family and the presence of a smoker in the family was completed for each subject. Validity and reliability of English and Persian version of questionnaire were documented previously (18, 19). This questionnaire is comprised of 2 portions and each portion includes 8 questions. The final score varied between 0-100. Zero is the worst score and 100 is the best.

2-4-2. Ozeretski test

Ozeretski test includes 8 items comprising several another items. Items 1-4 describe the gross motor performance and items 5-8 describe the fine motor performance and all of them describe the total performance. Sensitivity and specificity of Ozeretski test were documented previously (20).

2-5. Sample size

According to Andrade et al. (21) with power of 0.9 and α=0.05 and according to spirometric parameters as primary outcomes, the sample size was determined 10 patients in each group and totally 20 patients.

2-6. Data Analysis

Statistical analysis was performed using SPSS software version 19.0 (SPSS Institute, Inc., Chicago, IL, USA). All experimental values are presented as mean ± standard deviation (SD). Paired sample T- test was used for pre- and post-test analysis. Independent T- test was used for comparisons between the two groups. The statistical significance was set at P<0.05.

3- RESULTS

Among 20 included children, 15 children completed the study. There were 9 patients in experimental group and 6 patients in control group. Among them 66.7% (10 patients) were male and 33.3% (5 patients) were female. The mean age, weight, BMI of the studied patients were 9.06±3.23 years, 32.8±12.3 kg, and 134.6±17.9 cm and 17.4±2.81 kg/m^2, respectively. Baseline characteristics of the studied patients are presented in **Table.1**. The mean spirometric parameters before and after the intervention are presented in **Table.2**. The mean of FEF25-75% increased after the intervention in the experimental group (P<0.05). The mean FEV1, FVC, FEV1% and FEF parameters increased after the exercise in the experimental group, but the difference was not statistically significant (P>0.05). The results showed no progress in spirometric parameters in the control group. The mean of quality of life, fine and gross motor performance increased after the intervention (P<0.05). However, there was no progress in the control group (P>0.05).

Gross motor performance in the control group was significant at the beginning and at the end of the study (P<0.03). Sport parameters of asthmatic patients before and after the intervention are presented in **Table.3**. The mean difference in spirometry parameters between the experimental and control groups was significant for FEF and FEF2575 (P<0.04). The mean difference in quality of life between the experimental and control groups was also significant (P<0.001) (**Table.3)**.

Table-1: Baseline characteristics of the participants (n=15)

Variables	Experimental (n=9)	Control (n=6)	P-value*
Age (years)	9.66 ± 3.7	8.16 ± 2.3	0.41
Weight (kg)	34.4 ± 15.02	30.3 ± 7.4	0.45
Height (cm)	134.8 ± 20.3	134.3 ± 15.2	0.93
BMI (kg/m^2)	18.1 ± 3.2	16.4 ± 1.6	0.26

BMI: Body mass index, *independent sample t-test.

Table-2: Spirometric parameters of studied patients before and after the study (n=15).

Groups	FEV1	FVC	FEV1%	FEF	FEF25-75%
Control					
Pre- test	1.27±0.3	1.78±0.6	0.86±0.1	2.28±0.9	1.93±0.9
Post- test	1.21±0.3	1.66±0.6	0.87±0.1	2.12±0.8	1.81±0.9
P value	0.3	0.1	0.4	0.1	0.4
Experimental					
Pre	1.32±0.6	1.68±0.8	0.91±0.1	2.64±1.4	2.26±1.3
Post	1.33±0.6	1.86±1.17	0.93±0.05	3.11±1.7	2.68±1.7
P value	0.9	0.2	0.7	0.06	0.04*

FEV1: Forced expiratory volume in 1 second; FVC: Forced vital capacity; FEF: Forced expiratory flow.

Table-3: Sport parameters of studied patients before and after study (n=15).

Groups	Fine motor performance (mean ± SD)	Coarse motor performance (mean ± SD)	Total (mean ± SD)	Quality of life (mean ± SD)
Control (n=6)				
Pre- test	25.8±3.5	28.3±12.3	57.6±12.6	43.09±17.3
Post- test	28.8±5.6	31.8±11.1	64.3±16.1	43.1±17.9
P- value	0.06	0.03*	0.7	0.9
Experimental (n=9)				
Pre- test	23.3±6.5	29.6±5.07	53.5±12.8	52.3±15.8
Post- test	27.3±8.2	37.3±6.8	65.2±14.9	45.8±14.6
P- value	0.003*	0.001*	0.001*	0.001*

SD: standard deviation.

4- DISCUSSION

The present study aimed to determine the effect of a selective exercise program on spirometry parameters and quality of life in Iranian asthmatic children. The intervention in the experimental group was eight weeks of physical training, including aerobic exercise and strength training for children. Finally, the spirometric parameters (FEV1, FVC, FEV1 / FVC, FEF and FEF25-75%), Ozeretski test items and SGRQ were compared between the experimental and control groups. The present study showed that FEV1, FVC, FEV1%, FEF and FEF2575 as well as quality of life of asthmatic children in a selective exercise program were higher than patients with no exercise. The results of the present study are comparable to the findings of previous researches (1, 9, 13, 22). Other studies have generally stated that regular exercise improves pulmonary function of asthmatic patients which is in agreement with the present study. Hallstrand et al. in a study on patients with mild intermittent asthma and normal control subjects, reported that exercise rehabilitation improves aerobic fitness in both asthmatic and non-asthmatic individuals in a 10-week aerobic fitness program (13). Alfaro et al. in a study on thirteen stable and moderate to severe chronic obstructive pulmonary disease (COPD) patients, reported that an adjusted rehabilitation program is able to increase exercise tolerance in stable COPD patients affected by dyspnea during exercise, through an apparent reconditioning of both skeletal and respiratory muscles (23). In another pilot study it was suggested that asthmatic children improved after regular exercise (24). In a review article it was stated that physical activity is a possible protective factor against asthma development in children as well as adults (25). In another review study it was concluded that children and adolescents with low physical activity have an increased risk of new-onset asthma (6). It has been documented that exercise increases work tolerance by reducing ventilation rate for a given workload (22).

Also, it seems that exercise in asthmatic patients increases their knowledge and skill for better care and management of the disease (8). Results of the present study indicated that a selective exercise program has a positive effect on improvement of some spirometric parameters. Moreover, fine and gross motor performance and quality of life improved significantly after the intervention. According to the present study and in agreement with other reports, it is not advisable to limit exercise in asthmatic patients. Accordingly, it was shown that selective exercise programs significantly increase the quality of life in asthmatic children. As a common belief, asthmatic children must perform no exercises as it may lead to EIA. This prohibits the patients from doing daily activities. Therefore, their physical fitness

decreases in comparison to the average of the society. In addition, patients without regular supervised exercise have no opportunity to increase their knowledge regarding the prevention of symptoms and possible asthma attacks.

4-1. Limitations of the study

The sample size decreased, because some patients withdrew during the study. Because the intervention of present study was home exercise, it was a concern that patients did not perform exercise properly.

5- CONCLUSION

According to present study, the mean of quality of life, fine and gross motor performance improved after aerobic exercises (in 8 weeks with St. George's respiratory questionnaire) in the asthmatic children. These results suggest that a selective exercise program is a useful complementary means for the treatment of asthmatic children.

6- CONFLICT OF INTEREST: None.

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