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# Effectiveness of Respiratory Muscle Stretch and Chest Mobility Exercise on Pulmonary Function and Chest Expansion in Elderly Population

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**Abstract:** ***Background**: People above 60 years of age are considered as 'elderly' population. There is marked variation in the effect of ageing on PFT and is associated with reduction in chest wall compliance and increased air trapping resulting in decline in FEV1 and vital capacity **Objective**: To compare the effect of respiratory muscle stretch and chest mobility exercise on pulmonary function and chest expansion in elderly population. **Method**: Based on the inclusion and exclusion criteria 30 subjects were selected & divided into 2 groups, Group A &B (15 in each). After the pre-test Group A were given with diaphragmatic breathing exercise and respiratory muscle stretch where as Group B given with diaphragmatic breathing exercise and chest mobility exercise for 2 weeks. As pre & post-test they are assessed for PFT and Chest expansion measurement. **Result**: Statistical analysis of intergroup significance by independent 't' test for FVC, the 't' value is 2.312, was found to be statistically significant at p=0.025, Whereas p value of FEV1 is 2.25, was found to be statistically significant at p=0.042.and for chest expansion 't' value is 2.83, was found to be statistically significant at p=0.003.**Conclusion**: The result of the study supports the effectiveness of respiratory muscle stretch and chest mobility exercise on pulmonary function and chest expansion in elderly population.*

**Keywords:** PFT, FVC, FEV1, chest expansion

## 1. Introduction

People above 60 years of age are typically considered as 'old' and called 'elderly' population [1]. At the biological level, ageing results from the impact of the accumulation of a wide variety of molecular and cellular damage over time. The age-related decline in muscle strength, vision, memory, locomotion, nutrition, immunity and homeostasis progress slowly. A decline in immunity as well as age-related physiologic changes leads to an increased burden of communicable diseases in the elderly. According to the Government of India statistics, cardiovascular disorders account for one third of elderly mortality. Respiratory disorders account for 10% mortality while infections including TB account for another 10% [2].

As age increases, musculoskeletal deterioration increases such as kyphotic curvature of the Spine and AP diameter of chest increases thus reducing chest wall compliance. Vertebral intersegmental motion decreases gradually which eventually leads to reduced range of thoracic extension resulting in tightness of the shoulder quadrant muscles. Postural changes such as kyphosis from osteoporosis limits chest expansion during inspiration and places the diaphragm at a mechanical disadvantage. Age related. There is marked variation in the effect of aging on pulmonary function tests and is associated with reduction in chest wall compliance and increased air trapping resulting in decline in FEV1 and vital capacity because of reduced elastic recoil the chest wall stiffness invariably increases[3,4] .

Suitable lengthening of soft tissue around the chest wall and respiratory muscles is required for efficiency of contraction force of respiratory muscles and chest movement. Conventionally, to increase flexibility of muscles, techniques such as passive stretching, PNF stretching, self-stretching, passive mobilization of joints, chest/thorax mobility exercises and massage are recommended[5] .Respiratory muscle stretch is given to stretch the inspiratory chest wall muscles during inspiration and expiratory chest wall muscles during expiration [6]. Respiratory muscle stretching has been suggested as an intervention that is able to reduce chest wall rigidity, consequently increasing its expansion and improving ventilatory patterns in patients with chronic obstructive pulmonary disease [10].

Chest mobility exercises is one of many techniques and very important in conventional chest Physiotherapy for increasing chest wall mobility and improving ventilation. Chest mobilizations help to increase chest wall mobility, flexibility, and thoracic compliance. The focus of the treatment is most commonly on improving the range and quality of thoracic extension and rotation and on increasing the mobility of thoracic ribs. The techniques of chest mobilization are composed of rib torsion, lateral stretching, back extension, lateral bending, and trunk rotation [7, 8, and 9].

## 2. Methodology

The study was designed to determine the effectiveness of respiratory muscle stretch and chest mobility exercise on pulmonary function and chest expansion in elderly population. Ethical approval was obtained from the ethical committee of co-operative institute of health sciences, Thalassery.

**Materials and Tools**
Computerised spirometer, Inch tape, Pen, Couch, Chair Nose clip, Towel

**Study Setting:** Community level in Thalassery.
CIHS- Thalassery.
**Research Design:** comparative study
**Sample Design:** Simple random sampling
**Sample Size:** 30
**Study Duration:** 2 months

**Measurement Tools:**
**Computerised spirometry:** FEVI, FVC
**Chest expansion –**Inch tape measurement

**Inclusion Criteria**: Age group: 65-70 Years
Both M&F, Ability to communicate and follow commands, who had independent mobility.

**Exclusion Criteria:** Musculoskeletal disease, Rheumatic diseases, COPD, Orthopaedic diseases, Osteoporosis, Chest wall deformities Spinal abnormalities or deformities that compromise respiratory mechanics. Respiratory comorbidities, recent history of thoracic or abdominal surgery, Hemodynamic instability, Psychiatric illness, Non-smokers, Non cooperative patients.

**Study Procedure**
Based on the inclusion and exclusion criteria 30 subjects were selected. Signed written consent had been taken from all the subjects. The subjects were divided into two groups Group A & Group B, 15 subjects in each group. Prior to the test demographic data are collected (age, weight, height). Pre-test was assessed with pulmonary function test[42] and chest expansion measurement. The pulmonary function test was performed in a seated position using a portable spirometer according to the American Thoracic Society guidelines, Dynamic volumes including FVC and FEV1 are recorded whereas Chest expansion measurement was measured at 4$^{th}$intercostal level using inch tape. After the pre-test Group A given with diaphragmatic breathing exercise as 3 sets of 3-4 deep breaths and respiratory muscle stretch includes two sets of 10 consecutive active assisted stretches for each muscle, with a 30-s interval whereas Group was also given with diaphragmatic breathing exercise as 3 sets of 3-4 deep breaths and chest mobility exercise carried out as 5 sessions /week for 2 weeks. As a post-test they are assessed for pulmonary function test and Chest expansion measurement after 2weeks. All subjects rested before the pulmonary function test to avoid fatigue.

Pectoralis Major: The patient was positioned sitting with their back supported, with the arm to be stretched abducted, forearm flexed and hand kept on the occipital region, with one the therapist's hands supporting craniocaudal direction, following the muscle fibers arm and the other hand in the lateral region of the upper third of the upper chest, displacing the hand in the direction.

Lateral chest : The patient was positioned in lateral and dorsal decubitus using a half-moon-shaped foam roller placed in the lateral region, the supra-lateral forearm flexed with the hand placed in the occipital region with the therapist supporting rib mobilization in the craniocaudal direction and displacing the supra-lateral arm of the patient to perform shoulder abduction with the other hand. The exercises were explained to the patients before a stretching session by providing a demonstration to them performed by the therapist. The participants were also Instructed to exhale slowly. The stretching occurred throughout the expiratory phase allowing inspiratory muscles to reach their maximum length during the relaxation time.

CHEST MOBILITY EXERCISE: Each active assisted exercises listed below was repeated 6 times on each side with rest of period for 30 seconds in between. The intervention was carried out as 5 sessions /week for 2 weeks .Each Exercise was accompanied by breathing pattern. In neutral position of exercises, subjects were asked to exhale during flexion, turning or extension subject was asked to do inhale.

1) Lateral flexion of thorax in supine lying: Subject in supine, asked to fold hands or keep it by side of his body. Therapist then passively flexes subject thorax from head end of body on left and right side with slight over stretched at the end range alternately.
2) Lateral flexion in side lying on pillows Subject lying on one side on 2 pillows Therapist stretches the upper side of thorax with shoulder abduction. The same exercise was repeated on other side.
3) Direct rib mobility: Subject in supine lying with arms folded and hands clasped on back of neck, therapist performs flexion and extension of the subject thorax.
4) Trunk rotation in sitting position: Active and passive trunk rotation on both sides were performed. Exhalation in a forward position was carried out at the beginning of flexion, and rotation of the left side was performed laterally with inspiration.
5) Trunk side flexion in sitting position: Active and passive trunk side flexion on both sides were performed. Exhalation in a forward position was carried out at the beginning of flexion, and rotation of the left side was performed laterally with inspiration. Side flexion on left was accompanied by shoulder abduction of right hand and vice versa.

## 3. Results

Paired 'T' Test (Comparison With in the Group)
The mean column displays the mean pre-test and post-test FVC among individuals in the Group A. Since the *p-value* is 0.021, that is less than 0.05 ,this shows there is significant difference between the pre-test and post-test FVC in Group A. The FVC has significantly increased in the post test. This proves the effect of respiratory muscle stretch exercise on FVC.

The mean column displays the mean pre-test and post-test FVC in Group B. Since the *p-value* is 0.029,that is less than 0.05, this shows there is significant difference between the pre-test and post-test FVC in Group B. This shows the effect of chest mobility exercise. So we have seen that there is significant increase in FVC among the individuals in Group A as well as in Group B.

The mean column displays the mean pre-test and post-test FEV1 among individuals in the Group A. Since the *p-value* is

0.003, that is less than 0.05, this shows there is significant difference between the pre-test and post-test FEV1 in Group A. The FEV1 has significantly increased in the post test. This proves the effect of respiratory muscle stretch exercise on FEV1.

The mean column displays the mean pre-test and post-test FEV1 among individuals in the Group B. Since the *p*-value is 0.007, that is less than 0.05, this shows there is significant difference between the pre-test and post-test FEV1 in Group B. This shows the effect of chest mobility exercise. So we have seen that there is significant increase in FEV1 among the individuals in Group A as well as in Group B.

The mean column displays the mean pre-test and post-test chest expansion among individuals in the Group A. Since the *p-value* is 0.002, that is less than 0.05, this shows there is significant difference between the pre- test and post-test chest expansion among individuals in the Group A. The chest expansion has significantly increased in the post test. This proves the effect of respiratory muscle stretch exercise on chest expansion.

The mean column displays the mean pre-test and post-test chest expansion among individuals in the Group B. Since the *p-value* is 0.005, that is less than 0.05, this shows there is significant difference between the pre- test and post-test chest expansion in Group B. This shows the effect of chest mobility exercise. So we have seen that there is significant increase in chest expansion among the individuals in Group A as well as in Group B.

**Table 1:** Paired 'T' Test (Within Group)

Paired T Test (Comparison With in the Group)

The difference (0.39) shows the difference between post- test mean in two groups (2.78&2.39).

| Paired 'T' Test (Within Group) | | Group A | | | Group B | | |
|---|---|---|---|---|---|---|---|
| Outcomes | | FVC | FEV1 | Chest Expansion | FVC | FEV1 | Chest Expansion |
| Mean | Pre Test | 2.19 | 1.55 | 2.67 | 2.37 | 1.68 | 2.65 |
| | Post Test | 2.78 | 2.17 | 3.26 | 2.39 | 1.83 | 2.79 |
| Sd | Pre Test | 0.46 | 0.4 | 0.52 | 0.55 | 0.39 | 0.59 |
| | Post Test | 0.34 | 0.39 | 0.39 | 0.56 | 0.43 | 0.50 |
| Table 'T' Value | | | | | | | |
| Calculated 't' Value | | 9.12 | 12.78 | 7.76 | 2.67 | 6.57 | 3.46 |
| P Value | | 0.021 | 0.003 | 0.002 | 0.029 | 0.007 | 0.005 |

**Table 2:** Independent T Test Values

| Independent 'T' Test (Between Group) | | FVC | FEV1 | Chest Expansion |
|---|---|---|---|---|
| Mean | Group A | 2.78 | 1.55 | 3.26 |
| | Group B | 2.39 | 1.68 | 2.79 |
| SD | Group A | 0.34 | 0.4 | 0.39 |
| | Group B | 0.56 | 0.39 | 0.50 |
| Table 'T' Value | | | | |
| Calculated 'T' Value | | 2.312 | 0.926 | 2.83 |
| P Value | | 0.025 | 0.36 | 0.003 |

Whereas the *p-value is 0.025, i.e.,* < 0.05, this shows the significant difference in post-test FVC scores between the Group A and Group B. The FVC in the Group A is significantly high.

Hence respiratory muscle stretch exercise has significant high effect as compared with chest mobility exercise.

The Mean column in the t test table displays the mean post-test FEV1 scores in Group A and Group B respectively. SD is 0.34, shows the difference between post-test mean in two groups (2.17&1.83). Whereas *p- value* is 0.042, i.e., < 0.05, this shows the significant difference in post-test FEV1 between the Group A and Group B. The FEV1 in the Group A is significantly high. Hence respiratory muscle stretch exercise has significant high effect as compared with chest mobility exercise.

The Mean column in the t test table displays the mean post-test chest expansion scores in Group A and Group B respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.47) shows the difference between post- test mean in two groups (3.26&2.79).Since the *p-value* is 0.003 that is less than 0.05 this shows there is significant difference in post-test chest expansion between Group A and Group B. The chest expansion in the Group A is significantly high.

Hence respiratory muscle stretch exercise has significant high effect as compared with chest mobility exercise.

## 4. Discussion

This study is to compare respiratory muscle stretch and chest mobility exercise on pulmonary function and chest expansion in elderly population, ageing results from the impact of the accumulation of a wide variety of molecular and cellular damage over time. This leads to a gradual decrease in physical and mental capacity, a growing risk of disease, and ultimately, death.

In this study based on the inclusion and exclusion criteria 30 subjects were selected. The subjects were divided into two groups Group A & Group B, 15 subjects in each group. Pre-test was assessed with pulmonary function test and chest expansion measurement. In PFT dynamic volumes including FVC and FEV1are recorded whereas Chest expansion measurement was measured at $4^{th}$intercostal level using inch tape. After the pre-test Group A given with diaphragmatic breathing exercise and respiratory muscle stretch where as Group B was also given with diaphragmatic breathing exercise and chest mobility exercise carried for 2 weeks . As a post-test they are assessed for pulmonary function test and Chest expansion measurement after 2 weeks.

On statistical analysis the mean pre-test FVC in group A is 2.19 which is increased to 2.78 in post- test. In Group B pre-test FVC is 2.37 which is increased to 2.39 in post-test. Which indicate that respiratory muscle stretch have considerable increase in forced vital capacity than patients who receive chest mobility exercise.

The mean pre-test FEV1 in Group A is 1.55 which is increased to 2.17 in post-test. In Group B pre-test FEV1 is 1.68 which is increased to 1.83 in post-test. Which indicate that respiratory muscle stretch have considerable increase in forced expiratory volume in one second than patients who receive chest mobility exercise

The mean Pre-test chest expansion in Group A is 2.67 which is increased to 3.26 in post-test. In Group B pre-test chest expansion is 2.65 which is increased to 2.79 in post-test. Which indicate that respiratory muscle stretch have considerable increase in chest expansion than patients who receive chest mobility exercise.

Respiratory muscle stretch is given to stretch the inspiratory chest wall muscles during inspiration and expiratory chest wall muscles during expiration. Respiratory muscle stretching has been suggested as an intervention that is able to reduce chest wall rigidity, consequently increasing its expansion and improving ventilatory patterns in patients with chronic obstructive pulmonary disease. B Rupnar Ganesh,et al concluded that five days of respiratory muscle stretch gymnatics improves chest expansion in and pulmonary function within the elderly population.

Chest mobility exercises is one of the techniques used in conventional chest Physiotherapy for increasing chest wall mobility and improving ventilation. Chest mobilizations help to increase chest wall mobility, flexibility, and thoracic compliance. The focus of the treatment is most commonly on improving the range and quality of thoracic extension and rotation and on increasing the mobility of thoracic ribs. The techniques of chest mobilization are composed of rib torsion, lateral stretching, back extension, lateral bending, and trunk rotation. Gopi parth mehta, et al proves that chest mobility exercises shown significant improvement in chest expansion and PFT such as FEV1 and FVC than only active assisted exercise program for elderly subjects.

Statistical analysis of intergroup significance by independent't' test for FVC, the 't' value is 2.312, was found to be statistically significant at $p=0.025$, i.e , $p<0.05$. Whereas' value of FEV1 is 2.25, was found to be statistically significant at $p=0.042$. i.e., $p<0.05$, and for chest expansion 't' value is 2.83, was found to be statistically significant at $p=0.003$, i.e, $p<0.05$. So we can conclude that FVC, FEV1 and chest expansion among the groups are significant whereas respiratory muscle stretch group (Group A) shows higher significance.

Muscle stretching is a technique which is widely used in rehabilitation program to increase flexibility. Stretching of muscle fibers promotes increase in the number of sarcomeres, in respiratory muscle stretch, ventilation in the lungs are effected by the length of muscle which relates to the maximal force of either diaphragm and intercostals muscles. If chest muscle stretch exercises are used with breathing exercises it improves breathing pattern and pulmonary functions. During respiratory muscle stretch there is increase in muscle length ,an adequate length of respiratory muscles would promote an improvement in their contractile capacity and an increase in thoracic expandability providing benefits in the performance of respiratory mechanics and also stretching of muscles around shoulder joint like scalene, sternocleidomastoid, upper trapezius, pectoralis major, and serratus anterior can increase vital capacity. The activity of these muscles elevates shoulder girdle and increases vertical motion of the rib cage during the inspiratory phase of breathing. Retraction of these soft tissues and muscles around the chest wall limits the chest expansion. Lengthening of soft tissue around the chest wall and respiratory muscles helps efficiently in the contraction force and chest movement by gaining the lung volumes, breathing control. Hagbarth et al. reported respiratory muscle stretching, designed to stretch the respiratory muscles which affected chest wall compliance and decreased chest wall stiffness hence improved the pulmonary function and chest expansion .

Chest mobility exercise are also effective in improving the mobility of chest wall, trunk, and shoulders and improves ventilation on the side to be treated, emphasising depth of inspiration and controlling expiration. But based on our result both techniques shows significant effect on pulmonary function and chest expansion, but when comparing , respiratory muscle stretch group shows higher improvement than chest mobility group. So that the present study suggest that respiratory muscle stretching is more effective for pulmonary function and chest expansion than the chest mobility exercise.

## 5. Conclusion

The result of the study support the effectiveness of respiratory muscle stretch and chest mobility exercise on pulmonary function and chest expansion in elderly population. There was a significant improvement on FVC, FEV1 and chest expansion in group (Group A) who receive respiratory muscle stretch than chest mobility group (Group B). With an intervention that is safe, efficious and cheap, we can apply respiratory muscle stretch for improving pulmonary function in elderly.

## 6. Future Scope

Limitation of the study include small size which might affect the generalization of the result, less study duration and all measurements were taken manually and this may introduce human error which could affect the reliability of the study. Based on the result of the statistical analysis, it is suggested that the future studied should be modified to accommodate the following changes: long term study must be carried out for more reliability and validity. Long term follow up is needed to evaluate the effect of training. To establish greater efficacy of the training, the study should be undertaken in large scale randomized clinical trial that would include a large sample size and longer period of training session.

## References

[1] Govt. of India; central statistics office ministry of statistics and programme implementation – situation analysis of elderly in India –June 2011.

[2] WHO- ageing and health , Feb 2018.
[3] Gopal k ink ,Geriatric health in India : concerns and solutions –2008.
[4] Dey AB. Handbook of Geriatrics, 1st edition. Hyderabad, India: Paras Medical Publisher; 2007. p. 118.
[5] Banerjee S. Geriatric health in India. West Bengal Branch, Kolkata: Association of Physicians of India; 2009
[6] Santhosh b salagre Health issues in geriatrics- 2013, page 765-770
[7] Ganesh BR and Anantlaxmi Goud .Short term effects of respiratory muscle stretch gymnastics versus hold relax PNF on pulmonary functions and chest expansion in elderly individuals, International Journal of Applied Research 2017; 3(7): 1018-1022
[8] Frownfelter dona , dean Elizabeth –cardiovascular and pulmonary physical therapy evidence and practice :4 th edition 2005.
[9] Kakizaki F, Tsuzura Y, Yamada M: Immediate effect of respiratory muscle stretch gymnastics and diaphragmatic breathing on respiratory pattern- 1999 Feb;38(2):126-32.
[10] Dornelas de Andrade A**: Respiratory muscle stretch acutely increases expansion in hemi paretic wall.** 2018 Aug;254:16-22. 10.1016/j.resp.2018.03.015. Epub 2018 Mar 30
[11] ShuklaGopiAtulkumar, Parth Mehta , G., Babu K., V., Akshata, & Kumar N: Effect of combined Hold-relax PNF stretching with chest mobility exercise on improving chest expansion and pulmonary function test in elderly people- *International Journal of Physiotherapy*, *2*(3), 563-671. https://doi.org/10.15621/ijphy/2015/v2i3/67032
[12] Oyariaun, James Goodwin :'Pulmonary function in aging'. 2006 Sep; 1(3): 253–260.Published online 2006 Sep. doi: 10.2147/ciia.2006.1.3.253
[13] Cleber Nascimento do Carmo, Sandra et al 1986 to 2006Mortality due to cardiorespiratory diseases in elderly people in Mato Gro sso State, Dec;54(12):1703-006
[14] JP Janssens, Pache JC, Nicod LP:physiological changes in respiratory function associated with ageing- 1999 Jan;13(1):197-205
[15] Mark lYamada M:Immediate effect of respiratory muscle stretch gymnastics and diaphragmatic breathing on respiratory pattern- 1999 Feb;38(2):126-32
[16] Miriam Johnson, J Martin Bland, Bland JM, Gahbauer EA, Ekström M, Sinnarajah A, Gill TM, Currow DC'Breathlessness in the Elderly During the Last Year of Life Sufficient to Restrict Activity: Prevalence, Pattern and Associated Factors- PMC jan 2017
[17] Xuemei Sui, respirator LaMonte MJ, Laditka JN, Hardin JW, Chase N, Hooker SP, Blair SN:Fitness and adiposity as Mortality Predictors in Older Adults**.-** 2007 Dec 5;298(21):2507
[18] Paul L.Enright, et al 'Prevalence and Correlates of Respiratory Symptoms and Disease in the Elderly', Published online Sep. doi: 10.2147/ciia.2006.1.3.253Sep1994
[19] D M Mannino, KJ davis'Lung function decline and outcomes in an elderly population' Published online 2006 Mar 3. doi: 10.1136/thx.2005.052449
[20] Cecil, 'Prevalence and Correlates of Respiratory Symptoms and Disease in the Elderly' et al Sep1994
[21] Deiki Daiki Adachi, Shu Nishiguchi, Naoto Fukutani, Takayuki Hotta, 'Age-Related Decline in Chest Wall Mobility Jun;115(6):384-9. doi: 10.7556/jaoa.2015.
[22] Bruce M. Psaty, Joseph A delany,Alice marnold, 'Prevalence of Cardiovascular Diseases among Older Adults', , International Journal of Applied Research Published online 2015 Nov 4. doi: 10.1161/circulation.115.018610 . 2015
[23] Ganesh BR and Anantlaxmi Goud .Short term effects of respiratory muscle stretch gymnastics versus hold relax PNF on pulmonary functions and chest expansion in elderly individuals3(7): 1018- 1022
[24] Minoru ITO,F kakizaki,Y T ,zuzura,'Immediate Effect of Respiratory Muscle Stretch Gymnastics and Diaphragmatic Breathing on Respiratory Pattern,.;38(2):126-32. doi: 10.2169/internalmedicine.38.126. 1999 Feb
[25] Putt m t, Michelle watson, Helen sele, 'Muscle stretching technique increases vital capacity and range of motion in patients with chronic obstructive pulmonary disease'. Arch Phys Med Rehabil 2008 Jun;89(6):1103-7.

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