



“COMPARATIVE EFFECT OF RESISTANCE EXERCISE TRAINING VERSUS TRADITIONAL EXERCISE TRAINING ON CARDIOVASCULAR FITNESS IN OVERWEIGHT COLLEGE FEMALES”- A COMPARATIVE STUDY

¹ Dr Sonia Bhatia(PT), ² Dr Rahul Suman(PT)

¹Assistant Professor, ² Intern Student

B N Patel College of Physiotherapy, Anand, Gujarat

Abstract:

Background: Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. More than 100 million individuals are obese in India and the prevalence of obesity varies from 10% to 50%, there is an increase in obesity among young adults, mainly college students.

Materials and Method: This study is an experimental study performed on 30 female college students of B.N. Patel College of physiotherapy. Sampling was done using a convenient sampling method. The Assessment tool used to record VO₂ max was the queen's step test. The experimental group was given 6 weeks of Resistance exercise training, and the Traditional group was given 6 weeks of traditional exercise, both groups have followed 45 minutes for a session for 4 days a week. Results were analyzed using SPSS software and unpaired and paired t-test.

Conclusion: we have found that there was a significant increase in VO₂max after 6 weeks of Resistance exercise training and Traditional exercise training. Resistance exercise training is more effective than traditional exercise training. Having relevant long-duration resistance exercise training is recommended to all overweight college females to improve cardiovascular fitness and prevent future cardiovascular risk.

Keywords: Maximum Oxygen Uptake (VO₂max), Body Mass Index (BMI)

I INTRODUCTION:

Overweight and obesity is the underlying cause of death for about 3 million people every year. More than 100 million individuals are obese in India and the prevalence of obesity varies from 10% to 50%, there is an increase in obesity among young adults, mainly college students. Few studies have been carried out among Indian undergraduate students where irregular dietary patterns, stress, and anxiety are more prevalent due to academic pressure. The prevalence of overweight in women in Gujarat in the year 2005-06 was 15.01% to 20% and 20.01% to 25% in the year 2015-16 ^[1]

Due to overweight the adaptations and alterations in cardiac structure and function occur in the individual as adipose tissue accumulates in excess amount with numerous cardiac complications such as coronary heart disease, heart failure, and sudden death through its impact on the cardiovascular system. The irregular aggregates and bands of adipose tissue separate myocardial cells, a result of pressure-induced atrophy from the intervening fat. The pathophysiology of the cardiomyopathy of obesity is the lipotoxicity of the myocardium induced by free fatty acids, which can cause apoptosis of lipid-laden cells such as cardiomyocytes.^[2] Moderate to a high prevalence of overweight and obesity and lack of physical activity is the most common risk factor associated with obesity among highly active age group (college going students).^[3]

Resistance exercise is the type of active exercise in which both the dynamic or static muscle contraction is maintained by an outside force applied manually or mechanically. Resistance exercise is also known as resistance training in which an essential element of rehabilitation programs for persons with/or imperfect function and an integral component of conditioning programs for those who wish to promote or maintain health and physical well-being, potentially strengthen the performance of motor skills, and decrease the risk of injury and disease. The improvement of muscle strength is an essential component of most rehabilitation or conditioning programs for individuals of all ages and all abilities. Strength training (strengthening exercise) is defined as a fundamental method of a muscle or muscle group lifting, lowering, or controlling heavy loads (resistance) for a relatively low number of repetitions or over a short period time.^[4]

Resistance training cause an absolute increased in left ventricular thickness and left ventricular mass. The increase is not noticeable when they are expressed relative to body Surface area or lean body mass. There is little or no change in left ventricular and internal dimension in absolute terms which are relative to body surface area and Resting heart rate, resting blood pressure, and diastolic function of the left ventricle due to resistance training. No Change or slightly positive effect is noted in the systolic function of the left ventricle with training. Left ventricle volume is increased. The Diastolic function has not shown decreased examining cardiac hypertrophy in the person taking resisted training, as in pathological condition, but enhanced diastolic function.^[5]

The effect of resistance exercise training on the cardiovascular system during exercise, a reduction in the pulse rate. An increase in stroke volume may occur because of an increase in myocardial contractility and an increase in ventricular volume. Increased in cardiac output may occur because of increased stroke volume. Increased extraction of oxygen by the working muscles occurs due to enzymatic and biochemical changes in the muscles, as well as increased maximum oxygen uptake (VO₂max). Greater VO₂max results in a greater work capacity. Increased cardiac output increases oxygen delivery to the working muscles.^[4]

It is an undeniable fact that a potent stimulus for muscle hypertrophy and strength gain. The resistance training-induced increase in VO₂max may be associated with an improvement in the ability of oxygen to be utilized in hypertrophied muscles. The resistance training can be expected to improve all together both muscular (muscle hypertrophy and functional ability) and cardiovascular (VO₂max) fitness with a single mode of resistance training when young and old persons have initially low fitness levels.^[6]

Aerobic capacity (Vo₂max) predicts the strong health and fitness and is considered as a key physiological measure in healthy adult population. Sub maximal step test, it provides a safe, simple and equal assessing VO₂max which is logically valid in both general population and rehabilitation setting. Varied validity measures, with broad range of correlation coefficient across the 11 studies (r = 0.469- 0.95). Reliability measures, demonstrating good test- retest reliability (mean- 0.8 + 3.7 ml kg⁻¹ min⁻¹).^[6]

The most used measure of cardio respiratory fitness is maximal oxygen consumption (VO₂max). Each liter of oxygen consumed liberates approximately 5 kcal, dependent upon the intensity of work. This means that at any given relative work intensity, a higher VO₂max is accompanied with a higher energy expenditure. Energy expenditure has been shown to correlate with the rate of body weight change. Cardio respiratory fitness may affect body weight change. However, to our knowledge, no previous study has addressed the association between cardio respiratory fitness and body weight change in patients with severe obesity undergoing an intensive lifestyle intervention program.^[7]

Progressive resistance training provides overweight and obese youth an opportunity to improve their health, fitness, and quality of life, to enhance motor skill performance, to gain confidence in their abilities to be physically active.^[8]

Considering all this points, this study is to find effect of resistance exercise training on cardiovascular fitness in overweight college students.

II MATERIAL AND METHODS:

Study Design and setting:

- Study setting: B.N. Patel College of physiotherapy, Anand.
- Study design: An experimental study.

Method of collection of data:

- Study population: students going to college.
- Sampling Method: Convenient sampling.
- Sample size:30 (Group A Sample size 15, Resistance exercise training group. GroupB Sample size 15, Control group.)
- Study duration: 6 weeks
- Treatment duration: 4 session per week for 45 minutes

Selection criteria: Age of the students is 18 to 25 years old, BMI is 25 to 29.9 kg/m² and those students who want to participate willingly were included in this study. If student having cardiovascular pathology, pulmonary diseases, musculoskeletal disorders, inflammatory diseases and recently undergone any typical intervention were excluded.

Materials: Essential component needed as per Covid-19, Stool of 16.25 inches (41.3 cm) of height, stopwatch, measurement tape, dumbbell and yoga mat.

Procedure : The written consent was taken from all the selected subjects and we explained about confidentiality of personal data, and withdrawal at any time during and after the study. Pre fitness assessment was taken with required demographic data and information regarding to their life-style and weight, height, BMI, 1RM, and vitals and outcome measure for VO₂ max. Pre and post VO₂ max values were compared within group and between both the groups to determine result and conclusion of the study.

Exercise Protocol: Warm-up Period (10 minutes)-Neck movements, side arm raises and toe touch, marching in one place followed by Exercise Programme as shown in Table[1] and Cool down period: (5 minutes) stretching- 10 seconds hold with 3 repetition.

	Resistance Exercise	Traditional Exercise
Upper Limb	Arm Curl and Standing tricep extension	Shoulder extension with stick
Lower Limb	Leg Curl and Calm shell	Stepping, Squatting
Chest	Wall pushing, Military press	Corner press and Plank walk
Trunk	Lateral torso bend, Back extension exercise	Side to side bend, upper body twist
Abdomen	Flutter kick and crunches	Straight leg raise, Sitting twist
	45 minutes per day for 4 days in week for 6 weeks, Applied De'lomes technique 10 RM progress once in a week	3 Sets of 5 repetitions progress once in a week

Table[1]: Exercise of both groups

OUTCOME MEASURE:-Queen's Step Test: To find cardiovascular fitness:- Since the accuracy of the test relies on the heart rate response, try to eliminate factors that might alter this outcome measure. Ideally, 24 hours prior to initiation of step test subject will have to avoided exercise and consumption of foods and drugs that alter heart rate (e.g., coffee, soda, energy drinks, diet pills, beta blockers).^[7]

STEP 1: Prior to procedure check radial pulse of participant for 15 second and multiply that result by 4^[7]

STEP 2: The four step of cadence done in step test is described as a "up up down down". The step test is performed by using a tool of 16.25 inches (41.3cm) over height. Stepping is done for a total duration of three minutes at the rate of 24 steps up per minute for males and 22 steps up per minute for females which is set by manually. The time of three minute is setup stopwatch. To avoid muscle fatigue the participant should switch the leading leg at least once during the test.^[7]

STEP 3: After exactly three minutes of stepping the subject should stop and the tester should palpate for the radial pulse again. Begin counting at exactly 3:05 minute and count for 15 seconds. (I.e. to 3:20). And multiply the result by 4.^[7]

STEP 4: Calculate the predicted VO₂ max by the recovery heart rate in the equation below where heart rate is beats/minute. (The Borg rating of perceived exertion will also taken).^[7]

$$\text{Women: VO}_2 \text{ max (ml. kg}^{-1} \text{ min}^{-1}\text{)} - 65.81 - (0.1847 \times \text{HR})^{[7]}$$

III RESULT: The data analysis was done by SPSS software. Descriptive statistics indicators such as mean and standard deviation and inferential statistics indicators such as paired T test and Unpaired T test were used .

Characteristic	Resistance group	Traditional Group
Age(Years)	21.6±0.98	20.26±0.79
Height(cm)	155.60 ±7.65	156.26 ±5.31
Weight(kg)	66.93 ±6.00	66.26 ±5.50
BMI(kg/m ²)	26.33 ±1.86	26.14±1.59

Table[2] Demographic data of Resistance group and Traditional group

No. of Participant	Pre Value (Vo2max)		PostValue (Vo2max)		P value
	Mean	Standard Deviation	Mean	Standard Deviation	
15	44.40	0.50	51.40	4.07	<0.001

Table[3] Group A within Group

No. of Participant	Pre Value (Vo2max)		PostValue (Vo2max)		P value
	Mean	Standard Deviation	Mean	Standard Deviation	
15	46.98	0.50	46.98	2.10	<0.001

Table[4] Group B within Group

No. of Participant	PostValue (Vo2max)		P value
	Group A Resistance Exercise	Group B Traditional Exercise	
30	3.041	0.508	<0.001

Table[5] Inter group test of experimental group and control group

IV DISCUSSION

In this study after 6 weeks of resistance exercise there was significant increase in total VO₂max in which pre mean score was 44.40 with standard deviation 0.50 and post mean score was 51.40 with standard deviation 4.07, After 6 weeks of traditional exercise training there was no significant increase in VO₂max in which pre mean score was 46.98 with standard deviation 0.50 and post mean score was 46.98 with standard deviation 2.10 respectively.

This suggests that resistance exercise training is effective in improving VO₂max (maximum oxygen capacity) in overweight college female students. Statistically there is less significant increase in VO₂max in resistance exercise group; this may be due to diet plan was not given regularly and perform on small sample size for short duration. Due to communicating subjects in traditional exercise training group they got fatigue and this is the confounding factor due to which traditional exercise training not shown significant increase in VO₂max.

Strength Gain and Muscle Hypertrophy are a potent stimulus. The increase in resistance training-induced in VO₂max is associated with an improvement in the oxygen' to be utilized in hypertrophied muscles. The resistance training can be expected to improve all together both muscular (functional ability and muscular hypertrophy) and cardiovascular (VO₂max) fitness with a single mode of resistance training when young and old persons have initially low fitness levels. Adaptation to resistance training are highly specific and several society has published resistance training guidelines to optimize muscle hypertrophy and strength gains as well as to improve VO₂max.^[8]

Large and excessive leads to increase in oxygen consumption have been reported in older subjects after endurance training. Strength training has similar effect on endurance work capacity and peak oxygen consumption in older subject. We performed a population based randomized based control trial in women aged 76-78 years, using standard criteria for medical screening. We found individual and limited variable response, together with unexpected health changes..^[10]

Peak heart was 12% rates during circuit weight training than target or approximately 73% of the maximum measured on treadmill testing. These heart rates were somewhat less than the 80% observed in a more vigorous circuit weight. Training program in normal subjects and also demonstrated that subjects exercising at 80% of their maximal heart rate were working at less than 50% of their maximal oxygen uptake. In that study, despite the relatively low oxygen uptake during training there was significant improvement in treadmill time, although maximal oxygen uptake increased only in women. Our present data suggest that improvement in aerobic capacity in cardiac patients can be accomplished with less vigorous exercise than previously observed in normal subjects..^[11]

Higher-intensity compared with lower-intensity activities may cause an even greater response during the rapid EPOC component because of a greater use of anaerobic energy systems and greater work inefficiency during exercise. It demonstrated that 22% more energy is required to perform the same amount of bicycle work at a high intensity compared with a low intensity. Although it is unclear what mechanisms contribute to the inverse relationship between efficiency and exercise intensity, a potential list includes increased utilization of inefficient fast twitch muscle fibers, increased recruitment of stabilizing muscles, and increased work of the heart and respiratory muscles..^[12]

Higher levels of sympathetic nervous system activity may also contribute to an elevated metabolic rate post exercise. Epinephrine and nor epinephrine are strong stimulators of energy metabolism, and, although not measured in the current study, it is possible that higher levels of catecholamines were present after the HI exercise condition. The plasma concentrations of catecholamines increases exponentially with the exercise intensity and demonstrates the same relationship as that observed between the exercise intensity and EPOC..^[12]

The heart rate: intensity relationship is limited in its application to resistance training. As muscle loading increases, the heart and blood pressure responses differ from dynamic exertion. A maximal lift with its isometric component has a predictably lower heart rate and higher systolic blood pressure than maximal dynamic exertion. Thus, exertional heart rates were not comparable indicators of overall intensity. An alternative method to compare weight training and dynamic exertions intensity would be the metabolic pathways used..^[13]

Because heavy weight lifting is a burst activity, using predominantly glycolytic pathways and anaerobic muscle metabolism, it may be considered a more intense form of training, despite a lower heart-rate response. Total caloric expenditure is another variable that may relate to EPOC. The total caloric expenditure of continuous cycling and low-resistance circuit training were comparable for our subjects, while the least total energy use was during heavy-resistance training. Although values for caloric expenditure during lifting were extrapolations, findings during circuit weight lifting were similar to those observed by other investigators, suggesting accurate caloric use estimates..^[13]

Engaging in physical activity is arguably preeminent cardio protective health behavior panels and consensus panels recommended for both patients and healthy people alike. Strength training lowers the heart rate and increase cardiac parasympathetic regulation..^[13]

V LIMITATION OF STUDY: This study is performed in only college females age group, the study is conducted only for short duration (6 weeks) and diet plan is not included Metronome was not available in a procedure of performing queens college step test.

VI FURTHER RECOMMENDTION: The study should be done with large sample size with longer duration. The study should be conducted to any relevant age group. It should be conducted in males also.

VII CONCLUSION: It is concluded that there is significant increase in VO₂max in after 6 weeks of Resistance exercise training and Traditional exercise training. Resistance exercise training is more effective than traditional exercise training. Having a relevant long duration resistance exercise training is recommended to all overweight college females to improve cardiovascular fitness and prevent future

cardiovascular risk.

Conflict of Interest: None

Disclaimers: None

Source of Funding: self

REFERENCES

- [1] Shannawaz M, Arokiasamy P. Overweight/Obesity: An Emerging Epidemic in India. *Journal of Clinical & Diagnostic Research*. 2018 Nov 1;12(11).
- [2] Poirier P, Giles TD, Bray GA, Hong Y, Stern JS, Pi-Sunyer FX, Eckel RH. Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss. *Arterioscler Thromb Vasc Biol*. 2006 May;26(5):968-76. doi: 10.1161/01.ATV.0000216787.85457.f3. PMID: 16627822.
- [3] Arumugam B, Premlal KS, Nagalingam S. Prevalence of overweight and obesity among college going students at Kancheepuram town, Tamil Nadu. *International Journal of Preventive and public health sciences*. 2015 Nov 30;1(6):15-9.
- [4] Kisner C, Colby LA, Borstad J. *Therapeutic exercise: foundations and techniques*. Fa Davis; 2017 Oct 18.
- [5] Ozaki H, Loenneke JP, Thiebaud RS, Abe T. Resistance training induced increase in VO₂ max in young and older subjects. *European Review of Aging and Physical Activity*. 2013 Oct 1;10(2):107-16.
- [6] Bennett H, Parfitt G, Davison K, Eston R. Validity of submaximal step tests to estimate maximal oxygen uptake in healthy adults. *Sports Medicine*. 2016 May 1;46(5):737-50.
- [7] Berge J, Støren Ø, Hertel JK, Gjevestad E, Småstuen MC, Hjelmæsæth J. Associations between cardiorespiratory fitness and weight loss in patients with severe obesity undergoing an intensive lifestyle intervention program: retrospective cohort study. *BMC endocrine disorders*. 2019 Dec;19(1):1-9.
- [8] Faigenbaum AD. Resistance training for overweight and obese youth: Beyond sets and reps. *Obesity and Weight Management*. 2009 Dec 1;5(6):282-5.
- [9] Kallinen M, Sipilä S, Alen M, Suominen H. Improving cardiovascular fitness by strength or endurance training in women aged 76–78 years. A population-based, randomized controlled trial. *Age and ageing*. 2002 Jul 1;31(4):247-54.
- [10] Kelemen MH, Stewart KJ, Gillilan RE, Ewart CK, Valenti SA, Manley JD, Kelemen MD. Circuit weight training in cardiac patients. *Journal of the American College of Cardiology*. 1986 Jan 1;7(1):38-42.
- [11] Thornton MK, Pottleiger JA. Effects of resistance exercise bouts of different intensities but equal work on EPOC. *Medicine & Science in Sports & Exercise*. 2002 Apr 1;34(4):715-22.
- [12] Elliot DL, Goldberg L, Kuehl KS. Effect of resistance training on excess post-exercise oxygen consumption. *J Appl Sport Sci Res*. 1992 May 1;6(2):77-81.
- [13] Stewart KJ, Kelemen MH, Gillilan RE, Valenti SA, Manley JD, Kelemen MD, Ewart CK. Circuit weight training in cardiac patients: effect of beta blockade. *Medicine & Science in Sports & Exercise*. 1985 Apr 1;17(2):239.