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Effectiveness of Breathing Exercise and Posture Correction Exercise in Improving Peak Expiratory Flow Rate in Adults with Forward Head Posture: A Randomized Controlled Trial

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ABSTRACT

Background & Aim: Forward Head Posture (FHP) causes the diaphragm to lose its ability to expand and ventilate, decreasing lung functioning which results in decreased forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), and peak expiratory flow rate (PEFR). This study aimed to determine the effects of breathing exercises in adults with FHP and to find out the co-relationship between PEFR and cranio-vertebral angle (CVA).
Method: An experimental study with 30 subjects aged between 18 to 50 years were included. The subjects were divided into two groups. The experimental group was instructed to perform breathing exercises and posture correction exercises five days a week for four weeks, whereas the control group was asked to perform only posture correction exercises. Craniovertebral Angle and Peak Expiratory Flow Rate values were measured before and after the intervention in both groups.
Results: Within- and between-group changes in CVA and PEFR were observed in both the experimental and control groups. The peak expiratory flow rate showed a significant difference between the experimental and control groups ($p = 0.042$), and the craniovertebral angle measurements were also highly significant among both groups ($p = 0.000$).
Conclusion: This study concluded that the inclusion of the breathing exercise program along with posture correction exercises is more effective than posture correction exercise alone in people with forward head posture.

***Keywords**:* forward head posture, breathing exercises, posture correction exercises, peak expiratory flow, CVA craniovertebral angle

INTRODUCTION

Forward Head Posture (FHP) is a bad neck posture characterized by the forward translation of the cervical vertebrae and hyperextension of the upper cervical vertebrae.[1] FHP is defined as the flexion of the lower cervical spine (C4-C7) and dorsal extension of the head and upper cervical spine (C1-C3), which results in an increase in the cervical curvature, or hyper-lordosis.[2] The craniovertebral angle, which is the angle between the tragus of the ear and the c7 vertebrae and is greater than 50 degrees, is known as the main predictor of FHP. A CVA less than 48–50 degrees indicate FHP. (3) It is caused by poor working posture, poor rest patterns, lack of physical activity, weight gain, decreased kinaesthesia, and poor movement and position patterns, and it has been proven that this inappropriate posture weakens respiratory function. [1,4]

Breathing is a complex process that includes both mechanical and non-mechanical components. Age, sex, lifestyle, illness, postural abnormalities, etc. are certain variables that affect the normal functioning of the respiratory system. [5] These factors are also seen to impede PFT outcomes. [6] Any alterations in the head or neck alignment, as well as any weakening of respiratory muscles, harm an individual's respiratory function. [1,5] 83% of individuals with neck pain accompanied by FHP show vivid alterations in their breathing patterns. [7] When breathing normally, the chest should expand horizontally rather than vertically and start with stomach breathing instead of chest breathing. Overactive sternocleidomastoid (SCM), trapezius, and scalene muscles raise the clavicles upward in the incorrect upper chest breathing pattern, which adds to muscular imbalance. [8] It has been observed that FHP patients with persistent neck pain have shorter and weaker respiratory muscles than healthy people.[9]

Due to increased FHP, the main respiratory muscle, the diaphragm loses its ability to expand, resulting in the recruitment of axillary muscle, the elevation of the rib cages, a decrease in thoracoabdominal mobility, and impaired diaphragmatic ability to ventilate. [10,11] As the respiratory muscles contract tightly, alveolar ventilation decreases [5] and as the se accessory muscles use more energy to accomplish the work of breathing, it may result in more exhaustion. [12] It is noticed that muscle imbalance is a major contributor to forward head position. [8] Furthermore, FHP also decreases lung functioning, which results in decreased forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow rate (PEFR), and maximal inspiratory and expiratory pressure. [12,13] Early FHP changes muscular strength and stiffness. Still, long-term FHP worsens diaphragmatic contraction and thoracoabdominal mobility, resulting in transitory entrapment of the phrenic nerve, which not only causes diaphragmatic activity but also lowers its neuronal activity. [5,14–16] Furthermore, it has been reported that forward head posture has an immediate negative effect on respiratory function and reduces breathing capacity which can be improved through manual therapy and therapeutic exercise. [1,5,8]

Forward head posture impacts respiratory function and reduces breathing, yet, no studies have been done to examine the effects of breathing exercises and posture correction exercises on improving breathing in people with forward head posture. The effects of both breathing and posture correction exercises to improve breathing in people with forward head postures are unknown. This study is done to rationalise the combined effect of both posture correction exercises with breathing exercises for people with forward head postures.

Study design

A randomized control trial was done with a sample size of 30 to check the effectiveness of breathing exercises and posture control exercises in individuals with FHP. In this study, individuals of both genders, ages 18 to 25, with a cranio-vertebral angle less than 50 degrees and a PEFR value less than 400 ml, were included. Individuals with any other cervical or spinal deformities, cardio-pulmonary conditions, smokers, and any unresolved underlined conditions were excluded.

Photogrammetric method:

The photogrammetric method is an accurate, non-invasive, and objective method for posture analysis of adolescents using MB-ruler software, as it eliminates the risk of exposure to harmful radiation encountered with the radiographic method, and this method is also highly reliable ICC>0.972) and test-retest (ICC>0.774).[17,18] The craniovertebral angle may vary between sides in FHP patients who have mechanical neck discomfort. [19]

Peak Flow Meter:

A peak flow meter is an instrument used to measure peak expiratory flow rate, which is the maximal rate of airflow a subject can achieve by a forced expiration. [20] The peak flow meter can be used by healthy individuals, asthmatic patients, and COPD patients to check the exhalation capacity. [12,21]

PROCEDURE

After receiving the approval of the Institutional Ethical Committee, all subjects were screened for study eligibility prior to enrolment. Demographical data was collected from all consented subjects followed by a thorough examination.

For measuring cranio-vertebral angle using the photogrammetric method.

A smartphone (an iPhone 11) was mounted on a tripod stand and set at a height of 100 cm above the subject's shoulder. The camera was set to be parallel to the ground using the Level application. The subjects were instructed to flex and extend their neck three times before taking a resting position while standing. Before taking photos, it was explained to every participant to adopt a relaxed resting position, to look forward to the target, and place their arms beside their bodies while placing a long pen was placed on the participant's C7 spinous process. The digital camera took three sagittal plane pictures, from each side. Three images were taken with to aim to reduce bias brought on by participants' stress during photographic capture and eliminate measurement discrepancies caused by postural swaying.

The photos were taken, saved to the laptop, and opened in JPG format with the MB Ruler software. The MB Ruler software's points were placed on the images of the C7 spinous process. A line was drawn from the spinous process to the tragus of the ear and the angle was measured (measuring the craniovertebral angle; the intersection of a horizontal line passing through the C7 spinous process and the line joining the midpoint of the tragus of the ear is identified as the craniovertebral angle).

For measuring PEFR

A peak flow meter (PULMOPEAKTM) was used to assess the peak expiratory flow rate. The subjects were handed the peak flow meter for taking the measurement. Subjects were instructed to inhale as deeply as they could, clamp the nostril to prevent air from escaping, and forcefully exhale in one swift, strong, and thorough blow into the peak flowmeter's mouthpiece. To prevent an air leak, the mouthpiece was securely sealed between the participants' teeth and lips. After each test, care was taken to clean the mouthpiece and return the peak flow meter's point to its initial point. Three trials were made and the highest core of those three was recorded.

Exercise protocol for Control versus experimental group

30 participants were chosen for the study and evenly split into two groups. While Group B only received the posture correction exercises, Group A received both breathing and postural correction exercises five days per week for a month.

The workout regimen includes diaphragmatic breathing drills with a 1kg resistance, thoracic expansion drills, and relaxed breathing drills. Exercises for correcting posture included flexor strengthening, shoulder retractors, and cervical extensor stretching. Exercises for the neck's isometric muscles and the pectorals were also done, as well as chin tucks to strengthen the deep cervical flexors.

To determine the impact of the exercise program on FHP, pre- and post-interventional PEFR and CVA angles were evaluated.

Pictures

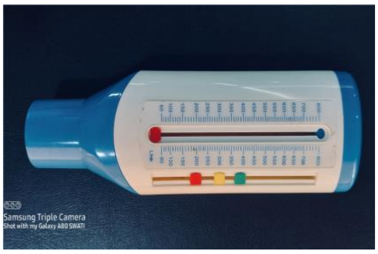

Figure 1: Peak flow meter

Figure 2: Photogrammetric Method

Figure 3: Resisted diaphragmatic breathing

Data Analysis

Data analysis was carried out by SPSS (version 21.0, SPSS Inc, Chicago, IL) software. Descriptive statistics including mean, standard deviation, and ranges (means and medians) were used to describe participants' demographics and variables. Moreover, the paired t-test and independent t-test were used to assess the effect between and within both the experimental and control groups wherein a P-value<0.05 is considered statistically significant.

RESULTS

The study included 30 subjects. Of those 15 were in the experimental group and 15 were in the control group with a mean age of 28.46 ± 6.24 and 33.46 ± 8.05 respectively. In the experimental group, 11 were female and 4 were male whereas in the control group, 13 were female and 2 were male. The BMI of the experimental group was 22.92 ± 2.39 and 24.20 ± 3.92 in the control group. (Table1)

A comparison of peak expiratory flow rate shows a significant difference between the experimental and control group, (p=0.042) and the craniovertebral angle between the experimental and control group shows a highly significant difference. (p=0.000) (Table2)

DEMOGRAPHIC ANALYSIS (TABLE1):

Variables	Experimental group	Control group
Age (years)	28.46±6.24	33.46±8.05
Sex (F: M)	11:4	2:13
Height (cm)	167.46±6.95	169.93±5.24
Weight (kg)	64.33±8.19	69.86±11.81
BMI (kg/m^2)	22.92±2.39	24.20±3.92

COMPARISONS OF OUTCOME MEASURES IN BOTH THE GROUPS (TABLE-2)

OUTCOMES		EXPERIMENTAL	CONTROL	DIFFERENCE	PVALUE
PEFR	PRE	291.33±32.04	285.33±61.62	58	0.009
	POST	376.66±43.03	312.66±69.74		0.042
CVA	PRE	46.18±2.42	42.86±3.85	1.42	0.009
	POST	48.90±1.97	44.16±3.97		0.000

Paired Samples Test

		Paired Differences				Sig. (2-tailed)
		Mean	Std. Deviation	95% Confidence Interval of the Difference		
				Lower	Upper	
Pair 1	Pretest1–Pretest2	243.80667	48.34280	225.75517	261.85816	.000
Pair 2	Posttest1-Posttest2	298.14000	64.15972	274.18237	322.09763	.000

DISCUSSION

Nowadays a large number of individuals use laptops, computers, TV, and video games for an extended period. As a result, maintaining poor ergonomics for a prolonged time might result in the development of a forward head posture. Continuous repetition of these postures results in a deformity that causes neck and upper back discomfort, stiffness, shallow breathing, and respiratory difficulties. Due to its diminished activities, those with FHP will develop lower diaphragmatic strength in the future.

This study will protect the people from this issue. It is done to determine the effect of breathing exercises and posture correction exercises in improving peak expiratory flow rate in adults with forward head posture. In this randomized controlled trial, we found evidence that breathing exercises along with posture correction exercises improved respiratory function in people with forward head postures after the 4 week of intervention program containing breathing exercises along with posture correction exercises compared to the same therapeutic program without breathing exercises.

It has been observed that due to FHP, there is shortening, and weakening of the accessory respiratory muscle and it also impairs the diaphragm's ability to ventilate, and breathing dysfunction also occurs leading to impaired pulmonary function. A study by *Juchul-et-al(2017)* found that upper thoracic spine mobilization and mobility exercise has helped to treat FHP and to improve CVA.[22] Similarly *Kim S Y et al (2015)*discovered that sustained neutral apophyseal glides (SNAGS) can benefit in the correction of neck postures and pulmonary functioning in individuals with forwarding head postures.[23] Scapular stabilization has been found to reduce the compensatory movements of the muscles implicated in FHP, which improves neck alignment.[24] In a pilot study, it has been found that in chronic neck pain patients with FHP, cervical stabilization enhanced respiratory strength and CVA.[10]

This study included a total number of 50 subjects, out of which 35 met the inclusion criteria and were divided into two groups. Group A was the experimental group and group B was the control group. The experimental group has a Female: Male ratio of 11:4 and the control group have 2:13. Breathing exercise along with posture correction exercise was given to the experimental group and only posture correction exercise was given to the control group. Breathing exercises were diaphragmatic breathing exercises, deep breathing exercises, and thoracic expansion exercises whereas posture correction exercises were chin tucks exercises, neck isometrics, and stretching of cervical extensors and pectoralis muscles. The experimental group undergoing both breathing and posture correction exercises showed significant improvements in primary and secondary outcomes as compared to a control group who underwent only postural correction exercises. A comparison of pre and post-test respiratory measures i.e. PEFR significantly increased in the experimental group (p=0.042) denoting improvement in pulmonary functions whereas no significant difference was noted in the control group (p= 0.000) after 4 weeks of intervention.

Moreover, CVA pre- and post-values improved significantly in the experimental group as compared to the control group. Despite of small sample size and lack of long-term follow-up. It is suggested that both breathing and posture correction exercises will be effective in improving pulmonary function as well as reducing forward head posture.

This study was done only on young people, thus a further study on different age groups such as teenagers or older individuals might be conducted. The sample size is quite small, therefore, a multicentric study can be done for further evaluation.

CONCLUSION

This study found that including the breathing exercise program along with posture correction exercises helps in activating the diaphragm which loses its functions due to forward head posture. It was also found that a decrease in craniovertebral angle decreases the peak expiratory rate hence, decreasing the breathing capacity of any person having a forward head posture. It can be concluded from this study that customized breathing exercises are to be prescribed to adults after assessing forward head posture.

Declaration by Authors

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