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EFFECT OF EXPIRATORY MUSCLE STRENGTH TRAINING ON PEFR AMONG COMMUNITY DWELLING ELDERLY RURAL POPULATION: AN INTERVENTIONAL STUDY

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Abstract: Peak Expiratory Flow Rate (PEFR) is a method of assessing the ventilatory capacity with single breath. Maximal Expiratory Pressure (MEP) is the greatest pressure which is generated during maximal expiration against an occluded airway. Expiratory Muscle Strength Training(EMST)for duration of one week training was given to see increase in PEFR and MEP in elderly rural population improve their quality of life. A pilot study was done taking 30 samples which was an interventional type of study. Before the intervention, pre PEFR and MEP was measured. PEFR was measured using peak flow meter and MEP was measured using MEP device. Then one week Expiratory Muscle Strength Training (EMST) Protocol was given. Later after a week, again the post PEFR and MEP was measured. For results Mean and SD was calculated. MEP pre intervention was 60.77±16.96 and MEP post intervention was 61.29±16.92. The PEFR pre intervention was 230±68.07 and post PEFR was 246.67±72.50. The correlation between pre and post values of PEFR (p-value) is extremely significant ($p<0.05$).

Key words: PEFR, MEP, Elderly population

1. INTRODUCTION

Peak Expiratory Flow Rate (PEFR) is a method of assessing the ventilatory capacity with single breath. It is largely a function of the caliber of large airways. Pulmonary changes due to aging are decrease in lung compliance with increased rigidity, lowered diaphragm and loss of internal alveolar surface area. Residual volume increases in aging due to less vigorously ascent of diaphragm and decreased elastic coil (1)

The forced expiratory maneuver required for accurate assessment of forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC), the key metrics for diagnosis and disease classification per American Thoracic Society/European Respiratory Society criteria, can be difficult for elderly persons to perform correctly, especially if they are physically debilitated or have cognitive impairment. (2) Using PEFR measurement is more economical and much more widely available, therefore it is proposed as an alternative to spirometry. (3)

This lung function test is useful for screening and monitoring the severity of asthma in a community, especially when the prevalence of asthma and asthma related hospital admissions are rising. [4] The PEFR value is lower as compared to their individual normal value in elderly population. The PEFR values are higher in males than in female. It also tells that PEFR values show the positive co-relation with age and height. [5] The aging process promotes a series of organism modifications, especially changes in the respiratory system such as the reduction of the total lung capacity (TLC), the forced expiratory volume in one second (FEV1) and the forced expiratory flow (FEF), as well as increases the functional residual capacity (FRC) and the expiratory reserve volume (ERV). These changes are related to decrease both lung elastic recoil and the thoracic complacency capacity. Such alterations when associated with a reduction of muscle strength can lead to a reduced peak expiratory flow (PEF). [14] The diagnosis is often missed out in elderly population and the factors that contribute to this include respiratory changes caused by aging, immune senescence, lack of symptoms, clinician unawareness, and lack of evidence-based guidelines for diagnosis and management that target this population. In community-dwelling older persons, several cardiorespiratory and non-cardiorespiratory impairments were significantly associated with moderate-to-severe dyspnea, associated to a multi factorial geriatric health condition. [13]

Exercise of the respiratory muscles using an individualized respiratory device had a positive effect on pulmonary function and exercise capacity[6] Respiratory muscle expiratory trainer increases both respiratory and cycling endurance, reduced perception of breathlessness and respiratory exertion during volitional and exercise-induced hyperpnoea, and slightly increased ventilation at identical workloads[7] It is found that expiratory muscle training (EMST) is useful in increasing quality of life and cardiopulmonary endurance in healthy adults[8] Since the respiratory muscles respond to training stimuli in the same manner as the skeletal muscles, i.e. improvement in the structural and functional aspects by improving strength, speed, power, endurance, peak inspiratory flow and maximal inspiratory and expiratory pressure, which in turn improves the respiratory endurance.[9] EMST also proves to improve the cough function which helps to remove out the secretions causing decreased risks of the infection and diseases like pneumonia which are likely to happen in elderly.[15]

Once the strength of the muscles has been improved, it shall help to provide a greater VO2 peak to the individual while exercising since the expiratory muscles shall function better by since the muscles have been strengthened to provide a higher end-expiratory volume which in turn shall lower the perception of breathlessness of the individual while exercising.[10]

2. Materials and Methodology

This interventional study was done at Vikhe Patil memorial Hospital,Vilad Ghat, Ahmednagar,Maharashtra with a sample size of 30 subjects. It was a pilot study. The lower age limit for this study was 60 yrs. Duration was from Sept 2019 to Feb 2020.

Study Design: Interventional study

2.2 Study Location: Vikhe Patil memorial Hospital,Vilad Ghat, Ahmednagar ,Maharashtra

2.3 Study Duration: Sept 2019 to Feb 2020

2.4 Sample size: 30 community dwelling elderly participants

2.5 Inclusion criteria:

1. Elderly population with lower age limit 60 yrs
2. BMI between 18.5 to 24.9
3. Non smokers

2.6 Exclusion Criteria:

1. No history of diabetes mellitus, asthma, TB, occupational lung diseases, COPD
2. Any recent surgery
3. Cognitive impairment and any psychiatry illness
4. Any previously known or diagnosed CVS, neurological condition

2.7 Procedure and Methodology:

The ethical clearance from ethical committee of college of physiotherapy was obtained. The participants were included according to inclusion and exclusion criteria. The entire procedures involved in the study were explained to each subject. After explaining the purpose of the study a written informed consent was obtained from the participants. The physiotherapist should fill up their data collection sheet which includes Demographic data. MEP (3 trials) and PEFR (3 readings) were calculated pre intervention. The highest or best reading of all the measurement was recorded.

Expiratory Muscle Strength Trainer 150 (EMST-150) [10,11,12] :

- It is an exercise tool consisting of a pexi-glass tube and a mouthpiece. Inside the trainer is a variable tension spring controlling a 'pop-off' valve that is calibrated in pressure (cmH2O) which is adjustable. At first, the maximum expiratory strength was measured using the MEP. The subject was then instructed to take a deep inspiration against a preset threshold of 75% of muscle strength. Post which the subject's nose was clipped and the subject was asked to forcefully expire maximum air into the device which shall last for a few seconds .This was followed by a resting period of 15-20 seconds followed by performing five repetitions of the same followed by a break of 1 minute and a total of 25 training breaths were performed each day for a span of three days/week. Protocol will be of one week.

Later after a week of protocol again the PEFR and MEP were calculated and there was comparison between pre and post intervention MEP and PEFR after the training for three times a week. The protocol was given for one week only.

2.8 Statistical analysis

SD and mean were calculated in an excel sheet pre and post intervention for PEFR and MEP.

3 .Results and Discussion

A pilot study result was calculated. 30 patients were taken with pre and post MEP and PEFR where pre and post MEP and PEFR was calculated using mean and SD. The correlation between pre and post values of PEFR (p-value=0.001) is extremely significant. Mean Age was 70±11.31. The PEFR pre intervention was 230±68.07 and PEFR post intervention was 246.67±72.50. MEP pre intervention was 60.77±16.96 and MEP post intervention was 61.29±16.92. PEFR is a method of assessing the ventilatory capacity with single breath. It is largely a function of the caliber of large airways. The observed mean value of PEFR was significantly less in elderly. Study done by Ms. Ashwini Mishra et.al on "Peak Expiratory Flow Rate Measure among Community Dwelling Elderly Rural Population" [(4)] and it was found that PEFR decreases in elderly and has relation with Age, Gender and Height. The mean PEFR in elderly found out in this study was 206±88 in elderly population while the expected normal mean value was 405±59 Hence it was clearly seen that the PEFR in elderly is poor as compared to normal value. These pulmonary changes due to aging were decrease in lung compliance with increased rigidity, lowered diaphragm and loss of internal alveolar surface area.

In the study done by . Freitas FS et.al. on "Relationship between cough strength and functional level in elderly" it was told that there are alterations in TLC, FEV1,FEF due to various reasons in elderly mentioned above, there is ultimate decrease in PEFR. As a result it is very necessary to improve the PEFR in elderly and it is also the simplest measure to diagnosis the obstruction or blockage in larger airways.

Maximal Expiratory Pressure is the greatest pressure which is generated during maximal expiration against an occluded airway. In the study done by Akshata Ashok Changwani et. al. on "Effect of 4 week expiratory muscle strengthening on exercise induced breathlessness in normal adults-a pilot study" [(11)] it was found that there is improvement in expiratory muscle strength after giving a 4 week protocol of Expiratory Muscle Strength Training (EMST) in exercise-induced breathlessness in normal individuals. Hence EMST has effect on PEFR which improves expiratory muscle strength.

In the study carried out by Anand S et.al., "Effect of training frequency on maximum expiratory pressure. American journal of speech-language pathology" [(12)] it was studied that effect of training frequency on maximum expiratory pressure was given. It commented about the frequencies of EMST to be given in a week and concluded that the effect of training after 3 times or 5 times per week is the same. Hence it could be beneficial that 3times per week training is given to elderly as it could not exert them much.1 week protocol was given to see the immediate study of EMST training on PEFR and the changes were positive.

Kim J et.al. in their article "Effect of expiratory muscle strength training on elderly cough function. Archives of gerontology and geriatrics" [(15)] commented about the improved cough function with 4 week EMST in sedentary elderly population. This is useful as the risks of infectious diseases caused particularly in elderly like pneumonia would decrease due to increased cough function.

Verges S et.al. studied on "Effect of respiratory muscle endurance training on respiratory sensations, respiratory control and exercise performance: a 15-year experience" [(8)] and it was found that EMST training improves the quality of life and helps in easing the daily activities.

In our study it was found that the PEFR improves pre and post intervention of expiratory muscle strength training (EMST) for duration of one week in community dwelling elderly rural population.

The PEFR had a significant change pre and post intervention and all the results were positive. The advantage of this study was that it shows an immediate effect on PEFR as well as MEP in 3 sessions for a week.

It was also found that there was improved maximum expiratory pressure (MEP) during the EMST training pre and post intervention. MEP did not have a sudden change in one week but was towards positive result. And hence due to increased duration in training there would be more improvement in MEP as well as PEFR which would help improve the overall strength and improve the pulmonary function and endurance in elderly population.

5.Tables and figures

Parameters	Pre intervention	Post intervention
PEFR	230±68.07	246.67±72.50
MEP	60.77±16.96	61.29±16.92

Table-1 PEFR AND MEP Readings pre and post intervention

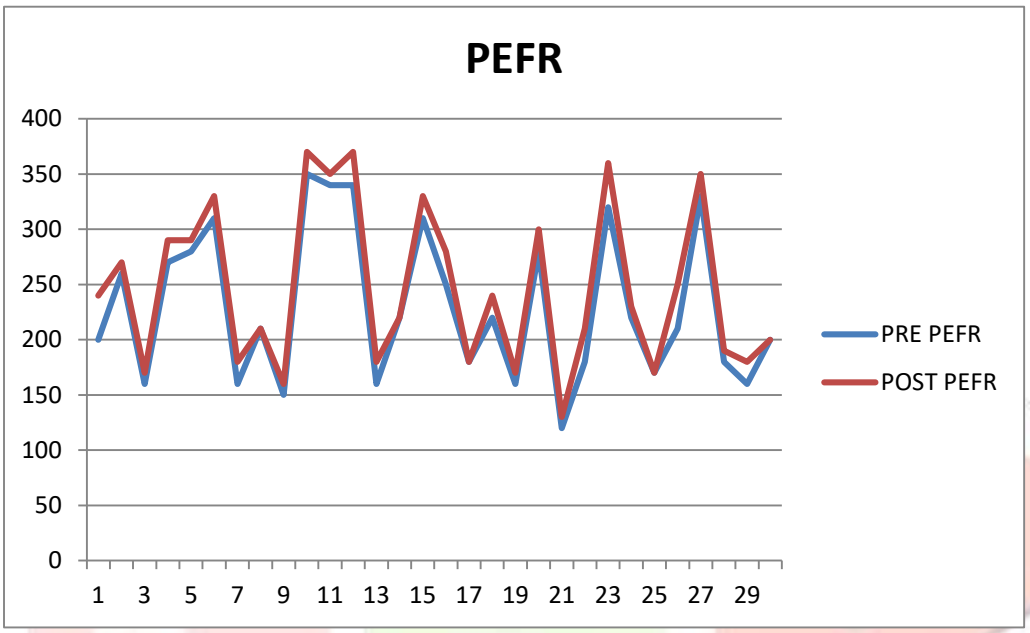

Figure 1 indicates the changes in PEFR pre and post IMST intervention of one weekin community dwelling elderly rural population

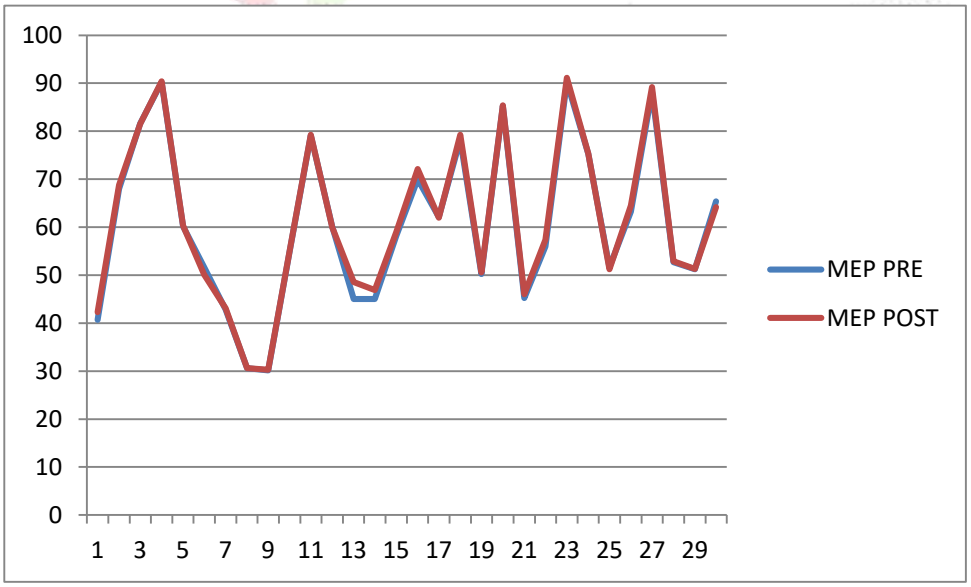

Figure 2 indicates the changes in MEP pre and post EMST intervention of one week in community dwelling elderly rural population

6. Conclusion

Effect of Expiratory Muscle Strength Training on PEFR among Community Dwelling Elderly Rural Population was found to be significant after a protocol of one week EMST training.

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