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Effects of low-intensity exercise and home-based pulmonary rehabilitation with pedometer feedback on physical activity in elderly patients with chronic obstructive pulmonary disease

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KEYWORDS

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Summary

Purpose: We evaluated the effects of low-intensity and home-based pulmonary rehabilitation (PR) on physical activity (PA) and the feedback provided by a pedometer in stable elderly patients with chronic obstructive pulmonary disease (COPD).

Methods: We assessed PA using a newly developed triaxial accelerometer (A-MES™, Kumamoto, Japan), which measures the time spent walking, standing, sitting and lying down. Twenty-seven elderly patients with COPD (age 74 ± 8 yrs; %FEV₁ $56.6 \pm 18.7\%$) participated. They were randomly selected to undergo PR (pulmonary rehabilitation only) or PR + P (PR plus the feedback from using a pedometer). Their PA and pulmonary function, exercise capacity (6-min walking distance; 6MWD), quadriceps femoris muscle force (QF) were evaluated before the PR began (baseline) and at 1 year later. We compared the patients' changes in PA and other factors between the baseline values and those obtained 1 year later and analyzed the

Abbreviations: COPD, chronic obstructive pulmonary disease; PR, pulmonary rehabilitation; PA, physical activity; A-MES™, Activity Monitoring and Evaluation System™; GOLD, global initiative for chronic obstructive lung disease; 6MWD, 6 min walking distance; FVC, forced vital capacity; FEV₁, forced expiratory volume in one second; QF, quadriceps femoris muscle force; ERS, European Respiratory Society; ATS, American Thoracic Society; MRC, Medical Research Council; QOL, quality of life; CRQ, chronic respiratory disease questionnaire; BODE, body-mass index, airflow obstruction, dyspnea, and exercise capacity.

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relationships between the changes in PA and other factors in the both groups.

Results: The increase in the time spent walking in the PR + P group (51.3 ± 63.7 min/day) was significantly greater than that of PR group (12.3 ± 25.5 min/day) after the PR. The improvement rate of daily walking time after PR was significantly correlated with that of the 6MWD and QF in all subjects.

Conclusions: These data suggest that low-intensity and home-based PR with the feedback from using pedometer was effective in improving PA, and the improvements of physiological factors were correlated with increased walking time in stable elderly patients with COPD.

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Introduction

The progress of chronic obstructive pulmonary disease (COPD) causes breathlessness, disability, and frequent hospitalization, and is associated with a reduction in physical activity (PA). It is known that the level of PA is an independent prognostic factor for mortality and hospitalization due to the severe exacerbation of COPD [1]. The primary goal of pulmonary rehabilitation (PR) has been to break the downward spiral of breathlessness, disability and inactivity that leads to deconditioning. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) guideline states that PA is recommended for all patients with COPD to improve their exercise capacity and decrease their dyspnea and fatigue [2].

The previous studies and guideline note that PR is beneficial for COPD patients as it improves exercise capacity, muscle force, symptoms, and health-related quality of life [2,3]. However, it has been reported that various types of PR had little or no effect on PA in COPD patients [4]. The evidence that increased PA is achieved through participation in PR is inconclusive. Some studies reported that PR had the immediate effect of increasing PA, but no long-term effects that could maintain the subjects' PA [5,6]. Agarwal et al. proposed that a longitudinal exercise program in addition to PR may be required for COPD patients [7].

These studies also suggested that alternative methods that affect behavior to increase daily physical activity are needed [8,9]. For example, bimonthly phone calls to subjects to provide motivational support for improving their activity were tested [8]. The effect of a counseling program with feedback from a pedometer during PR was shown to improve the patients' outcome and maintenance of rehabilitation [9]. A PR program we devised consists of home-based exercise at low intensity, nutrition counseling and weekly education sessions; we found that this program improves the participants' exercise capacity and other health status factors [10,11]. This program has been used for COPD patients who can come to our hospital. It may be effective for maintaining their conditioning, including physical activity.

Pedometers are easy to use and have been found to enhance PA and contribute to the maintenance of PA as a feedback tool [9,12]. Thus, the objective of the present study was to evaluate the effect of our PR program over a long term with or without the feedback of daily pedometer use by patients with COPD.

Methods

Subjects and study design

Forty-two patients who were diagnosed with stable COPD from mild to very severe stage (GOLD) [13] were enrolled in the present study. The patients were all retired. The inclusion criteria for this study were: (1) the patient was in stable condition with no infection or exacerbation of COPD for at least the prior 3 months; (2) the patient was able to walk unassisted and operate the device to measure their PA; (3) the patient had no severe and/or unstable cardiac disease, orthopedic disease, or mental disorder that could impair physical activities in daily life. The objective and content of the study were orally explained to the participants, with additional documents. Written consent was obtained after all patients were informed that they could decide whether or not to participate based on their own free will and that their privacy would be sufficiently considered.

The trial design was a prospective, randomized, controlled trial (Fig. 1). The patients were randomly assigned to one of two groups: the PR (pulmonary rehabilitation only) or PR + P (Pulmonary rehabilitation and feedback from using a pedometer) group. Patients were not blinded to the randomization. This study followed the COPD patients from baseline before the PR to 1 year later. The assessments of physical activity in daily life, pulmonary function, submaximal exercise capacity (6MWD; six-minute walk distance), respiratory and quadriceps muscle force, functional status, and health-related quality of life were done at baseline before the PR and 1 year from the baseline.

This study was reviewed and approved by the Ethics Committees of our hospital and the Akita University Graduate School of Medicine, and carried out in conformity with the Declaration of Helsinki, 2008 [14].

Intervention

PR group (pulmonary rehabilitation only)

Our PR program is a multidisciplinary home-based program. Breathing retraining consisted of pursed-lip breathing, diaphragmatic breathing, and slow-deep breathing, in both the supine and sitting positions. Exercise training included upper and lower limb exercises including COPD sitting calisthenics [10], respiratory muscle stretching calisthenics [15], level walking for at least 15 min, and inspiratory

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