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Immediate effect of intercostal stretch on chest expansion in healthy smokers

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ABSTRACT

Intercostal stretch is a neuro physiological facilitation technique which has been proved to be effective on the ventilator parameters. Smoking is a world-wide problem which causes major health risks that are related to respiratory and cardiovascular diseases. Cigerrete smoking causes the alteration in lung function, increase the air way resistance and also irritates the airways. 30 subjects were taken for the study those who met with inclusion and exclusion criteria. Intercostal stretch was given to the subjects from 3^{rd} to 8^{th} rib. Chest expansion and 6 minute walk distance was calculated pre and post intervention immediately. Paired t test was calculated. The results of the study suggest that there is no significant difference in six minute walk distance ($p>0.05$) and there is a significant improvement in the chest expansion ($p<0.05$) immediately after the intercostal stretch in healthy smokers.

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INTRODUCTION

Even though there is a decline in the incidence of smoking in the past few years but it still remain one of the major cause of morbidity and mortality (Ng *et al.*, 2014), smoking is one of the main predisposing cause for morbidity and mortality in the world (Lim *et al.*, 2012).

As per the report of World Health Organization (WHO) more than 5 million of deaths were because of the use of tobacco (World Health Organization, 2016). The main risk factor for the pulmonary and cardio vascular diseases is smoking. The respiratory function in many of youths is affected because of smoking (Tantisuwat and Thaveeratitham, 2014). Tobacco consists of more than 4000 different com-

pounds some are carcinogenic and some are irritative (Jaakkola *et al.*, 2019). Inhaling cigarette smoking irritates the airways causes the vaso constriction of airways leading to alteration in the resistance to the airflow (Reddy *et al.*, 2019).

Due to the smoking there will be chronic hypoxia, hypercapnia, hyperinflation of lung will be seen and this will lead to the reduction of the lung function. The GOLD guidelines has reported that there are many toxins present in the tobacco that causes the damage to the lung tissue and alter the function of the lung (Vestbo *et al.*, 2013). The results of pulmonary function test indicates the decline in the lung function and can be used to prevent or reduce the occurrence of lung diseases before the appearance of clinical symptoms (Tantisuwat and Thaveeratitham, 2014).

Chest expansion measurement was first described by Moll *et al.* (1972). Chest expansion is measured as thoracic girth measurement. It is calculated by subtracting the girth measurement on maximal expiration from maximal inspiration (Moll and Wright, 1972).

In the healthy person chest expansion varies between 4 cm and 7 cm. Chest expansion varies with aging it tends to decline (up to 50%-60% between age of 15 -75 years) and to be 20% greater in men (Debouche *et al.*, 2016).

Intercostal (IC) muscles are the several group of muscles that run between the ribs. Structurally and functionally intercostal muscles resembles skeletal muscles that helps in increasing the anterio posterior diameter of the ribcage by the upward and outward movement of the ribs (Troyer *et al.*, 2005).

Proprioceptive Neuromuscular Facilitation (PNF) is a form of stretching where the muscle is passively stretched and contracted alternatively. With the application of this technique the nerve receptors of a muscle extends its length. It is usually given as a combination of passive stretching and isometric contraction. Application of PNF results in increasing the strength of the muscle, endurance, enhances the stability as well as mobility of the muscle and helps in execution of the movement in a controlled and coordinated manner for better restoration of the function. Recent evidences has suggested that PNF is also known to improve lung functions. The stimuli can be given in many methods in order to facilitate the movement. The neurophysiological facilitation techniques used to facilitate the respiratory movements are intercostal stretch, vertebral pressure to the upper and lower thoracic spine, anterior stretch and posterior lift, moderate manual pressure, perioral pressure, abdominal co-contraction. Intercostal stretch is a technique that helps in re-establishing the normal breathing pattern and proved to be helpful in increasing the mobility of chest wall and thereby increasing chest expansion (Pryor and Prasad, 2008).

Limited studies were present on the effect of intercostal stretch in smokers. The present study aimed at finding the immediate effect of intercostal stretch on chest expansion in healthy smokers .

METHODOLOGY

This experimental study was done on 30 participants in an outpatient Department of Durgabai Deshmukh College of Physiotherapy from august 2020 to January 2021 after informed consent and institutional ethical committee approval. All the subjects were randomly selected according to inclusion criteria (Male smokers, had smoking duration more than one year, and aged between 20-40 years, absence of musculoskeletal disorders, respiratory and neuromuscular disease) and exclusion (if any comorbidities were present, such as heart disease, bronchial asthma, bronchiectasis, pulmonary fibrosis, ankylosing spondylitis, and any chest wall deformities) criteria.

Prior to the intervention chest expansion measurement. And six minute walk distance (6MWD) were calculated. Instructions to the subjects: clear instructions were given to all the subjects regarding the pattern of breathing. The examiner should place the inch tape around the thorax at the level of the fifth thoracic spinous process and the third intercostal space at the midclavicular line level and ask the subject to inhale slowly and deeply and exhale completely. Chest expansion should be calculated as the difference between the inspiratory and expiratory diameter.

Six minute walk distance was calculated as per the ATS (American thoracic society) guidelines. Place the subject in supine position and the pressure was applied on the 3rd rib upper border in the down ward direction i.e. widening of the intercostal space above it. The application of the stretch was timed with exhalation phase and maintain the stretched position as the patient continue to breath in usual manner. This technique was given from the 3^{rd}rib to the 8^{th}rib for three breaths with 1 minute rest and for three repetitions. Post intervention chest expansion and six minute walk distance was calculated.

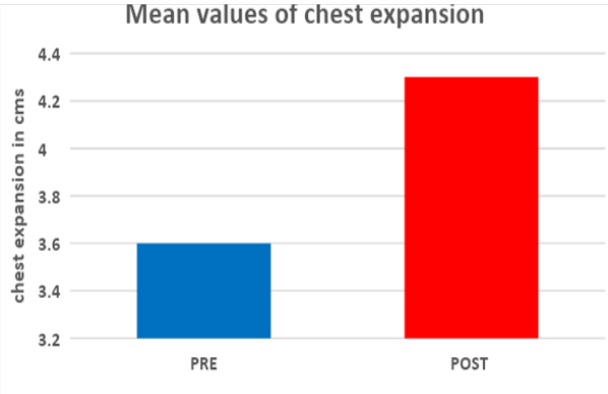
Statistical Analysis and Results

Statistical analysis was performed by using SPSS statistical software. The scores were analysed using statistical tests. Mean, standard deviation of all the

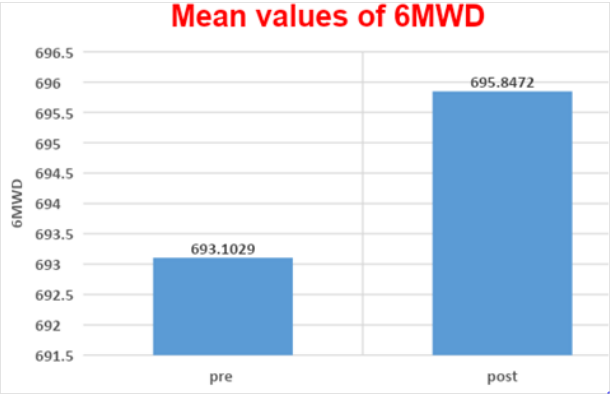
values were calculated. The observed differences were tested with the t at 95% level of significance. Paired t test is used to calculate the results.

RESULTS

The Table 1 shows the mean and standard deviation of the demographic data such as Age, Height, Weight and BMI. The results of the Table 2 and Graph 1 shows that there is increase in the mean values immediately after the intercostal stretch. Table 3 shows that there is a significant difference in the chest expansion ($p<0.05$) immediately after the intercostal stretch. Table 4 and Graph 2 shows that there is increase in the mean values of 6MWD immediately after the intercostal stretch. The results of the Table 5 shows that there is no significant difference in the 6 MWD as the p value is 0.687 ($p>0.05$) immediately after the intercostal stretch in the healthy smokers.



Graph 1: Mean values of chest expansion pre and post intervention



Graph 2: Mean values of 6MWD pre and post intervention

DISCUSSION

The main aim of the study is to know the immediate effect of intercostal stretch on chest expansion in healthy smokers. The outcome measures taken were chest expansion and 6 minute walk distance immediately after the intervention. The results of the study shows that there is increase in the chest expansion post intervention with a mean value of 4.3 from 3.6 cm at 5^{th} thoracic spine level. There is increase in the 6MWD immediately after the intervention from a mean value of 693.10 to 695.84. The statistical analysis of the data of 6 MWD also did not show the significant results immediately post intervention as the p value is 0.687($p>0.05$). The statistical analysis of the data for chest expansion shows that there is a significant improvement in the chest expansion immediately after the intervention ($p<0.05$).

Merghani and Saeed (2013) conducted a study on the 153 male school boys of age 9-14 years and he found that FEV1 and FVC were significantly lower in the group who has been exposed to tobacco smoking than the control group that is non-smoking group.

Rico-Martín *et al.* (2019) conducted a study on the effect of smoking and physical activity on pulmonary function and assessed the lung function of the youth and concluded that even though they were of young in age and short term smokers, the findings confirm that smokers have decreased pulmonary function as compared with their non-smoking peers, when they do not regularly perform moderate or vigorous physical activity. Significant differences ($p < .05$) were observed in the spirometric values of FEV1%, FEV6%, lung age, and lung age–chronological age in those who practiced mild physical activity.

Mohan *et al.* (2012) conducted a study on the healthy males on the effect of intercostal stretch on pulmonary function parameters. In this study experimental group were given intercostal stretch with breathing control and control group was given breathing control alone. The results showed there were significant difference in FEV1% ($P < 0.03$) compared to control groups ($P < 0.507$).

Gupta (2014) conducted a study on effect of intercostal stretch technique and anterior basal lift on respiratory rate, peripheral saturation of oxygen and heart rate in ICU patients and found that intercostal stretch is more effective than anterior basal lift in reducing the respiratory rate, increasing the saturation of oxygen and decreasing the heart rate which helps in weaning from the ventilator early in the ICU patients.

Intercostal stretch increases the alpha2021 motor

Table 1: Demographic data

Variable	Mean	Standard deviation
Age	31.15	9.045
Height	172.28	7.415
Weight	82.57	12.25
BMI	27.98	4.517

Table 2: Mean and Standard Deviation for chest expansion pre and post intervention

		Mean	N	Std. Deviation	Std. error mean
Pair 1	Chest exp pre	3.6000	30	.82078	.18353
	Chest exp post	4.3000	30	.57124	.12773

Table 3: Paired sample statistics for chest expansion pre and post intervention

	Paired differences					
	Mean	Standard deviation	Standard error mean	T	Df	Sig(2 tailed)
Pair1 pre-post	-.70000	.57124	.12773	-5.480	19	.000

Table 4: Mean and Standard Deviation for 6MWD pre and post intervention

		Mean	N	Std. Deviation	Std. error mean
Pair 1	Pre 6MWD	693.1029	30	81.11697	18.13831
	Post 6MWD	695.8472	30	94.97589	21.23725

Table 5: Paired sample statistics for 6MWD pre and post intervention

	Paired differences					
	Mean	Standard deviation	Standard error mean	T	Df	Sig(2 tailed)
Pair1 pre post	-2.74425	30.04477	6.71821	-.408	19	.687

neuron activity causing the muscle fibers to contract. The gamma and alpha motor neuron activity is enhanced by the application of the stretch to the chest wall before the inspiration (Eklund *et al.*, 1964).

The results of the study conducted by Inkaew *et al.* (2016) concluded that there is no significant difference in the FEV1 and FVC values between the experimental group (intercostal stretch) and the control group (breathing control) as the P>0.05.

Limitations of the study includes small sample size, duration of the treatment protocol. Further, studies can be done by taking a large sample size, can be done on different age groups. The present study was conducted on the immediate effect of intercostal stretch on healthy smokers further studies can be done for the longer duration of the intervention.

CONCLUSION

The results of the present study suggest that immediately after the application of intercostal stretch there is a significant difference in the chest expansion as it enhances the chest wall elevation and chest expansion and diaphragm excursion to improve intrathoracic lung volume which contributes to improvement in flow rate percentage whereas there is no significant difference in the 6-minute walk distance in healthy smokers.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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