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Original Research Article

Is There any Effect of Abdominal Muscle Exercises on Peak Expiratory Flow in Normal Individuals?

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ABSTRACT

Background: The life style and pollution has direct impact on respiratory system in patients as well as normal individuals. Determination of Peak Expiratory Flow Rate (PEFR) is useful for assessing the respiratory diseases especially to differentiate the obstructive and restrictive diseases. Generally PEFR is reduced in all types of respiratory disease. Abdominal muscle exercises improves the strength of abdominal muscle and also it assist in act of the forced expiration. Abdominal muscle exercises are safe and beneficial for any normal individual to improve peak expiratory flow rate which improves quality of life.
Objective: The objective of the present study was to evaluate the effect of abdominal muscle exercises in improving the forced expiratory rate in normal individuals.
Methods: Experimental study consists of 30 male participants between the age of 20 to 35 years randomly selected as per inclusion and exclusion criteria. The participants received upper and lower abdominal strengthening exercises for 3 weeks, total 42 sessions. Peak Expiratory Flow Rate, an outcome measure was measured before and after intervention.
Results: The result showed that there was highly significant increase in peak expiratory flow (419 ± 38.63 to 488.28 ± 35.16) after 3 weeks of abdominal muscle exercises.
Conclusion: Abdominal muscles exercises improves Peak expiratory flow rate in normal individuals.

Keywords: Peak flow rate, abdominal muscle exercises, Expiratory Flow Rate.

INTRODUCTION

Respiration is the process by which oxygen is taken in and carbon dioxide is given out. Respiration is often classified into two types: 1. external respiration that involves exchange of respiratory gases, i.e. oxygen and carbon dioxide between lungs and blood. 2. Internal respiration which involves exchange of gases between blood and tissues. Respiratory movements: during normal quiet breathing, inspiration is an active process involving contraction of the diaphragm and external intercostals muscles. On the contrary, expiration is a passive process involving elastic recoiling of the lungs and thoracic cage. Muscles of respiration: respiratory muscles are generally classified into two types: Primary or major respiratory muscles and accessory respiratory muscles. Expiratory muscles: Primary expiratory muscles: these are internal intercostals muscles, which are innervated by intercostals nerves. Accessory expiratory muscles: these are abdominal muscles. The abdominal muscles (Rectus abdominis, external oblique, internal oblique, transverse abdominis) are regarded as powerful expiratory muscles. Whose

action help to force the diaphragm back to its resting position and thus force air from the lungs. [1]

There have been many studies on the role of the abdominal muscles in both quiet and forceful breathing. It is believed that when the ventilatory capacities of the lungs are compromised, the respiratory functions are affected, and the individual would utilize the abdominal muscles to effect forced expiration, thus giving way for improved inspiration action. It is also believed that the abdominal muscles could be strengthened in order to assist the ventilatory process. [2]

The weakness of abdominal muscles may be due to nerve involvement, disuse atrophy, stretch weakness or fatigue. So, strengthening of abdominal muscle will help to improve the strength of abdominal muscle and also the muscles assist in act of the forced expiration. The person with partial or complete weakness of abdominal muscles is unable to cough and produce forced expiration effectively which affects in clearing secretions from the lungs and sputum retention. So, abdominal strengthening exercises are useful, which help to clear the secretions and sputum thereby improving the lung compliance and general activities of the individuals. Abdominal muscle strengthening exercise is safe and beneficial for any normal individual as to improve peak expiratory flow rate which improves quality of life.

PEFR is one of the important parameters in pulmonary function testing that has been evolved as clinical tools for diagnosis, management and follow up of respiratory diseases. For the assessment of ventilatory capacity, Peak Expiratory Flow (PEF) rate is considered to be the simplest one among the pulmonary function indices which was first introduced by Adorn in 1942 as a measurement of ventilatory function and was accepted in 1949 as an index of spirometry. By definition, it is "the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration, expressed in liters/min". [3] It is determined by using the instrument Wright's peak flow meter. Determination of PEFR is useful for assessing the respiratory diseases especially to differentiate the obstructive and restrictive diseases. Generally PEFR is reduced in all types of respiratory disease. Thus, in restrictive diseases, PEFR is 200 liters / min and in obstructive diseases, it is only 100 liters /min. It is the most suitable and commonly used instruments in clinical practice are flow meters which measure peak expiratory flow only and hence, may be referred to as peak flow meters. Since they are relatively inexpensive; furthermore, they are portable and do require electrical power for their operation. It employs the principle of a variable orifice to measure airflow indirectly. [4-6]

Now-a-days as the life style and pollution has direct impact on respiratory system even for normal individuals, the demand will place a greater emphasis on maximizing the patient's independence, minimizing the disabilities and increasing the patient's functional status so their quality of life may improve. Hence, the objective of the study is to evaluate the importance of considering abdominal muscle exercise in improving the forced expiratory capacity to determine general activity improvement of the individual.

MATERIALS AND METHODS

The research design used for the study was experimental study. The 40 participants were recruited according to inclusion and exclusion criteria. The inclusion criteria for this study were normal healthy male participants, age between 20-35 years, those willing to participate in the study, able to perform abdominal exercise for 21 days, abdominal muscle power 3+ (according to oxford muscle grading classification), BMI between 18.5- 24.9. [8] The exclusion criteria for the study were participants with cardio pulmonary pathology, history of back pain or abdominal pain in last 3 months, recent musculo-skeletal injuries, hernia, abdominal

cramps, juvenile rheumatoid arthritis, smoking and female participants. [8,9]

They were then explained about the flow meter and test protocol and an informed written consent was obtained from participants. Participants underwent a pre intervention of Peak Expiratory Flow Rate (PEFR). Then abdominal strengthening exercises were given for 3 weeks. [8] The participants again underwent a post intervention of PEFR. Each treatment session lasted for 20-25 minutes including rest period. The interventions were given twice a day (42 sessions).

Outcome Measure: Peak expiratory flow rate

Peak Expiratory Flow Rate is the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration. It is determined by using the instrument Wright's peak flow meter. The Working Party of the European Respiratory Society (ERS) has solely addressed technical and physiological issues relating to peak expiratory flow (PEF) (flow describes the rate of change of volume(volume rate), so that flow rate is equivalent to volume acceleration. [4,5] (figure 1)

Figure 1: Peak Expiratory Flow Meter

Procedure

Instructions were given to the participants about how to use the peak-flow meter and trials were also allowed. The highest value of peak expiratory flow from three correctly performed blows was recorded. The test was performed in sitting position, with neck in neutral position. Mouth piece was attached to side marked in the arrows then side the indicatory to bottom of the numbered scale. Having taken a maximal inspiration, and after a maximum pause of 2 seconds at Total Lung Capacity (TLC),then the mouth piece was placed, the participant blowed as hard as possible in a single blow, maintaining an airtight seal between the lips and the mouthpiece, the final position was the indicator of peak flow. [7]

The participants were screened from Out Patient Department of Physiotherapy, M.V.P' Samaj's College of Physiotherapy, Nashik and after finding their suitability according to the inclusion and exclusion criteria, they were requested to participate in the study. The participants were briefed about the nature of study, the duration of intervention and the intervention being used. They were encouraged to clarify queries regarding the study, if any. The demographic data was obtained and a detailed assessment of 30 participants was done on the basis of name, age, height, weight, BMI and pre treatment peak expiratory flow rate was calculated. According to inclusion criteria the participants were taken into the study.

Peak Expiratory Flow Rate was assessed with the help of Peak Expiratory Flow Meter. A suitable and commonly used instruments in clinical practice which measure peak expiratory flow only and hence, may be referred to as peak flow meters. Specifications of Mini-Wright Standard Peak Flow Meter are below: [7]

Size- 100 x 60 x 240 mm
Weight- 25 grams
Measurement Range- 60-880 L/min (ATS scale)
Accuracy +/- 10% or 10 L/min
Repeatability < 5 l/min

PROCEDURE:

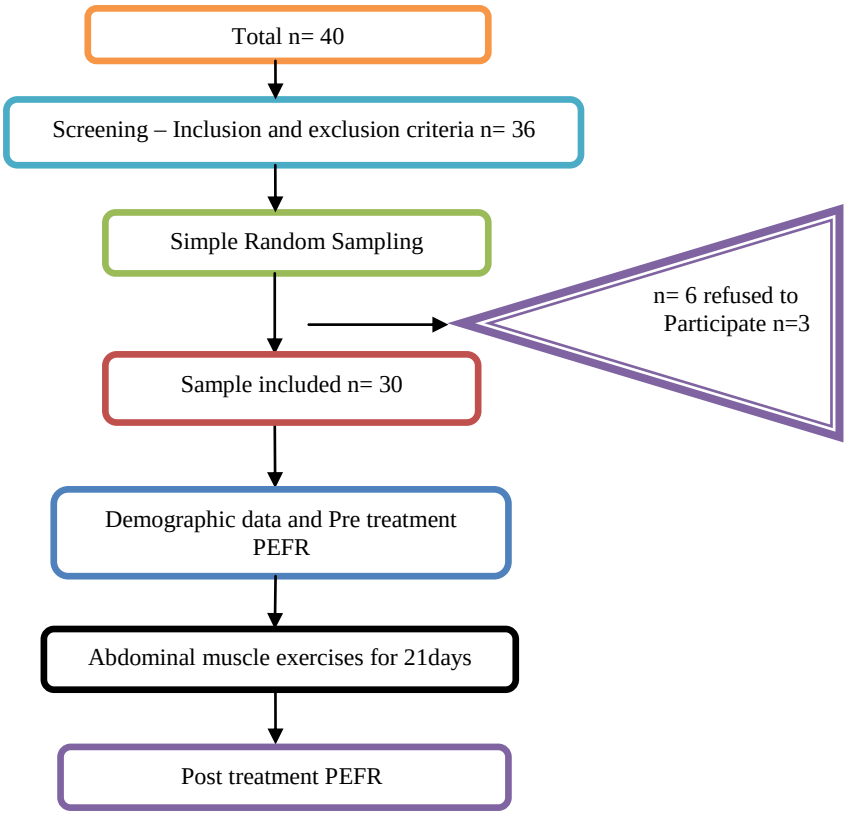


Figure 2: Flow chart representing the procedure of selection of participants

Abdominal Strengthening Exercises: Upper Abdominals: Curl ups: The participants were in crook lying position and were asked to lift the head off the mat. Then they were asked to lift the shoulders until the scapulae and thorax cleared the mat, keeping the arms horizontal. The participants do not come to a full sit up because once the thorax clears the mat the rest of the motion is performed by the hip flexor muscles. [8,10,11]

Lower Abdominals: Leg Lowering Movement: The participants were in supine lying position and forearms were folded across the chest to ensure that the elbows were not resting on the mat for support. The participants were with the hips at 90^0 and knees extended; then they lowered the leg as far as possible while maintaining stability in lumbar spine (should not increase the lordosis), followed by raising the legs back to 90^0. [8,10,11]

Total duration: 21 days. The intervention was started with 5 min warm up followed by abdominal strengthening exercise with 5 min of cool down session. Total time: 20 minutes.

DATA ANALYSIS AND RESULTS

Assessment of the results: Study variable the peak expiratory flow rate was done before starting physiotherapy sessions and at the end of the study.

Data analysis

Statistical analysis was performed on the data obtained from 30 patients. Data was analyzed using Graph Pad Instat Trial Version 13.3. Descriptive statistics for all outcome measures were expressed as mean, standard deviations and test of significance such as paired‘t’ test used for comparing data within each group. Data was considered statistically significant with $p<0.05$ and highly significant with $p<0.01$.

Group composed of 30 participants with a mean age of 23.96 ± 1.6 years. The mean baseline value for PEFR was 419 ± 38.63 years. After intervention the mean

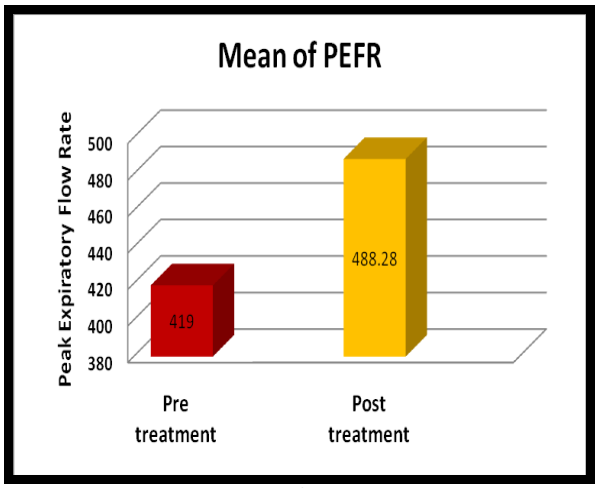
value of PEFR was 488.28 ± 35.16. (Table 1 and Graph 1)

Table 1: Pre-Post Comparison of Peak Expiratory Flow Rate

	Pre-PEFR(L/min)	Post-PEFR(L/min)
MEAN	419	488.28
SD	±38.63	±35.16
SEM	7.05	6.53
N	30	30

t = 22.0588, Degree of freedom= 28, Standard error of difference = 3.158, P = < 0.0001. The mean value for Pre-treatment and Post-treatment PEFR is 419 and 488.28 respectively and the standard deviation is 38.63 and 35.16 respectively.

As t= 22.0588 and p=0.0001, the result is highly statistically significant.



Graph 1: Mean Comparison of Peak Expiratory Flow Rate

DISCUSSION

The result from the statistical analysis of the present study supported the alternative hypothesis that stated there will be a beneficial effect of peak expiratory flow rate on the subjects treated with abdominal muscle strengthening exercises. The mean values of data from present study indicates that subjects showed better peak expiratory flow rate after 3 weeks of abdominal strengthening exercises. When intra group mean values of peak expiratory flow rate were analyzed it was found statistically significant on post 3 weeks of intervention.

A compromised respiratory efficiency reduces the individuals stress tolerance. Exercise increases the respiratory muscle strength. It is possible to train the respiratory muscles of normal subjects for increased endurance. [12]

Peak Expiratory Flow Rate: There was extremely significant improvement of peak expiratory flow rate. The mechanism underlying improvement in peak expiratory floor rate is probably because of the abdominal muscles have facilitator function by improving the efficiency of diaphragm to generate pressure during respiration. [8] During expiration, diaphragm simply relaxes and elastic recoil of the lung, chest wall and abdominal structures compresses the lungs and expel the air. The muscles that pull rib cage downward during expiration are mainly Abdominal recti, which have powerful effect of pulling downward on lower ribs at same time that they and other abdominal contents upward against diaphragm and the Internal intercostals.

During heavy breathing, however, the elastic forces are not powerful enough to cause the necessary rapid expiration, so that extra force is achieved mainly by contractions of abdominal muscles, which pushes the abdominal content upward against the bottom of the diaphragm, thereby compressing the lungs.

A study conducted by Sheela RS stated that daily Peak Expiratory Flow Rate monitoring is a useful measure both clinically and epidemiology. [13]

Badaruddin M, in his study of peak expiratory flow rate in different positions and concluded that Peak Expiratory Flow Rate can be measured in any position. [14]

Physical inactivity and low cardio-respiratory fitness are recognized as important causes of morbidity and mortality. It is generally accepted that people with higher levels of physical activity tend to have higher levels of fitness and that physical activity can improve cardio-respiratory fitness. A study by Chaitra B saw the effects of aerobic exercises training on Peak Expiratory Flow Rate. [15]

A comparative study was done by Karia RM on Peak Expiratory Flow Rate between smokers and non smokers and found that Peak Expiratory Flow Rate was

significantly lower in all smokers group than non-smokers. [16]

Ilango S studied correlation of Obesity Indices with Peak Expiratory Flow Rate in males and females, results revealed that PEFR was significantly lower in obese males but not in obese female when compared to their non obese counterparts. [17]

CONCLUSION

This study concludes that three weeks of abdominal muscle exercises is beneficial for the improvement of forced expiratory flow rate in normal individuals.

Limitations: In the present study, the duration of the intervention was short. Home exercise program was not given. There was no follow up.

Recommendations: As this study was done only for a 3 weeks, a short term study could be conducted with long term follow up sessions to know the effectiveness of the treatment. Study should be conducted with a larger sample size. There were few dropouts that can be strategically improved in future. Specific obstructive and restrictive diseases can be taken into consideration.

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