

# Effects of diaphragm respiration exercise on pulmonary function of male smokers in their twenties

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**Abstract.** [Purpose] We investigated how diaphragm respiration exercises can affect pulmonary function in long-term male smokers in their twenties. [Subjects and Methods] Twenty-eight healthy males between 20 and 29 years of age were randomly divided into an experimental and a control group (14 members each). The experiment was conducted during 30 min sessions, 3 times a week for 4 weeks. The experimental group performed diaphragm respiration exercises and the control group performed exercises using MOTomed. Pulmonary function (tidal volume, breathing capacity, inspiratory reserve volume, inspiratory capacity, and expiratory reserve volume) was evaluated and analyzed before and after the experiment. [Results] Our results revealed significant increases in tidal volume, inspiratory reserve volume, inspiratory capacity, and breathing capacity in the experimental group. These increases were greater in the experimental group than in the control group. [Conclusion] In our study, the experimental group which performed diaphragm respiration exercises showed a greater improvement in pulmonary function compared with the control group. It is hypothesized that greater improvement in pulmonary function is expected if diaphragm respiration exercises are implemented taking into account the age of the smokers.

**Key words:** Pulmonary function, Diaphragm respiration exercise, Smoking

*(This article was submitted Mar. 9, 2015, and was accepted Apr. 16, 2015)*

## INTRODUCTION

According to predictions by the World Health Organization, the number of smokers who will die from cigarette-related diseases will surpass the number of people dying from AIDS, traffic accidents, suicide, and murder combined by 2020<sup>1)</sup>. Due to the presence of various harmful substances in cigarettes, smoking can cause many diseases. Nicotine—which is one of the major constituents of cigarettes—causes arteriosclerosis, coronary artery disease, chronic obstructive pulmonary disease (COPD), and other problems that result not only in low cardiopulmonary function<sup>2)</sup> but also in relatively diminished daily living ability and endurance in smokers compared with that in non-smokers<sup>3)</sup>. Moreover, it is common knowledge that smoking is very highly correlated with occurrence of respiratory diseases. Diaphragmatic breathing is a good technique for respiration and relaxation of the lungs because it enables sufficient exchange of oxygen and carbon dioxide. It is reported to be effective in (1)

improvement of ventilation efficiency, dyspnea, and activity ability<sup>4)</sup>; reduction of metabolic acidosis; alleviation of back pain<sup>5)</sup>; spine correction<sup>6)</sup>; abdominal strengthening<sup>7)</sup>; and improvement of body composition and flexibility<sup>8)</sup>. In our current social climate, the number of male smokers in their twenties is rapidly increasing and this trend is becoming a social problem. Our study attempts to verify the effects of diaphragm respiration exercises on respiratory function in long-term male smokers in their twenties.

## SUBJECTS AND METHODS

All research subjects were 40 male students between 20 and 29 years of age enrolled at University P, located in Gyeongbuk, Korea. They were randomly and evenly divided (14 members per group) into a diaphragm respiration exercise group and a control group. We conducted interviews with every subject and recorded individual measurements for each weight, body fat percentage, smoking history, smoking amount, smoking habit, drinking habit, diet, disease history, and family history. Only subjects who were not receiving medical treatment for respiratory diseases and who had a clean family medical history and personal habits were selected. Among smoking habits, those who smoked cigars other than filtered cigarettes or tobacco pipes were excluded. Only subjects who have been smoking for 1 to 3 years were included. We ensured that the research subjects

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fully understood the research project and signed consent was obtained from each participant. Our study was approved by the Committee of Clinical Testing at Korea Nazarene University and was screened according to the ethical standards of the Helsinki Declaration. General characteristics of study participants are summarized in Table 1.

The experimental group performed 30-min diaphragm respiration exercises 3 times per week for 4 weeks. The exercise involved subjects lying in the supine position with the researcher placing his or her hand on the upper part of the subject's rectus abdominis, (i.e., immediately below the frontal costal cartilage), and the subject breathing in deeply and slowly out through the nose. Simultaneously, the shoulder was maintained in relaxed position and the upper chest was fixed so that only the abdomen was allowed to rise. Afterward, using controlled exhalation, the subject was told to slowly release all of the air outward<sup>9-11</sup>.

In the control group, each participant performed a cycling exercise using MOTomed (RECK-Technik GmbH & Co, Betzenweiler, Germany), which allowed for regular and repetitive training without affecting respiration. The strength of the training was controlled so that the heart rate of the participants did not exceed 20% of the heart rate reserve<sup>12</sup>.

If a subject complained of fatigue or dizziness during the respiration exercise, a break was taken and exercise resumed some time later. Prior to the experiment, the tester taught each subject the proper method for the respiration exercise 2 or 3 times to ensure that the subject was comfortable performing it.

Pulmonary function of the participants was measured in a sitting position using a tool called Fitmate (COSMED, Sri, Italy). To ensure accurate measurements, the tester explained and demonstrated the exercise to each subject beforehand. Both the experimental and control groups were instructed

to use the mouthpiece and to block the nostrils during the measurement so that air was neither inhaled nor exhaled through the nose. Starting from exhalation, subjects slowly exhaled to maximum level following the tester's signal and then slowly inhaled; tidal volume (TV), inspiratory reserve volume (IRV), expiratory reserve volume (ERV), inspiratory capacity (IC), and volume capacity (VC) were measured at this time<sup>13</sup>. Three measurements were made for each pre-test and post-test value, and the average of the 3 values was used as the final value. Each subject was given a 5-min break after each measurement.

## RESULTS

When comparing the breathing capacity of the experimental and control groups before and after the experiment, the experimental group showed significant changes in TV, IRV, IC, and VC ( $p < 0.05$ ), but no significant change in ERV ( $p > 0.05$ ). By contrast, the control group showed no significant change in any parameter ( $p > 0.05$ ). In testing the differences between the experimental and control groups in their changes before and after the experiment, VC showed a significant change ( $p < 0.05$ ), while TV, IRV, ERV, and IC showed no significant changes ( $p > 0.05$ ) (Table 2).

## DISCUSSION

Korea is currently experiencing a steady increase in smoking rate among males in their teens and twenties. In all likelihood, this population is at a greater risk of developing respiratory diseases in future. Respiration training in addition to psychological and medical treatments should be an active intervention in any anti-smoking program; however, in reality, the approach to professional respiration training is very limited and depends on simple respiration exercises. Hence, it is important to implement professional respiration training as a means of recovering the decreased breathing ability of current smokers and of lowering the smoking rate. The effectiveness of direct treatment by therapists specializing in respiration training has already been proven<sup>14, 15</sup>. Our study implemented diaphragm respiration training that improved breathing ability, along with lung window setting of the thoracic cage, by improving diaphragmatic function, which is the major factor that affects the efficiency of breathing. We examined the impact of diaphragm respiration train-

**Table 1.** General participant characteristics

	EG (n = 14)	CG (n = 14)
Age (years)	23.1 ± 1.3	22.8 ± 0.4
Height (cm)	173.7 ± 5.0	175.2 ± 3.9
Weight (kg)	64.5 ± 4.2	61.7 ± 5.7
Smoking period (years)	2.2 ± 0.2	0.0 ± 0.0

Values are means ± SD. EG: experimental group; CG: control group

**Table 2.** Comparison of respiratory function between experimental and control subjects

	EG		CG	
	Pre-test	Post-test	Pre-test	Post-test
TV (L)	0.5 ± 0.1	0.6 ± 0.0*	0.5 ± 0.0	0.5 ± 0.0
IRV (L)	2.2 ± 0.1	2.4 ± 0.1*	2.4 ± 0.1	2.5 ± 0.1
ERV (L)	1.5 ± 0.0	1.8 ± 0.0	1.6 ± 0.0	1.6 ± 0.0
IC (L)	2.7 ± 0.3	3.0 ± 0.2*	2.9 ± 0.1	3.0 ± 0.2
VC (L)	4.2 ± 0.2	4.8 ± 0.2 <sup>a</sup>	4.5 ± 0.6	4.6 ± 0.1 <sup>a</sup>

Mean ± SE.

\*Significant difference from pre-test value,  $p < 0.05$

<sup>a</sup> significant difference in gains between the two groups,  $p < 0.05$

EG: experimental group; CG: control group

ing on pulmonary function of normal males in the age range of 20 to 29 years. In order to ameliorate subject muscle fatigue and efficiently increase muscle strength, exercise repetition number, sustained time, and resting time should be properly standardized<sup>16)</sup>. It is known that the experiment is most effective when implemented for 4 to 12 weeks, 2 to 5 times per week, with each session lasting no longer than 20 to 30 min. Taking this fact into consideration, we opted for 30-min exercise sessions performed 5 times per week for 4 weeks.

Pulmonary function tests were conducted 4 weeks after the experiment concluded. The experimental group showed significant increases in TV, IRV, IC, and VC after the experiment, while there was no significant increase in ERV. Meanwhile, the control group showed no significant increase in any parameter. Examining the changes in the experimental and control groups after the experiment, the experimental group showed more increases than the control group in every section; however, only VC revealed a significant increase. It is hypothesized that repetitive training of reinforcing the strength of the diaphragm muscle against therapist resistance improved the subjects' inspiratory muscle function. This subsequently increased thoracic mobility, thereby resulting in improved breathing ability.

In a study conducted by Enright et al.<sup>17)</sup>, normal people who had undergone high frequency inspiratory muscle training registered significant increases in breathing capacity, total breathing capacity, inspiratory muscle strength, and inspiratory endurance. In a study conducted by Townsend<sup>18)</sup>, normal people who had undergone respiration training exhibited large differences between the resultant inspiratory volumes and expiratory volumes. Jones et al.<sup>19)</sup> reported that under normal conditions, TV increased among COPD patients after diaphragmatic breathing exercises. Moreover, pursed-lip breathing exercises contributed to increased final IC and instant ventilation volume<sup>20)</sup> in these patients. Decreased final expiratory capacity and increased final IC were observed among COPD patients who performed the pursed-lip breathing exercise<sup>21)</sup>. Previous studies that examined the effect of respiration exercises on normal people like those in this study or on COPD patients showed results consistent with or similar to this study.

We believe that data that are more objective can be obtained by comparing breathing between different age groups through a study on smokers from different age groups, in addition to those in their twenties. In addition, we consider it imperative to implement diverse exercise programs aimed at improvement of breathing, especially among smokers.

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