The effect of thoracic region self-mobilization on chest expansion and pulmonary function

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Abstract. [Purpose] The aim of this study was to determine the effects of thoracic region self-mobilization on chest expansion and pulmonary function in healthy adults. [Subjects] Nineteen healthy adults were randomly allocated to either an intervention group (n = 8) or a control group (n = 11). [Methods] Subjects in the intervention group performed self-mobilization of the thoracic region 3 times per week for 6 weeks (18 sessions). The outcome measures included chest expansion when breathing, pulmonary function, and predicted pulmonary function. [Results] There was a significant difference in chest expansion between the intervention group and the control group. However, there was no significant difference in pulmonary function between the intervention group and the control group. [Conclusion] Thoracic region self-mobilization may be beneficial for increasing chest expansion in healthy adults.

Key words: Thoracic self-mobilization, Chest expansion, Pulmonary function

INTRODUCTION

In modern society, the incidence of cervical lordosis and thoracic and lumbar kyphosis is increasing, because many people maintain a fixed posture for long periods and number of aged people is increasing. An increase in thoracic kyphosis causes restrictions in chest expansion and respiratory muscle weakness, thereby reducing lung capacity and the thoracic cavity size and deforming vertebral column alignment1–3).

Previous studies have investigated the use of thoracic joint mobilization and thoracic flexibility exercises to improve deformations of the chest and vertebrae and thereby enhance pulmonary function1, 4). These interventions enhanced pulmonary function and thoracic mobility and improved respiratory muscle function, chest expansion, and diaphragm movement by reducing the stiffness of the inter-vertebral discs and surrounding tissues and by improving vertebral extensor muscle stretch and endurance with thoracic flexibility exercises1, 4).

As reported in previous studies, chest mobilization exercises and stretching exercises increase thoracic vertebral mobility, chest expansion, and lung capacity. However, these exercises required firsthand therapeutic application by therapists and cannot be easily performed by the subjects in a non-clinical environment5).

Therefore, the present study examined self-mobilization of thoracic vertebrae in healthy adults and investigated the effect of these exercises on pulmonary function and chest expansion.

SUBJECTS AND METHODS

The subjects of this study were 19 healthy adults who understood the purpose of the study and provided written consent to participate. Those diagnosed with neurological findings and had undergone operations, or were receiving surgical treatment, or taking medicines on a regular basis to relieve pain, were excluded from the study. The study was approved by the Ethics Committee of the Catholic University of Pusan and adhered to the tenets of the Declaration of Helsinki (1975, revised 1983). The subjects were assigned to one of two groups, the thoracic region self-mobilization group (TSMG; 2 males and 6 females) or the control group (CG; 5 males and 6 females). None of the subjects showed restrictive pulmonary disease or obstructive pulmonary disease, as determined by a spirometer pretest. Age, height, and weight were 22.50 ± 1.06 years, 164.25 ± 10.60 cm, and 60.12 ± 13.35 kg, respectively in the TSMG, and were 22.36 ± 3.26 years, 165.50 ± 7.37 cm, and 65.09 ± 14.90 kg, respectively in the CG.

To measure chest expansion when breathing, the subject’s chest wall was measured with a tapeline in an upright sitting position. Chest expansion was calculated using the difference in chest wall circumference during the state of maximal expiration and maximal inspiration6, 7). A spirometer (Pony Fx, COSMED, Italy) was used to measure pulmonary function. Using a maximal-effort expiratory spirogram, forced vital capacity (FVC), forced expiratory volume in one sec-
and lumbar angles. Although many interventions have vertebral mobility and structural changes in the thoracic vertebral pain are adversely affected by reduced thoracic no significant differences between group variations or within measurement results are summarized in Table 1. Comparison of pulmonary function results from the two groups showed that the intervention was applied to healthy subjects, who were relatively less affected by the intervention. However, the intervention applied in the present study resulted in larger increases in axillary region and sternum region measurements, than in previous studies in which respiratory muscle stretch gymnastics were applied.

Interestingly, previous studies have reported that changes in low costal region measurements were relatively larger than changes in axillary region and sternum region measurements when thoracic flexibility exercise was applied. Conversely, changes in lower costal region measurements were not significantly larger in the present study. These results may be attributable to the fact that although thoracic region self-mobilization directly affected ribs 1–10, which are directly connected to the thoracic vertebrae or to the cartilage, it could not directly affect ribs 11 and 12. The control group showed a statistically significant decrease in low costal region measurements post-test. Thus, it could be indirectly concluded that if thoracic vertebrae are not mobilized, chest region muscle stiffness persists and the mobility of the muscles around the chest wall declines owing to over activation of the muscle spindles, potentially leading to respiratory disorders. Therefore, thoracic region self-mobilization is an easy intervention that can be self-applied by patients with low chest mobility in order to improve expansion capability of the entire chest region.

### RESULTS

Chest expansion (axillary, sternum, low costal region) measurement results are summarized in Table 1. Comparison of pulmonary function results from the two groups showed no significant differences between group variations or within group variations (p > 0.05).

### DISCUSSION

Chest expansion, respiratory function, and thoracic vertebral pain are adversely affected by reduced thoracic vertebral mobility and structural changes in the thoracic and lumbar angles. Although many interventions have been applied in previous studies to address these issues, those interventions have shortcomings because they require firsthand application by therapists. Therefore, the present study aimed to verify whether active thoracic vertebrae self-mobilization methods are sufficient to investigate changes in chest expansion and pulmonary function caused by thoracic region self-mobilization.

Although engaging in thoracic joint mobilization and self-stretching exercise for 6 weeks improved pulmonary function in a previous study, another study showed no improvement in pulmonary function after chest region respiratory muscle stretching exercise for 4 weeks. Therefore, the argument that interventions applied to the thoracic region are involved in pulmonary function improvement is controversial. In the present study, no significant change in pulmonary function was observed. This may be attributable to the fact that the intervention was applied to healthy subjects, who were relatively less affected by the intervention. However, the intervention applied in the present study resulted in larger increases in axillary region and sternum region measurements, than in previous studies in which respiratory muscle stretch gymnastics were applied.

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### Table 1. Within-group and between-group comparisons for outcome measures

|          | TSMG (n=8) | Difference (post-pre) | z^a | CG (n=11) | Difference (post-pre) | z^b |
|----------|------------|-----------------------|-----|-----------|-----------------------|-----|
| Pre-test | 4.3±2.10   | 3.9±2.01              |     | 3.1±3.07  | 3.6±2.56              |     |
| Ax       | 6.18±2.01  | 1.87±1.45             | -2.31* | 3.6±3.07  | 3.6±3.07              |     |
| St       | 3.18±3.16  | 2.00±1.53             | -1.68* | 2.90±1.54 | 3.7±2.56              |     |
| LC       | 5.06±2.70  | 1.06±1.74             | -1.55 | 2.07±1.38 | 1.29±1.49             | -2.53* |
|          | 6.12±1.95  | 1.06±1.74             |     | 1.29±1.49 | -2.53*                |    |

^aWithin-group comparison, ^bbetween-group comparison, Ax: Axillary region, St: Sternum region, LC: Low costal region, Unit; cm,*p < 0.05, all results presented as mean ± SD.
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