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Influence of Evjenth-Hamberg Stretching on the Lung Function of Adults with Forward Head Posture

This study was conducted to examine the effects of Evjenth-Hamberg stretching of the sternocleidomastoid, upper trapezius, and pectoralis major on the lung function of adults with forward neck posture. The subjects were 20 adult students in P university located in Pohang, Korea, whose degree of head forward displacement measured according to NEW YORK state posture test was mild. The subjects were randomly and equally assigned to the Evjenth-Hamberg Stretching group (EHSG, n=10) and the control group (CG, n=10). Their forced vital capacity (FVC), slow vital capacity (SVC), and maximal voluntary ventilation (MVV) were measured before and after the experiment. In within-group comparison, only the EHSG experienced statistically significant improvement in FVC, forced expiratory volume in the first second (FEV1), and peak expiratory flow (PEE) after the experiment, compared to before the experiment (.05<p). In between-group comparison, the PEE of EHSG was statistically significantly higher than CG (.05<p). Regarding SVC, only the EHSG experienced statistically significant improvement in inspiratory vital capacity after the experiment, compared to before the experiment. With regard to MVV, only the EHSG experienced statistically significant improvement in their tidal volume during maximal voluntary ventilation after the experiment compared to before the experiment. Our results indicated that Evjenth-Hamberg stretching was an effective physical therapy intervention to improve the lung function of adults with FHP by correcting their head forward displacement.

Key words: *Evjenth-Hamberg stretching, Forward head posture, Forced vital capacity, Slow vital capacity, Maximal voluntary ventilation*

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INTRODUCTION

Owing to the popularization of the computer, students came to frequently use the computer and increasingly have complained of functional problems with the musculoskeletal system including the neck and the shoulder [1]. In particular, while maintaining a static posture for a long time for example, watching the monitor one becomes influenced by gravity and this triggers a bad posture [2]. Forward head posture (FHP), the most representative postural deformation, is defined as the head placed forward or rotated against the trunk, and triggers imbalance in frame alignment and the muscles. Besides, patients who complain of neck and shoulder pain experience severer FHP and the protrusion of the acromion [3]. In general, FHP causes the neck flexor, rhomboid muscle, and lower trapezius muscle to weaken and the upper trapezius, levator spinae, subscapularis, and pectoralis muscles to shorten. FHP also increases anteflexion of the cervical vertebrae and retroversion of the thoracic vertebrae [4]. Continuous stress on the neck structure triggers FHP, which leads to neck pain and headache [5]. Patients with chronic neck pain find it difficult to have an optimal lung function, and their functional disability of the neck and back muscles are related with respiratory malfunctions [6]. Abnormal structural changes of the cervical vertebrae resulting from its anteflexion, and the thoracic vertebrae resulting from its retroversion, triggers disability in rib cage movement and changes in respiratory functions, and abnormal expansion of the rib cage decreases lung volume and vital capacity and weakens the respiratory muscles [7]. Dimitriadis et al. emphasized the importance of breathing exercises in relation to FHP, and Kapreli et al. suggested that the relationship of respiratory function due to FHP should be considered important [6, 8].

Those with FHP are able to improve their lung function through proper head and neck alignment [9]. Many studies concluded that a therapeutic approach to strengthen the muscles weakened for and stretch the muscles shortened for postural alignment was necessary [10, 11]. The method of stretching after isometric contraction, combined with antagonistic muscle contraction, which was introduced by Olaf Evjenth, is to conduct isometric contraction of the antagonistic muscle after isometric contraction of the agonist muscle and its repetitive passive stretching [12]. Evjenth-Hamberg stretching is different from other stretching methods introduced thus far in the last step, the agonist muscle, not the antagonistic muscle, is contracted. Stretching combined with contraction of the antagonistic muscle raises the protein synthesis level, thereby preventing muscular atrophy resulting from proteolysis and at the same time ameliorating muscle strength [13].

Lee had ordinary subjects with FHP perform an exercise to stretch the neck and back and strengthen their muscles and verified that such exercise was effective in correcting the subjects' FHP [14]. Jang had the subjects with FHP perform a respiratory exercise, and observed their lung function, muscle activity, and posture improve [15].

Like this, multi-directional research aimed at finding effective intervention methods, including stretching, to improve FHP has been conducted. Nonetheless, most research involved postural improvement and muscle strengthening by stretching and there was no research on lung function improvement by stretching. Accordingly, this study had the subjects with FHP perform Evjenth-Hamberg stretching of the sternocleidomastoid, upper trapezius, and pectoralis major muscles, thereby attempting to examine its effect on their lung function.

METHODS

Subjects

This study conducted for four weeks from September to October 2018. The subjects were 20 adult students in P university located in Pohang, Korea whose degree of head forward displacement measured according to NEW YORK state posture test was mild (Grade fair or less). The subjects were randomly and equally assigned to the Evjenth-Hamberg stretching group (EHSG, n=10) and the control group (CG, n=10). The result of frequency analysis and t-test showed that there was no statistically significant difference in gender, age, and weight between the two groups (Table.1). Those who had pain or injury on the shoulder girdle; an orthopedic, neurological, or dermatological history; or a cold or other respiratory disease were excluded from this study. Prior to the experiment, the content and purpose of the experiment were sufficiently explained to all the subjects and their written consent to voluntarily participate in the experiment was obtained.

Table 1. General characteristics of the subjects

	EHSG[1]	CG[2]
Sex (M/F)	7/3	7/3
Height (cm)	171.00	173.90
Weight (kg)	60.90	65.70
Age	20.40	21.50

EHSG [1] : Evjenth-Hamberg stretching group
CG [2] : Control Group

Measurements Method

For precise examination on the subjects' lung function, Fitmate (COSMED LTD. Italy) was used as measurement equipment. Prior to the measurement, the subjects were repetitively trained on how to receive the examination. Measurement was taken with the subjects standing. The examiner encouraged the subjects to exert their maximal respiratory capacity. They were trained to wear a nose plug during the measurement and not to let the air exit between the mouthpiece and the mouth. The subjects' forced vital capacity (FVC), slow vital capacity (SVC), and maximal voluntary ventilation (MVV) were measured to examine their lung function. The average value of three measurements was assumed as the measurement value. They had a rest for about one hour between measurement of each item.

Intervention method

How to perform Evjenth-Hamberg stretching was explained in detail to the subjects so that they fully understood how to do it. They sufficiently practiced how to do stretching so that unnecessary motions were able to be minimized during actual stretching. Before stretching, the subjects performed standing jump, a warm up exercise, for five minutes. They stretched the sternocleidomastoid, upper trapezius, and pectoralis major.

The subjects held isometric contraction for six seconds. They also slowly counted from one to six to prevent the Valsalva maneuver rapid increase in their blood pressure which may occur during isometric exercise.

While the subjects relaxed for two to three seconds after contraction, the experimenter manually moved in the direction of further stretching. The experimenter had the subject's positions changed to the point of being stopped by the muscles and maintained at the point for 15 to 16 seconds. Lastly, the experimenter further had the subjects' positions changed to the direction of extending the head in order to strengthen their antagonistic muscle. The experimenter pushed back the subjects with his own hands to strengthen the subjects' antagonistic muscle. They maintained the motion for six seconds and the subjects had a rest for 10 seconds while relaxing. They conducted this motion four times. Totally, they stretched for 160 seconds. This intervention was conducted once per day, three times per week, for a total of four weeks. The CG did not apply physical therapy interventions.

Statistical Analysis

This study employed SPSS 18.0 for data analysis. The means and standard deviation of the subjects' general characteristics were calculated and frequency analysis on them was performed. The Wilcoxon signed-rank test was employed to examine each group's difference in lung function between before and after the experiment and Mann-Whitney U test was used to look at difference in lung function between the two groups. A statistical significance level was set at $\alpha = .05$.

RESULTS

Within-group and between-group comparison of FVC

A comparison of lung function according to Evjenth-Hamberg stretching indicated that the EHSG had statistically significant increase in FVC, FEV1, and PEF ($p<.05$). In between-group comparison, the EHSG's PEF statistically significant increased than the CG($p<.05$).

Within-group and between-group comparison of static vital capacity (SVC)

A comparison of lung function according to Evjenth-Hamberg stretching indicated that the EHSG had statistically significant increase in IVC ($p<.05$). In between-group comparison, the EHSG's IVC more increased than the CG's, with no statistically significant difference between the two groups ($p<.05$).

Within-group and between-group comparison of maximal voluntary ventilation (MVV)

A comparison of lung function according to Evjenth-Hamberg stretching indicated that the EHSG had statistically significant increase in MVt

Table 2. Within-group and between-group comparison of FVC (unit : ℓ)

	Group	Before (mean±SD)	After (mean±SD)	After-Before (mean±SD)
FVC [3]	EHSG [1]	4.05±.87	4.43±.85*	.37±.30
	CG [2]	4.14±.86	4.24±.93	.11±.64
FEV1 [4]	EHSG	3.05±.86	3.62±.69*	.57±.54
	CG	3.11±.87	3.41±.66	.29±.82
PEF [5]	EHSG†	5.09±2.06	7.32±2.10*	2.23±2.81
	CG	6.53±2.69	6.88±2.36	.34±.99

Values are mean±SD, $p<.05$, *significant difference between before and after,
$p<.05$,†significant difference between EHSG and CG
EHSG [1] : Evjenth-Hamberg stretching group, CG [2] : Control Group, FVC [3] : Forced vital capacity, FEV1 [4] : Forced expiratory volume in the first second, PEF [5] : Peak expiratory flow

Table 3. Within-group and between-group comparison of SVC (unit : ℓ)

	Group	Before (mean±SD)	After (mean±SD)	After-Before (mean±SD)
IVC [3]	EHSG [1]	4.23±1.05	4.48±.98*	.25±.34
	CG [2]	4.23±.98	4.27±1.09	.04±.29

Values are mean±SD, p<.05.*significant difference between before and after.
EHSG [1] : Evjenth-Hamberg stretching group, CG [2] : Control Group, IVC [3] : Inspiratory vital capacity

(p<.05). In between-group comparison, the EHSG's MVV and MVt increased compared to the CG's, with no statistically significant difference between the two groups (p<.05).

DISCUSSION

Increase in time spent with the computer and the smartphone led to increase in time spent sitting as well as drooping posture for a long time, which resulted in failure to maintain normal spinal curvature and increased complaints of functional problems with the musculoskeletal system including the neck and the shoulders [16]. FHP shortens the levator scapulae, sternocleidomastoid, scalene, upper trapezius, pectoralis major, and pectoralis minor muscles and weakens the lower cervical and thoracic erector spinae, middle and lower trapezius, and rhomboid muscles [17]. Having a wrong posture for a long time creates mechanical stress, triggers pain, causes imbalance in strength and flexibility of muscles, and lowers their efficiency [18]. FHP may trigger neck pain and dyspnea and a frequent sense of fatigue caused by FHP may bring about a serious problem of decreased work efficiency [15]. Accordingly, this study intended to examine the effects of Evjenth-Hamberg stretching, which was applied for four weeks to the sternocleidomastoid, upper trapezius, and pectoralis major muscles of college students whose degree of head forward displacement was mild, on their lung function.

Only the EHSG group experienced statistically significant improvement in FVC, FEV1, and PEE after the experiment compared to before the experiment. In between-group comparison, the EHSG's PEE was statistically significantly improved compared to the CG's. Regarding SVC, only the EHSG's IVC was statistically significantly improvementt after the experiment. With regard to MVV, only the EHSG's MVt statistically significantly improved after the experiment.

Kapreli et al. noted that FHP changed the anatomical structure of cervical and thoracic vertebrae, thereby negatively affecting the function of the rib cage and lungs [8]. Okuro observed that FHP decreased the vital capacity, which in turn decreased the mobility of the diaphragm and adversely affected its function, inefficiently contracting the respiratory muscles [19].

Jang divided the subjects with FHP into the respiratory exercise group and the progressive loading exercise group and compared their lung function; both groups experienced effective changes in their lung function, with greater change in the respiratory exercise group [15]. Sutbeyaz et al. had stroke patients perform a respiratory exercise for six weeks, examined their lung function, and observed significant increase in their FVC [20]. In a study of the effects of Mckenzie exercise on the subjects' FHP and respiratory function, Jang reported that their FVC and FEV1 significantly improved four weeks after the experiment compared

Table 4. Within-group and between-group comparison of MVV (unit : ℓ)

	Group	Before(mean±SD)	After(mean±SD)	D-value(After-Before)
MVV [3]	EHSG [1]	95.92±38.74	108.35±23.35	12.4±28.53
	CG [2]	117.58±49.02	116.72±35.50	-.86±20.31
MVt [4]	EHSG [1]	2.75±1.26	3.27±.98*	.51±.44
	CG [2]	3.18±.95	3.39±.79	.20±.40

Values are mean±SD, p<.05 : *significant difference between before and after
EHSG [1] : Evjenth-Hamberg stretching group, CG [2] : Control Group, MVV [3] : Maximal voluntary ventilation, MVt [4] : Tidal volume during maximal voluntary ventilation

to before the experiment [21].

Nonetheless, most research on lung function involves lung diseases or direct training on actual respiration. Accordingly, this study examined the effects of stretching on the subjects' postural improvement and analyzed the effect of such postural improvement on their lung function. There has been no relevant previous research, and therefore this study comparatively analyzed previous theses that had applied exercises and derived a similar result from theirs, obtaining high reliability.

FHP increases the thoracic kyphosis [22]. The thoracic kyphosis due to FHP affects the movement of the chest, which is controlled by the movement of the joints around the vertebrae and the ribs. Although the deformation of the spine is known to have no major problems with respiration, short and shallow breathing occurs, resulting in increased respiratory function and decreased lung flexibility [23].

In this study, improvement in the subjects' lung function were considered to be because of enhanced FHP by Evjenth–Hamberg stretching. The researcher's views that the anatomical structure of the cervical and thoracic vertebrae deformed by FHP has become normalized, which improved the mobility of the neck and back areas and their muscle efficiency, thereby ameliorating their lung function. It is suggested that stretching may be applied to respiratory muscles to improve respiratory function when body alignment, muscle length change, and adverse effects on respiratory function are adversely affected by a deflected posture such as FHP.

CONCLUSION

This study verified that Evjenth–Hamberg stretching improves the lung function of those with FHP; it is a physical therapy intervention method effective in treating lung function diseases by changing FHP close to normal. This study result is regarded the base data that improvement of FHP positively affects lung function.

Nevertheless, the subjects of this study were young adults in their 20s and therefore this study failed to include different age groups. In addition, this study did not check whether the effect was continuous. Thus, future research should examine the effects of FHP on lung function in different age groups, how long such effect lasts, and compare the effects of Evjenth–Hamberg stretching with those of various physical therapy interventions.

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