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EFFECTS OF INSPIRATORY MUSCLE TRAINING FOR OBESITY

REKHA K*, ANANDH V AND ALAGESAN J

Saveetha College of Physiotherapy, Saveetha University, Chennai, India

*Corresponding Author: E Mail: futurdreams88@gmail.com; Mob.: +919840545975

ABSTRACT

Purpose of this study was to find out the effects of Inspiratory muscle Strength training in obese individuals with Inspiratory muscle weakness. We conducted 4 weeks Experimental study for 47 obese subjects with Inspiratory muscle weakness randomised into two groups based on the selection criteria. Group A – Experimental group (25 subjects) and Group B – Control group (22 subjects). Informed consent obtained from all participants. Outcome measures were modified Borg scale to record dyspnea and quality of life questionnaire using Nottingham extended activities of daily living, Maximum voluntary ventilation, Forced Expiratory Volume in one second and Forced vital capacity performed using Spirometer were tested at baseline and after intervention. Inspiratory muscle training using Incentive spirometer was performed as an intervention. Participants Age and BMI were similar for both the groups. Experimental group showed significant differences in improving Maximum voluntary ventilation, Forced expiratory volume in one second, Forced vital capacity. Reduce in dyspnea was reported in experimental group and improved quality of life.

Keywords: Obesity, Dyspnea, Inspiratory Muscle Training

INTRODUCTION

Obesity prevails in various communities of the world. Its prevalence is escalating at an alarming rate to epidemic proportions throughout the world. Furthermore, obesity is no longer just a concern for developed

countries, but it is a serious public health problem that is growing in countries with low or middle income [1]. Obesity is a complex, multifactorial disease develops from an interaction of genetic, metabolic, social,

cultural and behavioural factors [2]. It also increases the risk of various chronic diseases like diabetes, cardiovascular disease, stroke and some cancers [1].

Obesity can cause various deleterious effects to respiratory function, such as alterations in respiratory mechanics, decrease in respiratory muscle strength and endurance, decrease in pulmonary gas exchange, lower control of breathing, and limitations in pulmonary function tests and exercise capacity. These changes in lung function are caused by extra adipose tissue in chest wall and abdominal cavity, compressing the thoracic cage, diaphragm and lungs. The consequences are a decrease in diaphragm displacement, a decrease in lung and chest wall compliance, increase in elastic recoil, resulting in a decrease in lung volume and an overload of inspiratory muscles. These changes are worsened by an increase in Body Mass Index (BMI) [3]. Most pulmonary dysfunction studies among obese individuals have shown the presence of restrictive patterns, with the reduction of pulmonary volumes and capacities but with a normal tiffeneau index. In the same way as for other skeletal muscles of the body, the performance of the ventilator muscles can be described in terms of strength and endurance, such that strength is analyzed

through measurement of maximum static mouth pressures against closed airway [2].

Inspiratory muscles including the diaphragm are morphologically and functionally skeletal muscles and therefore should respond to training in the same way as would any locomotor muscle if an appropriate load is applied and stated that diaphragm increases its thickness when resistance is applied during weight training [4]. Incentive spirometry is widely used clinically as an adjunct to chest physiotherapy that provides the patient with visual feedback of the volume of air inspired during a deep breath. It provides low level resistive training while minimizing the potential of fatigue to the diaphragm. It has been used to enhance lung expansion and inspiratory muscle strength [5], as there are no such studies performed for training inspiratory muscles in obese individuals using incentive spirometer. Therefore Aim of the study was to investigate the effects of Inspiratory muscle strength training in obese individuals with Inspiratory muscle weakness.

MATERIALS AND METHODS

1. Weighing machine
2. Height scale
3. Chair Pulmonary function testing unit (RMS unit)
4. Modified borg scale of dyspnea

5. Nottingham extended activities of daily living questionnaire
6. Incentive Spirometer

Study Design: Experimental study design.

Sampling: Simple random sampling.

Sample Size: 47 individuals

Study Setting: Physiotherapy OPD, Saveetha medical college and hospitals.

Inclusion Criteria

1. Individuals with BMI greater than 25
2. Males and females between 20 to 45 years.
3. Obese individuals with Dyspnea

Exclusion Criteria

1. Subjects with restrictive lung disease other than obesity,
2. Chronic obstructive lung disease,
3. Unstable cardiovascular disease,
4. Tobacco consumers and alcoholics,

Procedure

Subjects were asked to rest in a chair for approximately 10 min after arriving at the Outpatient department. A questionnaire on quality of life using Nottingham Extended activities of daily living was administered to them. They provided the information on whether they had any trouble of breathlessness during their daily living activities and the severity of the breathlessness was recorded according to Modified Borg scale of dyspnea, ranging from

0 to 10 and Maximum voluntary ventilation (MVV), Forced expiratory volume in one second (FEV₁) & Forced vital capacity (FVC) were then measured using Spirometer.

47 subjects were randomly divided in two groups. Group A consists of 25 subjects were given Inspiratory muscle training using Incentive Spirometer. It was considered as a mechanical aid for lung expansion and was applied for 10 sets per session per day of which 15 – 20 repetitions with maximum resistance per set. For a period of 5 days per week and so on for 4 weeks. 22 subjects in Group B no training was given.

Following 4 weeks intervention assessments were performed to ensure any differences using Modified Borg scale to grade dyspnea and quality of life was assessed with using Nottingham extended activities of daily living index. And MVV, FEV₁, & FVC was measured using Spirometer.

Outcome Measures

1. Maximum voluntary ventilation (MVV)
2. Forced expiratory volume in 1 second (FEV₁)
3. Forced vital capacity (FVC)
4. Modified borg scale
5. Nottingham extended activities of daily living.

Statistical Methods

Data before and after intervention were computerized and analyzed using SPSS

software version 20.0. The mean value and standard errors were calculated for different variables and the difference in mean value was tested for statistical significance using parametric tests such as paired t test used to compare within the group and unpaired t test in between groups for the quantitative data and for qualitative data, non parametric tests are used such as Wilcoxon sign rank test used to compare within the group differences and Mann Whitney U test used to compare between the two groups. P value < 0.05 was considered as statistically significant.

RESULTS

Mean Comparison of Pretest and Post test in Group A and Group B for MVV were shown in **Figure 1**. MVV among Group A pretest showed significant differences p value < 0.0001 and Group B pretest not quite statistically significant as p value equals 0.0619. Comparison between both groups pretest results considered to not statistically significant p value 0.5475, posttest shows significant differences 0.0400.

Mean Comparison of pre test and post test in Group A and Group B for FEV1 shown in **Figure 2**. FEV1 Comparison of pretest showed statistical significant differences as p value < 0.0001 and among Group B pretest p value is 0.2600 not statistically significant.

Between both the groups p value of pretest is 0.5101 considered to be not statistically significant, post test p value 0.0115 is statistically significant.

Mean comparison of pre test and post test for Group A and Group B for FVC shown in **Figure 3**. Statistical significant differences was observed in Group A pretest for FVC p value being < 0.0001 and among Group B pretest equals 0.3602 not considerable significant differences were observed and comparison of both the groups considered to be statistically significant for posttest p value equals 0.0441 whereas pretest comparison is not statistically significant as p value is 0.7991.

Demographic data mean age between the two groups and BMI were shown in **Table 1**. Comparison within the group for Nottingham extended activities of daily living (NEADL) shown in **Table 2**. Comparison within the group for Modified Borg Scale of dyspnea shown in **Table 3**. Homogeneity of groups at baseline was analyzed by Mann Whitney U test for both outcome measures proved with p value more than 0.05. Between groups comparison of both outcome measures after intervention was showing p value less than 0.001 proves a significant difference between groups after intervention.

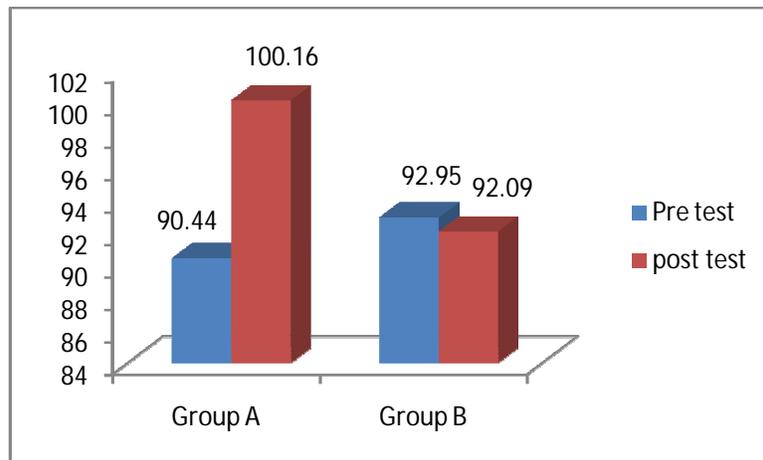


Figure 1: Mean Comparison of Pretest and Post test in Group A and Group B for MVV

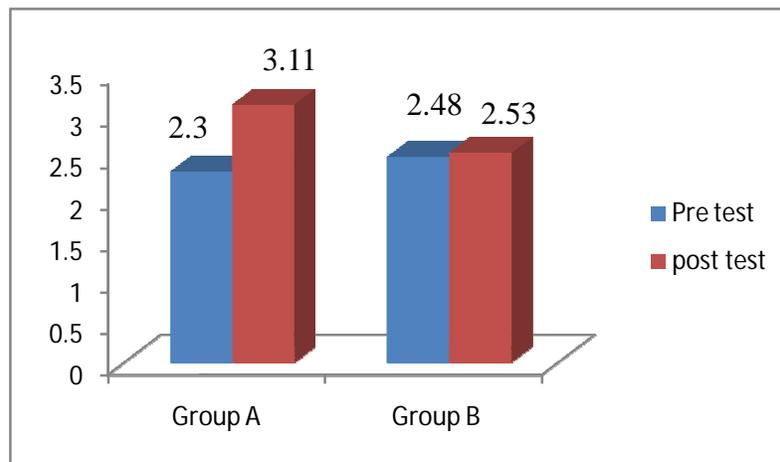


Figure 2: Mean Comparison of Pre Test and Post Test in Group A and Group B for FEV1

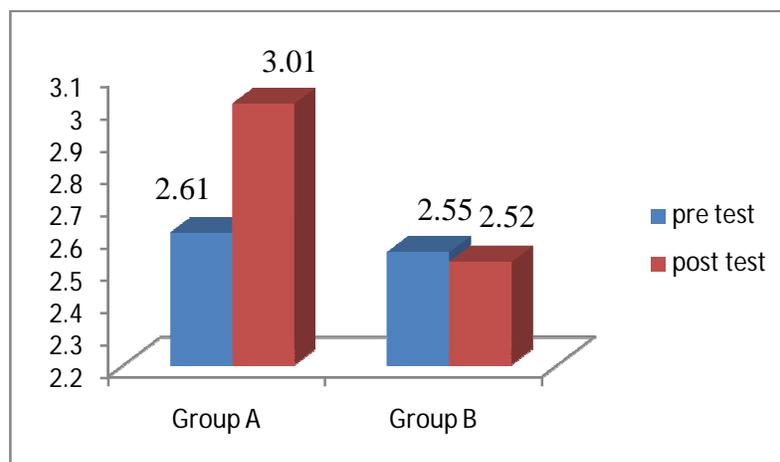


Figure 3: Mean Comparison of Pre Test and Post Test for Group A and Group B for FVC

Table 1: Demographic Data

| Demographic Characteristics | Group A Mean±SD | Group B Mean±SD |
|-----------------------------|-----------------|-----------------|
| Age (years) | 29.16±5.53 | 28.6±5.30 |
| BMI (Kg/m ²) | 28.4±2.74 | 28.2±2.12 |

Table 2: Comparison Within the Groups for Nottingham Extended Activities of Daily Living (NEADL)

| NEADL | Pre Mean±SD | Post Mean±SD | P value |
|---------|-------------|--------------|---------|
| Group A | 58.44±1.53 | 60.6±1.44 | 0.000 |
| Group B | 57.77±1.69 | 57.95±1.81 | 0.475 |

Table 3: Comparison Within the Groups for Modified Borg Scale of Dyspnea

| NEADL | Pre Mean±SD | Post Mean±SD | P value |
|---------|-------------|--------------|---------|
| Group A | 3.16±1.02 | 1.84±1.01 | 0.000 |
| Group B | 3.27±1.03 | 2.77±1.02 | 0.002 |

DISCUSSION

Obesity is directly or indirectly associated with respiratory system as various studies has been done on it to understand the exact pathophysiology. Obesity has an influence on the lung volumes and capacities which is known that reduces the strength and endurance of the inspiratory muscles. **Ali El Kosery, et al., 2011, [6]**, stated that the thorax is a complex assembly of muscles, the rational for inspiratory muscle training is that increasing the strength and endurance of the respiratory muscles and can improve clinical outcomes, reduce the severity of dyspnea and enhance the ability of individuals to perform daily activities [6].

Magnani, et al., 2007, [2] demonstrated that MVV test evaluates the respiratory endurance and is influenced by the respiratory muscle strength, the lung and chest compliance and the control of breathing and airways resistance. In case of obese individuals this

variable is reduced mainly by mechanical injury to the respiratory muscles, caused in particular by the excessive weight on the thorax. Also stated that obesity causes overload to accessory muscle and that these muscles are primarily responsible for dyspnea reported by the obese group [2]. **Sahebajami, 1998, [7]**, demonstrated that individuals with dyspnea are characterized by decreased inspiratory muscle strength. He compared spirometric parameters such as MVV which was lower in dyspneic group 90.2 and subjects without dyspnea had 107.8 [7]. Our study demonstrated a very low MVV 90.44 which significantly improved to 100.16 for intervention group. Though obesity causes dyspnea, during our study it has been noted that most of the subjects reported only light, moderate and somewhat severe dyspnea on Modified borg scale which meant to be the initial effects which can further lead to complications.

Shu, *et al.*, 2001, [8], demonstrated a study on dyspnea and quality of life in older people at home in which he used a MRC breathless scale and Nottingham extended activities of daily living index. Nottingham extended activities of daily living index used to assess quality of life with breathlessness and found to have significant relationship between dyspnea and functional status, also found that quality of life scores in dyspneic group was lower when compared with nondyspneic group and also found the strong association between dyspnea and obesity. It was reported that 66.3% of obese subjects were breathless compared with 36% non overweight subjects (BMI <25) [8]. Hence, Nottingham extended activities of daily living was very much relevant to the study it was used and though [8] demonstrated the relationship between obesity and dyspnea, study did not target on the intervention and the age group was around 70 years and had been concluded that relationship between obesity and dyspnea was striking and indicates a need to target health education programmes at this sector of the population [8].

Our study investigated the younger age group mean age being similar for both the groups 29.16 for group A and 28.6 for group B with BMI mean being 28.4 for group A and 28.2 for group B shows baseline obesity though

many reported higher BMI greater than 30 and intervention targeted on Inspiratory muscle strength training in obese individuals with dyspnea and found the role of Nottingham extended activities of daily living. A questionnaire on quality of life was administered in various studies related to dyspnea. Dyspnea related to mobility are very much relevant but dyspnea related to leisure activities like writing letters significantly had negative effects, but in some cases of severe dyspnea positive effects were also reported on driving a car which was also observed in some studies.

Danger, *et al.*, 2011, [9], demonstrated a study on Respiratory Muscle Endurance Training in which respiratory muscle was trained with isocapnic device for 26 ± 6 days with 3-4 times of Respiratory muscle endurance training per week which had significantly improved Respiratory muscle strength [9]. We found that Inspiratory muscle strength had improved using Incentive spirometer which is feasible in India and had significantly improved strength in 4 weeks with only 5 days intervention per week.

CONCLUSION

A 4 weeks, supervised Inspiratory muscle training program had significant effects on Inspiratory muscle strength in obese population and improved measures such as

Maximum voluntary ventilation, Forced expiratory volume in one second, Forced vital capacity. Improvements in dyspnea and quality of life were also seen. Hence, this study can be applied to obese individuals to reduce dyspnea and improve quality of life.

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