Original Article

EFFECTIVENESS OF THORACIC CORE CONDITIONING USING STRETCH POLE FOR COMMUNITY ELDERLY WITH MODERATE COPD- A SINGLE BLIND STUDY

Kritica Boruah [1], Vinod Babu. K *[2], Sai Kumar. N [3], V.R. Ayyappan [4].

[1] MPT 2012-2014, *[2] Assistant Professor in Physiotherapy,[3] Principal & Professor in Physiotherapy, [4] Associate Professor.

K.T.G. College of Physiotherapy and K.T.G Hospital. Bangalore. India.

ABSTRACT

Back ground and introduction: Thoracic Core conditioning exercises are found to be effective in increasing chest expansion in healthy middle aged individuals. The purpose is to find the short term effect of thoracic core conditioning using stretch pole on improving thoracic expansion, intensity of perceived exertion of breathlessness and functional performance for community elderly with moderate COPD.

Method: A Single blinded experimental study design, 40 subjects with moderate COPD randomized 20 subjects into each Study and Control group. Study group received thoracic core conditioning exercises with stretch pole while Control group received thoracic core conditioning exercises without stretch pole for one week. Subjects were followed up after one week post intervention where no intervention was given during follow up week.

Results: Analysis using RMANOVA found that there was a statistically significant ($p<0.05$) greater percentage of improvement in Chest expansion, intensity of perceived exertion and functional performance following one week of intervention in Study group when compared with Control Group. During follow-up there is statistically significant greater percentage of maintenance of improvements were found in study group than control group.

Conclusion: It is concluded that thoracic core conditioning exercises with stretch pole found to be more effective than without stretch pole in short term improving chest expansion, intensity of perceived exertion and functional performance in community elderly with moderate COPD.

KEYWORDS: COPD; Thoracic core conditioning exercises; Stretch pole; Community elderly; Chest expansion; Breathlessness; Dyspnea; Functional performance; Thoracic mobility; Perceived exertion.

Address for correspondence: Vinod Babu.K, Assistant Professor, K.T.G. College of Physiotherapy and K.T.G. Hospital, Bangalore-560 091, India. **Email:** vinodbabupublications@gmail.com

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INTRODUCTION

Global Initiative for chronic Obstructive Lung Disease defined chronic Obstructive pulmonary Disease COPD a common preventable and treatable disease characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airway.[1] Moderate COPD is defined as FEV1/FVC < 0.7 and FEV1 < 80% predicted.[2] The prevalence of moderate COPD is 7.2% in 45-54 years age group, 14% between 55 and 64 years, 20.7% at 65-74 years and 22.9% at 75 years and older.[2]

In COPD impairments such as shortened muscle length and weakness, reduced chest configuration, chest movement, and reduced thoracic mobility in all the three planes increases the effort of breathing involving more of accessory muscles of respiration.[3] As a compensatory response in advanced stages of COPD barrel chest and pursed lip breathing further reduces thoracic mobility and upper limb activity that may lead to tightening and stiffness around the muscle of upper quadrant increasing chest wall resistance and work of breathing.[4]

Thoracic Core Conditioning training or Core instability strength training involves exercises that are given for both trunk muscles and postural control and may thus have the potential to induce benefits in trunk muscle strength, spinal mobility and balance performance.[5] Thorax is easily extended or elevated in supine position on stretch pole, cylinder shaped tube made of materials similar to a special Styrofoam (Bolster) with a length of 98 cm and diameter of 15cm, and is therefore expected to improve thoracic mobility by core conditioning.[6] Thoracic Core Conditioning training with stretch pole exercises are found effective in increasing thoracic expansion in healthy, non-smoking middle aged and elderly females. [6] It proved to be a feasible exercise program for aged seniors and their related deficits in measures of trunk muscle strength, spinal mobility, dynamic balance and functional mobility[5] but its effect on pathological condition has not been studied and limited.

Community Geriatrics with COPD presents with greater exercise limitations due to significant age related changes in lung function, reduced thoracic mobility, chest expansion, cardiac function, decreased peripheral muscle strength and endurance, dyspnea, sensory impairment, and loss of coordination.[7] The study with research question does the thoracic core conditioning using stretch pole have an effect in community elderly with moderate chronic obstructive pulmonary disease. Hence, the purpose of the study to find the effect of thoracic core conditioning using stretch pole on thoracic expansion, severity of breathlessness and functional performance for community elderly with moderate COPD. Study hypothesis stated there will be a significant difference in thoracic core conditioning with or without stretch pole on improving thoracic expansion, intensity of perceived exertion and functional performance in community elderly with moderate chronic obstructive pulmonary disease.

MATERIALS AND METHODS

Repeated measures single blind two group experimental study design. The ethical clearance was obtained from ethical committee of K.T.G. College of Physiotherapy and K.T.G. Hospital, Bangalore and study was registered with University Reg. No. 09_T031_39081. Subjects were recruited and study conducted at community day care centers and Community Geriatrics centers across Bangalore. Subject included were elderly with age group 65-75 years both males and females[8], moderate airflow obstruction graded as GOLD 2: 50% FEV_1 < 80% predicted[2], history of exacerbation during stair climbing that reduces with rest or short-acting drugs, score d"7 in Body mass index (B), Airway obstruction (O), Dyspnea (D) and Exercise capacity (E) i. e BODE index[9-11], subjects with chest expansion <1.5cm[12] of average of three trial at xiphisternal level. Subjects were excluded with comorbid conditions- cardiovascular disease, diabetes mellitus. Cor pulmonale which present with ankle swelling, diagnosis of heart failure [13], history of severe exertion, angina or other pain in six minute walk test, pathology of spine such as disc protrusion, spondylolisthesis, Osteoporosis, mostly seen with a risk of fracture provided by bone marrow density test.

Procedure of randomization and single blind:

The forty (n=40) subjects were selected based on inclusion criteria. Once the subject agrees to participate in the study, an informed written consent was taken from the subjects. The subjects were randomly allocated using simple random sampling method 20 each into two groups using forty pieces of marked paper were tightly folded and placed in a box. After shaking the box, each subject was asked to withdraw a paper and allotted to groups based on group code. Complete explanations were given to subjects in both the groups separately. Subjects were blinded on either type of intervention and to which group they were belonged. Throughout the treatment sessions, subjects from both the groups were not allowed to have any interaction to each other and the subjects were not aware of what kind of treatment they received and its effects.

Intervention: Study group subjects received thoracic core conditioning using stretch pole. Control group subjects received thoracic core conditioning without stretch pole. Total duration of treatment was 2 weeks, 2 sessions per day, each lasting for 30-45 minutes, for a total of 14 treatment sessions over 1 week followed by one week follow up.

Intervention for study group: The exercise intervention were performed supine on stretch pole that was placed longitudinally down the length of the spine.[6] The intervention included a total of ten exercises consisting of three preliminary motions:

A. Preliminary Motions[6]: 1.Maintenance of shoulder adduction: Subjects supine on stretch pole were asked to take both their arms away from the body with their elbow extended till a comfortable extent and relax for about 60 seconds. The knees had to be in flexed position; 2. Maintenance of external rotation of hip joint: Subjects supine on stretch pole were asked to take both their legs away from midline with the knees slightly flexed till a comfortable extent and relaxing for about 60 seconds. Arms were placed beside the body; 3. Unilateral shoulder abduction and contralateral hip external rotation: Subjects supine on stretch pole were asked to take one arm away from the body with elbow extended and the opposite leg away from the midline with knee in slight flexion and relaxing for about 60 seconds. The same procedure were followed by the opposite arm and leg. The uninvolved arm was placed beside the body and the uninvolved leg was kept in knee flexed position. **B. Main Exercises:** 4.Floor polishing: Subjects supine on stretch were asked to round hands to draw circles on the floor. The knees were maintained in flexed position; 5. Scapular adduction and abduction: Subjects supine on stretch pole with their knee in flexed position were asked to repeatedly extend both arms with hands reaching the ceiling with scapular abduction and then relaxing the scapulae while maintaining the arm in extension; 6. Shoulder abduction and adduction: Subjects supine on stretch pole with their knees flexed were asked to repeatedly abduct and adduct both shoulders with both forearms sliding on the floor; 7. Internal and external rotation of hips: Subjects supine on stretch pole were asked to repeat hip external and internal rotation with both hips in extension and knees in slight flexion; 8. Slight knee extension: Subjects supine on stretch pole were asked to repeat hip abduction in extension and external rotation with knees in slight flexion; 9. Swaying: Subjects supine on stretch pole were asked to repeat sliding the trunk laterally on the stretch pole; 10. Abdominal breathing: Subjects supine on stretch pole were asked to puff out the abdomen during inspiration and drawing it in during expiration. The exercises were performed for 30-45 minutes where each main exercise had to be repeated 8-10 times per session.[14] Subjects were advised to perform the exercises with deep breathings. The intervention was carried out twice a day for 7 days with total of 14 sessions.

Intervention for Control Group: The same exercise intervention was followed without a stretch pole and the exercises were performed in supine flat on floor.

Follow up intervention: Subjects were instructed to carry their routine daily activities, but no intervention was given during this one week period.

Outcome Measurements:

Pre, Post-Intervention and Follow up measurements were taken in both the groups. Outcome measurements such as Thoracic expansion using inch tape, Intensity of perceived breathlessness using Modified Borg Scale of Dyspnea and Functional performance using Clinical COPD Questionnaire were measured.

Thoracic Expansion: It was assessed using inch tape at two levels of thorax, the axillary and the xiphisternal level. The subject was instructed to stand with the arms relaxed by the sides. The tape was placed around the circumference of the chest. To measure the upper thoracic excursion, tape was placed at the level of 5th thoracic spinous process and 3rd intercostal space at mid clavicular line. To measure the lower thoracic excursion, tape was placed at 10th thoracic spinous process and tip of xiphoid process. The measurements were taken at peak inhalation and an average of 3 trials was documented.[15] The reliability of this technique shows an interclass correlation coefficient of 0.81 to 0.91 proving it reliable in clinical setting.[15]

Intensity of perceived exertion: It was measured using the Borg Scale of dyspnea or Modified Borg Scale. The subjects were given and explained clearly about the scale which consisted of grades from 0-10. They had to accurately grade their breathlessness which they had felt while performing their daily activity during the week.[16] The scale showed a sensitivity of 75% and a specificity of 78%.[16, 17, 18, 19]

Functional performance: It was measured by using Clinical COPD Questionnaire which contained 10 questions and were divided into 3 domains namely symptom, mental and functional state. The subjects were instructed to circle the response that best describe their feeling since the previous week of assessment.[20] CCQ is the best patient-reported outcome tools to measure functional performance.[20]

Statistical Methods:

Descriptive statistical analysis presented as mean ± SD. Significance is assessed at 5 % level of significance with p value was set at 0.05 (1 tailed Hypothesis). Repeated Measures Analysis of Variance (RMANOVA) with Bonferroni's as post-hoc test was used to find the significance in pair-wise comparison pre to post treatment, post to follow-up treatment and pre-treatment to follow-up. Friedman's ANOVA was used analysis within the group to perform pair-wise contrast comparison. Independent 't' test as a parametric and Mann Whitney U test as a non-parametric test have been used to compare the means between the groups with calculation of percentage of difference between the means. The Statistical software namely SPSS 16.0 Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS AND TABLES

Within the group multiple level analysis found that there is a statistically significant change in means of Chest Expansion at Axilla and Xiphisternum, Modified Borg Scale when means were analyzed from pre intervention to post intervention and to follow up measurements where as means of Functional Performance shown statistically significant change from pre intervention to post intervention and no statistically significant change in follow up measurements. There is a clinical significance effect with large effect size. When pre-intervention means of measurements were compared between the groups there is no significance difference, whereas, there is a statistically significance difference between the groups when means were compared at 1st week of post intervention and at follow up.

Chart- 1: Analysis of chest expansion between the Groups.

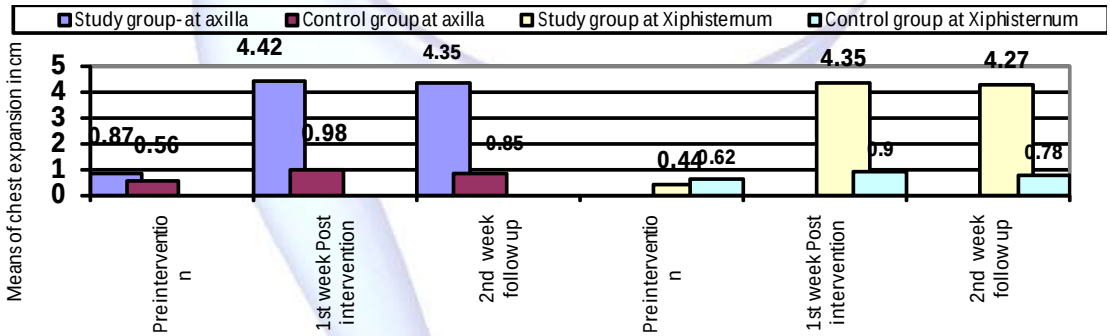


Fig. 1: Scapular adduction and abduction.

Table 1: Basic Characteristics of the subjects studied.

Basic Characteristics of the subjects studied		Study Group	Control Group	Between the groups Significance
Number of subjects studied (n)		20	20	--
Age in years (Mean± SD)		69.15 ±3.42 (65-75)	68.45± 2.85 (65.0 - 75.0)	p= 0.827 (NS)
Gender	Males	11	12	p=0.763 (NS)
	Females	9	8	
	Significance	P=0.000**	P=0.000**	

Table 2: Analysis of CE, MBS and FP within the Study group (Repeated measures analysis).

Study Group	Pre intervention (Mean±SD) min-max	1st week Post Intervention (Mean±SD) min-max	2nd week Follow up (Mean±SD) min-max
Chest Expansion at Axilla in cm	0.87± 0.52 (0.2- 2.0)	4.42±0.59 (3.9-5.1)	4.35± 0.61 (3.7-5.0)
Chest Expansion at Xiphisternum in cm	0.44± 0.41 (0.1- 2.0)	4.35±0.81 (3.4-5.1)	4.27± 0.78 (3.4-5.0)
Modified Borg Scale	3.20± 1.05 (2.00- 5.00)	0.77± 0.25 (0.5-1.0)	0.82± 0.24 (0.5-1.0)
Functional Performance	3.16± 0.74 (2.0- 4.0)	0.72± 0.19 (0.5-1.0)	0.73± 0.20 (0.5-1.0)

** Statistically Significant difference p<0.05; NS- Not significant; a. Friedman's ANOVA.

		Percentage of change	F value[a]	Significance[b] (1-tailed) P value	Effect size r	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Chest Expansion at Axilla in cm	Pre to post	40.80%	432.02	P= 0.000**	+0.95 (Large)	-4.11	-3.09
	post to follow up	-15.83%	85.5	P= 0.000**	+0.05 (Large)	0 .06	0 .13
	Pre to follow up	40.00%	393.84	P= 0.000**	+0.95 (Large)	2.98	4.02
Chest Expansion at Xiphisternum in cm	Pre to post	88.86%	392.05	P= 0.000**	+0.95 (Large)	-4.49	-3.32
	post to follow up	-18.39%	60.34	P= 0.000**	+0.05 (Large)	0.05	0.11
	Pre to follow up	87.04%	396.05	P= 0.000**	+0.95 (Large)	3.25	4.39
Modified Borg Scale	Pre to post	-75.93%	152.66	P= 0.000**	+0.84 (Large)	1.84	3
	post to follow up	-18.39%	2.111	P= 0.975 (NS)	+0.10 (Large)	-0.15	0.05
	Pre to follow up	-74.37%	134.49	P= 0.000**	+0.84 (Large)	-2.97	-1.77
Functional Performance	Pre to post	-77.21%	229.31	P= 0.000**	+0.91(Large)	1.96	2.9
	post to follow up	13.88%	2.111	P= 0.975 (NS)	+0.02 (Small)	-0.03	0.01
	Pre to follow up	-76.89%	231.86	P= 0.000**	+0.91 (Large)	-2.89	-1.95

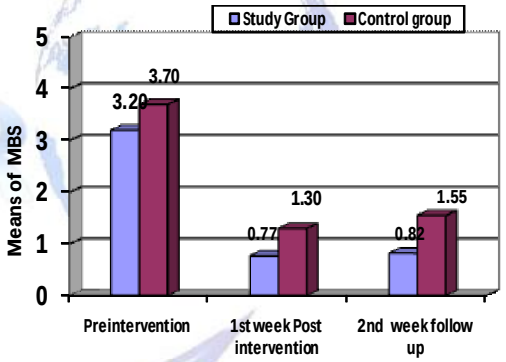
a- Adjustment for multiple comparisons: Bonferroni.

Table 3: Analysis of CE, MBS and FP within the Control group (Repeated measures analysis).

Control Group	Pre intervention (Mean±SD) min-max	1st week (Mean±SD) min-max	2nd week Follow up (Mean±SD) min-max
Chest Expansion at Axilla in cm	0.56± 0.35 (0.1- 1.2)	0.98± 0.33 (0.5-1.5)	0.85± 0.31 (0.4-1.5)
Chest Expansion at Xiphisternum in cm	0.62± 0.35 (0.1- 1.3)	0.90 ± 0.32 (0.3-1.5)	0.78± 0.30 (0.2-1.3)
Modified Borg Scale	3.70± 1.08 (2.0- 5.0)	1.30± 0.47 (1.0-2.0)	1.55± 0.60 (1.0-3.0)
Functional Performance	3.10± 0.66 (2.0- 4.0)	2.80± 0.65 (1.8-3.8)	2.79± 0.65 (1.8-3.9)

** Statistically Significant difference p<0.05; NS- Not significant; a. Friedman's ANOVA.

Chart- 2: Analysis of Modified Borg Scale between the Groups.



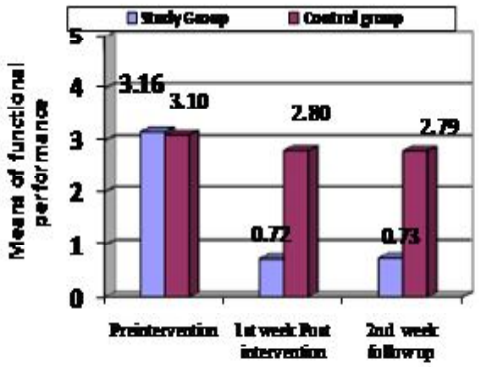
Control Group		Percentage of change	F value	Significance b (1-tailed) P value	Effect size r	95% Confidence Interval for Difference	
						Lower Bound	Upper Bound
Chest Expansion at Axilla in cm	Pre to post	7.50%	246.49	P= 0.000**	+0.52 (Large)	-0.49	-0.33
	post to follow up	-1.32%	45.22	P= 0.000**	+0.19 (Large)	0.07	0.18
	Pre to follow up	5.17%	72.53	P= 0.000**	+0.40 (Large)	0.18	0.38
Chest Expansion at Xiphisternum in cm	Pre to post	4.51%	128.41	P= 0.000**	+0.38 (Large)	-0.35	-0.2
	post to follow up	-1.33%	76.72	P= 0.000**	+0.47 (Large)	0.07	0.15
	Pre to follow up	2.58%	33.86	P= 0.000**	+0.23 (Large)	0.08	0.24
Modified Borg Scale	Pre to post	-64.86%	202.66	P= 0.000**	+0.84 (Large)	1.90	2.89
	post to follow up	19.23%	6.33	P= 0.126 (NS)	+0.22 (Large)	-0.54	0.04
	Pre to follow up	-58.10%	120.72	P= 0.000**	+0.77 (Large)	-2.72	-1.57
Functional Performance	Pre to post	-9.67%	106.84	P= 0.000**	+0.22 (Large)	0.21	0.37
	post to follow up	-0.35%	1.3	P= 1.000(NS)	+0.008 (Small)	-0.02	0.05
	Pre to follow up	-10%	91.75	P= 0.000**	+0.23 (Large)	-0.40	-0.21

a- Adjustment for multiple comparisons: Bonferroni.

Table 4: Comparison of parameter measured between the groups (COMPARATIVE ANALYSIS).

	Percentage of difference	Effect size D	Z value and non-Parametric Significance [a] P value	t value [a] & Parametric Significance [b] P value	95%Confidence interval of the difference Lower	Upper
Pre intervention						
Chest Expansion at Axilla in cm	-43.35%	0.33 (Large)	-1.83 P=0.068 (NS)	2.177 P=0.036*	0.02	0.59
Chest Expansion at Xiphisternum in cm	33.96%	0.23 Large	-2.08 P=0.038 (NS)	-1.444 P=0.157(NS)	-0.42	0.07
Modified Borg Scale	14.49%	0.22 Large	-1.457 P=0.165 (NS)	-1.480 P=0.147(NS)	-1.18	0.18
Functional Performance	-1.91%	+0.04 (Medium)	-0.150 P=0.883(NS)	0.270 P=0.788(NS)	-0.38	0.5
1st week of post intervention						
Chest Expansion at Axilla in cm	-12.74%	0.96 Large	-5.483 P=0.000**	22.60 P=0.000**	3.13	3.75
Chest Expansion at Xiphisternum in cm	-13.14%	0.94 Large	-5.451 P=0.000**	17.60 P=0.000**	3.05	3.85
Modified Borg Scale	20.00%	0.57 Large	-3.864 P=0.000**	-4.38 P=0.000**	-0.76	-0.28
Functional Performance	11.81%	+0.90 Large	-5.429 P=0.000**	-13.55 P=0.000**	-2.39	-1.76
Follow up						
Chest Expansion at Axilla in cm	-13.46%	0.96 Large	-5.384 P=0.000**	22.62 P=0.000**	3.18	3.81
Chest Expansion at Xiphisternum in cm	-13.82%	0.94 Large	-5.450 P=0.000**	18.41 P=0.000**	3.1	3.86
Modified Borg Scale	61.60%	0.62 Large	-4.099 P=0.000**	-4.97 P=0.000**	-1.02	-0.42
Functional Performance	34.17%	0.9 Large	-5.431 P=0.000**	-13.44 P=0.000**	-2.36	-1.74

Chart- 3: Analysis of Functional performance between the Groups.



DISCUSSION

It is found from the analysis that the subjects who received one week of thoracic core conditioning exercises with or without stretch pole have shown significant short term effect on improving chest expansion, perceived intensity of exertion of breathlessness and functional performance and these improvement in thoracic expansion and dyspnea were maintained significantly up to one week follow up. However, the greater percentage of improvement is found in study group who received thoracic core conditioning exercises with stretch pole.

In study group, the improvements in thoracic expansion from pre to post intervention could be because of the thoracic core conditioning exercises using stretch pole. Following exercises using stretch pole thoracic spine extension range of motion increases. Simply lying supine with one's spine on the stretch pole is thought to reduce hyper nutation of sacrum and if combined with core conditioning exercises realigns spine and respiration related muscle[6] particularly thorax is easily extended in supine on stretch pole that improve thoracic mobility.[6] In elderly with COPD response to hyperinflation impairments such as increased work of breathing, secondary postural deformities occur which further puts the accessory respiratory muscles into mechanical disadvantage.

The core conditioning exercises helps to stretch the respiratory muscles which reduces the muscle tension resulting in relaxation of the muscles of the respiration. Watanabe N et al., stated that core conditioning exercises are designed to relax the trunk muscles which might enhance thoracic expansion.[21]

In this study group improvement in perceived intensity of exertion dyspnea is attributed to decreased frequency of breathing as a result of increased dead space ventilation following core conditioning exercises. The elderly in study group performed the exercises with deep breathing on stretch pole which might have added to the improvement due to use of proper breathing pattern thereby reducing tightness, chest wall resistance and work of breathing resulting in the reduction of dyspnea and improving thoracic mobility. Janos P et al in their study stated that reduction in breathing frequency through exercise training reduces and delays the development of dynamic hyperinflation.[22] While performing the stretch pole exercises thorax is observed to expand on the pole. These exercises are subjected to be more comfortable in supine on the stretch pole with reduced strain or pressure and a better feeling of relaxation of the whole body that influence the relieve tension in respiratory muscle and reducing dyspnea.[6]

In this study group improvement in Functional Performance measured using Clinical COPD Questionnaire domains namely symptom, mental and functional state. The improvement in these domains following stretch pole exercises the actual mechanism is unknown. Functional performance also affected due to severity of dyspnea, reduction in dyspnea might have shown improvement in function. Exercises provide general relaxation to the whole body and a feeling of well being which in turn mediate improving functioning.[23]

In study group, the improvements were significantly maintained up to one week post intervention follow up. This could be because accessory muscles such as scalene and pectoralis major due to disuse results in tightness and add to reduced upper limb activity altogether increasing effort of breathing. The exercises help by improving the upper limb range of motion improving thoracic mobility.

Michael T Putt et al in their study stated that stretching is able to increase ROM in the chest and shoulder girdle and increase vital capacity in patients with COPD in the short term.[24] The dosage of stretch pole exercises used in this study might have brought the short term sustainability of improvement in thoracic expansion and relieving dyspnea thereby improving functional performance.

When means were compared at multiple levels between the groups, at baseline there was no significant difference between the groups this could be standardization of selection of subjects based on inclusion criteria.[9,10,11] Whereas at post intervention and at follow up there was statistically significant differences between the group with great percentage of improvement in post means were found in study group than in control group. At follow up there was significantly greater percentage of maintenance of the improvement in study group than control group. Therefore, it signifies that the thoracic core conditioning exercises with or without stretch pole clinically and statistically effective however greater effect was brought when using stretch pole.

In this study the effectiveness of thoracic core conditioning exercises was determined using standard procedure by blinding the subjects to avoid influences of Placebo effect and reliable measurements tools were used.[15, 16, 17, 18, 19, 20]

Thoracic Core Conditioning training with stretch pole exercises were found effective in increasing thoracic expansion in healthy, non-smoking middle aged and elderly females.[6] It proved to be a feasible exercise program for aged seniors and their related deficits in measures of trunk muscle strength, spinal mobility, dynamic balance and functional mobility.[5]

Based on the finding, it signifies that the thoracic core conditioning exercises with or without stretch pole clinically and statistically have significant effect on improving chest expansion, perceived intensity of exertion of breathlessness and functional performance however greater effect were found by using stretch pole. Hence, the present study rejects the null hypothesis.

Limitations:

Community Geriatrics with COPD presents with

greater exercise limitations due to significant age related changes.[8,25] Therefore, influence of stretch pole exercises on exercise capacity, respiratory muscle strength, cardiorespiratory endurance, quality of life were not evaluated in this study. The study found only short term effects. The study findings are limited to community geriatric with Moderate airflow obstruction. Due to dynamic hyperinflation, the chest wall also expands[26] causing reduced ventilatory capacity affecting pulmonary functions that limit thoracic mobility impairing Quality of life.[27] Therefore, pulmonary functions were not measured in this study.

Further research Recommendations:

Influence of stretch pole exercises on exercise capacity, respiratory muscle strength, pulmonary functions tests, cardiorespiratory endurance, quality of life need to be evaluated in future studies. Further randomized controlled trail are needed to find long term effect of thoracic core conditioning exercises with stretch pole in different pulmonary conditions. Effect of these exercises during pulmonary rehabilitation need to be evaluated in future study. Studies on stretch pole exercises comparing with other thoracic mobility exercises are needed.

CONCLUSION

It is concluded that thoracic core conditioning exercises with or without stretch pole clinically and statistically have significant short term effect on improving thoracic mobility, relieve dyspnea and improve functional performance however greater effect was found when using stretch pole in community geriatric with moderate COPD. Therefore, implementation of thoracic core conditioning exercises with stretch pole in rehabilitation of moderate COPD if aiming to improve thoracic expansion, relieve dyspnea and improve functional performance is recommended in clinical practice.

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Conflicts of interest: None

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