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KEY WORDS: Resisted Diaphragmatic Breathing Exercise, Cardiovascular Endurnce, Overweight Adults.

EFFECTIVENESS OF RESISTED DIAPHRAGMATIC BREATHING EXERCISE ON CARDIOVASCULAR ENDURANCE AMONG OVERWEIGHT ADULTS

Mr. E. Jayakanthan* B.P.T, ASSISTANT PROFESSOR, SRM College of Physiotherapy, SRM Institute of Science and Technology, Kattankulathur, Chennai-603202. *Corresponding Author

Mr. C. Sathishkumar Student, SRM College of Physiotherapy, SRM Institute of Science and Technology, Kattankulathur, Chennai-603202.

ABSTRACT

BACKGROUND: Overweight defined as excessive or abnormal fat accumulation that may leads to impairment of health an individual. When the person attains overweight the expiratory reserve volume of his lungs is reduced by 50 percent and the functional residual capacity of his lungs is reduced by 25 percent, They limit the lungs capacity to attain the maximum work of the lungs which could results in lowered Vo_2maximum levels.
OBJECTIVE: The aim of this present study is to determine the effectiveness of resisted diaphragmatic breathing exercise on cardiovascular endurance among overweight adults.
STUDY DESIGN: Quasi experimental study design, pre and post type.
PROCEDURE: Totally 30 overweight adults were selected for this study and Overweight adults were taught Resisted Diaphragmatic Breathing Exercise by using weight plates.
RESULTS: The data was analyzed using statistical package for social science (SPPS 16.0). Post-test values of all the subjects mean value was improved, hence the p value is < 0.005.
CONCLUSION: Resisted diaphragmatic breathing exercise had registered significant improvement in cardiovascular endurance among overweight adults.

INTRODUCTION

Cardiovascular endurance is defined as the ability of the human heart, lungs and blood vessels to deliver the amount of oxygen to the tissues. Good cardiovascular endurance is also playsimportant role in individual health and helps in prevention of certain disease including stroke, cardiovascular diseases, diabetes and hypertension[1]. The process of respiration plays a important role in human body metabolism and energy production this is requiredto meet the demands which placed on human body by various systems.

The human body is deriving energy mainlyby two forms of energy production, chiefly aerobic energy and anaerobic energy system. In the aerobic energy system the metabolicoxidation of blood glucose and muscle glycogens begins with the process of glycolysis. During any exercise the Oxygen that helps to convert the lactic acid which produced to the form of pyruvate. The pyruvate is transported at the level mitochondria, where in which the pyruvate is not converted into lactic acid process is taken up and which enters into the Krebs cycle. Formation of Adenosine Tri-Phosphate via the adenosine triphosphate- phosphocreatine system if the glycolysis is does not involved in oxygen then its called anaerobic metabolism. The individual aerobic capacity which determines thatindividual performance [3].

Individual aerobic capacity is determined by many factors such as gender, age, body mass index, exercises module, state of training and the power of muscles.when the training to the skeletal muscles applied in aappropriate way the Skeletal muscles willrespond to the training in a successful way. Which depends uponthevariability of the loadof the training module and intensity of the exercises. Therefore the intake of oxygen can be increased by respiratory muscle strength training. The extent of the skeletal muscles adaptation to the training which depends upon the application of the principles of strength training such as specificity, reversibility, overload[4].

Diaphragm which has its own endurance same likein the other limb muscles and also in themuscles of abdomen [5]. Strength training to the diaphragm and other respiratory muscles will also help to improve the endurance of the human body.Diaphragmatic breathing is the major process in the form of respiration, because the diaphragmatic breathing, the lower one third of human lungs which receives its oxygenation, and also the two third of the blood supply in the human body.

Resisted diaphragmatic breathing technique that will improve the oxygen transportation and efficiency of the human lungs. And alsohelpsto improve the ability to metabolize the oxygen. Diaphragmatic breathing has been supported by many research papers to the improve general endurance.[7,8]

Obesity and overweight is defined as excessive or abnormal fat depositionin human body that may leads to impairmentof health of an individual. Body mass index is a index used to measure the weight for height that is used for the classification of overweight and obesity. This is defined as anpersons weight in kilograms divided by the square of the persons height in meters.Body fatness is classified based on body mass index & is considered as healthy if body mass index >18.5, if body mass index >25 which is considered as overweight. Obesity is if the body mass index is greater than 30 and morbidly obese is if the body mass index >40. Gaining of weight may leads to primary changes in the metabolic process in certain groups, According to the world health organization, Asians are considered as overweight according to Asian criteria if the body mass index is > 22.9-24.9 and obesityis if body mass index is > 27.5. In2014, nearly 1.9 billion adults were overweight, and over 600 million adults were obese.

Excessive accumulation of fatthat impairs the individual functions and cardio respiratory system. and which decreases the amount of the mechanical efficiency of the individual [8].When the body mass index of the individual which reaches 23, considered as overweight this leads to the changes in the functional residual capacity of the individual lungs is reduced by 25 percent from its total value, and the expiratory reserve volume of the overweight individual lungs are reduced by over 50 percent from its total value while these two lungs functions are decreases they limits the capacity of the human lungs for achieving the highest work and could result in reduced Vo_2 maximum levels in overweight adults.The amount of accumulation of fat and individual central pattern of fat which might be related to functions and volumes of the lungs via various process, such as mechanicalefficiency of the diaphragm decreases that may leads to descent the diaphragm into the cavity of the abdomen and also into the chest wall that may leads alteration in the compliance of lungs and also the elastic recoiling of lungs and work of breathing which isdue to decreased strength of the diaphragm[9]. The major causative factor for overweight is an imbalance of energy between calories expended and calories intake of an individual.Due to Increased intake of foods that are rich in fat composition and its dense, also due todecreased in

physical activity of the individual due to the increased sedentary lifestyle and also various forms of work. Many Studies have been concluded that the level of Vo_2 maximumwere significantly decreases in the overweight individuals. Which is depends upon the amount of fat accumulation which may leadsto the possibility of loss of physical fitness and severely changes in cardiovascular and respiratory system functions in overweight individuals.

AIM OF THE STUDY

To findout the effectiveness of Resisted Diaphragmatic Breathing Exercise on Cardiovascular Endurance among Overweight Adults and to increase the cardiovascular endurance (aerobic capacity) among overweight adults.

NEED FOR THE STUDY

When the person attains overweight the strength of the diaphragm and the Vo_2max drastically decrease. This present study was focused on strengthening the diaphragm to improve the uptake of oxygen and thereby to increase the aerobic capacity of the overweight adults. Diaphragm is the major inspiratory muscle, when the diaphragm has good endurance and strength the amount of oxygen supply to the lower one third of the lungs will be more.

METHDOLOGY

STUDY DESIGN: Quasi experimental
STUDY TYPE: Pre-test and Post-test
SAMPLING METHOD : Convenient sampling
SAMPLE SIZE:30 subjects
STUDY DURATION : 6 weeks ,

STUDY SETTING : SRM college of physiotherapy, SRM health sciences gent's hostel.

INCLUSION CRITERIA, Overweight adults in the age group of18-25 years, Only men subjects were included,Overweight adults (BMI -23.0 –24.9 kg/m^2),Non-smoking overweight adults.

EXCLUSION CRITERIA Individuals with posturaldeviations like scoliosis and kyphosis, Cardiovascular diseases like history of rheumatic heart diseases, Any obstructive lung diseases, Any recent injury to chest wall, Vascular problems in lower limb.

MATERIALS USED

Countdown timer (stopwatch), Chair, Sphygmomanometer, Stethoscope, Step, Metronome mobile app, Pencil, Pen, Paper, Stadiometer, Weight plates, Weighing scale and Thermometer

PROCEDURE

Sampling method of this present study was Convenient sampling. Conveniently 30 overweight adults were selected for this study and subjects was clearly explained about the procedure and participants consent was obtained before to start the study. Subjects cardiovascular endurance was documented by performing 6 minutes step test. All the overweight adults performed 2 minutes stepping down and stepping up in the stairs as a form of warm-up. Pretest values of six minutes step test results of overweight adults was assessed and noted. Duration of this present study was period of 6 weeks. At the end of 6^{th} week, aerobic capacity of the overweight adults is reassessed and documented by using six minutes step test and progression was recorded.

EVALUATION OF STRENGTH OF THE DIAPHARAGM

The diaphragm strength was graded by using as follows, during the deep inspiration the subject who don't have the ability to raisethe epigastric region fully, when they are in supine lyingwhich is considered as poor-power. During the deep inspiration if the person is able to raise and expandthe epigastric region fully in supine lying, which is considered as fair power.

Therapist should place his hand on the epigastric region with fingers are open out,and the maximum manual resistance was applied during inhalation of the subject,if the subject able to docomplete epigastric region expansion against the manual resistance then itsreferred as Good power.The person who do nothave the abilityto hold but able to take resistance referred as Fair plus. Persons who are with fair plus power of diaphragm and above were selected for resisted diaphragmatic breathing exercises [10].

EVALUATION OF WEIGHT FOR THE TRAINING

The subject position was supine lying directed to breathing exercise. Then a minimal weight which starts with 1 kilogram weight plate was placed over the epigastric region on the folded Turkish towel, after that the subjects wereasked to inspire and expire and the weight plates should beraised fully during every inspiratory cycle.

If the subject says any discomfort, shows tired or if the subject is started to use accessory respiratory muscles means the weight plates was with drawnimmediately.Subjects is allowed to take rest, then the session was continuedby using a minimal weight than first time and if the subject is continues theinspiration with weight plates without any discomfort for 5-6 minutes, few minutesrest was given and the session was againcontinued by increasing the weight platesfrom 1 kilogram[11].

PLACEMENT OF WEIGHT PLATES

The folded towel was kept over the epigastrium and the weight plates was placed over the folded towel. Towel was used to reduce the friction between and subject skin weight plate. One of the corner of weight plate should touch the xiphoid and remaining two corners should touch the anterior and borders of the rib cage.,(figure 10).

During the training period of resisted diaphragmatic breathing exercise subjects were asked and monitored to do a normal inspiration and expiration with the weight plates for 10 minutes. And the weightprogression was done once for every 2 weeks. Resisted diaphragmatic breathing exercise was done for 6 weeks with the weight was progressively increased every 2 weeks, in the following manner [13](figure 10).

Total duration of this study was 6 weeks, each session was done for 10 minutes per day, 6 days per week,at the end of $6^{th}$the six minutes step test values of 30 subjects was reassessed and final value was documented.

TABLE I

Duration	Weight
1^{st} and 2^{nd} week	2 Kgs
3^{rd} and 4^{th} week	3 Kgs
5^{th} and 6^{th} week	4 Kgs

OUTCOME MEASURES

Six minutes step test

SIX MINUTES STEP TEST

The Six Minutes Step Test was performed on a high step, it should be in 20 cm in height, 80 cm in length and 40 cm in width. The subjects were instructed to step up and down i.e. supporting their two feet over the step and then return to the starting position. The subjects was asked to repeat this cycle as much as possible. The subjects were allowed to use either of their legs to start the test and can alternate when they wanted. Demonstration of the test was given before the subject's starts the test. The subjects were instructed to maintain a steady four beat cycle, at rate of 24 steps/min with metronome setting of 96 beats per minute. Subjects were allowed to slow down, stop and even rest in chair when they need but were encouraged to resume climbing as soon as possible. Subjects were not allowed to use their arms to help them to step but if the subject feels like losing balance, they could use their arms for regaining balance. The test was timed for 6 minutes. At the completion of test, subject's carotid pulse was measured for 15 seconds and then converted to beats per minute 15sec x 4.

Vo2 max Equation for six minute step test:
Vo2 max for Men = 111.33 - (0.42 x pulse rate beats/min)

DATA ANALYSIS

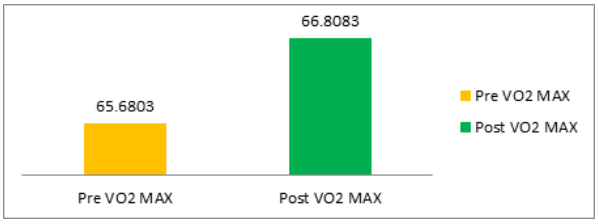
The collected data were tabulated and analyzed using descriptive and interferential statistics. The data was analyzed using statistical package for social science (SPPS 16.0) to present the study. To asses all the parameters, mean and standard deviation were used.

TABLE II PRE AND POST TEST VALUES OF Vo_2 MAXIMUM LEVEL AMONG OVERWEIHT ADULTS

Variables	N	Mean	Standard Deviation	Df	t	Significant Value
PREVO$_2$ MAX	30	65.6803	3.12049	29	-3.666	0.01
POST VO$_2$ MAX	30	66.8083	3.21838			

The table shows the comparison of pre-test and post-test Mean values, Standard Deviation within the group. The mean value ranges from 65.6803 to 66.8083 and the standard deviation from 3.12049 to 3.21838. Reveals the Mean value, t value and p value. Hence the p value is < 0.05 and hence there is a significant increase in the Vo_2 max level.

GRAPH I COMPARISON OF PRE TEST AND POST TEST VALUES OF Vo_2 MAXIMUM LEVEL AMONG OVER WEIHT ADULTS



RESULTS

The results were analyzed using paired t – test by using statistical package for social science (SPPS 16.0).

According to table II and graph IVo_2in six minutes step test has shown change in mean value of Pre - test Vo_2max and it increased range from 65.6803 to the mean value of 66.8083 and also Six minute step test showed a significant difference in heart rate and Vo_2 max level and shows the significant value of 0.01; since (p <0.05) in overweight adults, Hence the results were significant.

DISCUSSION

This study aimed to find out the effectiveness of resisted diaphragmatic breathing exercise on cardiovascular endurance among overweight adults.

The results of this study shows that there is a significant improvement in the resisted diaphragmatic breathing exercises on cardiovascular endurance among overweight adults.

This result was supported by an author **sathish, et al.,**thatresisted diaphragmatic breathing exercise can be used to improve the fitness and also the cardiovascular endurance of the hockey players. In this study they were compared the effectiveness of resisted abdominal exercise by using abdominal curl ups and resisted diaphragmatic breathing exercise by using weight plates over the diaphragm, in the duration of 8 weeks in basketball and hockey players the study proved that significant improvement in aerobic capacity among hockey players who received resisted diaphragmatic breathing exercise.

When the person attains overweight the strength of the diaphragm and the Vo_2max drastically decrease. This present study was focused on strengthening the diaphragm to improve the uptake of oxygen and thereby to increase the aerobic capacity of the overweight adults. Diaphragm is the major inspiratory muscle, when the diaphragm has good endurance and strength the amount of oxygen supply to the lower one third of the lungs will be more.

According to the outcome measures table II and graph Iproves that resisted diaphragmatic breathing exercise was effective among overweight adults. The mean values pre-test is increased from 65.6803 to 66.8083. The results documented difference between the pre and post Vo_2maximum level which was statistically significant (p value 0.01) which infers that better improvement in cardiovascular among overweight adults by using of resisted diaphragmatic breathing exercise.

The results can be explained with a fact that the physiological basis of resisted diaphragmatic breathing exercise will increase the strength of the diaphragm and this will increase the amount of oxygen supply to the lower one third of the lungs and also two third of blood supply in the human body and also helps to improve the oxygen metabolism. **According Demsy, et al.,** Excessive accumulation of fatthat impairs the individual functions cardio respiratory functions, and which decreases the amount of the mechanical efficiency of the individual [8].When the body mass index of the individual which reaches 23, considered as overweight this leads to the changes in the functional residual capacity of the individual lungs is reduced by 25 percent from its total value, and the expiratory reserve volume of the overweight individual lungs are reduced by over 50 percent from its total value. While these two lungs functions are decreases they limits the capacity of the human lungs for achieving the highest work and could result in reduced Vo_2 maximum levels in overweight adults. **According to Lazarus R,et al.,** The amount of accumulation of fat of a individual body fat pattern which might be related to functions and volumes of the lungs via various process, such as mechanical efficiency of the diaphragm decreases that may leads to descent the diaphragm into the abdomen and its cavity and also into the chest wall that may leads alteration in the compliance of lungs and also the elastic recoiling of lungs and work of breathing which is due to decreased strength of the diaphragm[9]. And also **Stanley John Winser**, proved weight training to the diaphragm by using abdominal weights which showed significant results in improvement of the strength of the diaphragm. In the form of pulmonary rehabilitation amongtetraplegic patients .They were compared the effectiveness of abdominal weight training and effect of incentive spirometer to improve the mechanical efficiency of diaphragm and its strength amongtetraplegic patients. This study proved that when the endurance component is added to develop the highest level of musculoskeletal function and cardiovascular and respiratory system of a individual which showed a significant improvement in the tetraplegic patients exercise capacity. And they stated that this can be successfully incorporated into increase the exercise capacity in the individual who have lowered exercise capacity. This study was supported by various authors that resisted diaphragmatic breathing exercise can be successfully incorporated to improve the aerobic capacity and general endurance of the human body. And this present study also proves that resisted diaphragmatic exercise can be succ**e**ssfully used to improve the cardiovascular endurance among overweight adults.

CONCLUSION

This study concludes thatthere is a significant improvement in cardiovascular endurance measured using Resisted Diaphragmatic Breathing Exercise among overweight adults, hence this indicates that resisted diaphragmatic breathing exercise can successfully be incorporated to improve the cardiovascular endurance for overweight adults.

LIMITATIONS: Samples were smaller in size.Female subjects were not included in the study. Indirect method of estimating VO_2 max was used

RECOMMENDATION: Duration of the study can be larger.Pre and post blood pressure should be correlated.Post body mass index can be assessed

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