Original Article

Effect of Respiratory Muscle Stretch Gymnastics on Exercise Capacity in the Elderly – A Randomized Control Trial

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Abstract

Background: Aging is associated with structural degeneration and functional limitations in the respiratory system, reducing exercise capacity. Respiratory muscle stretch gymnastics (RMSG) is used to improve the function of lungs and respiratory muscles with some success in various populations. **Materials and Methods:** Eighty-four individuals in the age group of 60–70 years were randomly allocated to the experimental and control group. Individuals in the experimental group were put on a 4-week RMSG supervised program. Distance covered in incremental shuttle walk test (ISWT), maximal inspiratory pressure (MIP), and quality of life (QoL) were the outcome measures for the study. **Results:** There was an improvement in distance covered in ISWT, MIP, and scores of World Health Organization QoL-BREF (WHO QoL-BREF) questionnaire of subjects in the experimental group ($P = 0.000$) as compared to the control group. **Conclusion:** Prescription of RMSG for 4 weeks was beneficial in improving exercise performance, maximal inspiratory muscle strength, and QoL in elderly individuals.

Keywords: Geriatric, incremental shuttle walk test, maximal inspiratory pressure, quality of life, respiratory muscle strength

Introduction

The respiratory system shows many slow but progressive age-related changes in healthy individuals in lung parenchyma and thoracic cage, and respiratory muscles.[1,2] These changes include loss of muscle fibers, strength, oxidative capacity, and decreased elastic recoil, hence increased lung compliance, leading to reduced ventilatory reserves available.[3,4] During periods of illness or increased metabolic demands, reduction of inspiratory muscle performance and increase in the energy expenditure exceed system demands above available reserves resulting in a reduction of exercise tolerance. Respiratory muscle stretch gymnastics (RMSG) is a combination of stretching and breathing used simultaneously, which is proven to be beneficial in improving the function of respiratory muscles in the elderly and patients with chronic obstructive pulmonary disease (COPD). The present study focuses on whether these documented benefits are reflected in actual exercise performance and quality of life (QoL) of elderly individuals.

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Materials and Methods

Randomization

This was a prospective, randomized control trial conducted in a metropolitan city of Maharashtra from March 2020 to September 2021. A break in recruitment was taken from March-end 2020 to October 2020 due to COVID-19 lockdown and higher risks of transmission of COVID to the study population. Few subjects recruited in March 2020 were able to do only a couple of sessions and hence were not considered for data analysis, and these subjects were recruited again to the pool of sample post lockdown. After obtaining ethical approval for the proposal and registration of the trial to Clinical Trials Registry – India (CTRI/2020/12/030149), 84 sedentary individuals between the age group of 60–70 years

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who have an understanding of the English language and do not have any acute infection, recent illness, or any major cardiovascular, respiratory, metabolic, musculoskeletal, or neurological condition altering health status of the individual were recruited. After obtaining written informed consent, these participants were allocated into two groups randomly using a computer-generated table of random numbers – experimental group (Group A) and control group (Group B).

Baseline assessment of exercise capacity was done for all the participants using the incremental shuttle walk test (ISWT),[5] maximal inspiratory pressure (MIP) using Micro Respiratory Pressure Meter (RPM) machine (CareFusion MicroRPM), and QoL using World Health Organization QoL-BREF (WHO QoL-BREF) questionnaire.[6] All the assessments were done in the participant's home environment or within the residence's premises with the necessary permissions from the residential societies. All anti-COVID-19 measures were taken as per the government guidelines for the safety of participants.[7] Group A participants were started on a supervised exercise protocol consisting of ten repetitions each of five patterns [Figures 1-5] of RMSG and continued for five times a week for 4 weeks.[8] Each pattern consisted of holding a particular posture with deep inhalation, followed by exhalation and release of the posture. All the sessions were conducted at the participants' homes and supervised personally by the researchers. Participants of Group B were asked to continue their routine activities with no added intervention.

At the end of 4 weeks, all the Group A and B participants were reassessed at home for parameters assessed at the baseline, and there were no dropouts.

Outcome measures

Distance walked during ISWT – The subjects were asked to walk to and fro on a track of 10 meters, in specified duration, to a set of auditory beeps played on audiotape. With each phase, the expected walking speed was to be increased. The subjects were asked to walk for as long as they could until they were either too breathless, experienced pain in the lower extremity, or could no longer keep up with the beeps of audiotape. The number of shuttles was recorded, and the total distance was calculated.[5]

MIP was measured with Micro RPM device. The subjects were asked to exhale to residual volume, followed by forced

Figure 1: Pattern 1 – Elevating and pulling back the shoulder

Figure 2: Pattern 2 – Stretching the upper chest

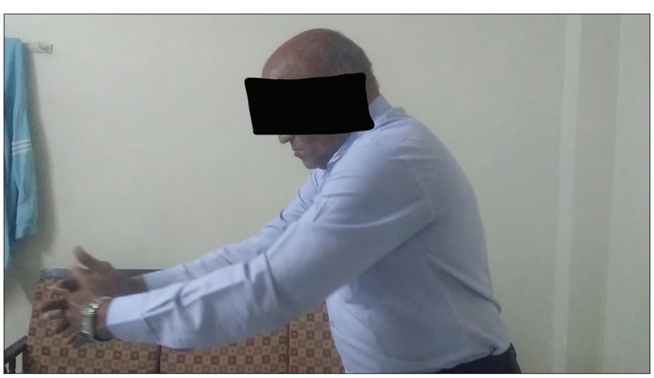

Figure 3: Pattern 3 – Stretching the back muscle

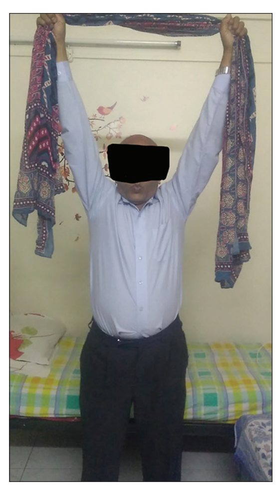

Figure 4: Pattern 4 – Stretching the lower chest

inhalation through the device with maximal effort possible held for a minimum of 2 s. The procedure was repeated thrice, and the best reading was recorded.

QoL-World Health Organization (WHO QoL-BREF) scale – QoL scores were assessed for all the individuals using the WHO QoL-BREF questionnaire consisting of 26 questions covering domains such as physical and psychological social health and 37 environmental factors. Individuals were asked to fill out the questionnaire within 10 min.

Statistical analysis

The data collected were analyzed using SPSS version 26 (IBM, Chicago IL USA). The data were tested for normality using the Shapiro–Wilk test. Within-group and between-group comparisons for distance covered in ISWT were done using paired *t*-test and unpaired *t*-test, respectively. The within-group data of MIP and WHO QoL (WHO QoL) were analyzed using the Wilcoxon test. Mann–Whitney test was used for MIP and WHO QoL (WHO QoL) between the groups. Nonparametric comparison tests were used for MIP as the values did not present in the normal distribution curve.

Results

Details of the population demographics are explained in Table 1.

At the end of the intervention period, a statistically significant improvement was found in the distance walked on ISWT, MIP, and WHO QoL scores within Group A as well as on comparison with Group B [Tables 2 and 3].

Figure 5: Pattern 5 – Elevating the elbow

Table 1: Population demographics of Groups A and B

	Group A	Group B
Males (number)	23	25
Females (number)	19	17
Age (years)	64.23±3.41	64.64±3.12

Discussion

There was an improvement in ISWT distance covered by subjects, which measures exercise capacity after performing 4 weeks of RMSG. Various studies have reported changes in ventilatory capacity and chest wall compliance, improved respiratory pattern, and decreased chest wall stiffness. The reduction in functional residual capacity (FRC) following RMSG could thus explain the greater distance walked during the ISWT ($P = 0.000$). Mistry Hetal *et al*. found similar results in their study, documenting the improvement in maximum breathing capacity, peak expiratory flow rate, and distance walked in 2-min walk test in elderly individuals.[8] Minoguchi *et al*. reported a significant improvement in the 6-min walk distance (6MWD) and reduction of FRC in patients with COPD after RMSG training of 4 weeks.[9]

Maintaining optimum respiratory muscle function is vital for normal mechanics. Aging increases diaphragm and intercostal muscle stiffness due to heightened collagen concentration in the diaphragm. RMSG increased the number of sarcomeres that increased the cross-sectional area of the muscle fibers. It increased in functional length of muscle leading to better interaction between the filaments of actin and myosin and improvement in MIP due to enhanced length–tension relationship of muscle fibers with decreased passive tension in inspiratory muscles.[10]

Stretching the contracting muscle is a powerful stimulus for the muscle spindles. According to Kanamaru *et al*., electromyographic activity from respiratory muscles during RMSG is greater than during deep breathing alone.[11] The present study also reports similar results with increased MIP at the end of 4 weeks RMSG intervention.

WHO QoL-BREF questionnaire contains components that cover the person’s physical, social, and psychological aspects.[6] QoL in the elderly is mainly affected due to a decline in exercise capacity and age-related changes in the body’s various systems. Improvement in exercise capacity and MIP may lead to better performance of the elderly in their daily activities. Studies have reported that reduction in FRC decreases the dyspnea with RMSG program and causes improvement in well-being allowing overall improvement in QoL. The present study also concluded that there was an improvement in the QoL of elderly people ($P = 0.000$). However, baseline for this outcome did not match the two groups, so actual change cannot be commented.

Limitations

The carry-over effect of RMSG was not in view of the study objectives. The convenience sampling strategy was used because of the COVID-19 pandemic, resulting in the inability to generalize the results.

Conclusion

The study concluded that after the practice of RMSG program for 4 weeks by the elderly participants of 60–70 years, there

Table 2: Within-group comparison for Groups A and B

	Group A			Group B		
	Mean±SD			Mean±SD		
	Preintervention	Postintervention	*P*	Preintervention	Postintervention	*P*
Distance (m) (ISWT)	221.78±51.43	230.69±51.37	0.000	212.6±59.35	212.07±59.25	0.294
MIP (cm of H_2O)	49.85±9.62	54.88±9.12	0.000	49.16±10.0	48.61±9.8	0.362
WHO QoL score	79.23±5.8	80.85±5.6	0.000	82.26±6.02	81.33±8.64	0.034

SD: Standard deviation, MIP: Maximal inspiratory pressure, WHO QoL: World Health Organization Quality of Life, ISWT: Incremental shuttle walk test

Table 3: Comparison between Groups A and B of change in distance covered in incremental shuttle walk test, maximal inspiratory pressure, and World Health Organization Quality of Life

	Mean±SD		P
	Group A	Group B	
ISWT (m)	8.904±6.20	0.59±3.62	0.000
MIP (cm of H_2O)	5.02±5.97	0.54±3.20	0.000
WHO QoL score	1.61±1.84	0.92±7.79	0.000

ISWT: Incremental shuttle walk test, SD: Standard deviation, MIP: Maximal inspiratory pressure, WHO QoL: World Health Organization Quality of Life

was an improvement in distance covered in ISWT, MIP, and WHO QoL-BREF questionnaire score.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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