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ARAŞTIRMA RESEARCH ARTICLE

Effects of physical exercise on quality of life, pulmonary function and symptom score in children with asthma

Astımlı çocuklarda fizik egzersizin yaşam kalitesi, solunum fonksiyonları ve semptom skorlarına etkisi

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ABSTRACT

Objective: To evaluate the effects of regular exercise on asthma symptom score, quality of life and pulmonary function in asthmatic children.

Materials and Methods: Thirty children with newly diagnosed mild-moderate asthma (mean age 9.8 ± 1.78 years) were randomly allocated into exercise group (group 1) and control group (group 2). Both groups received inhaled fluticasone and montelukast treatment. Children in the exercise group were also included in an exercise training program. The program consisted of condition bicycle for one hour two times a week for 8 weeks. Pediatric Asthma Quality of Life Questionnaire (PAQLQ), a disease spesific quality of life questionnaire, and KINDL, a generic quality of life questionnaire, were used to assess health related quality of life in both groups. Spirometric tests were also performed and asthma symptom scores were recorded.

ÖZET

Amaç: Astımlı çocuklarda düzenli egzersizin yaşam kalitesi, akciğer fonksiyonu ve astım semptom skoruna etkilerini değerlendirmekti.

Gereç ve Yöntem: Yeni tanı almış hafif-orta astımlı (yaş ortalaması 9.8 ± 1.78 yıl) 30 çocuk gelişigüzel egzersiz (grup 1) ve kontrol grubuna (grup 2) ayrıldı. Her iki grup inhale flutikazon ve montelukast tedavisi aldı. Egzersiz grubundaki çocuklar ilave olarak egzersiz eğitim programına alındı. Egzersiz programı 8 hafta boyunca, haftada 2 kez, 1 saat süreyle kondisyon bisikleti ile yapıldı. Her iki grupta yaşam kalitesini ölçmek için bir hastalık spesifik yaşam kalite anketi olan "Pediatric Asthma Quality of Life Questionnaire (PAQLQ)" ve jenerik bir yaşam kalite anketi olan KINDL kullanıldı. Spirometrik testler yapıldı ve astım semptom skorları kaydedildi.

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Results: The degree of improvement in all scores of PAQLQ (total, activity, symptom, emotion) and symptom score in group 1 were significantly higher than those in group 2 in final evaluation, (p= 0.005, 0.000, 0.003, 0.009, respectively). Moreover, the scores of self-esteem and family subscales of KINDL in group 1 were significantly higher than those in group 2 (p= 0.047, 0.030, respectively). Although insignificant, the degree of improvement in pulmonary function values (FEV_1, FVC and FEV_1/FVC) in group 1 were higher than those group 2.

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Conclusion: Regular exercise added to conventional treatment in children with asthma significantly improves quality of life besides symptoms score.

Key words: Asthma, exercise, quality of life, symptom score

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Bulgular: Son değerlendirmede grup 1'deki PAQLQ' nün tüm skorları (total, aktivite, semptom, duygulanım) ve astım semptom skorundaki iyileşme düzeyi grup 2'ye göre anlamlı olarak daha yüksekti (p= 0.005, 0.000, 0.003, 0.009, sırasıyla). Ayrıca, grup 1'de KINDL'ye ait aile eve özgüven alt skorları grup 2'ye göre anlamlı olarak daha yüksekti (p= 0.047, 0.030, sırasıyla). Gruplar arasındaki fark anlamsız olmakla birlikte, grup 1'in akciğer fonksiyon testlerindeki (FEV_1, FVC ve FEV_1/FVC) iyileşme düzeyi grup 2'den daha fazla idi.

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Sonuç: Astımlı çocuklarda konvansiyonel tedaviye eklenen düzenli egzersiz hastaların yaşam kalitesini ve semptom skorlarını anlamlı olarak iyileştirmektedir.

Anahtar kelimeler: Astım, egzersiz, yaşam kalitesi, semptom skoru

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INTRODUCTION

Asthma is one of the most common chronic conditions seen in children throughout the world[1]. Asthmatic children show less tolerance to exercise because of shortness of breath, so-called exercise-induced bronchoconstruction, and restriction of activities secondary to medical advice or family influence[2]. Asthma has potential interference with society in terms of morbidity, quality of life (physical activity, education, socialization and self-esteem) and health care costs[3]. It has been reported that asthmatic children have significantly poorer health-related quality of life (QoL) than their healthy peers[4].

Evidence-based analysis identifies exercise training as the most effective part of pulmonary rehabilitation (PR) programs, which comprise multidisciplinary therapy with essential components such as assessment, patient education, exercise training, psychosocial intervention and follow-up[5-7]. These programs have been proven to increase functional capacity, decrease symptoms, especially dyspnea, reduce utilization of healthcare resources and, finally, improve QoL[5,7,8]. Both the American College of Sports Medicine (ACSM) and the American Thoracic Society (ATS) guidelines recommend exercise for patients with asthma. Exercise training is the key component to pulmonary rehabilitation[9,10]. The ACSM guidelines state that "current evidence suggests that the standard principles of exercise prescription (mode, frequency, intensity, and duration) can be applied to patients with respiratory diseases, including asthma". The recommended mode of aerobic exercise is walking or any mode of aerobic exercise with large muscles[9]. The British Thorax Society (BTS) also reports that physical aerobic training, particularly of the lower extremities (brisk walking or cycling) is mandatory and upper limb and strength-building exercises can also be included[8]. A few randomized controlled trials have searched the effects of physical training methods in children with asthma, but none of these concentrated on QoL[11]. Recently, Basaran et al. suggested that eight weeks of basketball training had beneficial effects on quality of life and exercise capacity in children with asthma[12].

The purpose of the present study was to investigate the effects of a regular bicycle training program on QoL, symptom score and pulmonary function in moderate asthmatic children.

MATERIAL and METHODS

The study was conducted at the outpatient clinic of the Department of Pediatric Allergy and Pulmonology Unit. The local ethics committee approved the study and written informed consent was obtained from all of the patients and their parents.

Subjects

Newly diagnosed thirty moderate asthmatic patients admitted to the Department of Pediatric Allergy and Pulmonology Unit for their follow-up visits were evaluated. The patients had been diagnosed with moderate asthma according to the guidelines of Global Initiative for Asthma (GINA)[13]. Children participating regularly in sport activitites or making exercises previously were not included in the study. The study population comprised 30 moderate asthmatic children (22 boys, 8 girls) with a mean age of 9.8±1.8 years (range 8-13 years). In this study sample selection was randomly arranged. Patients were divided into 2 groups, exercise (group 1, n= 15, 9 boys and 6 girls) and control (group 2, n= 15, 13 boys and 2 girls) group, according to admission order. Both groups received inhaled fluticasone and montelukast treatment. Children in the exercise group were also included in the exercise training program.

Baseline Assessment

Clinical and medical history was obtained from all subjects, followed by physical examination, spirometric tests and determination of symptom scores. To evaluate the quality of life in the patients Pediatric Asthma Quality of Life Questionnaire (PAQLQ) that is a disease specific QoL questionnaire and KINDL that is a generic QoL questionnaire were used. Most of the studies about QoL in asthma have evaluated PAQLQ that aims to evaluate QoL based on disease symptoms. We have added KINDL to PAQLQ in this study to evaluate parameters such as social life, school life and self esteem. Lung function was measured using a spirometer and the variables were expressed as percentage of predicted value. Asthma symptom scores were determined on a scale. Turkish validation of asthma symptom score was performed by Yuksel et al.[14]. It is a 6-item scale that reflects chronic asthma symptomatology (eg, shortness of breath, tightness in the chest, daytime wheezing, nocturnal wheezing, daily performance, and variability of peak expiratory flow). Scoring of the 1., 2., 3., 4., and 5. items are as 0,1,2,3 while that of the 6. item is as 0,1.

PAQLQ is a disease-specific questionnaire administered to evaluate health-related QoL of the asthmatic children. The interviewer-administered form of the questionnaire was used. The instrument includes 23 items in 3 domains; activity limitation, symptoms and emotional function. In the activity limitation domain, 3 of the items are individualized according to the activities that affected the patients most because of their asthma. Both the scores of 3 domains and the overall score range from 1 to 7 (1 indicates maximum impairment and 7 indicates no impairment). For PAQLQ, an average change in score of 0.5 per domain and for overall QoL has been shown to be the minimal clinically important difference[4,15,16].

KINDL, survey instrument was used to assess health related quality of life in children. This survey instrument is available for use with permission from developers[17]. This 24 item generic instrument has six subscales: physical functioning, emotional well-being, self-esteem, family, friends, and school. The response scale is from 1 (never) to 5 (all the time) and is based on a four week recall. The summary scores of the total and the six subscale KINDL subscales were computed and transformed (range: 0 lowest to 100 highest) using the algorithm provided by the developer. Higher scores indicate better health. The reliability and validity of the KINDL questionnaire was previously estimated among children with and without chronic illnesses, including diabetes, and was found to be satisfactory[18,19].

Exercise Program

Group 1 underwent an exercise training program. The exercise training program consisted of condition bicycle for 8 weeks. During the 8-week training program the sessions were performed 2 times a week (Monday and Wednesday) for one hour in each session.

Submaximal heart rate was calculated as the 50% increased basal heart rate. Target heart rate was calculated as 80% of the submaximal heart rate. Bicycling rate that corresponded to the target heart rate was determined via the aid of a pulseoximeter[20]. After 15 minutes of warm-up exercise, patients bicycled at the determined rate for 45 minutes. As a precaution for a possible asthmatic execerbation, patients were instructed to bring their medications with them. None of the patients experienced an execerbation during the exercise in the 8 week program.

Final Evaluation

After the 8-week period, spirometric tests, symptom scores, PAQLQ and KINDL were reassessed in both groups.

Statistical Analysis

Statistical analysis were performed by the SPSS 10.0 (Chicago, IL) computer program. Mann Whitney U test was used to determine the statistical significance of the difference between the two groups. Results were presented as mean (SD) and n (%). The level of statistical significance was set at $p< 0.05$.

RESULTS

Fifteen patients in group 1 and 15 patients in group 2 underwent final analysis at the end of the 8-week period. The exercise training program was well tolerated and completed by all of the children in group 1. No exercise induced bronchospasm was observed throughout the training sessions.

In the baseline evaluation, no significant differences in pulmonary function, quality of life and symptom scores were found between group 1 and group 2 ($p> 0.05$) (Table 1).

In final evaluation, when we compared two groups after the 8-week period, the degree of

Table 1. Baseline evaluation of parameters in groups 1 and 2

	Group 1 (preexercise + medical treatment) Mean rank	Group 2 (premedical treatment) Mean rank	p
PAQLQ total	15.60	15.40	0.950
PAQLQ activity	16.27	14.73	0.630
PAQLQ symptom	15.13	15.87	0.819
PAQLQ emotion	15.37	15.63	0.937
KINDL total	17.97	13.0	0.124
KINDL physical functioning	16.00	15.00	0.743
KINDL emotional well-being	16.60	14.40	0.486
KINDL self-esteem	17.93	13.07	0.108
KINDL family	18.50	12.50	0.058
KINDL friends	16.63	14.37	0.472
KINDL school	17.47	13.53	0.210
Symptom score	18.17	12.83	0.095
FEV_1	16.00	15.00	0.755
FVC	14.80	16.20	0.662
FEV_1/FVC	16.10	14.90	0.708
PEF	13.60	17.40	0.237

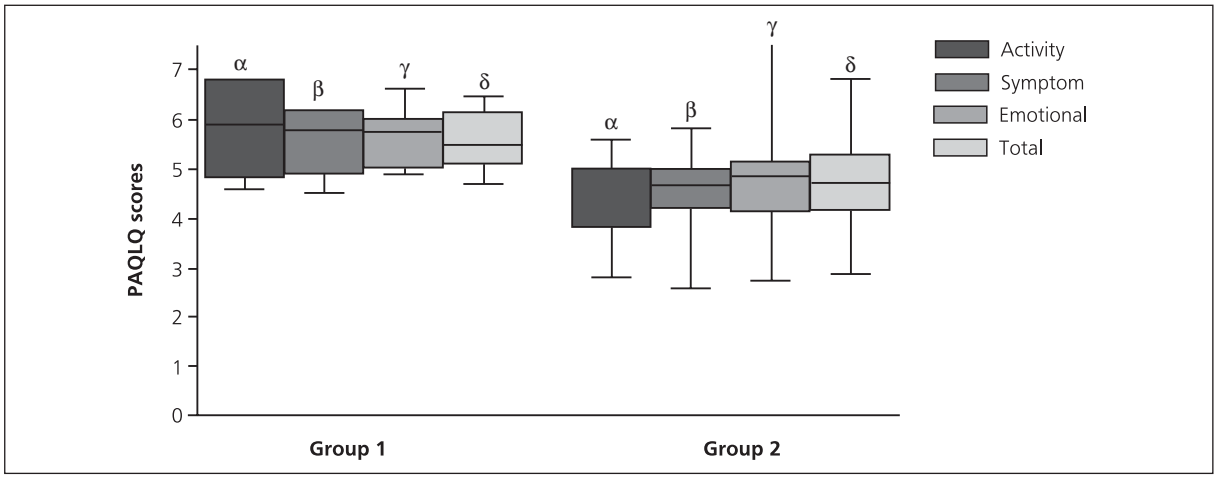

Figure 1. Differences for total, activity, symptom and emotional scores of Pediatric Asthma Quality of Life Questionnaire (PAQLQ) of group 1 and group 2 in final evaluation (Group 1: exercise + medical treatment, group 2: medical treatment). The differences are significant for all scores in group 1 and group 2 ($^{\alpha}$p = 0.02; $^{\beta}$p= 0.001; $^{\gamma}$p=0.02; $^{\delta}$p= 0.004).

improvement in all scores of PAQLQ (total, activity, symptom, emotion) in group 1 was significantly higher than those in group 2 (p= 0.005, 0.000, 0.003, 0.009, respectively) (Figure 1). The scores of self-esteem and family subscales in KINDL in group 1 were significantly higher than those in group 2 (p= 0.047, 0.030, respectively). Also, the degree of improvement in symptom scores in group 1 was significantly higher than those in group 2 (p= 0.001) (Figure 2). Although pulmonary function values (FEV_1, FVC and FEV_1/FVC) in group 1 were higher than those in group 2, the comparison of pulmonary function values between the two groups revealed no statistically significant difference at the final evaluation (p> 0.05) (Table 2).

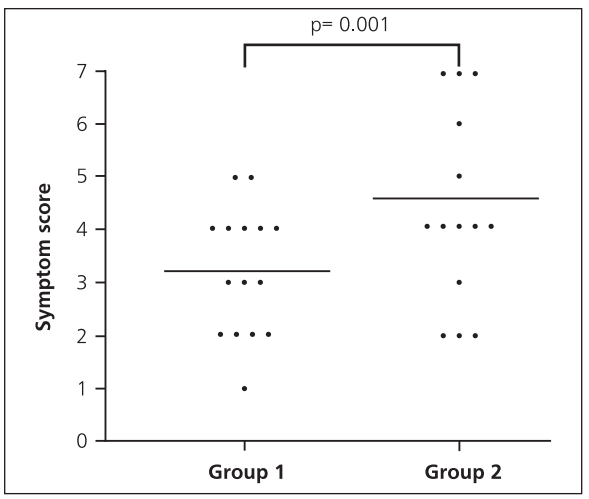

Figure 2. Symptom scores of group1 and 2 in final evaluation.

DISCUSSION

Physical training programmes have been designed for patients with asthma with the aim of improving physical fitness, neuromuscular coordination, and self confidence. Subjectively, many patients report that they are symptomatically better when fit, but the physiological basis of this perception has not been systematically investigated. A possible mechanism is that an increase in regular physical activity of sufficient intensity to increase aerobic fitness will raise the ventilatory threshold, thereby lowering the minute ventilation during mild and moderate exercise. Consequently breathlessness and the likelihood of provoking exercise induced asthma will both be reduced. Exercise training may also reduce the perception of breathlessness through other mechanisms including strengthening of the respiratory muscles[11].

There are reviews of controlled trials on the benefits of exercise training in asthmatic patients in adults[21-24]. In review of 48 articles on exercise training for patients with asthma, Satta highlighted the health benefits of exercise

Table 2. Final evaluation of parameters in group 1 and 2 at the end of 8 weeks

	Group 1 (exercise + medical treatment) Mean rank	Group 2 (medical treatment) Mean rank	p
PAQLQ total	20.03	10.97	**0.005**
PAQLQ activity	21.13	9.87	**0.000**
PAQLQ symptom	20.0	10.80	**0.003**
PAQLQ emotion	19.70	11.30	**0.009**
KINDL total	17.77	13.23	0.15
KINDL physical functioning	16.13	14.87	0.688
KINDL emotional well-being	18.03	12.97	0.111
KINDL self-esteem	18.63	12.37	**0.047**
KINDL family	18.90	12.10	0.030
KINDL friends	17.20	13.80	0.263
KINDL school	18.10	12.90	0.093
Symptom score	12.53	18.47	**0.001**
FEV_1	18.50	12.50	0.062
FVC	16.80	14.20	0.418
FEV_1/FVC	15.60	15.40	0.950
PEF	13.50	17.50	0.212

training on asthmatic subjects, including improved fitness level and quality of life[25]. He also highlighted positive outcomes, including reductions in the need for medications, fewer visits to the emergency department, decreased exercise-related fear and anxiety, and less absenteeism from school. Matsumoto et al. found that a six week swimming training programme has a beneficial effect on aerobic capacity but not on histamine responsiveness in children with asthma[26]. In metaanalysis of Ram et al., eighteen randomised controlled trials of physical training of patients with asthma were identified in the literature covering the years 1966 to 1999[11]. Eight of these trials met the inclusion criteria: objective asthma diagnosis, age (> 8 years), and at least 20 minutes whole body exercise on two or more times a week for a minimum of four weeks. The outcomes of interest, resting lung function, asthma state, and cardiorespiratory fitness, were subjected to a meta-analysis. Physical training resulted in a significant increase in cardiorespiratory fitness as measured by an increase in the V_{O2MAX}. Work capacity was also significantly increased in one of these studies. There was no effect of physical training on resting lung function. No data were available on measures of quality of life.

Childhood asthma contributes significantly to morbidity among children and has a significant impact on the QoL and daily routines of both the children and their parents[27]. Bingol et al. also demonstrated that children with asthma had improved quality of life after the daily pulmonary rehabilitation at home[28]. There are limited studies that evaluate the influence of physical exercise on OoL. Basaran et al. had reported that quality of life and exercise capacity improved after regular submaximal basketball training in asthmatic children[12]. In their study, although significant effects of the interventions were found on the overall PAQLQ scores and on each domain scores within each group, the degree of improvement in

exercise group was significantly higher than in control group. We evaluated QoL by disease specific questionnaire as known PAQLQ and generic questionnaire known as KINDL. We revealed that regular physical exercise training by bicycle in astmatic children could improve the QoL. We observed that improvements in PAQLQ domain scores (total, activity limitation, symptom, emotional function) and family and self-esteem domain scores of KINDL in exercise group were higher than those in control group.

Pulmonary rehabilitation program had both physiological and psychological beneficial effects on patients with chronic obstructive pulmonary diseases. Field et al. also had demonstrated that children with asthma had improved pulmonary function after the daily relaxation and massage therapy[29]. Bingol et al. also found pulmonary rehabilitation at home could improve pulmonary functions[28]. In Satta's literature review about exercise training on asthmatic subjects, some studies have documented improvement in spirometry (decreased peak flow variability and increased FEV_1), whereas others did not[25]. Basaran et al. demonstrated the intervention had no significant effect on pulmonary functions except a significant improvement in peak expiratory flow (PEF) values in the exercise group. However, the comparison of PEF values between groups revealed no significant difference at the final evaluation[12]. In our study, although pulmonary function values (FEV_1, FVC and FEV_1/FVC) in group 1 were higher than those in group 2, the comparison of pulmonary function values between two groups revealed no statistically significant difference at the final evaluation ($p > 0.05$).

Basaran et al. reported that significant improvement in symptom scores was observed at the final evaluation indicating a better health status despite higher baseline mean symptom score in exercise group. No significant improvement was detected in symptom scores of the control group[12]. We also found improvement in symptom scores of exercise group were significantly higher in final evaluation. Improvement in symptom score and quality of life is the main goal of asthma treatment. Convention reports since 2006 has recommended control-based follow-up planning[13]. For this reason improvement in symptom scores regardless of pulmonary function tests is a rational outcome.

In this study, we found no significant correlations between QoL and pulmonary functions and symptom scores. Similar to our results Basaran et al. had reported that they observed no significant correlations between QoL and other variables such as exercise capacity, pulmonary functions, duration of disease, socioeconomic variables and symptom scores. In their study, change in symptom scores was the only parameter to correlate significantly with the change in total QoL scores[12].

In conclusion, our results show that physical exercise training by bycycle in asthmatic children has beneficial effects on QoL and symptom scores. Further researchs using larger samples are needed to confirm these findings and to assess the duration of the training induced beneficial effects in treatment requirements, the effectiveness of long term aerobic exercise, the response to submaximal protocols and, finally, to determine which profile of childhood asthma is likely to respond to exercise therapy.

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