



Original Article

Effects of expiratory muscle training on the frail elderly's respiratory function

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Abstract. [Purpose] The present study examined the effects of expiratory muscle training on elderly day care service users, who had been classified into Care Grades 1 and 2 based on Japan's long-term care insurance system. [Subjects and Methods] Intervention was provided for 29 Care Grade 1 or 2 day care service users. During intervention, expiratory muscle training was performed by slowly expiring using the abdominal muscles and a device after maximal inspiration. Each intervention session lasted for approximately 10 minutes, and 2 sessions were held weekly for 3 months to compare respiratory function test values before and after intervention. [Results] The results were favorable. The vital capacity (VC) and peak expiratory flow (PEF) significantly varied between before and after intervention. [Conclusion] Expiratory muscle training generally improved their respiratory function, particularly their VC and PEF that significantly varied between before and after intervention. As both of these items influence the cough capacity, they may be key to the prevention of aspiration pneumonia. Expiratory muscle training may also contribute to activities of daily living (ADL) and the quality of life, and it is expected to play an important role in rehabilitation as a field of preventive medicine.

Key words: Frail elderly, Respiratory function, Expiratory muscle training

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INTRODUCTION

In Japan's super-aging society, caring for the elderly is a serious issue, and the importance of maintaining/promoting their activities of daily living (ADL) while preventing their physical function from declining is increasing. Community-based facilities providing outpatient care services (day care services) are also facing the challenge of adopting effective measures for such prevention.

These measures for the elderly include expiratory muscle training to prevent aspiration pneumonia¹⁾. The present study examined the effects of expiratory muscle training on elderly day care service users, who had been classified into Care Grades 1 and 2 based on Japan's long-term care insurance system.

SUBJECTS AND METHODS

Intervention was provided for 29 Care Grade 1 or 2 day care service users (Table 1). The exclusion criteria were as follows: 1) those with serious heart disease, 2) those with a history of pneumothorax, 3) those with impaired comprehension and a score of 20 or lower on the Revised Hasegawa Dementia Scale as a cognitive function test, and 4) those who did not consent. In addition, those who showed signs of infection during the training period and those who became unable to continuously participate in training withdrew from the study.

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During intervention, expiratory muscle training was performed by slowly expiring using the abdominal muscles and a device after maximal inspiration. This device resists expiratory. The expiratory muscle training device (Threshold PEP; CHEST M. I., Inc., Japan) used for training is compact, light, and easy to use, as it is only necessary to hold it in the mouth when expiring. The loading level was set at 60% or lower of the maximum permissible pressure in each case. Each intervention session lasted for approximately 10 minutes, and 2 sessions were held weekly for 3 months to compare test values before and after intervention.

The respiratory function test was conducted using an electronic spirometer (Multifunctional Spirometer HI-801; Nihon Kohden Corporation) to measure basic items, in addition to the maximal expiratory muscle strength.

For statistical analysis, the Wilcoxon signed rank sum test was used to evaluate the users' respiratory function before and after intervention. SPSS Statistics Ver. 20 was also used, with the significance level set at <5% of the risk rate.

The study was approved by the Ethics Committee of Kan-etsu Chu-oh Hospital (approval number: 20160516). Furthermore, the patients were previously provided with oral and written explanations of the study outline to obtain their consent.

RESULTS

The results were favorable. The vital capacity (VC) and peak expiratory flow (PEF) significantly varied between before and after intervention. On examining the effect size, there were small effects on the VC, forced expiratory volume in 1 second (FEV_{1.0}), and PEF (Table 2).

DISCUSSION

Regarding safety management, the elderly are frequently subject to circulatory/respiratory dysfunction and complications, such as nerve system, bone, and joint diseases. Therefore, medical checks or other appropriate safety confirmation processes should be performed before starting muscle strength training or rehabilitation. Outpatient care facilities need to consider its influences on their users' circulatory/respiratory function when providing it.

In the case of care-dependent individuals, it is important to prevent their expiratory muscle strength from decreasing. In a study involving healthy individuals and Chronic Obstructive Pulmonary Disease (COPD) patients, expiratory muscle training improved their respiratory function related to the expiratory flow rate²⁾, while such changes were not observed in another study³⁾. Kim et al.⁴⁾ provided expiratory muscle training for a healthy elderly group, and reported that their maximal expiratory muscle strength increased.

Table 1. Background of the subjects

Number	29
Age (years)	79.1 (65–92)
Height (m)	1.54 ± 0.10
Weight (kg)	53.4 ± 11.6
BMI (kg/m ²)	22.2 ± 3.83

BMI: body mass index.

Table 2. Pre- and post-intervention results

	Pre	Post	p-value	Effect size (Δ)
VC (l)	1.74 ± 0.58	1.96 ± 0.69	0.014*	0.38
%VC (%)	67.5 ± 13.8	72.4 ± 23.7	0.102	0.36
FEV _{1.0} (l)	1.01 ± 0.31	1.13 ± 0.33	0.49	0.38
%FEV _{1.0} (%)	54.8 ± 17.6	59.6 ± 19.8	0.12	0.27
FEV _{1.0} % (%)	64.7 ± 15.3	67.6 ± 13.8	0.26	0.18
PEF (l/s)	1.57 ± 0.66	1.81 ± 0.71	0.03*	0.36
PE max (cmH ₂ O)	42.9 ± 30.2	42.0 ± 20.1	0.59	-0.03

Mean ± SD. *p<0.05.

VC: vital capacity; %VC: % predicted VC; FEV_{1.0}: forced expiratory volume in 1 second; %FEV_{1.0}: % predicted FEV_{1.0}; FEV_{1.0}%: forced expiratory volume in 1 second percent; PEF: peak expiratory flow; PE_{max}: peak expiratory pressure maximum.

Effect size:

|0.20|≤Small<|0.50|.

|0.50|<Medium<|0.80|.

|0.80|≤Large.

The age of the elderly involved in the present study was similar to that of this group, but the former were care-dependent, and their activity levels were reduced. However, expiratory muscle training generally improved their respiratory function. This result seems to be due to improvement of chest expansion and increase of expiratory muscle activity, particularly their VC and PEF that significantly varied between before and after intervention. As both of these items influence the cough capacity, they may be key to the prevention of aspiration pneumonia.

Expiratory muscle training may be useful for all facilities providing conventional exercise programs for their users, represented by outpatient and home-visit rehabilitation centers, as well as health-promoting exercise classes for care prevention. As such training may also contribute to ADL and the quality of life, it is expected to play an important role in rehabilitation as a field of preventive medicine.

Conflict of interest

The authors declare no conflict of interest.

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