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Short term effects of respiratory muscle stretch gymnastics versus hold relax PNF on pulmonary functions and chest expansion in elderly individuals-a randomized clinical trial

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Abstract
Introduction: Respiratory muscle stretch gymnastics (RMSG) and hold relax PNF is effective in elder patients. RMSG is designed to stretch inspiratory muscle during inspiration and expiratory muscles during expiration. The upper chest wall intercostal muscles and back muscles consist of inspiratory muscles whereas the lower chest wall muscles consist of expiratory muscles. Hold relax PNF is for pectoral muscles to improve chest expansion and functional capacity.
Methods: A randomized clinical trial, 40 subjects with age group above 60 years were randomized into two groups (group A and group B).Group A received RMSG and Group B received Hold relax PNF for 5 days. Outcome measures such as chest expansion at axillary xiphisternal level and pulmonary function test such as FEV1 and FVC were measured before and after five days of treatment.
Results: Analysis by using independent "t" test between the group found that there is no statistically significant difference but by using dependent "t" test within the each group found that there is a statistically significant difference. Comparative analysis of pre intervention means shown that there is no statistically significant difference between the groups. Comparative analysis of post intervention mean shown that there is statistically significant difference in means of chest expansion only in Group A but there is no statistically significant difference in FEV1 and FVC between Group A and Group B.
Conclusion: Present study concluded that five days of RMSG improved chest expansion in Group A whereas both the techniques showed significant improvement in chest expansion and pulmonary function within the groups.

Keywords: RMSG, Hold relax PNF, chest expansion, pulmonary function, FEV1, FVC

Introduction

Background

Elderly persons are defined as people above 60 years of age. The aim of active aging is to extend healthy life expectancy & quality of life for all the elderly individuals.In 2012 WHO has launched World Health Day Theme as 'Ageing and Health' with slogan 'Good Health Adds Life To Years' [1]. The cause of mortality in elderly is mostly due to cardiorespiratory diseases [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 [3]. Vertebral intersegmental motion decreases gradually which eventually leads to reduced range of thoracic extension resulting in tightness of the shoulder quadrant muscles [4]. Postural changes such as kyphosis from osteoporosis limits chest expansion during inspiration and places the diaphragm at a mechanical disadvantage. Reduction in alveolar surface area for gas exchange furthermore increases the amount of physiological dead space [5]. Age related reduction in chest wall compliance is greater than the increase in lung compliance, thus compliance of respiratory system is 20% less in 60 years old people than the 20 years old [6]. Due to a decrease in vital capacity in older individuals because of reduced elastic recoil the chest wall stiffness invariably increases. Hence to the increased flexibility of muscles, PNF stretching can be recommended [5]. The upper chest wall intercostal muscles and back muscles consist mainly of inspiratory muscles, and the lower chest wall muscles consist mainly of expiratory muscles [7].

Respiratory muscle stretch gymnastics (RMSG) is given to stretch the inspiratory chest wall muscles during inspiration and expiratory chest wall muscles during expiration [8]. Tere are limited evidences stating that use of RMSG and Hold Relax PNF is effective in elderly individual. Hence, the present study is undertaken to evaluate short term effect of Respiratory muscle stretch gymnastics and Hold Relax PNF on pulmonary functions and chest expansion in elderly individuals.

Methodology

A randomized clinical trial was conducted in old age homes in and around the Belgavi city, Karnataka, India to evaluate the short term effect of RMSG and Hold Relax PNF on FEV1, FVC and chest expansion in elderly. Total number of subjects were 40 and study was conducted for 3 months.

Inclusion Criteria

- Both male and female ≥60 years
- Chest expansion less than 1.5 cms at two levels
- Ability to communicate and follow commands
- Who have independent mobility

Exclusion Criteria

- Musculoskeletal disorders
- Cardiovascular dysfunction
- Associated conditions restricting chest expansion eg:obesity, severe scoliosis
- Recent chest or abdominal surgeries
- Pathology of spine
- Malignancy

Procedure

Ethical clearance was obtained from Institutional Ethical Committee. Meeting with inclusion and exclusion criteria consent form were given to the subjects. An outcome measures were recorded before and after the treatment. In this study subjects were randomly allocated into two groups (Group A & Group B).Subjects of Group A (n=20) were receive all four patterns of RMSG and a subjects of Group B(n=20) were receive Hold relax PNF stretching.

RMSG:

The following four patterns of RMSG were performed either in sitting or standing position depending upon patient's comfort RMSG No. 1: From a relaxed position with a straight back, slowly elevate both shoulders while moving them backwards. At the same time, lean back while inhaling. After full inspiration, exhale slowly and resume original position. RMSG No. 2: With the back straight, hold both hands at the back of the buttocks. After full and slow inspiration, push the hands away from the body while slowly exhaling. After full expiration, breathe quietly and resume original position. RMSG No. 3: With the back straight, hold both hands in front of the chest with the fingers entwined and the palms in. Inspire fully in this position. Then extend the arms and bend the upper body as far forward as possible while exhaling slowly. After arm extension and body bending, take a full breath in that position. Then breathe quietly and resume original position. RMSG No. 4: With the back straight, hold both hands above the head with arms stretched and palms facing down. After full inspiration in this position pull the arms back while exhaling slowly. After full expiration, resume original position and breathe quietly. Each pattern of RMSG is given for 4 repititions /session and treatment was given twice a day for 5 days.

Hold Relax PNF stretching:

Subject was in sitting position on chair with back support and both arms are comfortably extended ad hands behind the occipital region. Both the shoulders will be position in horizontal extention, abduction and external rotation with elbow bend to perform stretch position of pectoral muscles. Subject is asked to contract the pectoral muscles while moving the limb in the direction of horizontal flexion, in the maintain position of 80^0 to 90^0 of abduction and external rotation with elbow bend to meet the 50-60% of resistance applied by therapist. This isometric contraction is hold for 6 seconds and relax and then stretch in opposite direction passively.6 times repetitions with 30 sec rest period and given twice a day for 5 days.

Result

The study was conducted on total 40 subjects (table 1), in group A there were 20 subjects with mean age 73 years and there were 7 males 13 females were included in this study. In group B there were 20 subjects with mean age 71 years and were 4 males 16 females were included in this study. There is no significant difference in mean ages between the groups.

Table 1: The baseline characteristics of the participants

Characteristic	Group A	Group B
Age(yr),mean(SD)	73(8)	71(6)
Gender, male: female	7:13	4:16
FEV1(%pred),mean,(SD)	56(17)	59(14)
FVC(%),mean (SD)	56(18)	60(18)

Table 2: Comparison of two study groups (A and B) with respect to FEV1 scores at different time points

Variable	Groups	Mean±SD	t-value	P-value
Pretest	Group A	56.60±17.54	-0.5312	0.5984
	Group B	59.30±14.47		
Pretest day 5	Group A	62.10±15.89	-0.6112	0.5447
	Group B	64.95±13.50		
Posttest	Group A	59.25±14.40	-1.2687	0.2123
	Group B	64.95±14.02		
Posttest day 5	Group A	67.00±13.76	-0.6569	0.5152
	Group B	70.00±15.10		

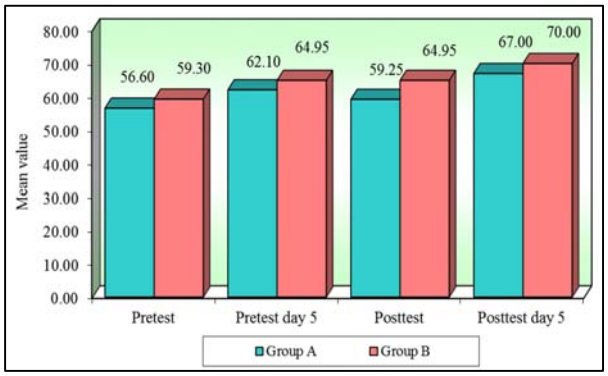

Fig 1: Comparison of two study groups (A and B) with respect to FEV1 scores at different time points

Table 3: Comparison of different time points with respect to FEV1 scores in two study groups (A and B)

Groups	Time points	Mean±Std.Dv.	Paired t	P-value
Group A	Pretest	56.60±17.54		
	Pretest day 5	62.10±15.89	-5.5514	0.0001*
	Posttest	59.25±14.40		
	Posttest day 5	67.00±13.76	-5.5101	0.0001*
Group B	Pretest	59.30±14.47		
	Pretest day 5	64.95±13.50	-5.6758	0.0001*
	Posttest	64.95±14.02		
	Posttest day 5	70.00±15.10	-4.6461	0.0002*

*p<0.05

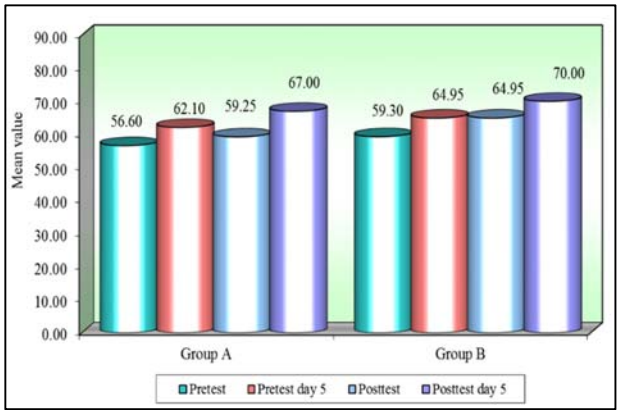

Fig 2: Comparison of different time points with respect to FEV1 scores in two study groups (A and B)

Table 3: Comparison of two study groups (A and B) with respect to FVC scores at different time points

Variable	Groups	Mean ±SD	t-value	P-value
Pretest	Group A	56.50±18.61	-0.7693	0.4465
	Group B	60.95±17.97		
Pretest day 5	Group A	64.55±14.84	-0.4926	0.6252
	Group B	66.95±15.96		
Posttest	Group A	59.60±16.35	-0.7645	0.4493
	Group B	63.60±16.74		
Posttest day 5	Group A	69.70±12.56	-0.5531	0.5834
	Group B	72.30±16.86		

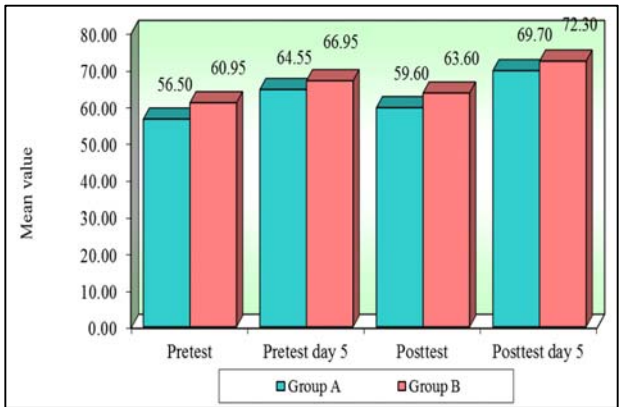

Fig 3: Comparison of two study groups (A and B) with respect to FVC scores at different time points

Table 4: Comparison of different time points with respect to FVC scores in two study groups (A and B)

Groups	Time points	Mean±Std.Dv.	Paired t	P-value
Group A	Pretest	56.50±18.61		
	Pretest day 5	64.55±14.84	-4.3574	0.0003*
	Posttest	59.60±16.35		
	Posttest day 5	69.70±12.56	-4.5852	0.0002*
Group B	Pretest	60.95±17.97		
	Pretest day 5	66.95±15.96	-4.1456	0.0005*
	Posttest	63.60±16.74		
	Posttest day 5	72.30±16.86	-6.5123	0.0001*

*p<0.05

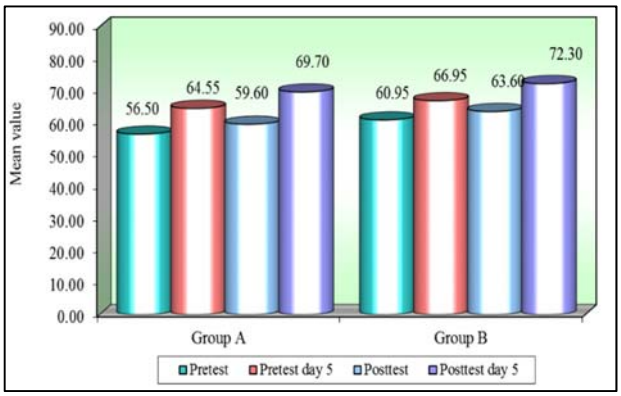

Fig 4: Comparison of different time points with respect to FVC scores in two study groups (A and B)

Table 5: Comparison of two study groups (A and B) with respect to Infraxillary scores at different time points

Variable	Groups	Mean ±SD	t-value	P-value
Pretest	Group A	1.70±0.73	-1.2521	0.2182
	Group B	1.95±0.51		
Pretest day 5	Group A	2.45±0.51	-0.5651	0.5753
	Group B	2.55±0.60		
Posttest	Group A	2.40±0.68	-0.2629	0.7941
	Group B	2.45±0.51		
Posttest day 5	Group A	2.90±0.64	-0.7614	0.4511
	Group B	3.05±0.60		

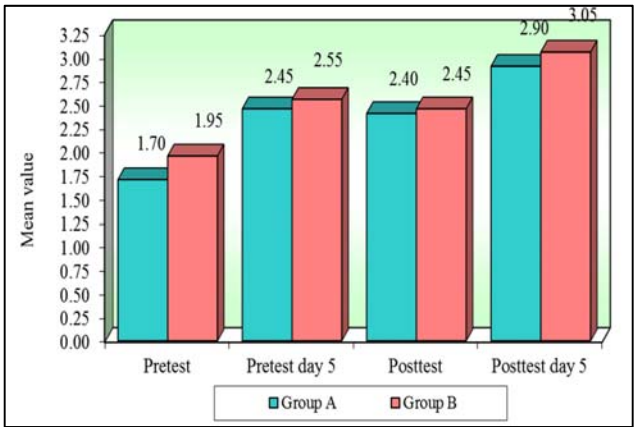

Fig 5: Comparison of two study groups (A and B) with respect to Infraxillary scores at different time points

Table 6: Comparison of different time points with respect to Infraxillary scores in two study groups (A and B)

Groups	Time points	Mean ±Std.Dv.	Paired t	P-value
Group A	Pretest	1.70±0.73		
	Pretest day 5	2.45±0.51	-5.2517	0.0001*
	Posttest	2.40±0.68		
	Posttest day 5	2.90±0.64	-4.3589	0.0003*
Group B	Pretest	1.95±0.51		
	Pretest day 5	2.55±0.60	-4.4853	0.0003*
	Posttest	2.45±0.51		
	Posttest day 5	3.05±0.60	-4.4853	0.0003*

*p<0.05

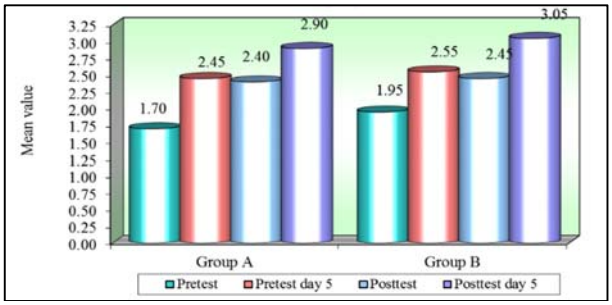

Fig 6: Comparison of different time points with respect to Infraxillary scores in two study groups (A and B)

Table 7: Comparison of two study groups (A and B) with respect to Xiphisternal scores at different time points

Variable	Groups	Mean±SD	t-value	P-value
Pretest	Group A	2.90±0.91	0.4065	0.6867
	Group B	2.80±0.62		
Pretest day 5	Group A	3.80±0.70	2.6042	0.0131*
	Group B	3.25±0.64		
Posttest	Group A	3.55±1.05	0.1582	0.8751
	Group B	3.50±0.95		
Posttest day 5	Group A	5.00±0.73	1.6330	0.1107
	Group B	4.60±0.82		

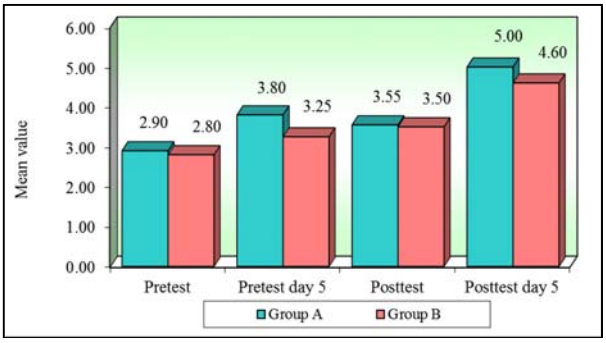

Fig 7: Comparison of two study groups (A and B) with respect to Xiphisternal scores at different time points

Table 8: Comparison of different time points with respect to Xiphisternal scores in two study groups (A and B)

Groups	Time points	Mean±Std. Dv.	Paired t	P-value
Group A	Pretest	2.90±0.91		
	Pretest day 5	3.80±0.70	-5.1073	0.0001*
	Posttest	3.55±1.05		
	Posttest day 5	5.00±0.73	-8.5419	0.0001*
Group B	Pretest	2.80±0.62		
	Pretest day 5	3.25±0.64	-3.9428	0.0009*
	Posttest	3.50±0.95		
	Posttest day 5	4.60±0.82	-5.7722	0.0001*

*p<0.05

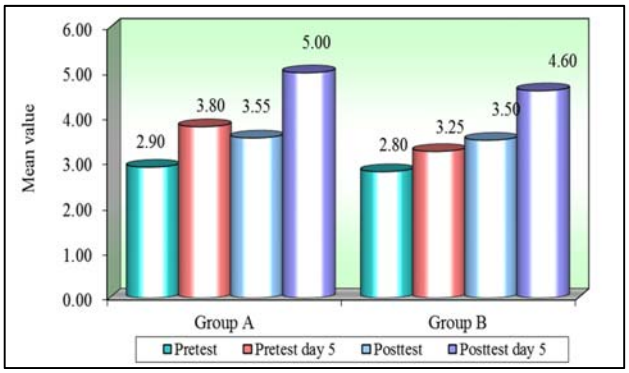

Fig 8: Comparison of different time points with respect to Xiphisternal scores in two study groups (A and B)

Discussion

In the present study we investigated the short term effect of RMSG and Hold relax PNF on pulmonary functions and chest expansion in elderly individuals. RMSG was designed to stretch inspiratory intercostals muscles during inspiration and expiratory intercostal muscles during expiration. In the present study there was overall statistically significant difference in Chest expansion and functional capacity after using both the techniques within the groups but there was no significant difference in between the groups after giving RMSG and Hold Relax PNF in normal elderly individual.

Both the techniques are effective and safe in elderly individual. It is not possible to compare many of the present results with other study results because the evaluation methods used in the present study did not previously applied for intervention. However, Michael T. Putts, *et al* in their study proven that hold relax technique can improve restrictive component in COPD and also improve the flexibility of pectoralis major muscle. Therefore, in this study there is improvement in outcome measures could be due to increase in pectoralis muscle lengthening.[10] The theory of Laplace's law suggests that ventilation in the lungs is affected by the length of muscle which relates to the maximal force of either diaphragm and intercostals muscles. There are some studies which have been shown that stretching of certain muscles around shoulder joint can increase vital capacity. Thus, active chest mobilizations help to increase chest wall mobility, flexibility, and thoracic compliance.[11] Hagbarth *et al*. reported RMSG, designed to stretch the respiratory muscles which affected chest wall compliance and decreased chest wall stiffness hence improved the pulmonary function and chest expansion.[12]Present study suggest that RMSG is more effective for chest expansion than the hold relax PNF hence the another study shows the same results.

Conclusion

Present study concluded that five days of RMSG improved chest expansion only at Xiphisternal level in Group A whereas both the techniques shown significant improvement in chest expansion at infraxillary and xiphisternal level and pulmonary function such as FEV1 and FVC within the groups.

Limitation of the study

Small sample size. No follow-up was done after 5 days of intervention which would have helped to find further

improvement and advising home program after intervention was not considered.

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Conflicts of interest: None.

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