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Original Article

EFFECT OF RESPIRATORY MUSCLE STRETCH GYMNASTICS (RMSG) ON CHEST EXPANSION IN ELDERLY

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Abstract:

Background: *Age-related musculoskeletal and structural changes in the respiratory system led to decreased chest expansion, compromised ventilation, and reduced functional capacity. Respiratory Muscle Stretch Gymnastics (RMSG) and Thoracic Expansion Exercises (TEE) are used to improve thoracic mobility in the elderly. This study aimed to compare the short-term effects of RMSG and TEE on chest expansion.*

Material and Methodology: *Forty-two elderly individuals (65–75 years) were selected using convenient sampling and divided into two groups using systematic random allocation: Group A (RMSG; n=21) and Group B (TEE; n=21). Chest expansion was measured at axillary, nipple, and xiphisternal levels before and after a one-week intervention.*

Result: *Both groups showed statistically significant improvement in chest expansion. Group A demonstrated superior improvement compared to Group B at all measurement levels: axillary (p=0.014), nipple (p=0.009), and xiphisternum (p<0.001). The greatest enhancement was observed at the xiphisternal level.*

Conclusion: *RMSG is more effective than TEE in improving chest expansion in elderly individuals and can be recommended as a simple, feasible intervention in geriatric rehabilitation.*

Keywords: Aging, Chest Expansion, Elderly, RMSG, Thoracic Expansion Exercises.

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Introduction:

According to the census 2011 - India is the second largest country in the World with 72 million elderly people. People above 65 years of age are considered as Geriatric.[1] "Ageing is defined as the progressive biological decline in normal functionality resulting from alterations in cellular structures and components." [2] Individuals aged 60 and above are generally classified as 'old' and are referred to as the 'elderly' population.[1] As explained by WHO at the biological level, aging 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. [3]

When it comes to the respiratory system, the natural process of aging includes muscle imbalances and structural changes in the musculoskeletal system due to geometric modification of the rib cage along with a reduction in chest wall compliance and chest expansion. This restricts the mobility of the rib cage and increases the breathing related energy expenditure. This leads to increased fatigue and stiffness of these muscles and thus again the pulmonary function is compromised. When a muscle loses its normal flexibility, the length-tension relationship is altered. This prevents the muscle from reaching sufficient peak tension leading to muscle weakness and retraction. This muscle shortening can result from various factors, such as alignment, incorrect immobilization, postural muscle weakness, and aging. In themselves, muscle fibers are incapable of lengthening, which requires an external force applied to the muscle. Muscle stretching is a resource that is widely used in rehabilitation programs since it can prevent injuries and increase flexibility. Thus, stretching exercises of the respiratory muscles may improve respiratory muscle functions in the elderly group of the population.[2]

There are various types of exercises, mobilizations, and respiratory muscle training techniques which have been employed to improve respiratory functions of the aging lung. Respiratory muscle stretch gymnastics (RMSG) is one such technique. Conventionally, the stretching and breathing exercises are given separately, but in RMSG stretching and breathing exercises are clubbed together. Thus, RMSG is an emerging technique for respiratory muscle conditioning. RMSG is a group of stretching exercises sequentially performed to stretch specific muscles involved in respiration. It stretches the external intercostal muscles during inspiration and the internal intercostal muscles during expiration, which aims to reduce chest wall stiffness.[2] Respiratory Muscle Stretch Gymnastics consists of 5 techniques: Elevating and Pulling Back of shoulder, Stretching the Upper Chest, Stretching the Lower Chest, Stretching the Back Muscle,Elevating the elbow.[1]

Thoracic Expansion exercises are one of many techniques in conventional chest physical therapy for increasing chest wall mobility and improving ventilation. This technique increases the length of the intercostal muscles and therefore helps in performing effective muscle contraction.

Thoracic expansion exercises include various techniques like head movements, shoulder girdle circling, chest stretch, back stretch, arm circling, trunk rotation, trunk extension, trunk side flexion, pelvic circling, calf stretch, pectoral stretch, and arms up. These sets of exercises have been proven to improve chest expansion, breathlessness, and ventilation.[12]

Materials and Methodology:

This study employed an experimental design. The study was conducted in old age homes located in the Pune region over a period of six months. A total of 42 elderly subjects fulfilling the inclusion and exclusion criteria were recruited using a convenient sampling method. Ethical approval was obtained from the Institutional Ethical Committee. Before participation, written informed consent was obtained from all subjects after explaining the study purpose and procedure. Eligible subjects were allocated into two equal groups using a random allocation (odd-even method) into Group A (RMSG,n=21) and Group B (TEE, n=21). Demographic details including name, age, gender, address, contact number, medical history, drug history, surgical history, and personal and occupational history were recorded. Basic vitals such as heart rate, respiratory rate, oxygen saturation (SpO_2), and blood pressure were assessed. Chest expansion was the primary outcome measure and was recorded in centimeters (cm) using a standard measuring tape pre and post intervention at three levels – Axillary, nipple, xiphisternal levels. Participants of Group A performed five patterns of RMSG-elevating of shoulder, stretching of upper chest, stretching of lower chest, stretching of back muscles and elevating of shoulder. Each stretch was performed for 10 repetitions with deep inhalation during posture holding followed by relaxed exhalation. The protocol was carried out once daily for one week under direct supervision of the researcher. Participants of Group B performed TEE while sitting on a chair with back support. Arms were positioned with shoulders adducted, elbows flexed, and hands placed at the occipital region. Subjects inhaled during shoulder abduction and returned to the starting position during exhalation. Each set involved 3–4 deep breaths followed by 60 seconds of rest. Sessions were conducted once daily for one week under supervision. Post intervention vitals and chest expansion was measured. Collected data were compiled and subjected to appropriate statistical tests to compare within-group and between-group outcomes. A significance level of $p = 0.05$ was considered statistically significant.

Results:

A total of 42 elderly participants aged between 65 and 75 years were included in the study. They were equally divided into two groups by odd–even method: Group A (RMSG) with 21 participants and Group B (Thoracic Expansion) with 21 participants.The mean age of Group A was 70.19±3.22 years, and for Group B it was 69.90±6.42 years. The mean height was 159.76±6.20 cm in Group A and 161.70±7.85 cm in Group B. The mean

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weight was 54.10±6.12 kg in Group A and 55.84±6.96 kg in Group B. Both groups demonstrated a normal BMI range with mean values of 21.07±1.32 (Group A) and 21.24±1.20 (Group B). This indicates that the groups were comparable at baseline.Both groups had an equal proportion of male and female participants. Each group consisted of 13 females (61.9 percent) and 8 males (38.1 percent), confirming that gender did not influence the group assignment.

The Shapiro–Wilk test revealed that all variables in both groups (pre and post chest expansion at axillary, nipple, and xiphisternal levels) showed p-values less than 0.05. This confirmed non-normal data distribution and justified the use of non-parametric statistical tests for further analysis.There was a statistically significant improvement in chest expansion at all three levels after one week of RMSG intervention.

Axillary level increased from 1 cm to 3 cm ($p<0.001$),Nipple level increased from 1 cm to 3 cm ($p<0.001$),Xiphisternal level increased from 2 cm to 4 cm ($p<0.001$).This indicates a meaningful enhancement of thoracic mobility following RMSG.A significant improvement was also observed in Group B. Axillary level increased from 1 cm to 3 cm ($p<0.001$),Nipple level increased from 2 cm to 3 cm ($p=0.001$),Xiphisternal level increased from 2 cm to 3cm ($p<0.001$), therefore it justifies the improvement in health outcome post-intervention.

To find out which of the two techniques is more effective, an independendent test for group statistics was performed using independent samples Mann Whitney Test. Post-intervention chest expansion was significantly higher in Group A than Group B. Axillary level($p=0.014$),Nipple level ($p=0.009$) and Xiphisternal level ($p<0.001$).This between-group analysis using the Mann–Whitney U test confirms that RMSG is more effective in improving chest expansion, particularly at the xiphisternal level where the greatest improvement was noted.

Table 1: Comparison between Pre and Post Chest Expansion values at different sites between Group A and Group B

Site	Time	Group	N	Mean	Median	Min	Max	P-value
Axillary	Pre	A	21	1.5	1	1	2	<0.001
	Post	A	21	2.7	3	2	4	
	Pre	B	21	1.5	1	1	2	<0.001
	Post	B	21	2.1	2	1	3	
Nipple	Pre	A	21	1.4	1	1	2	<0.001
	Post	A	21	2.6	3	1	4	
	Pre	B	21	1.6	2	1	2	0.001
	Post	B	21	2.1	2	1	3	
Xiphisternum	Pre	A	21	1.8	2	1	3	<0.001
	Post	A	21	3.2	3	2	4	
	Pre	B	21	1.5	1	1	3	<0.001
	Post	B	21	2.4	2	1	3	

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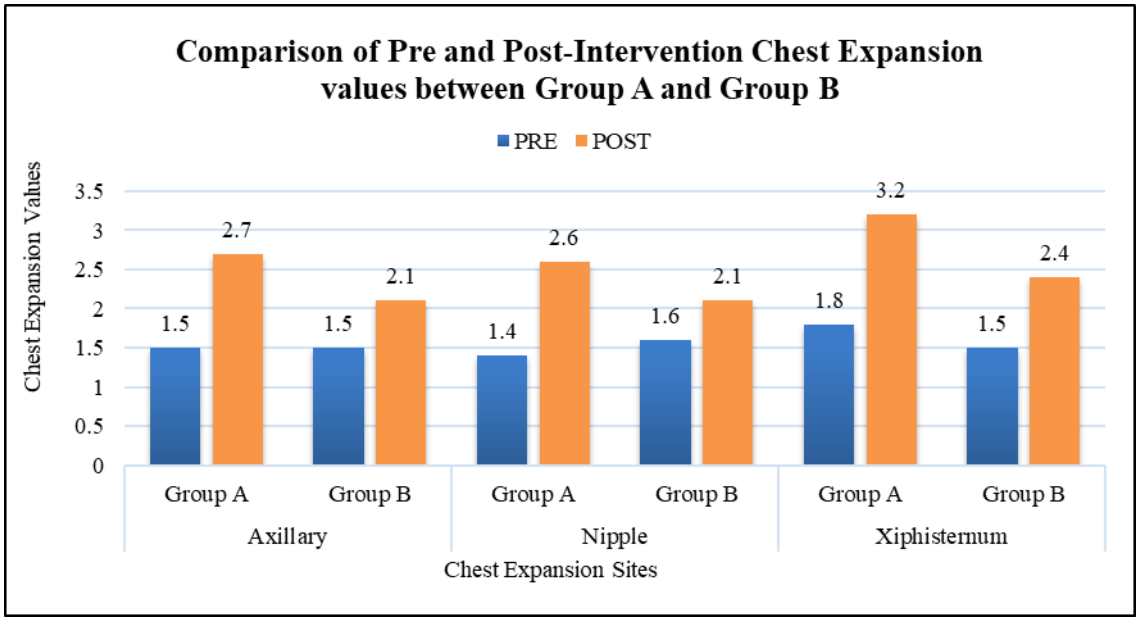

Figure 1: Comparison between Pre and Post Chest Expansion values at different sites between Group A and Group B

Discussion:

The present evaluated and compared the short-term effects of Respiratory Muscle Stretch Gymnastics (RMSG) and Thoracic Expansion Exercises (TEE) on chest expansion in elderly individuals. Both groups were similar in baseline characteristics including age, gender, height, weight, and BMI, which indicates that outcome differences can be attributed to the interventions. Chest expansion was assessed at axillary, nipple, and xiphisternal levels, which is recognized as a reliable method to determine thoracic mobility in geriatric populations.

In Group A, which received RMSG intervention, a significant improvement was observed across all three levels of chest expansion with $p<0.001$. This aligns with the principle that targeted stretching of respiratory muscles improves thoracic compliance and enhances rib cage expansion. RMSG consists of five manoeuvres that stretch and mobilize inspiratory muscles, including the intercostals, diaphragm attachments, pectorals, trapezius, and paraspinals (Ito, 1999). Stretching helps restore the optimal length–tension relationship, enabling more efficient muscle activation during inhalation. Minoguchi et al. (2002) similarly reported improvements in chest expansion and exercise tolerance following RMSG in individuals with COPD.

Aging commonly results in calcification of costal cartilages and stiffness of costovertebral joints, leading to reduced rib mobility. RMSG directly addresses these biomechanical changes by mobilizing the chest wall and improving respiratory muscle flexibility, which enhances thoracic expansion (Awachat et al., 2022).

Additionally, synchronized stretching with deep breathing promotes neuromuscular re-education by activating proprioceptors and mechanoreceptors, resulting in improved thoraco-abdominal coordination (Hetal & Ashok, 2020). RMSG has also been shown to improve ventilation efficiency, reduce dynamic hyperinflation, and enhance oxygenation, which supports the improvements noted in respiratory vitals in this study (Shanmugananth et al., 2022). These outcomes may be partially attributed to autonomic modulation driven by slow, deep breathing that reduces sympathetic drive and lowers cardiovascular parameters.

Group B (TEE) also demonstrated significant improvement in chest expansion with $p<0.05$ at all measurement levels. TEE emphasizes thoracic expansion through deep breathing synchronized with upper limb movements that mobilize the intercostal muscles, rib cage, and thoracic spine (Kim et al., 2014). Diaphragmatic activation during TEE enhances tidal volume, promotes lung inflation, and reduces the risk of atelectasis (Pagare et al., 2017). These findings are in agreement with prior research showing improved chest mobility and oxygen saturation through structured breathing exercises in elderly individuals (Awachat et al., 2022).

Although both techniques were beneficial, between-group comparison revealed that RMSG produced significantly greater improvements across all chest expansion levels, especially the xiphisternal region ($p<0.001$). This indicates a stronger effect on diaphragmatic movement and lower rib cage mechanics. RMSG specifically targets age-related muscle shortening and joint stiffness that TEE does not sufficiently address. Its proprioceptive and neuromuscular training elements also make breathing mechanics more efficient over time. These results are consistent with previous studies where RMSG outperformed conventional breathing exercises in improving respiratory function and chest mobility (Minoguchi et al., 2002; Shanmugananth et al., 2022).

Overall, the findings suggest that while TEE is useful in maintaining thoracic mobility and promoting diaphragmatic breathing, RMSG provides a more comprehensive and effective rehabilitation approach, improving chest wall compliance, inspiratory muscle function, neuromuscular coordination, and cardiopulmonary regulation. Therefore, RMSG can be recommended as a practical and efficient intervention to enhance respiratory function in the geriatric population.

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