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Evaluation of a Home-Based Pulmonary Rehabilitation Program for Older Females Suffering from Bronchial Asthma

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;
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Abstract

Background. Asthma is a disease that affects people of all ages worldwide.

Objectives. The aim of the study was to evaluate the effectiveness of a home-based pulmonary rehabilitation program, with one supervised session a week, for improvement of respiratory function, inspiratory muscle strength and physical fitness in older women suffering from asthma.

Material and Methods. The study involved 10 female patients (mean age 70.8) with diagnosed bronchial asthma in the slight and moderate stage. Before the program started, all the patients were in a stable phase of the disease. All the patients carried out a respiratory function test based on measurement of the flow/volume loop assessing FVC, FEV1, FEV1/FVC, PEF, MEF50 and MEF25/75. An inspiratory muscle strength test (PImax) was also performed. Agility was assessed by the Fullerton Functional Fitness test, which consists of sitting down on/standing up from a chair, bicep curls with weights, upper and lower body flexibility trials, a complex coordination trial and a six minute walk test (6MWT) to assess the patients' exercise capacity. To evaluate health-related quality of life, the Saint George Respiratory Questionnaire (SGRQ) was completed, and the Hospital Anxiety and Depression Scale was used to diagnose any signs of anxiety or depression. The main part of the program consisted of eight two-minute whole body exercises separated by one-minute intervals. Statistical significance was determined by the Wilcoxon test.

Results. Almost all the respiratory function parameters, PImax, exercise tolerance, lower body flexibility trial and 6MWT improved significantly after following the program for eight weeks. Among the parameters measured by the questionnaires and scales, only the component of the SGRQ related to symptoms of the disease has significantly improved.

Conclusions. The home-based pulmonary rehabilitation program significantly improved all respiratory function parameters. The patients' PImax scores also significantly improved. Among the physical fitness parameters, the 6MWT and lower body flexibility trials significantly improved. The home-based pulmonary rehabilitation program can be used effectively in patients suffering from bronchial asthma (*Adv Clin Exp Med* 2015, 24, 6, 1079–1083).

Key words: asthma, pulmonary rehabilitation, home-based program.

Asthma is a serious global health issue that affects people of all ages in countries throughout the world. This chronic airway disorder, when it is not controlled properly, can cause many limitations in daily living and can sometimes be fatal [1]. The increasing prevalence of asthma is a significant burden, not only in terms of health care costs, but also in terms of lost productivity and reduced participation in family life. It is estimated that there are

about 300 million affected individuals worldwide, ranging from 1% to 18% of the population in different countries [1].

The Global Initiative for Asthma (GINA) describes asthma as a chronic inflammatory disorder of the airways in which reversible airflow obstruction plays a major role. The main symptoms are wheezing, breathlessness, chest tightness and coughing, particularly at night or in the early morning. [1].

Many studies have shown that exercise training improves the quality of life, exercise capacity, muscle strength and breathing pattern in elderly individuals [2]. Exercise programs designed for asthmatic patients have a beneficial impact on their physical, physiological, and psychological parameters as well as on their social and personal relationships [3]. However, these interventions have not involved asthmatic senior women [4].

The aim of this study was to evaluate the effectiveness of a home-based pulmonary rehabilitation program, with one supervised session a week, in improving respiratory function, inspiratory muscle strength and physical fitness in older women suffering from asthma.

Material and Methods

Out of 11 female patients who were enrolled in the study, only 10 patients (mean age 70.8; mean BMI 26.4) were able to finish the program. All the women were students at the University of the Third Age in Wroclaw, Poland, and all of them suffered from diagnosed asthma at the slight or moderate stage. Before the program started, all the patients were in a stable phase of the disease. Medical supervision was provided during all the supervised training sessions. The patients were instructed to use a beta2-agonist inhaler before each supervised and home-based session.

The participants' exercise capacity and health-related quality of life (HRQoL) were evaluated before and after the program.

HRQoL was evaluated by the Polish version of the Saint George Respiratory Questionnaire (SGRQ), a disease-specific questionnaire designed to measure HRQoL in patients with chronic lung diseases. It consists of 17 questions divided into three categories: symptoms (wheeze, cough, and dyspnea), Activities that are limited by the disease, and Impact on the respondent's social life and mental state. The scores range from 0 to 100, and lower values indicate better health status [5].

To evaluate dyspnea, a modified 10-point Borg Scale of Perceived Exertion and the Medical Research Council (MRC) scale were used. The modified 10-point Borg Scale was used to assess both rest and exercise shortness of breath. This scale consists of numbers from 0 to 10 and a higher value indicates more severe dyspnea [6].

In chronic lung diseases, adequate monitoring of patients' mental state is crucial, because their dyspnea and deteriorating health condition can be a cause of anxiety and depression. To detect any signs of emotional disturbance, the Hospital Anxiety and Depression Scale (HADS) was used.

It consists of seven questions concerning anxiety and seven questions concerning depression [7]. Each question ranges from 0 to 3 points; a score up to 7 points indicates a normal mental state; a score between 8 and 10 points may be an indicator of possible mental deterioration; and results from 11 to 21 are a sign of anxiety or depression [7].

Another important factor concerning patients with chronic lung diseases is spirometric monitoring and assessment of inspiratory muscle force (P_Imax). All of these parameters were measured using a Jaeger Flowscreen Pro spirometer (Jaeger, Germany) according to the guidelines proposed by the European Respiratory Society [8].

To determine the fitness level of each individual, the Fullerton Fitness Test was used, which consists of following trials: a 30-s chair-to-stand test, a 30-s bicep-curl test with 5-pound (2.27 kg) weights, a chair sit-and-reach test, a back scratch test and an 8-foot (2.44 m) up-and-go test [9]. Due to the participants' good overall physical condition a 6-min walk test (6MWT) was performed to assess exercise capacity instead of a 2-min step test. The 6MWT is the most commonly performed and cited test for respiratory and cardiovascular patients [10]. It was performed in a 30-m corridor.

The data were analyzed using the STATISTICA 9.0 program (StatSoft Inc., USA). Statistical significance ($p < 0.05$) was determined by the Wilcoxon rank sum test.

Rehabilitation Protocol

The patients were enrolled in an 8-week pulmonary rehabilitation program consisting of 2 home sessions and 1 supervised session per week. Each training session began with a 5-min warm-up that engaged all the main muscle groups of the body.

The main training included eight exercises, each of them lasting 2 min and separated by 1-min intervals. Patients counted the number of repetitions and noted them down in a notebook integrated with a training manual. At the end a 5-min stretching exercise followed by abdominal breathing was performed. Table 1 shows the exercises constituting the main part of the training sessions.

Results

Almost all of the spirometric parameters, as well as P_Imax, significantly improved after the rehabilitation program. Only the component of the SGRQ concerning symptoms of the disease showed significant amelioration; none of the other parameters of the SGRQ or the HADS showed

Table 1. The exercises constituting the main part of the training sessions

Item No.	Exercise	Comments
1	march in place	whole body exercise, knees highly elevated, arms swinging
2	wall push-ups	triceps, pectoralis muscles
3	sit-to-stand	quadriceps muscles
4	bicep curls with weights	weight = 0.5-L bottle of water
5	heel elevation	calf muscles
6	arm abduction with weight	weight = 0.5-L bottle of water
7	hip extension	gluteus and hamstring muscles
8	march in place	whole body exercise, knees highly elevated, arms swinging

Table 2. The participants' results before and after the eight-week program

Parameter	Before program	After program	P
SGRQ Total	29.138	26.078	0.508
SGRQ S	43.705	30.297	0.047
SGRQ A	35.622	39.036	0.169
SGRQ I	21.991	17.488	0.445
HADS A	8.1	6.7	0.285
HADS D	5.3	4.6	0.447
MRC	2	1.6	0.068
FVC (forced vital capacity)	1.876	2.547	0.011
FEV1 (forced expiratory volume in 1 sec)	1.480	1.889	0.021
FEV1/FVC	0.71760	0.71811	0.678
PEF (peak expiratory flow)	2.959	4.270	0.008
MEF 50 (maximal expiratory flow at 50% of FVC)	1.502	2.023	0.008
MEF 25 (maximal expiratory flow at 25% of FVC)	0.333	0.592	0.008
MMEF 25/75 (maximal mid-expiratory flow between 25% and 75% of FVC)	1.060	1.467	0.021
PIMax	3.704	4.721	0.5
6MWT	543.1	580.3	0.028
30-s sit-to-stand	16.3	17.6	0.314
30-s bicep curls with 5-lb (2.27 kg) weight	11.7	13.3	0.193
Chair sit-and-reach	1.55	5.6	0.021
Back scratch	-4.9	-4.3	0.624
8-foot (2.44 m) up-and-go	5.9	5.9	0.799

significant change. Among the components of the Fullerton Fitness Test, the chair sit-and-reach and the 6MWT significantly improved; the mean

distance of the 6MWT was prolonged by over 36 m. Table 2 shows the participants' results before and after the program.

Discussion

Nowadays asthma treatment for the elderly is mainly limited to pharmacological treatment aimed at controlling the symptoms and bronchial inflammation caused by this disease, while other therapeutic approaches to controlling asthma have been neglected [11, 12]. Only a few studies based on physical exercise and breathing training have been carried out. There have been more studies associated with other chronic lung diseases, like chronic obstructive pulmonary disease (COPD). There are also many studies concerning physical training in adolescents and young adults suffering from asthma [13–20].

Both Lake et al. and Kamahara et al. have demonstrated that a properly designed pulmonary rehabilitation program based on circuit training can be an effective tool in improving exercise capacity and HRQoL [21, 22]. Moreover in the guidelines published by the American Thoracic Society and European Respiratory Society it is stated that a home-based pulmonary rehabilitation program can be administered as long as it is supervised once a week [23]. All these criteria have been met in the present study.

This study attempted to demonstrate that complicated and expensive training programs based on cycloergometers or treadmills, usually performed in special venues, are not the only way to improve participants' general physio-psychological condition. To carry out all the exercises prescribed in the training protocol, the patients were asked to prepare only a chair, four square meters of free space and one 0.5-L plastic bottle of water as a weight. In addition to the simplicity of these requirements, the appeal of staying at home is even greater in the winter season, when this program took place, since asthmatic patients are more likely to suffer from exacerbations in the winter.

Gomieiro et al. proposed a twice-a-week rehabilitation program, lasting 16 weeks, based on deep breathing. Each of the exercises was focused on stretching and strengthening the skeletal muscles of the thorax and abdomen and was combined with abdominal breathing and pursed-lip

expiration [4]. After this program, significant improvements in both inspiratory and expiratory muscle force (PI_{max} and PE_{max}) were observed. Considerable improvement in the quality of life was demonstrated, as well as a reduction of asthma-related symptoms, physical impairment in daily activities, the use of rescue medication and the frequency of nocturnal waking.

Emtner et al. decided to use a 10-week exercise program in a swimming pool [24]. There are many similarities between their exercise protocol and the one used in the present study. The training sessions started with a 12-min warm-up, and continued with interval training, comprising five 2-min periods of intensive repetitive exercise that engaged the large muscle groups, separated by 1.5-min periods of mild exercises (total 16 min). A cooling-down period (7 min) and stretching exercises (10 min) in the pool completed each 45-min session [24]. After this program an average improvement of 111 m in a 12-min walking test was observed, as well as a decreased heart rate at the same load on the cycloergometer (average of 12 beats/min). Many spirometrical results were significantly ameliorated, including FEV₁, MEF 25 and PEF. After 10 weeks the patients had fewer symptoms of exercise-induced asthma, they were less afraid of experiencing breathlessness during exercise and less anxious about exercising at a high intensity ($p < 0.05$). The interesting thing is that another study carried out by the same scientists two years later, comparing interval training in a swimming pool with interval training on land, showed that each type of indoor training, either on land or in water, is beneficial [25]. The effects of these two forms of training were almost equivalent [25].

The authors concluded that home-based pulmonary rehabilitation program significantly improved almost all the respiratory function parameters. The participants' PI_{max} significantly improved. Among the parameters that concerned physical fitness, the participants' 6MWT and lower body flexibility trial scores significantly improved. The home-based pulmonary rehabilitation program can be used effectively in women suffering from bronchial asthma.

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