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Original Research Article

EFFECT OF ABDOMINAL MUSCLE EXERCISES ON PEAK EXPIRATORY FLOW RATE IN OBESE INDIVIDUALS

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ABSTRACT

Background: Expiration is a passive process with active muscle contraction being used more during forceful activities such as coughing or sneezing. The abdominal muscles are major muscles of diaphragm. So it improves the efficiency of expiration. In obese individuals there is deposition of fat around the rib cage and the chest wall. Studies have shown that there is a decrease in the functional residual capacity and expiratory reserve volume in obese individuals. The expiratory flow limitation is important determinant of breathlessness in obese individuals. Abdominal and thoracic fat have direct effects on downward movement of diaphragm and chest wall. Abdominal muscles are powerful expiratory muscles whose actions help to force the diaphragm back to its resting position.

Aim: This present study was done to determine the effect of abdominal muscle exercises on peak expiratory flow rate in obese individuals.

Methods: In this experimental study 30 obese subjects with decreased peak expiratory flow rate who fulfilled the inclusion and exclusion criteria having a Body mass index of more than 30kg/cm^2 were selected for abdominal muscle exercise program for 4 weeks, 2 sets of each exercise, thrice a week for 10 repetitions for each set. The pre and post peak expiratory flow rate were measured by peak expiratory flow meter. Statistical analysis was done using one sample t and Wilcoxon test.

Results: There was a significant increase in post peak expiratory flow rate compared to pre peak expiratory flow rate.

Conclusion: This study showed that there is significant effect of abdominal muscle exercises on peak expiratory flow rate in obese individuals.

KEY WORDS: Abdominal Muscle Exercises, Peak Expiratory Flow Rate, Obese.

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INTRODUCTION

Obesity is defined as a condition with excessive fat accumulation in body to the extent that health and well being are adversely affected. Obesity results from complex interaction of genetic, behavioural and environmental factors causing imbalance in energy production and expenditure. It is a major risk factor resulting in respiratory conditions. This may result in obesity related morbidities such as cardiovascular, endocrinal and rheumatologic disorders, sleep related disorders etc. [1].

Expiration is a passive process with active muscle contraction being used more during forceful activities such as coughing or sneezing. Forceful expiration is also an important action of abdominal muscles. The abdominal muscles are the major muscle of the diaphragm.

So it improves the efficiency of expiration [2].

Obesity reflects a shift in the balance of inflationary and deflationary pressures on the lung due to the mass load of adipose tissue around the rib cage, abdomen and in the visceral cavity. Studies have been done on respiratory functions which have concluded a decrease in the functional residual capacity and expiratory reserve volume in obese individuals.In addition the abdominal and thoracic fat are likely to have direct effects on the downward movement of the diaphragm and on chest wall properties [3].

Body mass index is the ratio of weight in kilograms to height square in centimetres [3]. 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.The abdominal muscles are regarded as powerful expiratory muscles whose action helps to force the diaphragm back to its resting position and thus air from the lungs [5].

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 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 [5].

Peak expiratory flow is the maximum flow achieved during an expiration delivered with maximal force starting from the level of maximal lung inflation.There is decrease in peak expiratory flow rate in obese individuals as compared to non- obese individuals [6].

MATERIALS AND METHODS

Materials: Peak expiratory flow meter, pen, paper, height chart, weighing machine, mat.

Sample design

Sample size: 30

Type of sampling: Convenient sampling

Sampling population: Obese individuals (30-40 years)

Study design

Type of study: Experimental

Place of study: Metropolitan city

Study duration: 1 year

Selection criteria:

Inclusion criteria:

1.Obese individuals between 30-40 years of age

2.Body mass index of more than 30 kg/cm^2

3.Abdominal muscle strength of grade 2 .

Exclusion criteria:

1.Disorders of spine

2.Low back pain

3.Cardio respiratory diseases

4.Gynaecological disorders

5.Recent surgeries

6.Individuals undergoing any exercise programme

Procedure: Obese individuals willing to participate were included in the study according to the inclusion and exclusion criteria. Prior to starting the study a written consent was taken from all the subjects in the language best understood by them. Subjects were explained about the procedure. Body mass index was measured by measuring height in cm and weight in kg. The subjects were classified as obese by calculating the body mass index. The obese individuals with abdominal muscle strength of grade 2 were taken. Method to use the peak expiratory flow meter was explained to the subjects.The mouthpiece was attached to the side marked in the arrows then side the indicator to the bottom of numbered scale, standing up straight subject was asked to take a deep breath, completely filling the lungs then place the mouthpiece and blow out as hard and fast as possible in a single blow, the final position was the indicator of peak flow. The maximum of the 3 similar trials was taken. After recording the pre peak expiratory flow rate all subjects were given abdominal muscle

exercises for a period of 4 weeks, 2 sets of each exercise for 3 sessions per week.

Fig 1

Fig 2

Fig 3

Fig 4

Abdominal exercise protocol will include

Upper abdominal exercises:

1.Crunches- 20 repetitions.

Starting position: Crook lying

Procedure: Have the subject lift the head off the mat. This will cause a stabilizing contraction of abdominal muscle. Lifting the shoulders until the spine of scapulae and thorax clear the mat keeping the arms horizontal. The patient does not come to a full sit up because once the thorax clears the mat the rest of motion is performed by hip flexors.

2. Hip rolls- 20 repetitions.

Starting position: Supine lying position

Procedure: Knees are flexed keeping feet firmly on the ground. Lower the knees to one side turning at the waist.Aim is to allow the thigh to touch the floor then slowly repeat again on the other side. Avoid lifting the shoulders to come up from the floor

Lower abdominal muscle exercise

3.Double knee to chest- 20 repetitions.

Starting position: Crook lying

Procedure: Having the subject set a posterior pelvic tilt bring both knees to the chest and return.

4.Leg lowering movement - 20 repetitions.

Starting position: Supine lying and forearms are folded across the chest to ensure that elbows are not resting on the mat for support.

Procedure: Subject enable to keep low back flat to the table while lowering the legs to table level, the legs are elevated a few degrees. After 1 month, peak expiratory flow rate was again assessed as before starting the abdominal muscle exercises. One Sample t and Wilcoxon test has been used to find the significance between the pre and post peak expiratory flow rate values and $p<0.0001$ was considered significant.

RESULTS

Results were presented as Mean±SD. The age of the subjects ranged from 30-40 years. The mean age being 35±3.48 years.

Effect on peak expiratory flow rate

The peak expiratory flow rate of the subjects was increased significantly at the end of 4 weeks of abdominal muscle exercise programme.

Table 1: Effect of abdominal muscle exercises on peak expiratory flow rate in obese individuals.

	MEAN	SD
PRE PEFR	282	24.23
POST PEFR	303	27.49
p<0.0001		

DISCUSSION

The purpose of this study was to find the effect of abdominal muscle exercises on peak expiratory flow rate in obese individuals.

Obesity reflects a shift in the balance of inflationary and deflationary pressures on the lung due to the mass load of adipose tissue around the rib cage, abdomen and in the visceral cavity. There is extremely significant improvement of peak expiratory flow rate. The mechanism underlying improvement in peak expiratory flow rate is probably because the abdominal muscles have facilitator function by improving the efficiency of diaphragm to generate pressure during respiration. During expiration, diaphragm simply relaxes and elastic recoil of the lung, chest wall and the abdominal structures compresses the lungs and expels the air. The muscles that pull the rib cage downward during expiration are mainly Abdominal recti, which have a powerful effect of pulling downward on lower ribs at the same time that they and other abdominal contents move 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 [5].

Peak expiratory flow is the maximum flow achieved during an expiration delivered with maximal force starting from the level of maximal lung inflation [6]. Expiration is a passive process involving elastic recoiling of the lungs and thoracic cage. Expiratory muscles: Primary expiratory muscles: these are internal intercostal muscles, which are innervated by intercostal 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 [7].

Rochester et al. is of the opinion that obesity reduces the strength and endurance of the respiratory muscles, especially diaphragm, making the contraction inefficient; this statement was substantiated by the fact that the value of static maximal inspiratory pressure was 60 to 70% less in obese persons than in normal subjects .Because of this, the obese persons are compelled to breathe rapidly and shallowly, a pattern observed in patients with neuromuscular and musculo-skeletal disorders [10].

In the present study 4 weeks of abdominal strengthening protocol was given to obese subjects who had a decrease in peak expiratory flow rate. The sample consisted of 20 obese individuals. Prior to the abdominal muscle exercises the peak expiratory flow rate was noted and then after 4 weeks again the peak expiratory flow rate was recorded. Statistical analysis was done by using the one sample t and wilcoxon test to compare the pre and post peak expiratory flow rate which is statistically significant ($p<0.0001$)

Thus our study showed significant effect of abdominal muscle exercises on peak expiratory flow rate in obese individuals.

CONCLUSION

The study concluded that there is significant effect of abdominal muscle exercises on peak expiratory flow rate in obese individuals. Compared with the general population, obese individuals have a much higher prevalence of cardio respiratory symptoms. Practice of abdominal muscle exercises will help in improving the lung volumes like functional residual capacity and expiratory reserve volume. It is suggested that the measurement of peak expiratory flow rate could have been done using a large sample size and also the duration of the abdominal muscle exercise protocol could have been increased. The study can be clinically implied to improve respiratory parameters like dyspnea in obese individuals and cardiovascular rehabilitation programme. Abdominal muscle exercises can be used along with other adjunct therapies to improve the fitness of an individual.

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Conflicts of interest: **None**

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