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# EFFECT OF INSPIRATORY MUSCLE TRAINING ON RESPIRATORY MUSCLE STRENGTH IN INSTITUTIONALIZED GERIATRIC PATIENTS - OBSERVATIONAL STUDY

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**ABSTRACT**

Institutionalization factors like precarious social support, low income and the burden of increased spending for medical and health needs of geriatric patient have been seen observed on the greater extent in last three years. Aging may lead to ample number of physiological changes leading to deterioration of systemic functioning of the body, among which reduction in lung capacity can be highlighted here that can be due to reduced respiratory muscle strength over the period of time and is relevant to the clinical situation of elderly patients where age within 65 to 85 year is most likely to be affected. It is necessary to study the importance of inspiratory muscle training to improve the respiratory muscle strength which is less in institutionalized elderly people. Thus, the current study aimed to know the effect of inspiratory muscle training on respiratory muscle strength in institutionalized elderly people in and around Madurai District, Tamil Nādu. About 50 subjects (both male and female) between the age group of 40-70 years with BMI between 20-30 were included. An Inspiratory Muscle Training using Spirometer as well as Volumetric Inspiratory spirometer by SPIRO-BALL was carried out for 4 months.

Results of the study showed the statistically significant improvement in the post mean values of respiratory rate (RR), SpO2, Inspiratory capacity (IC) and Peak expiratory flow rate (PEFR) with $p<0.05$. Hence the study concluded that the respiratory muscle training is beneficial for improving respiratory muscle strength in institutionalized geriatric patients.

**Keywords**: Institutionalized Geriatric Population, Inspiratory Muscle Training, Respiratory Muscle Strength.

# I. INTRODUCTION

Life expectancy is increasing all over the world and the number of people aged 60 years or over in Brazil had increased to 19 million by 2006 (10.2% of the total population). The elderly population in Brazil is likely to reach more than 30 million by the end of the next 20 years, a number that would represent 13% of the population.[1]

Increasing demand for long-term care institutions (residential institutions) has accompanied this accelerated demographic transition in and around the world. The principal factors that lead to institutionalization of the elderly have been observed with greater frequency over the last three years. These factors are precarious social support, low income and the burden of increased spending for medical and health needs.

Aging results in a decline in lung function as in other systems. The principal changes in the respiratory system the elderly include loss of chest wall compliance, decrease in strength of elastic recoil of lung parenchyma, decrease in respiratory muscle strength, and decreased responsiveness to hypoxemia and hypercapnia [4-5].

The loss of muscle mass or age-related sarcopenia potentially reduces the production of maximum strength [6]. With the advance of age, the deficit in respiratory muscle strength affects physical performance leading to loss of exercise performance, deterioration of gait, and decrease of the quality of life [7-8]. The reduction of respiratory muscle function in the elderly makes this population more vulnerable to disease and disability. [9]

Therefore the prevention of a deficit in respiratory muscle strength reduces functional decline in the elderly by reducing the risk of morbidity and mortality [10].Peripheral muscle exercises promote an increase in respiratory muscle strength and endurance [11].

However, these gains appear to be higher when combined with specific training of the respiratory muscles [12], making this an option to supplement the training of peripheral muscles and generating benefits in different current comorbidities such as hypertension [13], obesity [14], and diabetes [15] that affect a large portion of the elderly.

Respiratory diseases occur with greater frequency when the functioning of the musculature responsible for the respiratory system is impaired.[16-18] Respiratory muscle dysfunction can lead to reduced tolerance for the demands of activities of daily living, and to hyperventilation and, in extreme cases, respiratory failure. Reduced respiratory muscle strength is relevant to the clinical situation of elderly patients, particularly in cases of pneumonia and cardiac diseases such as left ventricle failure, which lead to additional workload for the respiratory muscles.[19]

The measurement of maximal respiratory pressures (MRP) is now a routine procedure in many pulmonary function laboratories. Maximal inspiratory pressure (MIP) is an index of the strength of the diaphragm, whereas maximal expiratory pressure (MEP) measures the strength of abdominal and intercostal muscles. The primary indications for MRP tests are to quantitate the degree of respiratory muscle weakness present in patients who have dyspnea and respiratory failure, who are malnourished, or who are known to have neuromuscular diseases such as myasthenia gravis, Guillian Barre syndrome, amyotrophic lateral sclerosis, stroke, polio, or quadriplegia[20].Other uses include evaluation of unexplained reductions in the VC or maximal voluntary ventilation (MVV), and to predict the success of weaning a patient from mechanical ventilation (MIP) in the intensive care unit, or the ability of a patient to cough and bring up secretions (MEP).[21-22]

We found that between the ages of 65 to 85 (within the age range of those recruited into our study), the cross-sectional decreases of maximal respiratory pressure with age were between 0.8 and 2.7 cm H20 per year, with larger age-related declines in men. Black and Hyatt, who studied only 33 subjects older than 65 yr of age, found similar age-related declines in both MIP and MEP in their 55 to 80 age group [23]. A more recent study of 135 adults (18 to 65 yr of age) found that age was the only significant predictor of MRP in men and height in women [24], whereas a study of 104 men and women 55 to 75 yr of age found no relationship between MRP and age [25]. Like other pulmonary function parameters, mean MRPs may not change during young adulthood, as noted in a large study of 15 to 35-yr-olds [26]. We are unaware of any longitudinal studies of MRPs that would indicate whether the negative association of age with respiratory muscle strength, which we have noted is merely a cohort effect or caused by the general effects of aging on skeletal muscles such as atrophy and decreased metabolic efficiency [27,28] but we suspect the latter.

In the previous researches it was found that the population from 65 to 85 years of age showed the cross-sectional decrease in Maximal Respiratory Pressure (MPP) which was between 0.8 and 2.7 cm $H_2O$ with larger age – related decline in strength of respiratory muscles. A most recent study (with age group of 18 to 65) found that age was the only significant predictor of MRP in men as well as in women but may not change during young adulthood as noted in the larger studies (with 15- to 35-year-old population). Some studies also found there is no relationship between MRP and age. We are unaware of any longitudinal studies of MRPs hat would indicate whether there is negative association of age with respiratory muscle strength, however the records up till now are merely a cohort effect or caused by the general effects of aging on skeletal muscles such as atrophy and decreases metabolic efficiency that may be suspected latter. By this study we can understand the importance of inspiratory muscle training to improve the respiratory muscle strength which is reduced in institutionalized elderly people.

## II. RESEARCH METHODOLOGY

The aim of this Observational study is to know the effect of Inspiratory muscle training on respiratory muscle strength in institutionalized elderly people among the institutes (residential institutes). The objectives of this study were to analyze the inspiratory capacity using the Volumetric inspiratory spirometer, to measure the peak expiratory flow rate by Wright PEFR, to measure the Respiratory Rate, and to know the Oxygen saturation using the Pulse Oximeter for the institutionalized elderly subjects. The study focused on investigating the impact of inspiratory muscle training on respiratory muscle strength in institutionalized elderly individuals within the age range of 40 to 70 years, residing in and around Mangalore, Karnataka, India. A total of 50 subjects, both male and female, were included in the study, selected based on their body mass index (BMI) falling between 20 to 30. The patients who did not have any complicated cardiac diseases and cardiac surgery within a previous year, patient who are at least able to walk a stick were included. Whereas patients with any severe musculoskeletal, neurological, psychological disorders, patients who were taking physiotherapy treatment for last 6 months for improving lung function and those who were not co-operative were excluded.

Inspiratory muscle training was conducted using a Spirometer, as well as a Volumetric Inspiratory Spirometer known as SPIRO-BALL. The training regimen lasted for a duration of 4 months. Participants were divided into two group, control and the experimental, the control group received baseline treatment (conventional physiotherapy) whereas experimental group received a individualized structured cardio respiratory fitness protocol. After 6 weeks of 60 minutes of 3 session each per week, the post treatment assessment for physical function performance was taken with the help of outcome measures of PEFR, Borg scale, respiratory rate and heart rate. Pre and post outcome measures of both groups were taken for statistical analysis.

## III STATISTICAL ANALYSIS

Statistical analysis was performed on the data collected from the study subjects and the normality testing was done using Shapiro Wilk test. The results were analyzed using SPSS software version 22.0 statistical methods to determine the significance of the findings. A p-value of less than 0.05 was considered statistically significant. Within the group analysis was done with pared t-test. Between the group analysis was done with an independent t-test as shown in Table 1.

*Table 1: pre intervention Between the group statistics*

| No of Subjects | Values | HR | | RR | | PEFR | | RPE in Borg Scale | |
|---|---|---|---|---|---|---|---|---|---|
| 20 | Group | Con | Exp | Con | Exp | Con | Exp | Con | Exp |
| | Post Mean | 82.3 | 85.5 | 12.2 | 16.3 | 426.7 | 480.3 | 3.6 | 2.5 |
| | SD | 1.34 | 3.39 | 1.51 | 0.9 | 2108.46 | 1214.6 | 0.27 | 0.28 |
| | T value | -4.65122 | | -8.34978 | | -2.94039 | | 4.71429 | |
| | P Value | 0.000099 | | 0.06 | | 0.04373 | | 0.086 | |

## IV RESULTS

The outcomes of the study reveled noteworthy findings regarding the impact of inspiratory muscle training on respiratory parameters in institutionalized elderly individuals. The post – training mean values of various respiratory parameters were compared to their baseline values, and the results were statistically analyzed. The results demonstrated a statistically significant improvement ($p<0.05$).

*Table 2: Comparison of Pre and Post Mean Values of Respiratory Rate in Subjects:*

| No. of subjects | Intervention | Mean value | Standard Deviation | T-value | P-value |
|---|---|---|---|---|---|
| 50 | pre | 8.8 | 1.92 | -10.79 | 0.00001 |
| | post | 11.98 | 2.43 | | |

This table shows that the mean pre and post values of variable Respiratory Rate, SD, t value and p value. P value shows that there statistically significant difference in Respiratory rate after intervention.

*Table 3: Comparison of Pre and Post Mean Values of Spo2 in Subjects:*

| No .of subjects | Intervention | Mean value | Standard Deviation | T-value | P-value |
|---|---|---|---|---|---|
| 50 | pre | 83.8 | 14.52 | -14.7949 | 0.00001 |
| | post | 92.63 | 3.31 | | |

This table shows that the mean pre and post values of variable Spo2, SD, t value and p value. P value shows that there statistically significant difference in Spo2 after intervention.

*Table 4: Comparison of Pre and Post Mean Values of Inspiratory capacity in Subjects:*

| No. of subjects | Intervention | Mean value | Standard Deviation | T-value | P-value |
|---|---|---|---|---|---|
| 50 | pre | 2.91 | 0.22 | -13.848 | 0.00001 |
| | post | 4.14 | 0.17 | | |

$P<0.01^{S}$

This table shows that the mean pre and post values of variable Inspiratory capacity, SD, t value and p value. P value shows that there statistically significant difference in Inspiratory capacity after intervention.

*Table 5: Comparison of Pre and Post Mean Values of PEFR in Subjects:*

| No. of subjects | Intervention | Mean value | Standard Deviation | T-value | P-value |
|---|---|---|---|---|---|
| 50 | pre | 346.12 | 5353.17 | -8.36591 | 0.00001 |
| | post | 487.82 | 8991.25 | | |

$P<0.01^{s}$

This table shows that the mean pre and post values of variable PEFR, SD, t value and p value. P value shows that there statistically significant difference in PEFR after intervention.

*Figure 1: Comparison of Pre and Post Mean Values of Respiratory Rate in Subjects:*

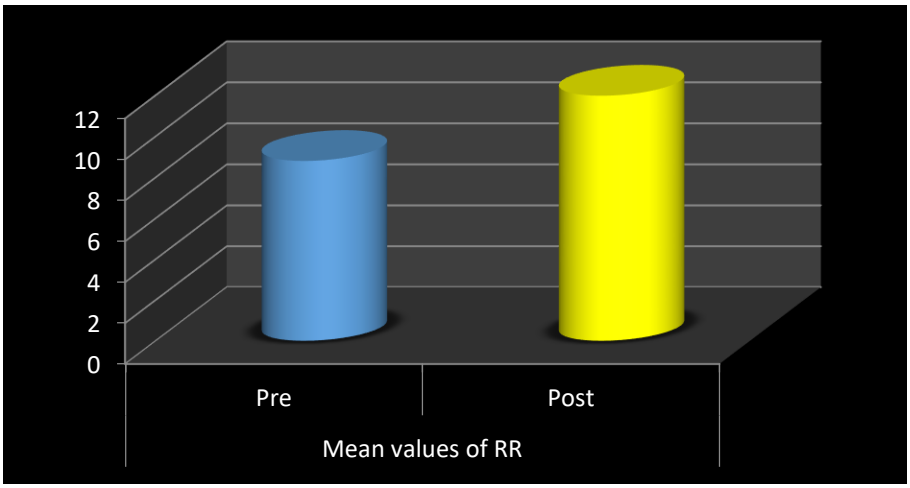



*Figure 2: Comparison of Pre and Post Mean Values of Spo2 in Subjects*

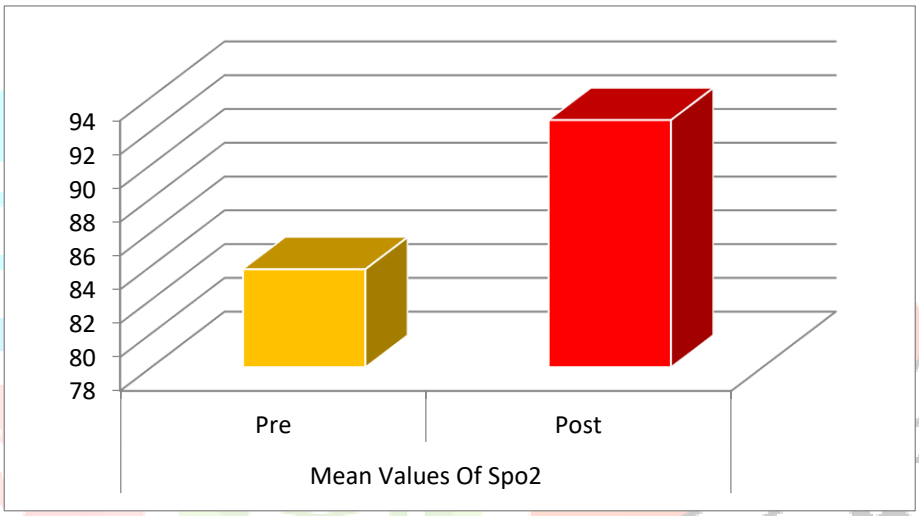



*Figure 3: Comparison of Pre and Post Mean Values of Inspiratory capacity in* Subjects:

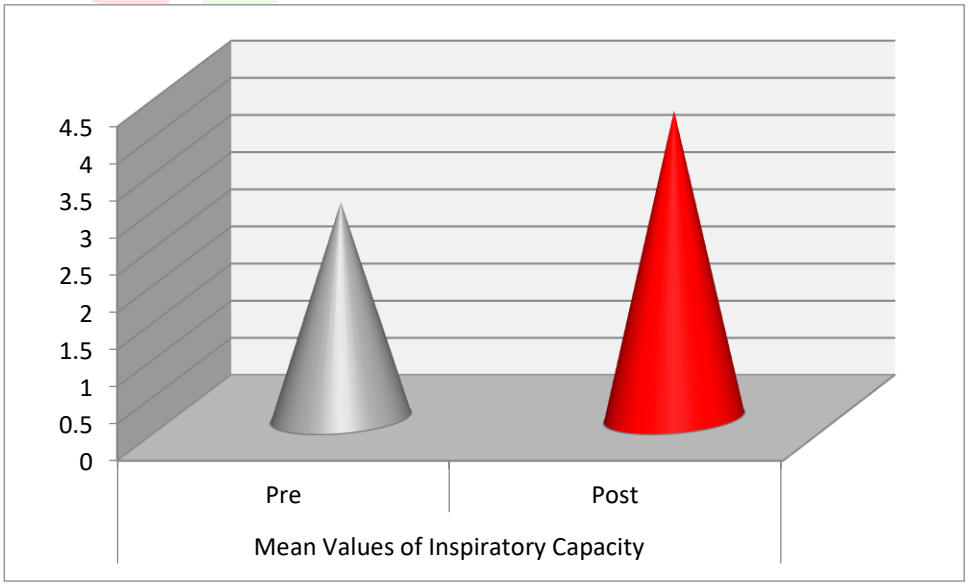
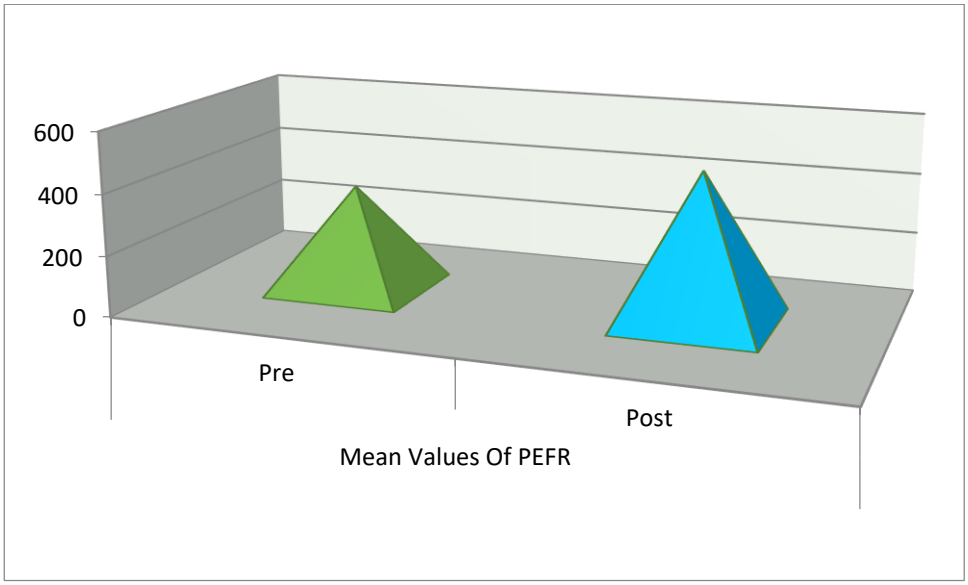


*Figure 4: Comparison of Pre and Post Mean Values of PEFR in Subjects:*




*Picture 1: Tools*

*Picture 2: Respiratory Assessment*

*Picture 3: Inspiratory Muscle Training*

*Picture 4: Assessment of Inspiratory Capacity*

*Picture 5: Assessment of peak Expiratory Flow Rate*

## V DISCUSSION

The study's findings corroborate the existing understanding of the physiological changes that occur with aging, particularly the deterioration of respiratory muscle strength aand lung capacity. The reduction in lung capacity, often attributed to decreased respiratory muscle strength, is common among elderly individuals, especially those between the ages of 65 and 85. The study aimed to address this issue by exploring the efficacy of inspiratory muscle training in institutionalized elderly individuals.

This study endorses that the geriatric population getting reduced physical function and performance due to aging and that can be improved by administrating a structured cardio respiratory fitness protocol to them. This study endorses that the geriatric population getting reduced physical function and performance due to aging and that can be improved by administrating a structured cardio respiratory fitness protocol to them.

The positive results observed in respiratory parameters such as RR, SpO2, IC, and PEFR post-training suggest that inspiratory muscle training has a beneficial impact on respiratory muscle strength. this is especially relevant in the context of institutionalized geriatric patients who are likely to face challenges related to reduced social support, low income, and increases medical expenditures.

The limitations for this study were the smaller sample size, randomization was not performed. There was no follow up planned, the duration od intervention was longer in one session, cost effectiveness was not addressed.

## VI CONCLUSION

This study was concluded that the individualized Structured cardio respiratory fitness protocol training have statistically significant improvement on Physical function and performance in geriatric population and Structured cardio respiratory fitness protocol statistically improvement in Heart Rate (HR), Respiratory Rate (RR), Peak expiratory Flow Rate (PEFR) and Borg-RPE scale which reflects in Physical function and performance in geriatric patients.

This study recommends to increase the sample size with the properly planned protocol in a certain time limits, a randomized control or clinical trials along with the follow-up can be carried out. Intervention can add various aerobic exercise programs.

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