

**RESPIRATORY RESPONSES TO SHORT TERM SUSTAINED ISOMETRIC  
MUSCLE CONTRACTION AMONG UNDERGRADUATES**

**ABSTRACT**

**AIM**

This study sets out to investigate whether a short-term isometric abdominal exercise can benefit adults with improvement in ventilatory functions.

**MATERIALS AND METHODS**

An experimental design with a convenience sample was used . The study enrolled 20 adults from the student population of I-BDS students with no history of smoking and respiratory illness. The participants did a daily 20-minute static abdominal exercise over a period of three days. The lung function test was assessed using spirometry and the values of forced vital capacity (FVC), forced expiratory volume in the 1st sec (FEV1), FEV1/FVC ratio, Peak expiratory flow rate (PEFR) and Forced expiratory flow (FEF25-75%).

**RESULTS**

The study demonstrated a significant increase in the mean values of forced vital capacity and forced expiratory volume in one second. The FEV1/FVC ratio,PEFR, FEF 25-75% did not reveal significant changes

**CONCLUSION**

The study concluded an innovative finding that ventilatory functions improved after short term isometric training and higher sample size need to be evaluated to demonstrate its efficacy in adults at high risk of chronic obstructive lung disease.

**Key words : sustained, isometric, exercise, lung function tests, innovation**

## **INTRODUCTION**

An isometric muscle contraction is a form of exercise involving the static contraction of a muscle without any visible movement in the angle of the joint.(1) Isometric exercises help maintain strength(2). They can also build strength, but not effectively. The cardiovascular responses to sustained, isometric muscle contractions have been well documented, and include FVC - Forced Vital Capacity, FEV1 - Forced Expiratory Volume, PEF - Peak Expiratory Flow Rate and FEF - Forced Expiratory Flow. For a particular muscle, or group of muscles, the respiratory changes are related to the force of contraction of the muscle after short term sustained isometric muscle contraction.(3)(4) The mass of muscle involved has less effect on the blood pressure and heart rate responses. The respiratory responses to isometric muscle contraction have been less well investigated. The studies have mainly been on short term isometric abdominal muscle contraction. (4) It represents the responses to short term isometric muscle contractions of a small mass of muscle. Some subjects hyperventilate inappropriately which leads to marked falls in alveolar partial pressure of CO<sub>2</sub> (P<sub>CO2</sub>). The present studies aim to compare directly the respiratory responses to contraction of a small mass of muscle and of a larger mass, the short term isometric abdominal muscle contraction. (5) We will test the hypothesis that the increase of ventilation during sustained isometric contractions is independent of the mass of the muscle involved, although oxygen consumption may rise with increasing active muscle mass. The reduction of alveolar P<sub>CO2</sub>, resulting from hyperventilation, should be less with a larger muscle mass as carbon dioxide production will be increased.(6) Preliminary accounts of this work have already been communicated to the Physiological Society.(7) This study sets out to investigate whether a short-term isometric abdominal exercise can benefit adults with improvement in ventilatory functions.(8)

## **MATERIALS AND METHODS**

A pre-experimental design with a convenience sample was employed. All the study participants signed consent forms before being enrolled. The study group consisted of 20 adult males, ranging from 18 to 25 years old with similar anthropometric measurements like age, gender, height and body mass index (BMI).

Inclusion criteria : Healthy adults from the student population of I-BDS students.

Exclusion criteria – Subjects with any respiratory illness, COPD or spinal deformities were excluded from the study.

The study was introduced and explained to the participants, who were then encouraged to handle the spirometer and arm. They were taught short term static isometric exercise for 20 mins over a period of three days . Both the pre and post exercise routine spirometry tests were evaluated using HELIOS SPIROMETER and the values of Forced vital capacity (FVC), forced expiratory volume at the end of the first second (FEV1), FEV1/FVC ratio and peak expiratory flow rate (PEFR) and FEF 25-75 % using a spirometer both before and after 3 days of isometric exercise for 20 mins.

Statistical Analysis was done using SPSS Software and the Paired dependant t test was done to evaluate the changes in lung functions pre and post evaluation

## RESULTS

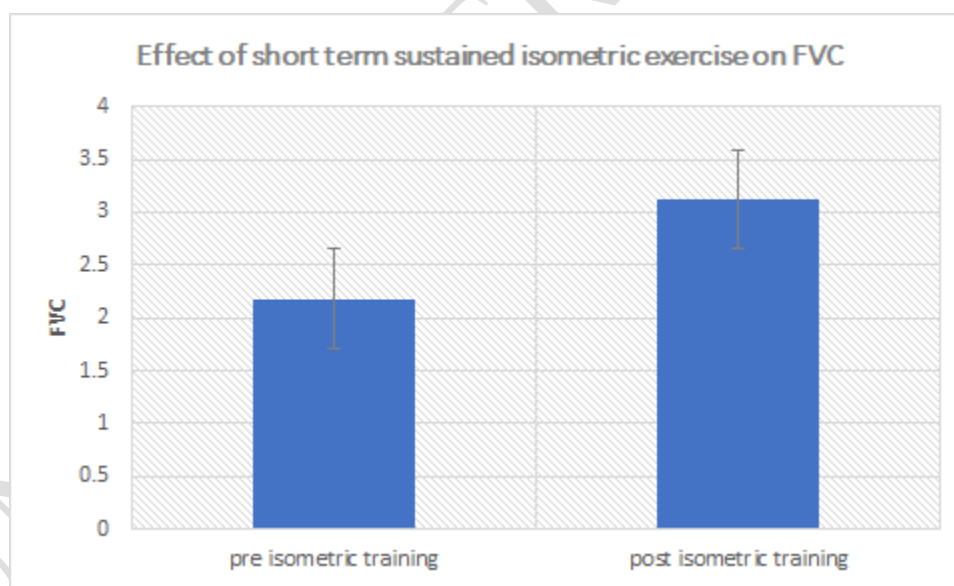
The present study showed that there was a significant increase in FVC, FEV1 after short term isometric exercise and it was found to be statistically significant ( $p < 0.05$ ). (Fig 1 & 2). There was a non-significant decrease in FEV1/FVC, PEFR and FEF25-75 (Fig 3,4 & 5). (Table -1)

Table-1 represents the lung functions in pre and post sustained isometric exercise training

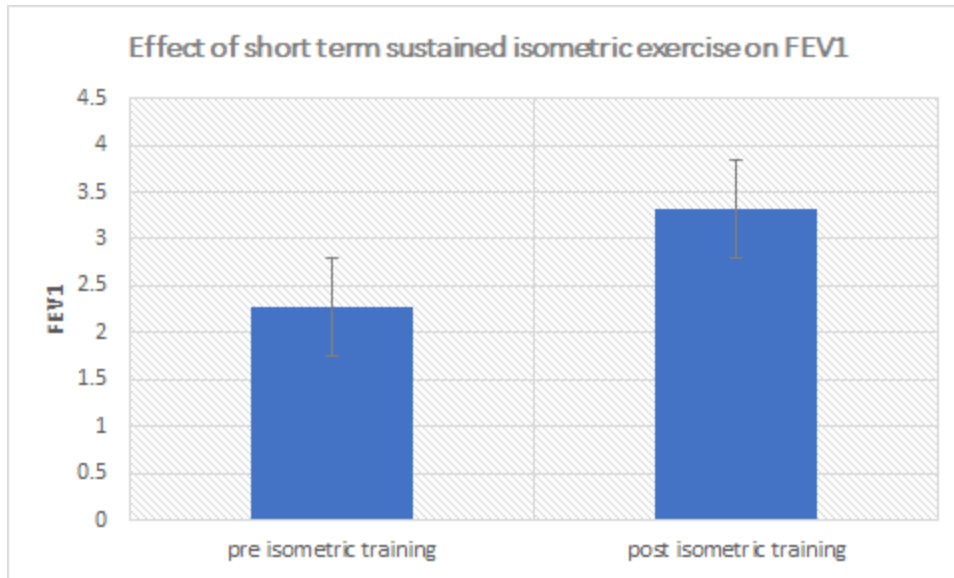
Lung function parameters	Pre isometric training	Post isometric training
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FVC	2.18 ± 0.444	3.12 ± 0.571
FEV1	2.28 ± 0.385	3.32 ± 0.284
FEV1/FVC	100.01 ± 0.000	100.01 ± 0.000
PEFR	4.72 ± 2.695	2.64 ± 1.342
FEF 25-75%	3.39 ± 2.007	3.39 ± 1.393

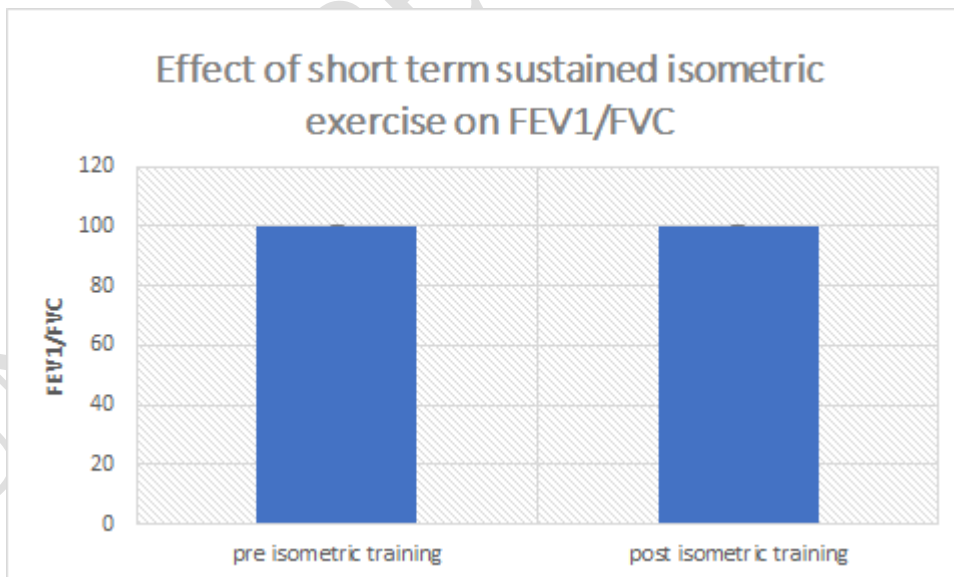
Values are expressed as mean ± stdev.



**FIGURE 1.** represents the changes in Forced Vital Capacity among the adults. FVC shows an increase after short term sustained isometric muscle contraction and the value was found to be statistically significant as in Paired dependant t test  $p= 0.05$  ( $p<0.05$ )

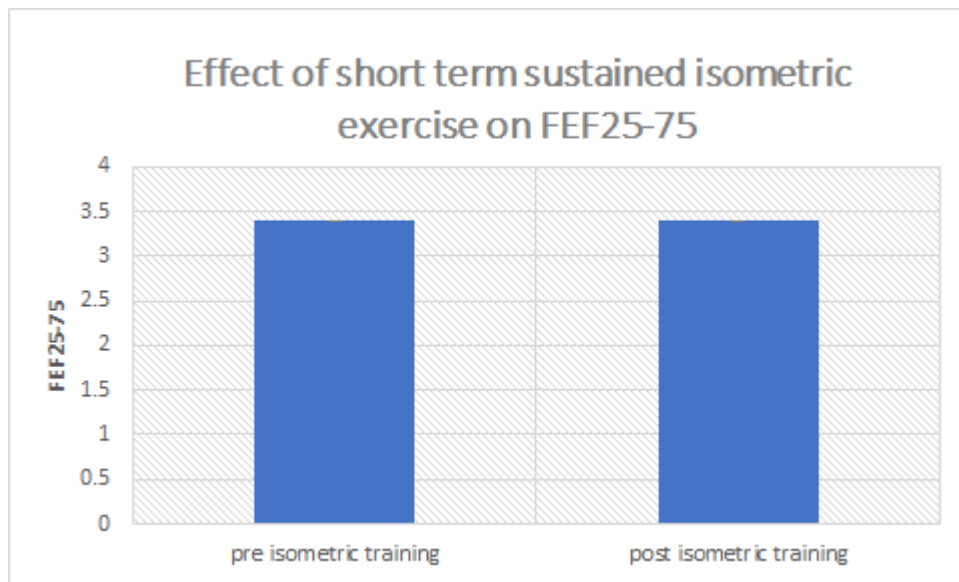


**FIGURE 2.** represents the changes in Forced expiratory volume among the adults. FEV1 shows an increase after short term sustained isometric muscle contraction and the value was found to be statistically significant as in Paired dependant t test  $p= 0.00$  ( $p<0.05$ )

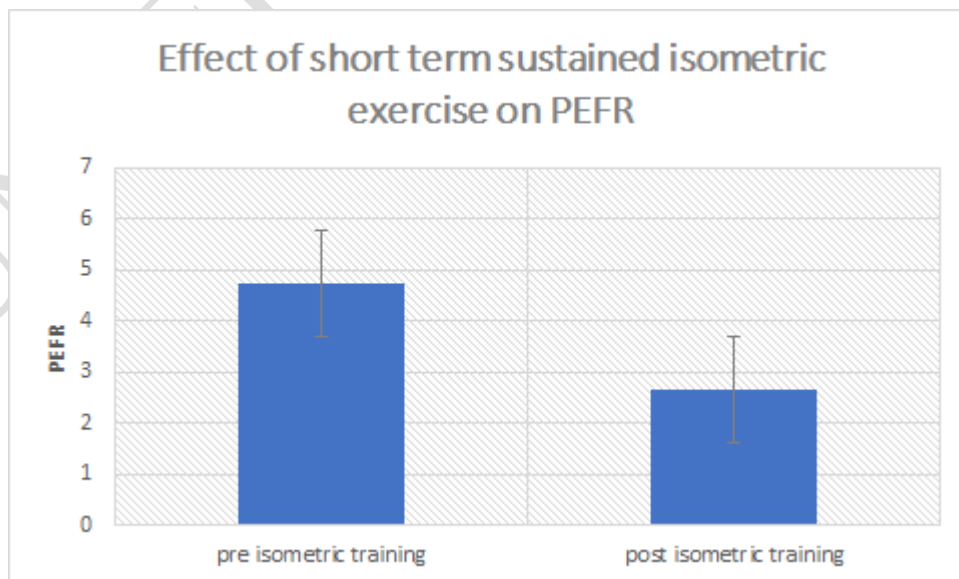


**FIGURE 3.** represents the changes in FEV1/FVC ratio among the adults. The FEV1/FVC ratio is equal before and after short term sustained isometric muscle

contraction and the value was found was not statistically significant as in Paired dependant t test  $p= 0.07$  ( $p>0.05$ )



**FIGURE 4.** represents the changes in FEF 25-75% among the adults. FEF 25-75% shows a decrease after short term sustained isometric muscle contraction and the value was not statistically significant as in Paired dependant t test  $p= 0.78$  ( $p>0.05$ )



**FIGURE 5.** represents the changes in PEFr among the adults. PEFr shows a decrease after short term sustained isometric muscle contraction and the value was not statistically significant as in Paired dependant t test  $p= 0.66$  ( $p>0.05$ )

## **DISCUSSION**

A number of research studies have been carried out to investigate the influence of physical activity and sport exercises on pulmonary function in patients who suffer from respiratory problems. The present study sets out to discover whether pulmonary function tests have different results in response to static abdominal exercise for 3 days. The present study revealed that there were significant improvements in FVC , FEV1 . Previous reports suggested that short term isometric exercises can have a facilitatory effect on the lungs particularly FEV1 values. It may be a three days exercise program, but this regimen enhanced the vital capacity and expiratory volumes. Also that the subjects' physical exertion during exercise could have helped to create reduced resistance to respiration and it has given the respiratory muscles an endurance training. This is likely to be an explanation for the significant difference in FVC values noted in our study.

Also that this effect is mediated to increase the ventilation caused by increased alveolar Pco<sub>2</sub>. However, cardiovascular and respiratory changes following short term isometric exercise are partly stimulated by drive from higher centres to the brain stem and role of chemoreceptors. (6)

Previous reports also suggested that aerobic exercise improves respiratory functions and increases the body's ability to use oxygen . It tones up all the muscles, improving the circulation in the process. It lowers blood pressure and reduces workload to the heart. It strengthens the respiratory muscles and, even reduces airflow resistance and facilitates the inflow and outflow of air in the lungs effectively (3)

## **LIMITATIONS OF THE STUDY**

The study population was confined only to a small group. If more sample size is added the results would have been statistically significant.

## CONCLUSION

The study concluded that short term isometric exercise significantly improves the lung functions and can reduce the predisposition of developing obstructive lung disease .

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