"EFFECTIVENESS OF CONTINUOUS TREADMILL RUNNING IN IMPROVING RESPIRATORY FUNCTION IN OVERWEIGHT AND OBESE YOUNG MALE COLLEGIATES"

A DISSERTATION SUBMITTED TO THE TAMILNADU

Dr. M.G.R MEDICALUNIVERSITY, CHENNAI,

AS PARTIAL FULFILLMENT OF THE

MASTER OF PHYSIOTHERAPY DEGREE

APRIL 2012.

CERTIFICATE

Certified that this is the bonafide work of **Mr. M. NISARUDEEN** of K.G. College of Physiotherapy, Coimbatore submitted in partial fulfillment of the requirements for the Master of Physiotherapy Degree course from the Tamil Nadu Dr.M.G.R. Medical University under the **Registration No:27102215** for the April 2012 Examination.

Date: Principal

Place : Coimbatore

Date :

"EFFECTIVENESS OF CONTINUOUS TREADMILL RUNNING IN IMPROVING RESPIRATORY FUNCTION IN OVERWEIGHT AND OBESE YOUNG MALE COLLEGIATES"

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Internal Examiner **External Examiner**

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INTRODUCTION

Obesity is the current prevailing health issue all around the world. Studies shows that there exists a positive relationship between obesity and pulmonary function and a negative relationship between Body Mass Index (BMI) and Forced Expiratory Volumes. “Obesity is associated with altered lung function independently of physical activity and fitness” ***Rebekh M Steele et al.***

Obesity is a causative factor for respiratory distress and sedentary lifestyle due to the industrialization, the World Health Organization (WHO) predicts that, by 2015 around 700 million adults will be obese at least 10% of the projected global population.

Obesity which has an ill effect on pulmonary function results in the increase in the prevalence of the lung disease resulting in mortality and morbidity. “Health and activity limitation index as a measure of quality of life in obesity” said by ***Edward H Livingston et al.***

Obesity in India has reached epidemic proportion in the 21st century with morbid obesity affecting 5% of the country’s population. The world wide epidemic of obesity continues unbeaten obesity is notoriously difficult to beat. Indians are susceptible to weight accumulation especially around the waist.

It is a statistical report taken among the different states in India Punjab ranks first in the country and Tamilnadu ranks fourth with population 19.8% and female population 24.4%. There is no peculiar age incidence for obesity starting from the age 4 till the age 5 to 14 is said to be childhood obesity "A statistical report taken in India in 2009-2010". A standardized prevalence of obesity total population aged 15 years and over by 2003 to 2007 the incidence of obesity among the adults became more because of increased usage of tobacco products.

"Do cigarette taxes increase obesity rates?" a journal ***published in the year 2011.*** According to author ***Arya M Sharma et al*** Tobacco products and alcohol consumption reduces metabolic rate .So in obese individuals it becomes still more difficult a target to achieve weight reduction.

Journal on "Health risks associated with obesity" ***published in 2006*** author ***Graze brook et al.*** Coronary heart disease, type II diabetes mellitus, high blood pressure, osteoarthritis of the weight bearing joints, sleep apnea, respiratory problem, and problem associated with overweight and obesity there exists a strong relationship between Forced Vital Capacity (FVC) Forced Expiratory Volume for one second (FEV1) to the physical activity and respiratory function. Sedentary lifestyle is a strong predisposing factor in reducing the FEV1 and FVC respectively. On the other hand active lifestyle helps in normalizing the FEV1 and FVC.

Respiratory muscle strength compliance of the lungs, thoracic cavity, airway resistance and the elastic recoil of the lungs are the factors which determine the pulmonary function. On the other hand expiratory muscle strength, force of the contraction, elastic recoil pressure of the lungs and the airway size are the factors responsible for Peak Expiratory Flow Rate (PEFR). Physiotherapists are challenged with obesity and its co-morbidities. Aerobic capacity and pulmonary function are being compromised in obese people.

Obese people also suffer from insufficiency of respiratory muscles, in particular the diaphragm. The pattern of breathing in obese patients is found to be rapid and shallow which in turn increases the cost of oxygen in breathing. There are several studies done to prove the effectiveness of weight reduction using the aerobic training and it is globally accepted the aerobic type of exercise training helps in metabolizing fat and reducing overall weight gain. On the other hand among obese, reduction in fat mass is found to be associated with increased lung volumes.

The treadmill training is a type of aerobic training with reduced effort done in all weather conditions. Working out for about 20-60 minutes at a target heart rate reduces the fat, this is a proven fact. Treadmill is used as a diagnostic tool for making any cardiac stress tests. Its benefits, extends up to patients having neuromuscular disorders, for example stroke. The intensity of using treadmill is

determined by the speed calculated in the miles or kilometers per hour the intensity could also be adjusted by ramping up the treadmill.

Treadmill training used for pulmonary rehabilitation is a recently followed trend that involves mostly walking on a treadmill. A subject does not change his horizontal position and is passively moved and forced to catch up with the running belt underneath the feet. The subject can also be fixed and moved with the robotic orthotic system utilizing the treadmill. The treadmill is a historical tool used first in U.S prisons invented by ***William Cubbit in 1817***, the medical use of treadmill was designed by ***Dr. Robert Bruce.***

Hence, in my project I decided to use treadmill to make the subjects run continuously which prospectively would enhance their aerobic capacity, reduced body fat and improved lung function to determine its effect on lung function parameters such as FEV1 and FVC ratio and measurement of Peak Expiratory Flow Rate(PEFR).

1.1 **NEED FOR THE STUDY**

This study focused on assessing the effect of continuous treadmill training in improving lung function of overweight and obese subjects .A total of 32 male collegiate subjects (out of 47) with a BMI > 25 and age group of 18 to 22 were randomly selected and assigned into two groups, after undergoing an 1 km run / walk endurance test. The group underwent continuous treadmill running for a period of 16 weeks at an intensity that corresponded to each individual. The outcome measures were FEV1 / FVC and PEFR as it was understood from previous studies that obesity consistency reported respiratory complications in the lung zone such as COPD , obstructive sleep apnea syndrome etc . Obesity I ***(2009) Rebakah et al,*** According to ***Inselma et al (1993)*** states that obese children have altered pulmonary function which is characterized by reductions in lung diffusion capacity, ventilatory muscle endurance and increment in airway resistance.

Previous studies have examined the strong co-relation between obesity and lung function, but very few studies have taken into account the confounding effects of physical activity levels and aerobic fitness. In the ***Epidemiology Journal published in December 2008*** first reported the association between obesity and lung functions to quantify the two important exposures and to confirm that the association exists independently of them.

1.2 STATEMENT OF THE PROBLEM:

To analyze the effect of continuous treadmill running in improving respiratory function in overweight and obese male collegiate**.**

1.3 OBJECTIVE OF THE STUDY:

The study was aimed to determine the effect of continuous treadmill running on respiratory function (FEV1, FVC and PEFR) in overweight and obese subjects.

1.4 KEY WORDS:

FEV1, FVC, PEFR, Treadmill running, Overweight and Obese Collegiate.

1.5 HYPOTHESES:

NULL HYPOTHESIS:

There is no significant difference in FEV1/FVC and PEFR for overweight and obese male collegiate following continuous treadmill running.

ALTERNATE HYPOTHESIS:

There is a significant difference in FEV1/FVC and PEFR for overweight and obese male collegiate following continuous treadmill running.

REVIEW OF LITERATURE

Ahmad Azad et al 2011

They conducted a study on effect of aerobic exercises on lung function in overweight and obese students. 30 subjects participated with poor endurance and mild deterioration of respiratory indices .The intervention group performed 24 weeks of continuous treadmill running .Respiratory indices was measured pre , mid and post exercise . Independent t test, paired t test, Pearlson correlation test and repeated measures were used for analyzing the data .In the intervention group post exercise respiratory indices were significantly higher than the pre exercise values .They concluded that appropriate aerobic exercise training can partly improve lung function by strengthening the muscles of respiration.

Tony G. Babb et al 2011

They conducted a study on weight loss via diet and exercise improves exercise, breathing mechanics in obese men. Obesity alters breathing mechanics during exercise. Weight loss improves lung function at rest , but the effect of weight loss , especially regional fat loss on exercise breathing mechanics is unclear.

Nine obese men were studied before and after weight loss, subjects underwent pulmonary function testing, underwater treadmill training .12 weeks diet and exercise programs were prescribed.

In the result they found that weight loss, lung volume, subdivisions at rest were increased and were moderately associated with changes in chest, weight and hip circumferences. They concluded that modest weight was improves breathing mechanics during sub maximal exercise in healthy obese men.

Sandeep Megnath Hulke et al 2011

They conducted a study to analyze the effect of endurance training on lung function. Physical activity is known to improve lung function, physical fitness and reduce mortality and morbidity from numerous chronic conditions and lung function is not an exception. This study was a longitudinal study which was done on the students of physical education college .51 male and 49 females were assess using MIR spirolab within 7 days of admission to college.

In the result significant changes was seen in FEV1 and FVC ratio in male. They concluded that physical activity does improve some of the lung function with 12 weeks of exercise.

Chaitra. B. Vijay Maitri et al 2011

They conducted a study to evaluate the effectiveness of aerobic exercise training on the peak expiratory flow rate for the patients undergoing pulmonary rehabilitation. They recruited 80 healthy medical students of either sex, aged 17 – 20 years. Experimental group participated in a 16 weeks aerobic exercise plan, it included 20 minutes session of jogging thrice in a week and controlled group with no plan of exercise, computerized spirometry was used to record the data. PEFR before training and after training of 4 months were recorded.

The results found that there is seventeen percentage improvement of a PEFR and they concluded that aerobic exercise training leads to improvement of pulmonary function in healthy subjects.

Robin Lawson DNP et al 2011

They conducted a study to understand the physiology underlying the obesity and the impact of it in the lung function. They say the alteration which is occurring in the pulmonary system which is connected to the obesity. And it is mainly because of the ventilatory control, ventilation – perfusion ratio and the cardiac output.

The above mentioned symptoms may worsen in an obese population adapts a supine posture. On the basis of the study findings they concluded that for an

every increase in the body mass index results in the extreme loss of respiratory function. The physiology underlying is the reduced expansion of the thoracic cavity and the exertion of the diaphragm.

Stephenie A Shore 2010

He studied the altered mechanics of the lung function because of the obesity and this is mainly because of the alteration of the static mechanistic properties of the lung function, the functional residual capacity (FRC) and the expiratory reserve volume (ERV).

There is variability in the effects of obesity on functional residual capacity and expiratory reserve volume which is more related towards the location of the adipose fat tissue and not because of the type of the adiposity.

The finally concluded that weight loss as a direct correlation with improvement in the lung functions. Thus the respiratory complication of obesity is reduced by the reduction of weight.

R.A Watson et al 2010

They conducted a study to analyze the reduction of total lung capacity in obese men and to improve total intrathoracic and gas volumes. Total subjects of 14 asymptomatic men (mean age 25 years) MRI volumes are compared with the

gas volumes at the total lung capacity TLC obese men had smaller functional residual capacity (FRC) and FRC to TLC ratio is less than compared to obese men.

There was a predicted difference in mean TLC between obese and control men. They concluded that major factor restriction TLC in some obese men was reduced thoracic expansion at full inflation.

Richard et al 2009

They conducted a study on body mass index on lung volumes. For this they collected 373 patients selected for the study their lung function testing had normal values for airway function but a wide range of BMI setting. They found significant linear relationship between BMI and vital capacity and total lung capacity. However the FRC and ERV decreased exponentially with increasing BMI. The morbidly obese patients were breathing near the residual volume. They concluded that BMI has significant effects on all the lung volumes and the greatest effects were on FRC and ERV.

Cheryl M. Salmone et al 2009

They conducted a study on physiology of obesity and effects on lung function and they stated the presence of adipose tissue around the rib cage and abdomen and in the visceral cavity loads the chest wall and reduces functional

residual capacity FRC. The reduction in FRC and expiratory volume is detectable even at a modest increase in weight.

A low FRC increases the risk of both expiratory flow limitation and airway closure, marked reduction in expiratory reserve volume may lead to abnormalities in ventilation distribution with closure of airways in the dependent zones of the lung and ventilation perfusion inequalities

Thus they found that obesity has effects on lung function that can reduce respiratory well – being, even in the absence of specific respiratory disease and may also exaggerate the effects of existing disease.

Khalili et al 2009

They conducted a study on intellectual disabled children to find out the effect of aerobic exercise in the improvement of lung function. The children had difficulty in swallowing and poor sinus function.

In this study they finally concluded exercises has a small but statistically significant effect on lung function in children with intellectual disability.

Joey .C .Eisenmann et al 2009

They conducted a study on obesity and pulmonary function in Navajo and Hopi children. There are several risk factors associated with childhood obesity; few reports have examined the effects of childhood obesity on pulmonary function. Subjects included 256 Hopi children (110 males and 146 females) in the age group between 6-12 years. BMI was used to classify subjects. FVC and FEV 1 and FEF were determined.

The results show an increase in pulmonary function between normal weight and overweight children and decrease in pulmonary function of obese children. At last they concluded by showing the results of consequences of obesity in children.

Dr. Rehana Rehman et al 2009

The study was conducted to analyze the influence of relative and central adiposity on lung functions of young adult medical students. The cross sectional study was conducted on 192 young healthy medical students. They calculated BMI and measured waist circumference was compared with pulmonary functions as determined by FEV1 and FVC with the help of a digital spirometry.

Results shows that central adiposity measurement by weight circumference notified a negative association of pulmonary functions with waist circumference They concluded that both overweight and obese subjects have lower levels of lung function test .

Amanda J Piper et al

They conducted a study to analyze the interaction between obesity , hypoventilation , weight loss and respiratory function .Obesity is affecting the lung volumes by placing a significant role over the respiratory muscles and the morbidly obese patients has the complaint of eucapnia and they may also suffer from hypercapnia in the morning time , this is described as Obesity Hypoventilation Syndrome (OHS).

There are a lot of compensatory mechanisms acting over helping out reduce the pulmonary function in the extremely obese population. On the basis of study findings they concluded that the significant improvement in the respiratory function could be achieved with the weight loss and a dietary supplement.

Kesavan et al 2009

They conducted a study to examine physical activity in maintaining the normal grades of body mass index and body fat percentage. They included 767 urban male volunteers performing physical activity and 469 age and socio-

economic status matched controls not doing any physical activities from the city limits of North India. Body mass index, body fat percentage and weight loss measure using body fat monitor 53% of physical activity performers showed normal BMI compared to 49% non – physical activity performers.

Overall study suggests that physical activity alone cannot help maintaining BMI and body fat percentage .It can reduce the risk of overweight and high body fat percentage in the obese population.

Nazmus saquib PhD 2009

They conducted a study to examine the healthy diet help weight management among overweight and obese people. They conducted a randomized dietary intervention trial across 4 years, examined diet, weight and obesity incidence, 1,510 subjects were involved in the study.

Dietary intake was assessed yearly by telephone; weight and height were measured at clinic visits. Intervention group was made to consume fruits, vegetables and fiber and less energy from fat the control group weight did not differ from that of the intervention group. They finally concluded that the dietary advice alone cannot help in controlling the weight gain.

Dirceu Costa et al, 2008

They conducted a study to investigate the impact of obesity on pulmonary function in adult women. 20 study samples were selected of 20 – 35 years old with a BMI of 35 – 49.99 Kg / m2. Spirometry was performed in all the subjects.

The results concluded that alterations evidenced in the components of the vital capacity (inspiratory reserve volume, expiratory reserve volume). This damaged the chest mechanics caused by obesity. They concluded that these are the factors that led to the reduction of maximal voluntary ventilation.

Pistelli .F. Bottai et al 2008

They conducted a study to evaluate the effects of changes in obesity status and lung function decline in a general population sample. On the basis of the study findings they concluded that people becoming obese and remaining in obese had decline in lung function over 8 years. On the other hand non – obese population had no decrease in lung function

Patrick Calders et al 2008

The study was conducted towards analyzing the prediction of anthropometric variables with that of 6 minute walk test and a 12 minute walk test (Cooper test) in obese children and adolescents. They revealed all relevant data, anthropometric

maximal graded exercise, lung function, six minute walk test and twelve minute walk test at admission and after 3 months.

They concluded that the BMI is a great predictor of the variability of the performance on the six minute walk test and twelve minute walk test at admission as well as after 3 months of treatment.

Akshay Sood et al 2008

They conducted a study to understand the relationship between obesity and pulmonary dysfunction. Total respiratory compliance in obesity may be reduced to as little as one third of normal subjects. The results not only show the effect of excess \body fat, trunk fat mass but also increase pulmonary volume. Severely obese patients may also demonstrate inefficiency of the respiratory muscles, particularly the diaphragm. Obesity and the hypoventilation syndrome are closely associated with each other, mechanistic basis for the association between obesity and asthma.

Biring et al 2007

They did a study on the effects of extreme obesity on pulmonary function test and the effect of smoking on these variables in a population group, 43 patients with extreme obesity who underwent pulmonary function testing. They found that patients with extreme obesity is associated with a reduced in a expiratory reserve

volume , functional vital capacity , force expiratory volume , functional residual capacity , maximum voluntary ventilation and flow during mid expiratory phase .

Yue Chen et al 2007

They conducted a study on weight circumference in association with pulmonary function in normal weight, overweight and obese subjects. Cross sectional study with 1674 adults aged less than 18 years belonging to a rural community. They found that 1 cm increase in waist circumference was associated with a 13 ml reduction in FVC and 11 ml in FEV1.

They concluded that waist circumference and BMI is negatively and consistently associated with pulmonary function in normal weight, overweight and obese subjects.

DV. Muralidhara et al 2007

These authors conducted a study to evaluate the factors responsible that the lung function in obese and undernourished subjects. The study aims at comparing the aspects of lung function in humans with varying quantity of body fat content and free fat mass.

On the basis of the study findings they concluded that there was no significant relationship between lung function, BMI in both men and women.

Debo.rah Leader RN et al 2006

The role of obesity plays in chronic obstructive pulmonary disease is significantly understood from this study. Actually the obesity is not a definite risk for COPD. But there exists an incidence of obesity and chronic obstructive pulmonary disease. Obesity results in decrease in the exercise tolerance and decrease in the quality of life. Chronic obstructive pulmonary disease is increasing because of air – pollution and sedentary life style.

Thus the obesity and the chronic obstructive pulmonary disease goes in hand in hand thus from this study this is clearly evident that the increase in the excess body weight directly resulted in shortness of breath which is also a symptom of chronic obstructive pulmonary disease. The incorporation of the pulmonary rehabilitation in the weight loss program helps the patients having COPD to get involved in the weight reduction program.

Wen Yuan Lin et al, 2006

The**y** conducted a study to analyze the relationship between impaired lung function **is** associated with obesity and metabolic syndrome in adults**, t**otal of forty six thousand five hundred and fourteen and age twenty years and over (twenty one thousand men and twenty four thousand eight and forty five women).

The relationship between metabolic syndrome and lung function test was examined using multivariate logistic regression analysis.

Results showed that age, gender, BMI, smoking, alcohol drinking and physical activity, restrictive impairment was independently associated with increased risk of having metabolic syndrome .The results imply that obesity and insulin resistance may be the common pathways underlying lung impairment and metabolic syndrome.

Nizar. A et al 2006

They did a study on to analyze that pulmonary rehabilitation is effective in improving exercise endurance and quality of life in chronic restrictive pulmonary disease .46 patients with restrictive lung disease were admitted to a pulmonary rehabilitation program. 26 completed the 8 week program and 15 were followed to a 1 year reassessment .one patient died with interstitial lung disease.

33 % of patients failed to complete the program. In the result they finally concluded that pulmonary rehabilitation is effective in improving exercise endurance and quality of life in patients with restrictive lung disease.

Yogesh Succinal et al 2005

They studied the determinants of peak expiratory flow rate (PEFR) in young Indian adult male. 100 healthy male volunteers participated in the study. BMI was measured and they were classified as non – obese and obese. PEFR was measured with Wright's peak flow meter. The study findings showed that obesity and the pattern of body fat distribution had independent effects on PEFR. They concluded that abdominal adipose tissue with WHR is a predictor of respiratory flow than body weight or body mass index.

Amy. L .Olson et al 2005

They defined the obesity hypoventilation syndrome in terms of chronic hypoventilation which is resulting in pulmonary hypertension, corpulmonale and probable early mortality. The classical description of this syndrome nearly 50 years ago has led to a better understanding of path physiologic mechanisms involved in this disease process and to the development of effective treatment options. Obesity has become a national epidemic. However the article reviews the current definition of obesity hypoventilation syndrome.

Cedric Nocrry et al 2005

They investigated the short duration running training on resting and exercise lung function. Healthy pre – pubescent nine children involving six boys

and three girls participated in eight weeks of high intensity intermitted training was compared with the control group. In conclusion they found high intensity intermittent training enhanced resting pulmonary function and led deeper exercise ventilation reflecting a better effectiveness in pre – pubescent children.

Joef Faintuch et al, 2004

They did a study on asymptomatic bariatric candidates with severe morbid obesity to assess the pulmonary function and aerobic capacity. They enrolled 46 subjects in the study. Ventilator variables were investigated by authorized spirometry aerobic capacity and were estimated by a modified Bruce test in an ergo metric treadmill and body composition was determined myoimpedence analysis. They concluded that cardiopulmonary evaluation was feasible and well tolerated in these severely obese patients.

Spirometry variables were diminished mild restrictive changes was there .Exercise tolerance was very negatively influenced by obesity resulting in reduced endurance and excessive metabolic cost for the treadmill run. More attention to fitness and aerobic capacity is recommended for seriously obese bariatric candidates.

GP Nassis et al 2004

They did a study to examine the influence of cardiopulmonary fitness on total and trunk fatness in children. A total of 1362 healthy children aged 6 to 13 years (742 boys and 620 girls). Anthropometric data were collected and percent body fat was calculated. Cardio respiratory fitness (CRF) was associated with the endurance shuttle run test. Participants were grouped into high (upper two quintiles) and low (lower two quintiles).

In the result they found that BMI, percent body fat were lower in overweight and obese youths with high CRF in comparison with youths at the same BMI category with low CRF .They concluded that central and total obesity were lower in overweight and obese children with high CRF.

Kim Garet et al 2004

The aim of this paper is to address the physiologic effects of obesity on the cardiopulmonary system and impact of obesity on medically ill patients. Total subjects of this study are asymptomatic men mean age 25 years .Lung volumes are compared with gas volumes at total lung capacity all calculations are calibrated in a linear correlation method and it is found less in obese subjects. They concluded that there is a significant reduction in cardiopulmonary endurance in obese subjects and this led to the mortality and morbidity of individuals who are critically ill.

Shawn D Aaron et al 2003

This study was done to analyze the effect of weight reduction on respiratory function and airway they conducted prospective study on 58 obese women with a body mass index less than 30 kg / m who were enrolled in an intensive 6 months weight loss program.

Results found that they lost an average of 20 kg over the six months period of every 10 % relative losses of weight improved by 92 ml and FEV1 improved by 73 ml. However bronchial reactivity did not significantly change with weight loss. They concluded that weight loss can improve lung function in obese women .However improvements appeared to be independent of changes.

F. Zerah et al 2002

They did a study to assess the effect of obesity on pulmonary function. 46 healthy subjects exhibited various degrees of obesity and underwent lung function tests. They found that respiratory flow is diminished in proportion to lung volume in the ratio of forced expiratory flows did not suggest bronchial obstruction. Both respiratory resistance and airway resistance goes significantly with the level of obesity. Taken this findings suggests that in addition to the elastic load , obese subjects have to overcome increased respiratory resistance resulting from the reduction in lung volumes related to being overweight .

Stenius Aarniala et al 2000

They conducted a study to analyze the immediate and long term effects of weight reduction in obese people with asthma. They investigated 19 obese patients with asthma. Supervised weight reduction including 8 week very low energy diet, body weight, Peak expiratory flow rate (PEFR), forced vital capacity (FVC), Forced expiratory volume in one second (FEV1) and also asthma symptoms are the outcome measures.

Result of this study shows weight reducing program for the participants in the treatment group had lost a mean of 14.5 kg .They concluded that weight reduction in obese patients with asthma improves lung function symptoms and health status.

F. Haas et al 1987

They conducted a study to analyze the effect of aerobic exercise training on Forced expiratory airflow in exercising asthmatic humans. Pulmonary function after exercise was evaluated in 22 asthmatic subjects before and after a 36 session training of aerobic exercise training session. Training did not change pulmonary function values except for small increase in maximal voluntary ventilation .They concluded that aerobic training significantly increase exercise induced broncho-dilation and diminishes exercise induced broncho-spasm.

W.P Marley et al 1979

It is a case study on 67 year old obese women about chronic respiratory failure and physical reconditioning. Arterial blood gas analysis and the spirometric measurements were taken. ECG was monitored during the training exercise procedure involves mainly treadmill walking , calisthenics, stair climbing , bench stepping , prewalking, abdominal diaphragmatic training with pursed lip breathing along with this physical reconditioning training were used . (Treadmill walking at 0.7 miles / hour) in the end of the training they found less apprehension of dyspnea and they also made a marking over the predicted unassisted walking with little and no dyspnea at last the spirometry measurements show improved ventilator function.

METHODOLOGY

3.1 STUDY DESIGN

Pre test and post test experimental study design.

3.2 STUDY SETTING

Department of Pulmonology KG Hospital and Post Medical Graduate Institute, Arts College Road, Coimbatore .

3.3 STUDY DURATION

- Total study duration : 6 months
- Intervention period : 16 weeks.
- Treatment frequency : 3 times/ week.

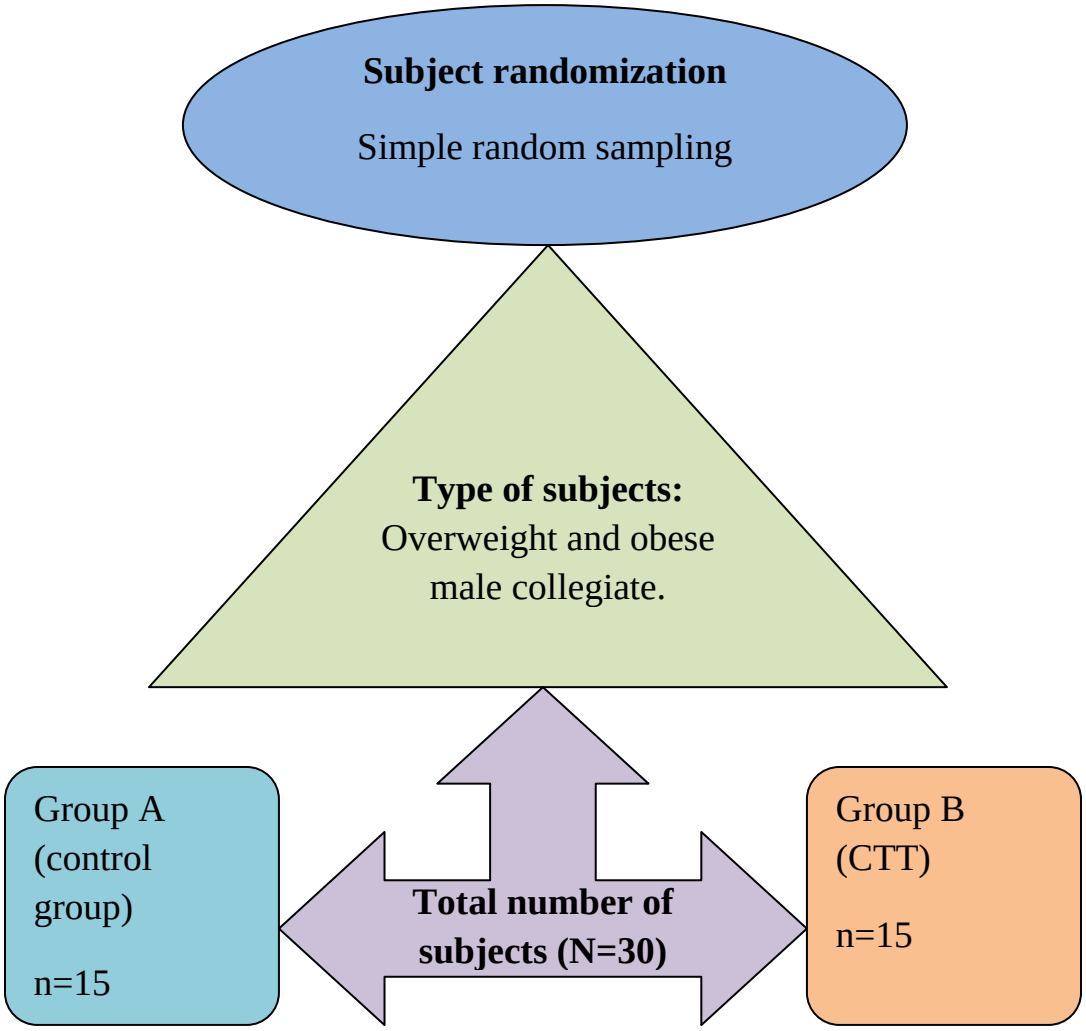
3.4 SAMPLE SIZE

- Subjects were selected by convenient sampling technique.
    - **N**=30(overweight and obese young male collegiate)
    - ***n***=15 (Group A – Control group)
    - ***n*** =15 (Group B – Experimental group).

3.5 SAMPLE RANDOMIZATION TECHNIQUE:

- Samples were randomized by simple random sampling , using lot method.

RANDOMIZATION ALGORITHM:



3.6 CRITERIA FOR SELECTION

INCLUSION CRITERIA

- Age between 18-22 years, male
- Body Mass Index (BMI) > 18-22 years, male
- Subjects with FEV1 / FVC < 70 % (predicted value)

  – based on ***American Thoracic Society*** and PEFR < 150 liters- based on ***wright's scale.***
- Subjects with physical inactivity for at least 2 years
- Students with poor endurance performance (based on the 1 km walk / run test) i.e. (run time > 7 minutes)

EXCLUSION CRITERIA

- Subjects with presence of airway responsiveness
- Lung infections
- Smoking history
- Female subjects due to their lack of response to training sessions

3.7 VARIABLES

INDEPENDENT VARIABLES:

1. Continuous Treadmill Training (CTT)

DEPENDENT VARIABLES:

1. FEV1/FVC
2. PEFR

3.8 PROCEDURE

A total of 47 male collegiate subjects from KG College of Physiotherapy were initially assessed by participating in 1 km walk or run test .According to the results of the test 32 participants had poor endurance performance i.e.(run time less than 7 minutes) of which 30 were overweight or obese (BMI > 25) were selected as study subjects two dropped out due to various reasons. Informed consent was obtained from them prior to the study.

These 30 subjects were randomized into two groups of 15 each, control group were given dietary advice and unsupervised free exercises and were matched for age, height, BMI, FEV1: FVC and PEFR. The exercise group participated in the exercise training program for 16 weeks at a frequency of 3 days a week .Exercise program was a continuous treadmill running (at 0% inclination) at a minimum speed required to achieve and maintain 75% of predicted maximum Heart Rate [Heart Rate$_{(max)}$] i.e. [Heart Rate$_{(max)}$] = 220 – age)

Total sessions : 48 (10 minutes of warm up session).

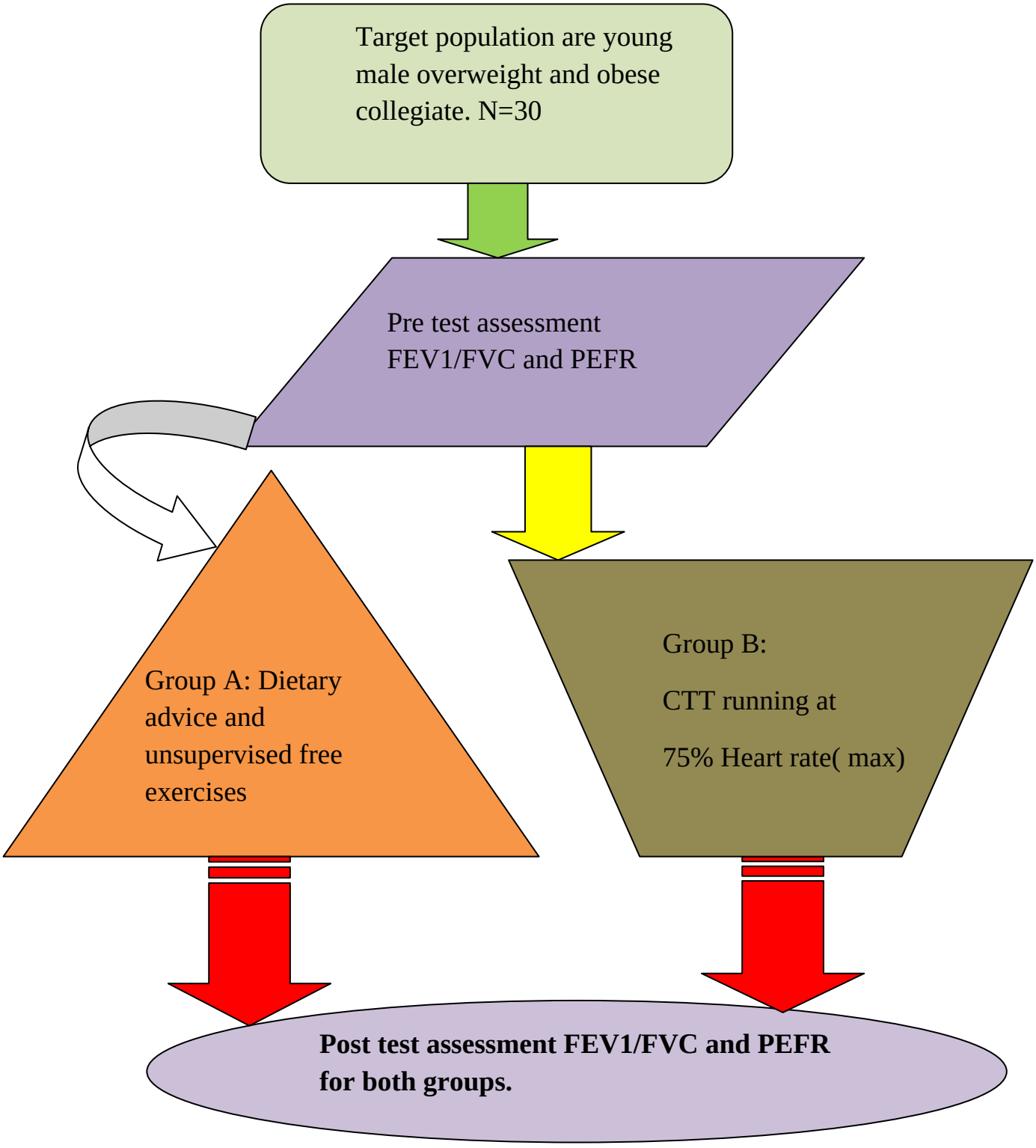
Session I : 15 minutes (running time).

Progression : increase the speed by 1 minute every consecutive 2 sessions up to 9 session's maximum up to 30 minutes.

Session 9 : running for 30 minutes (i.e. 3rd week).

Maintenance phase: Remaining 38sessions is maintenance phase at 30 minutes of running at a speed which reaches 75 % of Heart Rate maximum $HR_{(max)}$.

PROCEDURE ALGORITHM



3.9 OUTCOME MEASURES

a) FEV1 / FVC (%) - Spirolab II

b) PEFR - Peak Expiratory Flow Rate (Pulmo Peak)

Wright's scale (liters / min)

3.10 STATISTICAL TOOLS

All statistical analysis was done using student t- test.

Formula: Paired t-test

$$S = \sqrt{\frac{\sum d^2 - [\sum d]^2}{n-1}}$$

$$t = \frac{\overline{d\sqrt{n}}}{s}$$

d = difference between the pre and post test

d = mean difference

n = total number of subjects

Formula: Unpaired t – test

$$S = \sqrt{\frac{\sum(x_1 - \bar{x}_1)^2 + \sum(x_2 - \bar{x}_2)^2}{n1 + n2 - 2}}$$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

n1 = total number of subjects in group 1

n2 = total number of subjects in group 2

x1 = mean of group 1

x2 = mean of group 2

s = standard deviation

Percentage of difference formula:

Percentage difference (A)

$$= \frac{\text{Post test mean - Pre test mean}}{\text{Post test mean}} \times 100$$

3.11 TOOLS

Anthropometric Measurements:

a) Weighing scale - measured in kilograms

b) Inch tape - measured in centimeters.

Lung measurements

c) Hand held spirometer - (spirolab II)

d) Peak Expiratory Flow Meter - (Pulmo peak) Medicare equipments

DATA ANALYSIS AND INTERPRESENTATION

Table: I

Group A (FEV1/FVC)

The comparative mean values, mean differences, standard deviation and paired‘t’ test values for FEV1/FVC of group A subjects(control group).

FEV1/FVC

S. No	Group A	Mean	SD	‘t’value (p>0.05%)	Percentile difference
1.	Pre test	61.24	3.85	1.123	0.506%
2.	Post test	61.55	3.6		

Hereby, the FEV1/ FVC measured values subjected to paired‘t’ testing value for group A shows a calculated ‘t’ value of 1.123 at 5% level of significance which is less than the tabulated ‘t’ value 1.76. The result shows that there is no significant difference in the FEV1/FVC between pretest and post test values of group A. The values of probability (p>0.05) is considered to be statistically insignificant.

Table: II

Group B (FEV1/FVC)

The comparative mean values, mean differences, standard deviation and paired‘t’ test values for FEV1/FVC of group B subjects(experimental group).

FEV1/FVC

S. No	Group A	Mean	SD	‘t’value (p<0.05%)	Percentile increase
1.	Pre test	62.61	4.2143	7.1913	11.284%
2.	Post test	69.33	5.5746		

Hereby, the FEV1/ FVC measured values subjected to paired‘t’ tesing value for group B shows a calculated ‘t’ value 7.1913 at 5% level of significance which is greater than the tabulated ‘t’ value 1.76. The result shows that there is a significant difference in the FEV1/FVC between pretest and post test values of group A. The values of probability ($p<0.05$) is considered to be statistically significant.

Table: III

Group A vs. B (FEV1/FVC)

The comparative mean values, mean differences, standard deviation and unpaired‘t’ test values for FEV1/FVC of group A and group B subjects.

S. No	Group	Mean	SD	‘t’value (p<0.05%)	Percentile reduction
1.	Group A	61.55	3.604	4.53	0.506%
2.	Group B	69.33	5.5746		11.284%

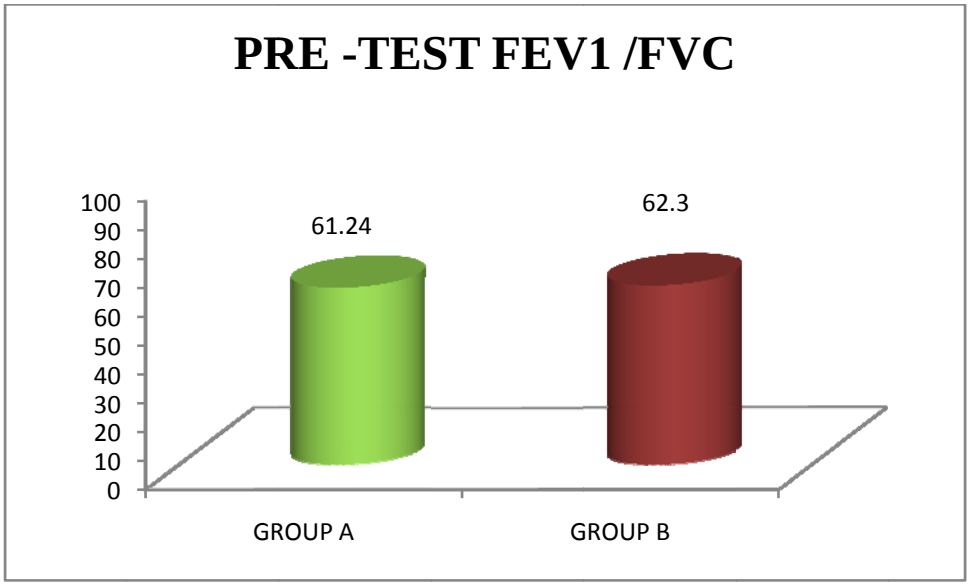
Hereby, the FEV1/ FVC measurement on unpaired‘t’ test value for group B is 4.53 at 5% level of significance which is greater than the tabulated ‘t’ value 1.76. The result shows that there is a significant difference in the FEV1/FVC between post test values of group A and group B. The values of probability ($p<0.05$) is considered statistically significant.

Graph: I

PRE-TEST OF FEV1/FVC

GRAPHICAL REPRESENTATION OF PRE TEST VALUES OF FEV1/FVC FOR GROUP A AND B SUBJECTS WHO WERE SUBJECTED TO CTT AND DIETARY ADVICE RESPECTIVELY.

PRE TEST ANALYSIS

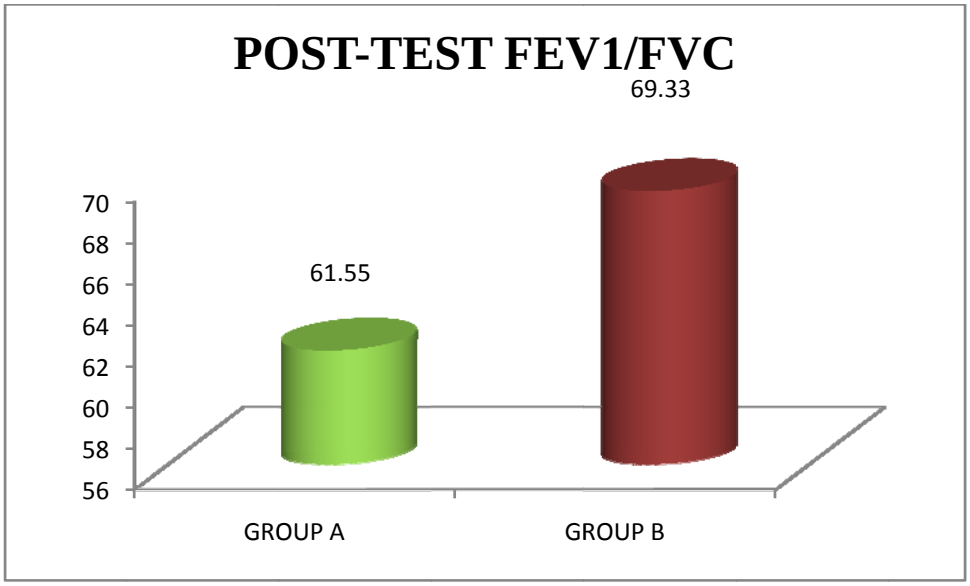


Graph: II

POST-TEST FEV1/FVC

GRAPHICAL REPRESENTATION OF POST TEST VALUES OF FEV1/FVC FOR GROUP A AND B SUBJECTS WHO WERE SUBJECTED TO CTT AND DIETARY ADVICE RESPECTIVELY.

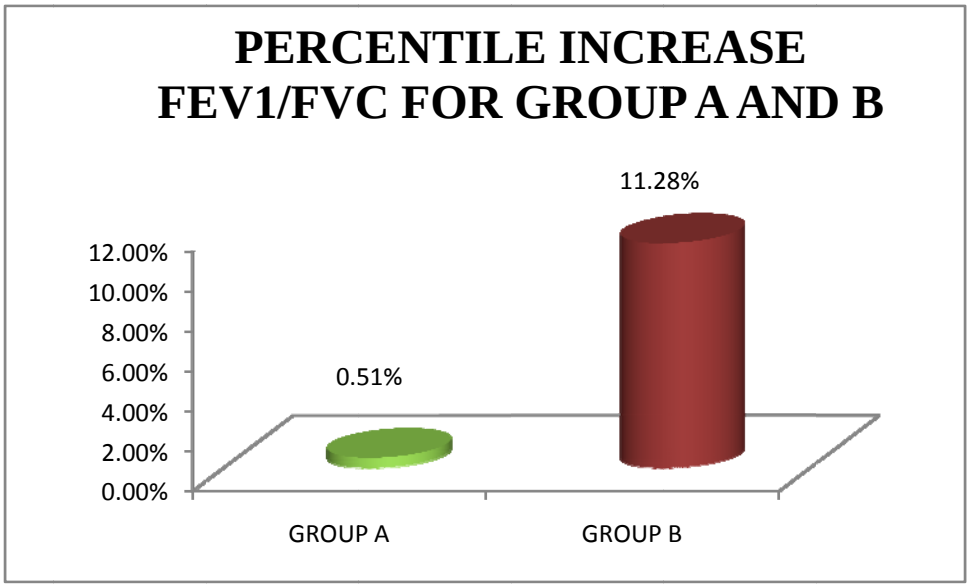
POST TEST ANALYSIS



Graph: III

PERCENTILE INCREASE FEV1/FVC

GRAPHICAL REPRESENTATION OF PERCENTILE REDUCTION IN FEV1/FVC FOR GROUP A AND GROUP B SUBJECTS WHO WERE SUBJECTED TO CTT AND DIETARY ADVICE RESPECTIVELY.



The pre test and post test mean values were subjected to percentile difference which has shown a greater significant improvement of FEV1/FVC measurements of group B compared to group A.

Table: IV

Group A (PEFR)

The comparative mean values, mean differences, standard deviation and paired‘t’ test values for PEFR of group A subjects(control group).

PEFR

S. No	Group A	Mean	SD	‘t’value (p>0.05%)	Percentile increase
1.	Pre test	198	15.68	0.5234	1.515%
2.	Post test	201	15.72		

Hereby, the PEFR measured values subjected to paired‘t’ testing value for group A shows a calculated ‘t’ value of 0.5234 at 5% level of significance which is less than the tabulated ‘t’ value 1.76. The result shows that there is no significant difference in the PEFR between pretest and post test values of group A. The values of probability (p>0.05) is considered to be statistically insignificant.

Table: V

Group B (PEFR)

The comparative mean values, mean differences, standard deviation and paired‘t’ test values for PEFR of group B subjects(experimental group).

PEFR

S. No	Group A	Mean	SD	‘t’value (p<0.05%)	Percentile increase
1.	Pre test	194	16.06	5.97	19.58%
2.	Post test	232	18.98		

Hereby, the PEFR measured values subjected to paired‘t’ testing value for group B shows a calculated ‘t’ value of 5.97 at 5% level of significance which is greater than the tabulated ‘t’ value 1.76. The result shows that there is a significant difference in the PEFR between pretest and post test values of group A. The values of probability ($p<0.05$) is considered to be statistically significant.

Table: VI

Group A vs. B (PEFR)

The comparative mean values, mean differences, standard deviation and unpaired‘t’ test values for PEFR of group A and group B subjects.

S. No	Group	Mean	SD	‘t’value (p<0.05%)	Percentile increase
1.	Group A	201	15.57	4.92	1.515%
2.	Group B	232	19.09		19.58%

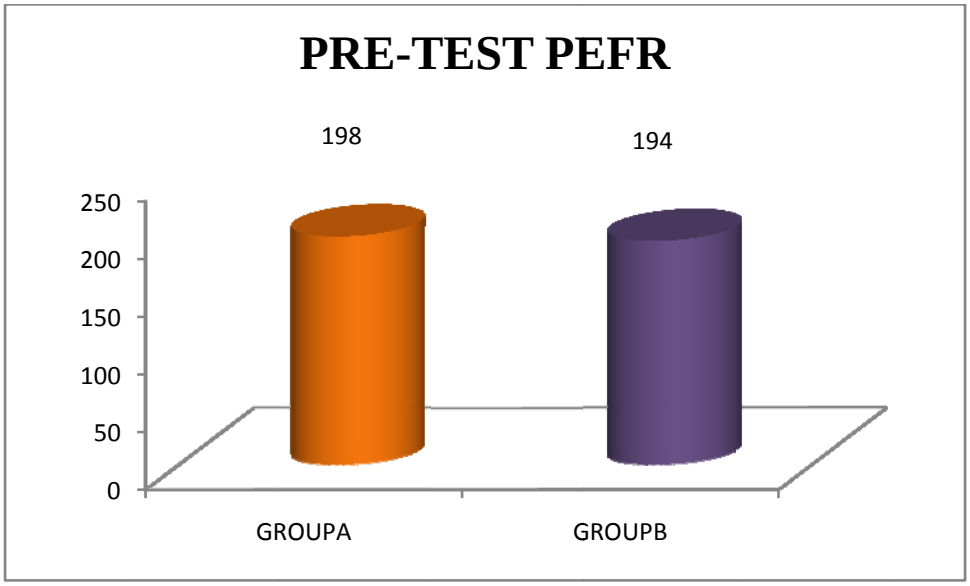
Hereby, the PEFR measured values subjected to unpaired‘t’ test value for group B shows a calculated ‘t’ value of 4.92 at 5% level of significance which is greater than the tabulated ‘t’ value 1.76. The result shows that there is a significant difference in the PEFR between post test values of group A and group B. The values of probability ($p<0.05$) is considered to be statistically significant.

Graph: IV

PRE-TESTOF PEFR

GRAPHICAL REPRESENTATION OF PRE TEST VALUES OF PEFR FOR GROUP A AND B SUBJECTS WHO WERE SUBJECTED TO CTT AND DIETARY ADVICE RESPECTIVELY.

PRETEST ANALYSIS

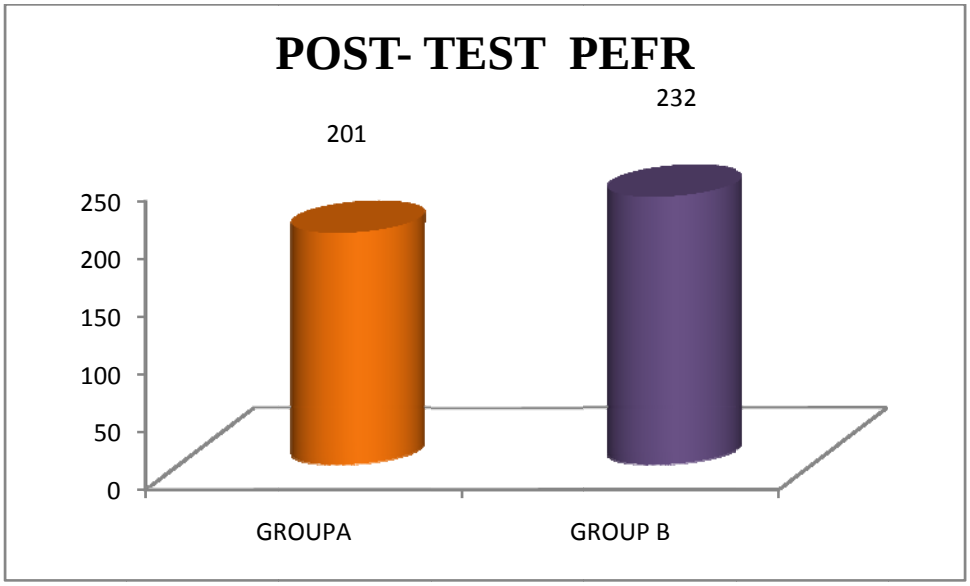


Graph: V

POST-TESTOF PEFR

GRAPHICAL REPRESENTATION OF POST TEST VALUES OF PEFR FOR GROUP A AND B SUBJECTS WHO WERE SUBJECTED TO CTT AND DIETARY ADVICE RESPECTIVELY.

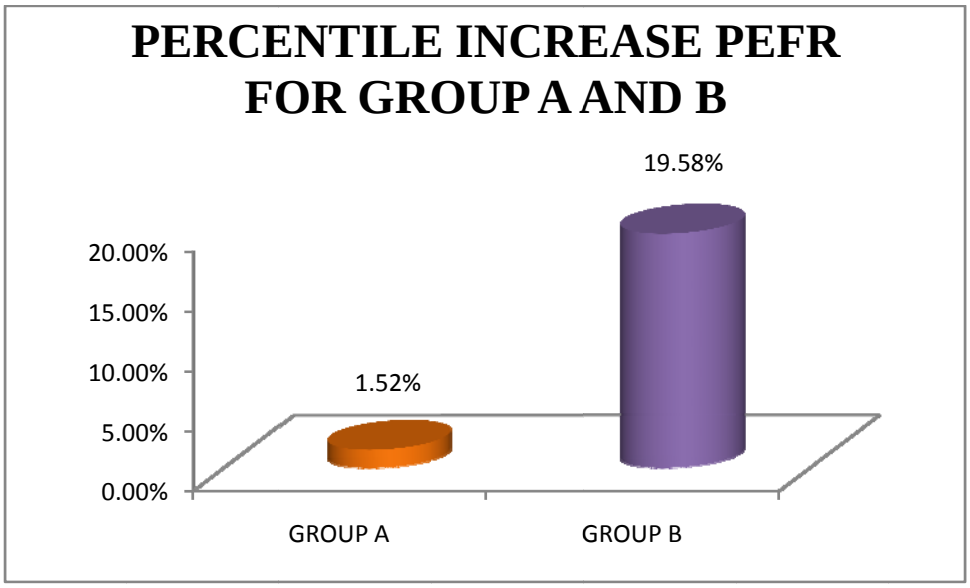
POST TEST ANALYSIS



Graph: VI

PERCENTILE INCREASE PEFR

GRAPHYCAL REPRESENTATION OF PERCENTILE REDUCTION IN PEFR FOR GROUP A AND B SUBJECTS WHO WERE SUBJECTED TO CMT AND DIETARY ADVICE RESPECTIVELY.



The pretest and post test mean values were subjected to percentile difference which has shown a greater significant improvement of PEFR measurements of group B were compared to group A.

DISCUSSION

This study focused on assessing the effect of continuous treadmill training in improving lung function of obese subjects .A total of 20 male collegiate subjects (out of 97) of BMI > 23 were randomly selected and assigned to a two groups,consisting of 15 subjects each using the lot method. After undergoing an 1 km run / walk endurance test.

Group A (control group) was given dietary advice and taught unsupervised free exercises and Group B (experimental group) underwent continuous treadmill running for a period of 16 weeks at an intensity that corresponded to each individuals Heart Rate$_{(max)}$. The outcome measures were FEV1 / FVC and PEFR as it was understood from previous studies that obesity consistenly reported respiratory complications in the lung zone such as COPD , obstructive sleep apnea syndrome etc . ***Obesity I (2009) Rebakah et al***

According to ***Inselma et al*** (1993) states that obese children have altered pulmonary function which is characterized by reductions in lung diffusion capacity, ventilation, muscle endurance and improvement in airway resistance.

Previous studies have examined the strong co-relation between obesity and lung function, but very few studies have taken into account the confounding effects of physical activity levels and aerobic fitness. In the ***Epidemiology Journal***

publisehed in ***December 2008*** first reported the association between obesity and lung functions to quantify the two important exposures and to confirm that the association exists independently of them.

Ghosh A.K. in the .Br. J. Sports Med 1985 has observed higher values of FVC and FEV1 in physically trained cases compared to sedentary subjects. FVC and FEV1 increased in 8 weeks of aerobic training in individuals and attributed this finding to this improved contraction of expiratory muscles as a circuit of aerobic training.

FEV1 / FVC and PEFR (dynamic lung functions were studied as the primary outcome measured for this study based on the findings of the ***TJPS vol 20 Sept 2007.*** It stated that these dynamic functions of the lung depend upon the compliance of the lungs and chest wall, the respiratory muscle strength and airway resistance. Increased fat is associated with markers of systemic vascular inflammation such as C – reactive protein in the hormone ceptein. These inflammatory factors may exert local efforts in lung tissue.

Repeated exercise may result in respiratory muscle strength and was focused that continuous aerobic training in intervention group in a study by ***Farrell et al*** in ***J Sports Med Phys Fitness 1981.***

FEV1/FVC AND PEFR (dynamic lung function were selected as the primary outcome measure for this study based on the primary outcome measures for this study based on the findings of the TJPS Vol 20 Sept 2007.

It stated that these dynamic functions of the compliance of the lungs and chest wall, the respiratory muscle strength and airway resistance. Increased body fat is associated with marked of systemic and vascular inflammation such as C. reactive protein the haemo leptin. These inflammatory factors may exert local effects in lung tissue.

Based on all the above discussions, this study can be summarized that obesity in youngsters does affects the respiratory mechanics. Which will have effects on the individual's respiratory system and any form of aerobic training can countermeasure the adverse effects of obesity and its effects of obesity and when its effects on the respiratory system.

CONCLUSION

The statistical analysis of the study's data collected from the 30 male obese collegiate who were randomized with two groups of 15 subjects each, showed the following results. Group A which was the control group were subjected only to dietary advice and supervised free exercises. The data analysis of this group showed in a significant difference of FEV1/FVC and PEFR values when compared with group B (experimental group) which underwent continuous treadmill training.

Group A and B was subjected to independent't' testing. The post test values of FEV1/FVC and PEFR of both groups were further subjected to independent't' testing .FEV1/FVC and PEFR of both group A and B showed a significant't' test values of 4.54 at 5% of confidence interval and PEFR of group A and B also showed a significant't' test value of 4.992 at 5% of confidence interval. Both these values were highly significant to the tabulated't' value of 1.701 with a $p > 0.05$.

LIMITATIONS AND RECOMMENDATIONS

LIMITATIONS

- This study was done only for young male collegiate. It has to be done for adult population involving both the sexes.
- This study was done mainly under a closed atmosphere.
- Airway hype responsiveness is not studied.
- Fat content and reduction of fat content were not recorded.
- Study is done only on a small sample size.

RECOMMENDATIONS

- Further studies have to be done on undernourished people and people having lean body mass.
- Further studies have to be done on people using only waist hip ratio classification.
- New centralized adiposity and its mechanical effects on lung function have to be further studied.
- Other form of aerobic training can be used to train the obese individuals.

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APPENDIX

APPENDIX I

CONSENT FORM

This is to certify that I _____ freely and voluntarily agree to participate in the study **"EFFECTIVYENESS OF CONTINUOUS TREADMILL RUNNING IN IMPROVING RESPIRATORY FUNCTION IN OVERWEIGHT AND OBESE YOUNG MALE COLLEGIATES"**

I have been explained about the procedures and the risks that would occur during the study.

Participant:

Witness:

Date:

I have explained and defined the procedure to which the subject has consented to participate.

Researcher:

Date:

APPENDIX II

CARDIO PULMONARY ASSESSMENT

Name: Age:

Sex:

Occupation: Date of admission:

Height: Date of assessment:

Weight:

Present complaints:

HISTORY

Past medical history:

Present Medical history:

Family history:

Social history:

Associated problems:

Vital signs

Blood pressure:

Respiratory rate:

Heart rate:

Temperature:

OBJECTIVE ASSESSMENT

On observation:

Built:

Color:

Chest shape:

Symmetry:

Breathing pattern:

Respiratory rate:

Chest movement:

Intercostals retraction:

Periphery/extremities:

Clubbing:

Cyanosis:

Edema:

Respiratory distress:

Type of respiration:

Usage of accessory muscles:

Vocal fremitus:

On palpation:

Tracheal deviation:

Chest expansion

Axillary level:

Nipple level:

Xiphoid level:

Tenderness

Edema

On examination

Onauscultation

Lung sounds:

Breath sounds:

Heart sounds

Percussion:

Investigation

X-ray:

ECG:

Echocardiogram:

ABG analysis:

Blood test:

Exercise tolerance:

Diagnosis

APPENDIX III

TREADMILL TEST WORK SHEET

Name Date Age

Sex Weight Height Diagnosis

Reason for test interpretation

12- Lead ECG Interpretation

Time last dose Time last meal

Physician Activity status

TEST RESULTS

Minutes completed limiting factors

Resting heart rate Maximal heart rate

Resting BP Maximal BP

BP response

Chest pain

Summary ST Changes

Heart sounds Dysrhythmias

Physical work capacity

Remarks/Recommendations

Interpreted by

APPENDIX IV

Criteria for termination of test

Absolute indications

- ST- segment elevation (1mm) in leads without Q waves (other than V1 or a VR).
- Drop in systolic blood pressure 10 mm hg (persistently below baseline), despite an increase in workload, when accompanied by any other evidence of ischemia.
- Moderate to severe angina (grade3 to 4).
- Central nervous system (ex; ataxia, dizziness, or near syncope).
- Signs of poor perfusion (cyanosis or pallor).
- Sustained ventricular tachycardia.
- Technical difficulties monitoring the ECG or systolic blood pressure.
- Subjects request to stop.

APPENDIX V

BODY MASS INDEX CHART www.who.int.bmi/index.jsp.

NORMAL WEIGHT (18.5 - 24.9)
OVERWEIGHT (25 - 29.9)
OBESITY (=> 30)

BMI	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Height cms (inches)	Body Weight (pounds)																
58" (4'10")	91	96	100	105	110	115	119	124	129	134	138	143	148	153	158	162	167
59" (4'11")	94	99	104	109	114	119	124	128	133	138	143	148	153	158	163	168	173
60" (5')	97	102	107	112	118	123	128	133	138	143	148	153	158	163	168	174	179
61" (5'1")	100	106	111	116	122	127	132	137	143	148	153	158	164	169	174	180	185
62" (5'2")	104	109	115	120	126	131	136	142	147	153	158	164	169	175	180	186	191
63" (5'3")	107	113	118	124	130	135	141	146	152	158	163	169	175	180	186	191	197
64" (5'4")	110	116	122	128	134	140	145	151	157	163	169	174	180	186	192	197	204
65" (5'5")	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210
66" (5'6")	118	124	130	136	142	148	155	161	167	173	179	186	192	198	204	210	216
67" (5'7")	121	127	134	140	146	153	159	166	172	178	185	191	198	204	211	217	223
68" (5'8")	125	131	138	144	151	158	164	171	177	184	190	197	203	210	216	223	230
69" (5'9")	128	135	142	149	155	162	169	176	182	189	196	203	209	216	223	230	236
70" (5'10")	132	139	146	153	160	167	174	181	188	195	202	209	216	222	229	236	243
71" (5'11")	136	143	150	157	165	172	179	186	193	200	208	215	222	229	236	243	250
72" (6')	140	147	154	162	169	177	184	191	199	206	213	221	228	235	242	250	258
73" (6'1")	144	151	159	166	174	182	189	197	204	212	219	227	235	242	250	257	265
74" (6'2")	148	155	163	171	179	186	194	202	210	218	225	233	241	249	256	264	272
75" (6'3")	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	279
76" (6'4")	156	164	172	180	189	197	205	213	221	230	238	246	254	263	271	279	287
BMI	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35

NORMAL WEIGHT (18.5 - 24.9)
OVERWEIGHT (25 - 29.9)
OBESITY (=> 30)

According to global database on body mass index the obesity classification is made. Body Mass Index (BMI) is a simple index of weight for height that is commonly used to classify under weight, over weight and obese in adults. It is defined as the weight in kilograms divide by the height in meter square (kg/m2).

This classification is an international classification for adult, underweight, over weight, and obesity according to BMI

Under weight	**<18.50**	**<18.50**
Normal range	**18.50-24.99**	**18.50-22.99**
Over weight	**>=25**	**>=25**
Obese	**>=30**	**>=30**
Obese class I	**30.00-34.99**	**30.00-32.49**
Obese class II	**35.00-39.00**	**35.50-37.49**
Obese class III	**>=40**	**>=40.00**

APPENDIX VI

DEMOGRAPHIC DATA:

s.no	Age	Ht(cms)	Wt(kgs)	BMI	FEV1/FVC%	PRFR
1.	20	160	69	27	57.4	175
2.	19	163	68	26	65.04	185
3.	18	160	72	28	56.8	200
4.	19	175	80	25	56.02	185
5.	20	170	81	28	59.84	190
6.	20	165	73	27	55.76	200
7.	21	178	82	26	63.85	205
8.	22	180	84	26	65.1	225
9.	21	165	76	28	67.48	200
10.	20	172	80	27	63.44	175
11.	18	170	75	26	61.32	185
12.	19	168	76	27	63.10	175
13.	20	165	71	26	67.46	185
14.	22	170	78	27	64.46	200
15.	21	175	89	29	67.46	225
16.	19	183	87	25	61.21	200
17.	21	157	64	26	68.56	185
18.	21	172	80	27	69.65	200
19.	20	170	75	26	57.40	225
20.	22	168	76	27	58.11	175
21.	19	170	75	25	60.9	225
22.	21	180	85	26	62.01	190
23.	20	165	75	28	59.23	185
24.	18	175	81	26	58.66	185
25.	22	173	80	27	65.41	185
26.	19	168	76	26	60.32	200
27.	20	180	84	26	59.81	195
28.	22	176	82	27	56.37	225
29.	20	175	82	27	56.37	190
30.	19	178	83	26	59.38	200

MASTER DATA FEV_1 / FVC

S.No	GROUP A		GROUP B	
	PRE	POST	PRE	POST
1	61.21	62.20	57.4	63.90
2	68.56	68.56	65.04	69.17
3	69.65	69.72	56.8	60.4
4	57.4	58.31	56.02	63.02
5	58.11	59.03	59.84	66.59
6	60.90	61.12	55.76	66.46
7	62.01	62.01	63.85	69.59
8	59.23	59.33	65.1	66.67
9	58.66	59.67	67.48	68.85
10	65.41	60.61	61.32	66.07
11	60.32	60.1	63.10	76.26
12	59.81	59.81	67.53	81.6
13	56.37	57.47	64.46	73.8
14	56.37	57.47	63.44	72.77
15	59.38	60.02	67.46	74.49

MASTER DATA FOR PEFR:

S.No	GROUP A		GROUP B	
	PRE	POST	PRE	POST
1.	200	210	175	210
2.	185	185	185	225
3.	200	200	200	250
4.	225	225	185	200
5.	175	180	190	225
6.	225	225	200	250
7.	190	195	225	250
8.	185	185	200	250
9.	185	190	175	225
10.	185	185	185	225
11.	200	205	175	200
12.	195	200	185	225
13.	225	230	200	250
14.	190	200	205	250
15.	200	200	225	250

APPENDIX VII

DESCRIPTION OF THE DEVICE

Spirolab is a new generation spirometer, it facilitates the total valuation of lung function. The product is designed for use by specialists who require a simple, compact device but one at the same time capable of calculating more than 30 spirometric parameters .

Spirolab makes **FVC**, **VC**, **IVC**, **MVV** and **breathing pattern** tests and calculates an index of test acceptability (test quality control) and a measure of reproducibility; and also gives functional interpretation with 11 possibile levels following the latest **ATS** (American Thoracic Society) classification.

The main spirometric parameters are measured and displayed and all data with Flow/Volume and Volume/time curves can be printed out in seconds by the built-in thermal printer. The Flow/Volume curve is shown in real time. Each test can be repeated several times. The best parameters are always available for rapid reference or printing. Several sets of predicted (or reference) values can be selected from five different authors. For example, in general within the European Union the values recommended by the **ERS** (European Respiratory Society) are used.

The device also calculates the response to drug administration, that is the percentage change between spirometry results obtained after the subject takes a drug and those prior to the drug (**PRE/POST**) plus the results of a bronchial

challenge test or a bronchodilation test. A comparison of data is made between **POST** (after-drug) and **PRE** (before drug administration). The keyboard is organized to be quick and user friendly, thanks to the 15 programmed keys.

The internal memory can contain more than 1000 spirometry tests complete with Flow/Volume and Volume/time curves.

Spirolab is supplied with an RS-232 optoisolated serial communication port, which guarantees excellent electrical protection (> 4 KV) both for the doctor and for the subject, and respects the most severe European safety requirements (EN 60601-1).

The machine can be connected directly to the *serial* port of a printer using the standard RS 232 communication port. To connect to the *parallel* port an optional serial to parallel converter is required. The internal software (or firmware) inside the device can be upgraded quickly and simply from a PC.

SPIROLAB II


Black and white display
Thermal paper container lid
Flow sensor
Key board
Flow sensor compartment

APPENDIX VIII

According to the American Thoracic Society they determined that .Forced Vital Capacity (FVC) is the amount of air that can be maximally and forcibly expelled from the lungs after a maximal inhalation. In patients with restrictive lung disease, the FVC will be smaller because the amount of air that can be forcefully inhaled or exhaled from the lungs is smaller to start with because of disease. This may be due to the fact that thoracic cage does not have the ability to expand very much. FVC will therefore be smaller due to mechanical limitations. However, since FVC will be smaller in obstructive disorders and in restrictive disorders (usually no one worries about the FVC unless it is 80% - 85% of predicted volumes), FVC alone cannot be used to diagnose obstructive and restrictive disorders all by itself. If the FVC did not change, it suggests the FVC was possibly low due to restrictive pathologies.

Forced Expiratory Volume in One Second: Forced Expiratory Volume in One Second (FEV1) is the amount of air that is forcefully exhaled in the first second of the FVC test. In general, it is common in healthy individuals to be able to expell 75% - 80 % of their vital capacity in the first second of the FVC test. Hence, FEV1 is a pulmonary function value that is highly diagnostic of obstructive disease - In patients with restrictive lung disease, the FEV1 will be lower than predicted normal values and so will the FVC. Since both of these values may equally be

effected in restrictive disease, the %FEV1 may well be calculated to be between 85% - 100% of normal. Hence, in restrictive disease look closely at %FEV1 when FEV1 and FVC are low and if the %FEV1 is 85% or greater, then you should suspect the patient has a restrictive **pathology.**