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RESEARCH ARTICLE

THE IMPACT OF AEROBIC TRAINING ON BODY MASS INDEX OF OBESE SEDENTARY FEMALES

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ABSTRACT

Introduction: Obesity is a rapidly escalating metabolic disorder. The impact of obesity is highest in the younger age which increases the risk for cardiovascular morbidity/mortality and shortens the life expectancy.

Aim: This study was aimed to evaluate the effects of aerobic training on Weight and BMI of obese sedentary females.

Materials and Methods: 80 females were selected with BMI>30 Kg/m2, aged 35-45 years. They were divided as two groups, exercise (n=40) and control (n=40). Healthy subjects without H/o pathologic/ orthopaedic limitations were included. Morbidly obese women were excluded. Informed consent was obtained. Experimental protocol was approved by Institutional Ethical Committee.

For all the participants, weight was recorded before the study and BMI was calculated. They were all requested to follow their usual diet. Control group did not perform any training. For the exercise group, aerobic training was given using Treadmill for 3 alternate days in a week for 6 weeks. Each session was provided by 10 minutes warming and stretching with 1.7 mph, adjusting the level at 60-70% of maximum HR up to the exhaustion level, followed by 10 minutes cool down &stretching. For the first 4 weeks, 20 minutes and next 2 weeks, 30 minutes exercise was given. Weight was recorded & BMI was calculated after the study. The results were statistically analysed using paired 't' test. $p<0.05$ was accepted as significant.

Results: The exercise group showed statistically significant favourable improvements in weight, BMI ($p=.000$, $p<0.05$) whereas controls showed no significance ($p>0.05$).

Conclusion: The results revealed that aerobic training is more beneficial to improve the fitness in obese females by reducing the body weight and BMI and thereby to reduce the cardiovascular morbidity and mortality.

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INTRODUCTION

Obesity can be called as 'New World Syndrome' whose prevalence is increasing worldwide, in every country, in adults as well as in children (Azam Ramezankhany *et al,* 2011). Obesity is a ''Modern Disease" due to the reflection of industrialisation, urbanisation and globalisation. Obesity is defined as an excess of body fat or excess adipose tissue mass (Hall Guyton, 12 th ed, Longo *et al.,* 18th ed). Obesity is a complex, multifactorial disorder which increases the risk for cardiovascular morbidity and mortality and shortens the life expectancy (Marschalls Runge *et al.,* 2nd ed). It involves a complex interaction of genetic factors, environmental factors like diet, physical activity level &early childhood factors (Charlotte Pooler *et al*., 2009). Obesity is more common among women (Longo *et al.,* 18th ed). Eventhough genetic predisposition leads to the development of obesity, sedentary lifestyle like excessive Television watching may play an important role in the development of obesity and diabetes in women (Carlos Ferrari *et al*, 2008). Obesity results from an imbalance between caloric intake and caloric expenditure (Marschalls Runge *et al*., 2nd ed). Lifestyle changes, changes in dietary habits and reduction in physical activity contribute to increased prevalence of obesity now a days (Mengistic Alemayehu Belay *et al.*, 2013). Frequent intake of junk foods, high fat snacks, soft drinks with poor intake of fruits and vegetables lead to obesity in children. Each 1 Kg increase in body weight leads to 9% increment in Type II Diabetes mellitus risk (Carlos Ferrari *et al*., 2008). A better way to define obesity is by measuring the body fat percentage. Body fat percentage of 25% or more in men and 35% or more in women defines obesity. However, the most widely used method to measure obesity is by Body Mass Index (BMI). Eventhough BMI is not a direct measure of determining adiposity and persons with higher BMI may have large muscle mass, still BMI is commonly used in clinical practice to assess obesity (Hall, Guyton, 12 th ed; Longo DL *et al.,* 18th ed). WHO has defined obesity based on BMI, as those individuals

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with BMI>30 Kg/m^2 as obese, BMI between 25-29.9 Kg/m^2 as overweight and BMI>40 Kg/m^2 as severe/morbid obesity (Marschalls Runge *et al.,* 2nd ed). BMI >30 Kg/m^2 is the commonly used threshold for obesity in both genders. Still at a similar BMI, women may contain more body fat than men (Longo *et al.*, 18th ed). It is even documented that women have greater prevalence of obesity as compared to men. 25-44 yrs are the dangerous years when adults develop obesity; In general, women tend to gain more weight. One reason may be that women may have a lower metabolic rate than men. Another reason that women gaining weight with age is due to postmenopausal loss, of the increase in metabolic rate that is associated with luteal phase of menstrual cycle. However, the age related decline in metabolic rate is not observed in women who continue their regular endurance exercise program (Krokenberg HM, chapter 35; Fritz *et al*; William McArdle *et al.*, 7th ed). According to WHO estimates in 2005, approximately 400 million adults (9.8%) are obese with higher rates of obesity in females when compared with males (Krokenberg, chapter 35). Physical inactivity is one of the factors leading to increasing obesity epidemic. WHO reports reveal physical inactivity as the 4th leading risk factor for global mortality. Physically inactive people have a 20-30% increased risk of all cause mortality (Mengistic Alemayehu Belay *et al.*, 2013). Persons who are overweight/obese with central adiposity are at elevated risk for hypertension, hyperlipidaemia (Charlotte Pooler *et al.*, 2009), coronary heart disease (Charlotte Pooler *et al.*, 2009 Dale *et al.*, ch 4), cardiovascular mortality and cerebrovascular diseases (Dale *et al*, ch 4).Overweight and obese individuals are at increased risk of developing coronary artery disease. It has been estimated that 5% deaths in males from Coronary Artery Disease (CAD) and 6% deaths in females from CAD are due to obesity. In addition, 36% CAD mortality in men and 38% CAD mortality in women are due to their sedentary lifestyle (Parveen Kumar *et al.,* 7th ed).

Obese are also at risk of developing Type II Diabetes mellitus with insulin resistance leading to metabolic syndrome, gallstones, high uric acid levels and Gout. They may develop hepatic steatosis, osteoarthritis, obesity hypoventilation, cardiac arrhythmias like atrial fibrillation, nephrolithiasis, malignancies like breast cancer, endometrial cancer etc (Parveen Kumar *et al.,* 7th ed). Obesity may lead to psychosocial/socioeconomic burden, lowered self esteem in children and depression in adult leading to decreased quality of life. Mortality increases in both men and women due to obesity with its associated co-morbid conditions. The impact of obesity on mortality is highest in the younger age groups (Dale DC *et al.*, ch 4). Obesity is correlated with impaired cardiac function. It is associated with abnormal diastolic function with or without associated systolic dysfunction. Obesity is linked with spectrum of minor cardiovascular changes from hyperdynamic circulation to subclinical cardiac structural changes (Wong *et al.*, 2004). The Physician's Health Study indicated that obesity with BMI ≥30Kg/m^2 was strongly associated with the risk of Ischemic Heart Disease and hemorrhagic stroke. Each unit increase in BMI leads to 6% increased risk of stroke. It has been found that obesity is associated with coronary/carotid atherosclerosis and is an independent predictor of cardiovascular morbidity and mortality (Carlos Ferrari *et al.*, 2008).

Fortunately, there is convincing evidence that with increasing physical activity, the risk of overweight /obesity decreases and also their complications. It decreases the cardiovascular and diabetes risk, beyond that achieved by weight loss alone. The physical activity helps to decrease the abdominal fat and to increase the cardio-respiratory fitness. It helps by preventing the large decrease in muscle mass that often occurs with weight loss (Charlotte Pooler *et al.*, 2009). Studies have shown that physical activity provides a greater degree of protection in women than men. Sedentary females who become physically active had 32% decreased risk of all cause mortality and 38% decreased risk of cardiovascular mortality rates (Peter Kokkinos *et al.*, 2010). Regular exercise even without dietary caloric restriction can significantly decrease the body weight and fat mass in overweight/obese persons. A minimum of 60 minutes, preferentially 80-90 minutes of moderate intensity, physical activity may be required to avoid regain of body weight and to prevent CVD in obese persons. To produce the maximum benefits, the activity needs to be regular and aerobic (Sarika Chaudhary *et al.*, 2010).

Aerobic exercise involves large muscle groups engaged in dynamic activities resulting in substantial increase in heart rate and energy expenditure. Eg: Walking, swimming. Aerobic training helps to maintain ideal body weight/ lean mass, reduction of blood pressure, improves HR variability & endothelial function, increases myocardial function/mitochondrial density/ capillary density & decreases myocardial O_2 demand/platelet aggregation/ abdominal adiposity/systemic inflammation, increases insulin sensitivity & fibrinolysis thereby improves the lifespan. It also reduces the risk for developing hypertension, metabolic syndrome, Type II diabetes, hyperlipidaemia, coronary heart disease, obesity, depression and delays premature ageing (Valentin Fuster *et al*., Sharon A Plowman *et al*., William McArdle *et al.*, 7th ed; Pal .2nd ed; Indu Khurana,1st ed; Clinical Lipidology, ch 20). Many studies were done involving obese sedentary females, advocating diet modifications/high intensity aerobics/aerobic & resistance combinations for long duration. However studies employing aerobic training only for a short duration without dietary restriction in obese sedentary females are comparatively minimal. Hence the present study was aimed to study the impact of 6 weeks of aerobic training on body mass index of obese sedentary females.

MATERIALS AND METHODS

Study Design

This study was done at Physiology department Research laboratory, Thanjavur Medical College, Thanjavur from August 2012 to October 2013. This study was conducted as an experimental study. The subjects were recruited from Thanjavur Medical College Hospital. 80 sedentary females aged 35-45 years with BMI >30 kg/m^2 participated. The participants were informed about all possible risks and benefits involved in this study; Written informed consent was obtained from them before participating in the study.

Inclusion and Exclusion Criteria

Only apparently healthy females aged 35-45 years with BMI>30Kg/m^2, but less than 40 Kg/m^2, not having any H/o pathological illness or orthopaedic limitations were included.Subjects who were underweight/overweight/morbidly obese were all excluded. Pregnant, lactating, postmenopausal women, subjects with Hypertension, diabetes mellitus, H/o cardiovascular/respiratory illness, fractures /surgeries, physiological/neurological/ psychological illness, subjects taking treatment for Hypertension/Diabetes, subjects on lipid lowering agents/on chronic medications for any ailments, subjects with bony deformities like kyphosis, scoliosis were also excluded. No subject was currently participating in any other exercise programs. All the study participants were requested to follow their usual diet and not to change their diet pattern. The study protocol was approved by the Institutional Ethical Committee, Thanjavur Medical College. The participants were divided into two groups, as Exercise group (n=40) and control group (n=40).

Training Program

Height of the individual was measured without shoes using Kinanthropometric rod. Weight was measured with minimal, loose fitting clothes using standard weighing machine to the nearest 0.5 Kg. BMI was calculated using the formula: BMI (Kg/m^2) = Weight (in Kg)/ Height(in m^2). Anthropometric variables like weight and BMI were recorded for all participants before and after the study. The control group (n=40) did not perform any type of training. To assess the effects of aerobic training on BMI, Exercise group (n=40) were given aerobic training using Treadmill (CardioTrack Whispermill Model 900XL, Browndove Health Care Ltd., Bengaluru). Before starting the aerobic training program, all the participants got familiarised with the treadmill to allay their anxiety and made it friendly. They were all made to accustom to the environmental and experimental conditions. They attended an orientation session before starting the exercise, describing about BMI, obesity and its complications, adverse effects of dyslipidaemia, cardiovascular morbidity and mortality due to obesity, management and prevention of obesity, the beneficial effects of aerobic training and increased physical activity in obesity management and their role in improving cardiovascular fitness. After the orientation program, they were demonstrated how to use the Treadmill and all the participants were allowed one trial.

Table 1. Timeline of Intervention

Duration (Week)	Work out Time line (In Minutes)			Frequency/Wk	Intensity Description
	warm-UP	Aerobic Exercise	Cool Down		
I –IV Weeks	10	20	10	3	AE-50-60% HR Max
V&VI Weeks	10	30	10	3	AE-60-70% HR Max

(*AE-Aerobic Exercise; HR Max-Maximal Heart Rate)

Aerobic Training was given in the morning, on thermo neutral conditions for the exercise group. After attending the Department, the subjects took rest for 10 minutes in supine posture before the test. After rested for 10 min, aerobic training using Treadmill (CardioTrack Whispermill 900XL) was given for 3 alternate days in a week for consecutive 6 weeks (Total 18 sessions). Each Exercise session was preceded by 10 minutes warming and stretching with 1.7mph in Treadmill, then adjusting the speed as accordingly so that they reach a level of 60-70% of maximum HR, up to the exhaustion level of the subjects. Slowly the time/duration, intensity of exercise sessions were increased so that they maintained their HR Max at 60-70% intensity level. This is followed by 10 minutes cool down with light stretching exercises. For the initial 4 weeks, 20 minutes exercise session and for the remaining 2 weeks, 30 minutes aerobic exercise was provided. All the subjects were informed about the adverse symptoms during exercise like chest pain, chest tightness, giddiness, sweating etc. HR Max was calculated using the formula (Krokenberg chapter 35; Dale *et al*., ch 4).

HR Max =220 –Age in years

During exercise session, heart rate was continuously monitored by Fingertip Oximeter to check whether the subjects have attended their HR Max and whether they were maintaining the intensity of Exercise at this level. After Exercise, subjects were allowed to attain active recovery in Treadmill.

Statistical Analysis

All datas were presented as Mean ± SD. The datas obtained both at baseline and after the study period were studied employing paired sample t-test using SPSS Window version 20.0 for statistical analysis. Statistical significance was accepted at $p < 0.05$ level.

RESULTS

Table 1. General characteristics of the two groups

Variables	Exercise group (n=40) (Mean ± SD)	Control group (n=40) (Mean ± SD)
Age(yrs)	39.12±3.632	40.93±3.46
Height(cms)	147.25±5.88	144.25±5.314
Weight(kg)	71.80±9.25	68.65±7.28
BMI(kg/m^2)	33.11±2.95	32.99±2.09

Body Weight

The results of body weight showed significant changes in aerobic exercise trained obese group [Preexercise71.8±9.25kg (mean ± SD); Postexercise70.60±9.08kg, p=0.000] when compared with control group who showed no such significant changes. [Weight before study-68.65 ±7.28 kg, After study-69.40 ± 7.18kg, p =0.072]. (Table 3, Fig. 1).

Table 3. Comparison of Weight, BMI of Exercise and control groups between I and VI weeks BMI

S.No	Variable	Exercise group		P value	Control group		P value
		I week	VI week		I Week	VI week	
1.	Weight (kg)	71.80± 9.25	70.6± 9.08	.000*	68.65±7.28	69.4± 7.18	0.072
2.	BMI (kg/m^2)	33.11± 2.95	32.46± 3.00	.000*	32.99±2.09	33.34± 2.11	0.170

(*p<0.05 accepted as significant)

The pre exercise to post exercise training results of BMI showed significant changes in aerobic trained obese females (pre-exercise-33.11 ±2.950 kg/m^2;Post exercise-32.46 ±3.002 kg/m^2, p=.000) in comparison with control group who showed no such favourable alterations (Before study-32.99±2.097 kg/m^2, After study-33.34 ±2.112 kg/m^2, p=.170). (Table 3, Fig. 2).

DISCUSSION

The present study assessed the effects of 6weeks moderate intensity aerobic training program on of obese sedentary females without any dietary modifications, over the anthropometric parameters like weight and BMI. Our study participants were not advised of any dietary modification.

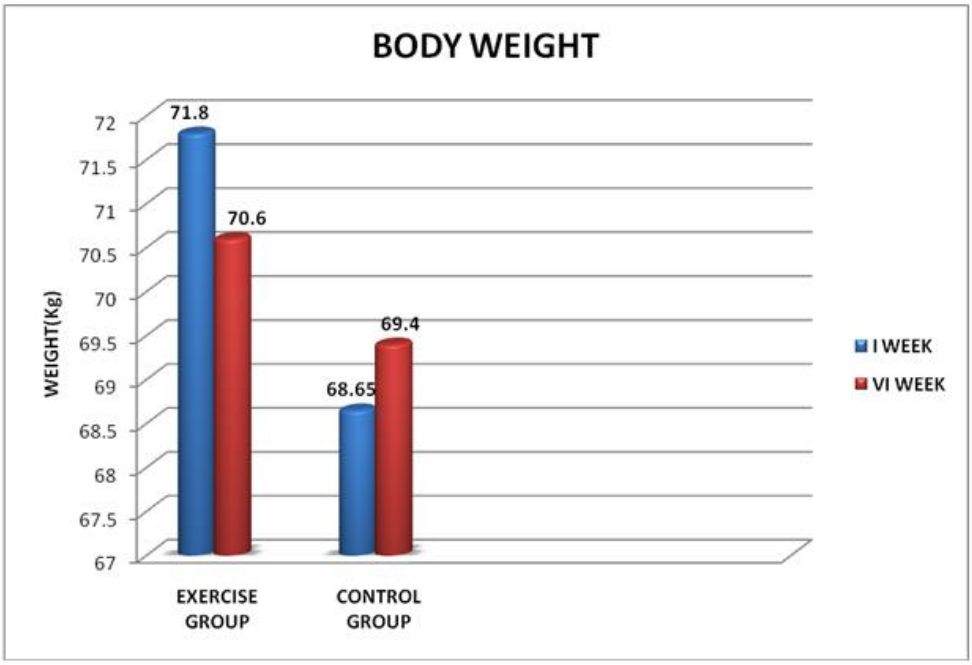

Figure 1. The pre and post exercise comparison of weight in exercise and control groups

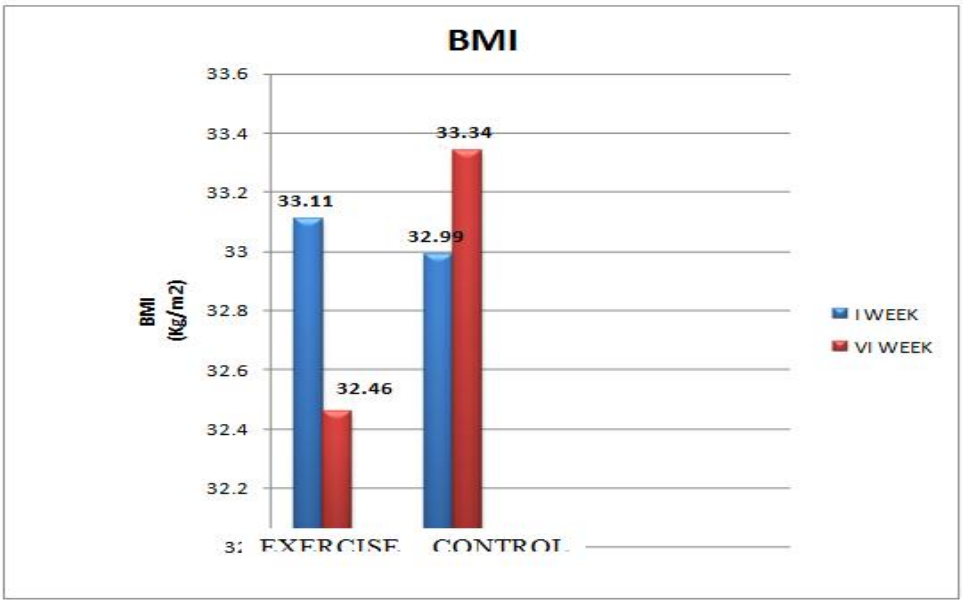

Figure 2. The pre and post exercise comparison of BMI in exercise and control groups

Inspite of no caloric restrictions, our study showed significant reduction in body weight and BMI in the exercise group as compared to control group. The reductions in body weight and BMI are often attributed to aerobic exercise training, providing a decline in a fat mass and maintaining or slight increase in fat free mass. This study indicated the importance of aerobic training in burning calories and losing body fat.Our study results are in agreement with various studies (Purvi Changela, 2013; Sarika Chaudhary *et al*., 2010). Chaudhary *et al.* studied the effects of aerobic versus resistance training on cardiovascular fitness of obese women. He reported a similar decrease in body weight and BMI which were contributed more by aerobic exercise (Sarika Chaudhary *et al.*, 2010). Similar study done by Purvi Changela who studied the effects of aerobic and resistance training effects on cardiovascular fitness of obese females reported a similar decline in body weight and BM I (Purvi Changela, 2013). Increased gain of weight may be associated with increased fat mass and lean body mass which leads to increase in total blood volume associated with increase in stroke volume and cardiac output and circulatory preload, afterload, hypertrophy of the left ventricle and hypertension (Purvi Changela, 2013; Sarika Chaudhary *et al.*, 2010).

More recently done large Cohort studies in females like women's Health Study, the Lipid Research Clinics Research Prevalence Study and Women Take Heart Project revealed an inverse and graded relationship between physical activity and mortality. Some data also suggests that physical activity offers a significant degree of protection in women than men (Peter Kokkinos *et al*, 2010). Mengistie Alemayehu Belay *et al* made a study on obese adults of North West Ethiopia with combined aerobic and resistance exercise training programs for a period of 12 weeks. They have reported a decrement in body weight and BMI (Mengistic Alemayehu Belay *et al.*, 2013) which supports our statement that physical activity provides weight reduction in obese individuals. Schjerve *et al.* studied the effects of both aerobic endurance and strength training programmes in cardiovascular health of obese adults. They concluded that only aerobic training leads to significant decline in body weight and the aerobic training was better in improving aerobic work capacity (Inga Schjerve *et al.*, 2008). Hamid Arazi *et al* provided 8 weeks morning aerobic training in sedentary overweight females who studied the body composition also reported a significant fall in weight and BMI and he concluded that the ill effects of sedantarism are decreased with aerobic training (Hamid Arazi *et al.*, 2012). Studies done by Husamettin Vatansev and Evrim cakmakci, who studied the effects of 8 weeks aerobic training on body composition declared similar results (Husamettin Vatansev *et al.*, 2010). Fatma Arslan in his studies, proved the beneficial effects of an eight weeks step-aerobic dance programme on body composition parameters, waist circumference and Body fat % (Fatma Arslan, 2011).

Shenbagavalli A and Mary RD studied the effects of aerobic training on Body Mass Index on sedentary obese men. The experimental group were administered 8 weeks aerobic training programme 5 days in a week for 8 week. They established that aerobic training was quite beneficial to decrease the body weight and BMI in obese subjects and they concluded that mild aerobic training can be adopted by obese individuals to bring down the magnitude of obesity (Shenbagavalli *et al.*, 2008). Robert Ross *et al.* and Janiszewski *et al.* proposed a notion that weight loss is associated with marked reduction in obesity related cardiovascular events, which provides a desired outcome of strategies, designed to reduce the coronary events associated with obesity. They have also stipulated that despite little or no change in body weight or BMI, but still, with increasing physical activity, is associated with profound decline in cardiovascular and metabolic risk and increase in cardio respiratory fitness in obese individuals (Robert Ross *et al*, 2008). Obesity is an independent predictor of cardiovascular morbidity &mortality. Aerobic training augments the energy expenditure by activating lipolysis and leads to significant reduction in body weight and favourable alteration of BMI and thus improves cardiovascular fitness (Purvi Changela, 2013; Sarika Chaudhary *et al.*, 2010 William McArdle *et al.*, 7th ed).

Conclusion

The results of the present study revealed that aerobic training is more beneficial to improve the fitness of obese individuals by reduction of body weight and improving the BMI favourably and can be used as a preventive measure in obese subjects who are at risk of developing cardiovascular diseases and in individuals with lifestyle related morbidities.

Limitations

This study has got certain limitations. This study includes only women in the age group of 35-45 yrs with BMI>30 Kg/m^2 but less than 40 Kg/m^2. Morbidly obese women were not included since many of them were on certain medications. More studies are needed to be done in the future to assess the effectiveness of aerobic training program on cardiovascular, metabolic and other anthropometric parameters in obese women of different age groups, in obese men and to study the gender variations in the effects of aerobic training so that definite strategies may be designed to fight the battle against obesity.

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