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The Study on Respiratory Function, Spirometric Lung Pattern and Fatigue of Elderly in a Facility

The purpose of this study was to investigate spirometric lung pattern, respiratory function and degree of fatigue by lung function tests and fatigue tests of 39 elderly people in a care facility aged 65 and over. The respiratory function tests were used to the Spirovit SP-1 and fatigue tests were used modified Piper fatigue scale(mPFS). Regarding the respiratory function, the FVC was 1.41±0.36ℓ, the FVC % predicted was 69.10±14.98%, the FEV_1 was 1.02±0.31ℓ, the FEV_1 % predicted was 63.27±16.05%, the FEV_1/FVC was 72.77±13.40%, and the fatigue score was 5.83±1.09. As for the spirometric lung pattern, 19 patients had a restrictive pattern(48.7%), followed by 11 with a mixed pattern(28.2%), 5 with an obstructive pattern(12.8%), and 4 with a normal pattern(10.3%). Regarding the respiratory function and fatigue by spirometric lung pattern, the FVC and the FVC % predicted of patients with a normal pattern or an obstructive pattern were greater than other groups at a statistically significant level. As for the FEV_1, that of patients with a normal pattern was significantly higher than others, and for the FEV_1 % predicted, that of patients with a normal pattern or a restrictive pattern was significantly higher($p<.001$). Fatigue score by patients with a normal pattern was significantly less than patients of other patterns($p<.001$). Therefore, pulmonary physical therapy is considered necessary to improve respiratory function and fatigue degradation of elderly in a facility.

Key words: *Respiratory Function; Fatigue; Elderly; FVC; FEV1*

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INTRODUCTION

In Korea, the proportion of elderly population (age 65 and over) was 7.2% in 2000 and 10.3% in 2008, and the country is well into an aging society, which is defined by a ratio of elderly population over 7%. In 2008, the proportion is expected to reach 14.3%, entering an aged society (threshold rate of 14%), and 20.8% by 2026 to be a super aged society (20% and over)(1). Demands for medical service would rise sharply amid an increasing life expectancy and the rapidly growing elderly population.

In Korea, there were 543 elderly care facilities in 2005, combining free and fee-charging facilities. The number is on the rise (1,332 in 2008 and 2,016 in 2009)(2).

As the population grows older, people' s respiratory system undergoes changes: increase in peripheral pulmonary alveoli due to declining elastic tissue around alveolar and alveolar duct, imbalance in ventilation-perfusion, and shrinking area per unit lung volume. Chest wall grows stiffer and respiratory muscles weaken due to osteoporosis in the rib, calcification of the costal cartilage, and a greater diameter of the thorax.

From age 55 and onward, both inspiratory and expiratory pressures decline, as well as endurance of respiratory muscles(3). If a person has illness such as pneumonia, the pace would be quickened and physical functions will deteriorate, increasing prevalence and mortality of the elderly(4).

Based on a respiratory function test, the patterns can be divided into a normal, a restrictive, an obstructive, and a mixed pattern. Typically, a lung demonstrates more than one pattern(5).

Fatigue is a frequently reported symptom by patients with a chronic obstructive pulmonary disease or with other chronic diseases. It is a subjective perception of general sense of tiredness, exhaustion and depletion of energy(6).

Patients with a chronic lung disease display symptoms of dyspnea, fatigue, depression, solicitude and sleep disorder. The symptoms become more frequent as the disease advances, and patients may have difficulty receiving medical treatment or maintaining daily routines, deteriorating quality of living. Chronic lung disease patients took a survey on the illness, and the results showed that fatigue was the second-most damaging factor, after dyspnea, that eroded the quality of life(7).

Previous studies on fatigue surveyed stroke patients(8), multiple sclerosis patients(9), rheumatoid arthritis patients(6), renal failure patients(10), abdominal region operation patients(11), and myocardial infarction patients(12). Not many focused on fatigue felt by the elderly people in a care facility. Against this background, this study conducted a preliminary survey among elderly people in care facilities to examine their spirometric lung pattern, respiratory function and fatigue.

METHODS

Subjects

The study examined 39 elderly people aged 65 or older residing in E care facility and S care hospital, who did not have chest malformation or rib fracture, and did not receive treatment to enhance respiratory function, and had a sound cognitive function with a score of 24 or higher in the mini-mental status examination. The study was conducted between September and November 2011.

Those who had a history of respiratory system disease and impairment, or complications (liver disease, heart disease, anemia) that might cause fatigue, or those whose respiratory function cannot be measured were excluded.

Prior to the study, the objective and method of the study were explained to the participants, and written consent were received.

Procedure and Measurement

Spirovit SP-1 (Schiller AG, Switzerland) was used to assess respiratory function by a therapist that went through the level 3 of the cardiopulmonary speciality physical therapy of the International Academy of Physical Therapy Research(IAPTR). The participants sat down in a comfortable position to measure the forced vital capacity(FVC), forced expiratory volume in 1 second(FEV_1), and the FEV_1/FVC. The measurement was done three times and the maximum values were used.

Regarding the spirometric lung pattern, criteria for people aged 60 and over were applied. Accordingly, a normal pattern was defined as $FEV_1/FVC\% \geq 65\%$ and $FVC \geq 80\%$ predicted.

An obstructive pattern was defined as $FEV_1/FVC\% \leq 65\%$ and $FVC \geq 80\%$ predicted. A restrictive pattern was defined as $FEV_1/FVC\% \geq 65\%$ and $FVC < 80\%$ predicted. Lastly, a mixed pattern was defined as $FEV_1/FVC\% < 65\%$ and $FVC < 80\%$ predicted(13).

The final diagnosis of a spirometric lung pattern was given by a visiting doctor of the care facility and a doctor of the hospital.

To test fatigue, Piper fatigue scale(PFS) developed by Piper(14) were used as modified by Kwon(15) to fit the cultural context of Korea and to be suitable for chronic lung disease patients. Among 149 items, 28 items were used, the validity of which was confirmed by a doctor of the respiratory department and two cardiopulmonary physical therapists. Cronbachs alpha values of the Kwon's(15) method and the study were .92 and .91 respectively.

Based on the modified PFS(mPFS), 28 items were measured in visual analogue scale(VAS), converting the length to score. The lower score indicates less fatigue, and the average score of the 28 items was used as fatigue score.

Data Analysis

The results were analyzed using SPSS 15.0 ver. for Window. Specifically, frequency analysis and one-way ANOVA were conducted to examine general characteristics of the patients as well as their spirometric lung pattern and respiratory function. A Duncan analysis was done for post-hoc test.

RESULTS

Characteristics of the Subjects

The study participants consisted of 13 men and 26 women. By type of illness, 13 had stroke(33.3%), six had dementia(15.4%), six had musculoskeletal disease(15.4%), five had the Parkinson disease(12.8%), and nine had other diseases.

Their average age was 74.68 with a standard deviation of 7.88; average height was 159.05㎝ with a standard deviation of 7.88㎝, and average weight was

57.15kg with a standard deviation of 7.55kg(Table 1).

Table 1. Characteristics of the subjects

Division		Value
Sex(n)	male	13 (33.3%)
	female	26 (66.7%)
Disease(n)	Stroke	13 (33.3%)
	Dementia	6 (15.4%)
	Parkinson	5 (12.8%)
	Musculoskeletal	6 (15.4%)
	Others	9 (23.1%)
Age(years)		74.68±6.53
Height(㎝)		159.05±7.88
Weight(㎏)		57.15±7.55

Mean±SD

Spirometric Lung Pattern of Elderly in a Facility

According to the classification criteria of the spirometric lung pattern(13), 19 patients in the facility had a restrictive pattern(48.7%), followed by 11 with a mixed pattern(28.2%), five with an obstructive pattern(12.8%) and four with a normal pattern(10.3%) (Table 2).

Table 2. Spirometric lung pattern

	Total (%)
Normal	4 (10.3)
Restrictive	19 (48.7)
Obstructive	5 (12.8)
Mixed	11 (28.2)

FVC by Spirometric Lung Pattern

The FVC turned out as follows: 1.89±0.46ℓ for patients with a normal pattern, 1.22±0.22ℓ for a restrictive pattern, 1.72±0.25ℓ for an obstructive pattern, and 1.40±0.33ℓ for a mixed pattern. The FVC % predicted was 92.72±12.47% for patients with a normal pattern, 62.58±11.53% for a restrictive pattern, 82.54±3.35% for an obstructive pattern, and 64.43±12.13% for a mixed pattern. The discrepancy among different spirometricl lung patterns was statistically significant($p<.001$).

The Duncan post-hoc analysis results showed that both FVC and FVC % predicted of patients with a normal pattern or an obstructive pattern were higher than the other two groups at a statistically significant level ($p<.001$) (Table 3).

FEV_1 by Spirometric Lung Pattern

The FEV_1 turned out as follows: 1.57±0.48ℓ for patients with a normal pattern, 1.01±0.20ℓ for a restrictive pattern, 1.01±0.19ℓ for an obstructive pattern, and 0.83±0.22ℓ for a mixed pattern. The FEV_1 % predicted was 90.53±12.74% for patients with a normal pattern, 67.33±12.09% for a restrictive pattern, 56.63±7.39% for an obstructive pattern, and 49.98±10.82% for a mixed pattern. The discrepancy among different spirometricl lung patterns was statistically significant($p<.01$).

The Duncan post-hoc analysis results showed that FEV_1 of patients with a normal pattern was higher than other groups at a statistically significant level($p<.001$). The FEV_1 % predicted of patients with a normal pattern was higher than other groups at a statistically significant level, and that of patients with a restrictive pattern was higher than those with a mixed pattern($p<.001$) (Table 3).

FEV_1/FVC by Spirometric Lung Pattern

The FEV_1/FVC value was 82.38±6.67% for patients with a normal pattern, 82.67±7.43% for a restrictive pattern, 58.95±7.65% for an obstructive pattern, and 59.71±5.73% for a mixed pattern. The discrepancy among different spirometricl lung patterns was statistically significant($p<.001$).

The Duncan post-hoc analysis results showed that the value of patients with a normal pattern or a restrictive pattern was higher than the other two groups at a statistically significant level($p<.001$) (Table 3).

Degree of Fatigue by Spirometric Lung Pattern

The degree of fatigue was 4.35±0.60 for patients with a normal pattern, 5.87±0.79 for a restrictive pattern, 5.67±0.56 for an obstructive pattern, and 6.39±1.40 for a mixed pattern. The discrepancy among different spirometricl lung patterns was statistically significant($p<.05$). The Duncan post-hoc analysis results showed that the value of patients with a restrictive pattern, an obstructive pattern or a mixed pattern was higher than those with a normal pattern at a statistically significant level($p<.05$) (Table 3).

Table 3. Respiaratory function and fatigue by spirometric lung pattern

	Normal	Restrictive	Obstructive	Combined	Total	F	p
FVC(ℓ)	1.89±0.46	1.22±0.22	1.72±0.25	1.40±0.33	1.41±0.36	8.849	.000 ***
Post hoc	B	A	B	A	A ＜ B		
FVC(%pred)	92.72±12.47	62.58±11.53	82.54±3.35	64.43±12.13	69.10±14.98	11.926	.000***
Post hoc	B	A	B	A	A ＜ B		
FEV_1(ℓ)	1.57±0.48	1.01±0.20	1.01±0.19	0.83±0.22	1.02±0.31	9.155	.000***
Post hoc	B	A	A	A	A ＜ B		
FEV_1(%pred)	90.53±12.74	67.33±12.09	56.63±7.39	49.98±10.82	63.27±16.05	14.460	.000***
Post hoc	C	B	AB	A	A ＜ B ＜ C		
FEV_1/FVC(%)	82.38±6.67	82.67±7.43	58.95±7.65	59.71±5.73	72.77±13.40	36.067	.000***
Post hoc	B	B	A	A	A ＜ B		
Fatigue	4.35±0.60	5.87±0.79	5.67±0.56	6.39±1.40	5.83±1.09	4.423	.01 *
Post hoc	A	B	B	B	A ＜ B		

Mean±SD
*: p＜.05, **: p＜.01, ***: p＜.001

DISCUSSION

The deteriorating respiratory function affects mortality. In a prospective study that surveyed 5,886 elderly people aged 65 and older, 5-year mortality was independently estimated based on the FVC(16), and it was shown that adults with a restrictive pattern were the only group whose mortality rose during the 22 years of observation(17).

Pulmonary disease for the elderly increases stiffness of the chest wall and thus raises mechanical resistance in breathing. As the defense mechanism of the lung deteriorates, cough and ciliary functions decline, contracture of skeletal muscle and respiratory muscle weakens, which leads to less active ventilation. Additionally, mental and neurological problems follow including weakening intellectual power, memory, depression, agitation and less sensitivity to stimulation(18).

As people age, the FVC, expiration volume, and maximum voluntary respiratory function declines. However, considering that respiratory resistance remains quite normal, the changes in the FEV_1 and maximum voluntary respiratory function can be attributed to less pulmonary compliance, rather than to bronchus blocking(19).

In this study, a test of respiratory function among 39 patients showed that their FVC was 69.10±14.98% and the FEV_1 was 63.27±16.05%, showing an overall decline. However, the FEV_1/FVC was 72.77±13.40%, indicating that the changes in respiratory function was due to less pulmonary function, not bronchus blocking.

One of the problems in treating patients with neuromuscular disease or neurodegenerative disease is a gradual damage to inspiration muscle function. Neuromuscular disease entails a decrease in chest wall and lung compliance, raising dynamic load on weakened respiratory muscles(5). The imbalance between the capacity and the load of respiratory muscles might cause fatigue or a respiration failure, which becomes a major cause of death. Therapy to improve muscular strength and endurance of weakened respiratory muscle is critical in treating patients with neuromuscular or neurodegenerative disease.

As for the general characteristics of the elderly in a facility, 14 had neuromuscular disease of stroke (35%), six had neurodegenerative disease of dementia(15%), five had the Parkinson disease(12.5%). That is, 25 patients had either neuromuscular or neurodegenerative disease(62.5%). Therefore, treatment of their weakened respiratory muscle is as important as tackling the disease itself.

Regarding previous studies, Ryu(20) surveyed 73 elderly patients and showed that 28 had a restrictive pattern(38.4%), 19 had an obstructive pattern(26%), 16 had a mixed pattern(21.9%), and ten had a normal pattern(13.7%). Similarly, in this study, 19 patients had a restrictive spirometric lung pattern(48.7%), followed by 11 with a mixed pattern(28.2%), five had an obstructive pattern (12.8%), and four had a normal pattern(10.3%). The restrictive pattern is most common probably because the elderly in a care facility often have a chronic neuromuscular or neurodegenerative disease.

Meanwhile, causes of fatigue are numerous and often complex, and thus, it is hard to effectively prevent fatigue.

A common symptom of chronic lung disease patients includes dyspnea, which is closely related to fatigue and physical activity, and adds psychological burden to physical activities. Dyspnea and barriers in physical activity affect each other; both can be a cause or result of fatigue. Patients felt fatigue because of disease-related symptoms, and as fatigue grew worse, so did the symptoms. Dyspnea that follows physical activity gradually narrowed down the scope of physical activity. In turn, the degree of dyspnea rose after routine activities, creating a vicious cycle(21).

In a study by Glell et al.(22), 60 patients with chronic obstructive pulmonary disease were examined. They went through a 12-week respiratory training, and reported less fatigue afterwards. Reid(23) examined 119 patients with chronic obstructive pulmonary disease. They underwent an 8-week respiratory training, and reported less fatigue.

Fahr(24) conducted a study and showed that the main cause of fatigue felt by patients with chronic lung disease was dyspnea. Breukink et al.(25) argued that dyspnea increased energy required for breathing and energy consumption, influencing fatigue perceived by the patients.

In this study, fatigue felt by elderly patients with a normal pattern was less severe than those with other patterns at a statistically significant level.

These findings suggest that a pulmonary physical therapy is needed for the elderly in a facility to enhance respiratory efficiency and reduce fatigue.

CONCLUSION

This study examined 39 elderly people in a care facility aged 65 and over in order to examine their spirometric lung pattern, respiratory function and degree of fatigue.

Regarding the respiratory function, the FVC was 1.41±0.36ℓ, the FVC % predicted was 69.10±14.98%; the FEV_1 was 1.02±0.31ℓ, the FEV1 % predicted was 63.27±16.05%, the FEV_1/FVC was 72.77±13.40%, and the fatigue score was 5.83±1.09. As for the spirometric lung pattern, 19 patients had a restrictive pattern(48.7%), followed by 11 with a mixed pattern(28.2%), five with an obstructive pattern(12.8%), and four with a normal pattern(10.3%).

Regarding the respiratory function and fatigue by spirometric lung pattern, the FVC and the FVC % predicted of patients with a normal pattern or an obstructive pattern were greater than other groups at a statistically significant level. As for the FEV_1, that of patients with a normal pattern was significantly higher than others, and for the FEV_1% predicted, that of patients with a normal pattern or a restrictive pattern was significantly higher($p<.001$). Fatigue felt by patients with a normal pattern was significantly less than patients of other patterns ($p<.001$).

A further research is needed to examine a larger number of patients, and analyze the effectiveness of pulmonary physical therapy and various causes of fatigue.

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