Impact of Aerobic Versus Anaerobic Exercises on Cardiopulmonary Functions in Obese Subjects

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ABSTRACT

Objective: This study was designed to determine the effect of aerobic exercise and anaerobic exercise on the cardiopulmonary functions. Subjects, material and methods: The present work was conducted on 40 adult obese subjects. Their age ranged between 20 and 28 years old and the subjects were divided into two equal groups. The first group performed aerobic exercise training program the duration of exercise was 12 weeks, at a frequency of 4 sessions per week in addition to diet regimen and the second group performed anaerobic exercise training program the duration of exercise was 12 weeks, at a frequency of 2 sessions per week in addition to diet regimen. Cardiopulmonary functions were measured in both groups before and after the exercise program. Results: The results of the study showed that there were a significant improvement in the cardiopulmonary functions in the aerobic exercise group, but the anaerobic exercise program indicated non significant changes in the Cardiopulmonary functions. Also the results indicated that there was a significant reduction in weight in both groups. Conclusion: It is recommended to use aerobic exercise and diet regimen in order to reduce weight and improve cardiopulmonary fitness.

INTRODUCTION

Obesity is an increasingly significant health problem. Over 4 decades, the prevalence of obesity (a body mass index [BMI] ≥30 kg/m2) has increased from 13% to 31% in adults Concurrent increases occurred in adolescents and children[10].

Obesity-related chronic conditions cause direct and indirect health care costs. Increasing BMI associates with increasing medical service use, such as medication use, visits to hospital emergency departments, doctor visits, and visits to outpatient clinics[7,13].

Increasing levels of physical activity in obese subjects are associated with a decrease in cardiovascular problems. Controlled clinical trials suggest that exercise has benefits in persons with coronary artery disease and in those with glucose intolerance. Exercise produces improvements in mood, blood pressure, insulin sensitivity, and plasma lipoprotein profiles[15].

The purpose of this study was to compare between the therapeutic efficacy of aerobic and anaerobic exercise program on cardiopulmonary function in obese subjects.

SUBJECTS MATERIAL AND METHODS

Forty obese adolescent males (body mass index ranged between 30 and 37 kg/m^2) were selected randomly from faculty of physical therapy, Cairo University, Egypt. Their ages ranged from 20 to 28 years old. They were divided randomly into two groups of equal number. The first group participated in the aerobic exercise program and diet for 12 weeks, while the second group enrolled in anaerobic exercise and diet program for 12 weeks. Subjects suffer from any cardiovascular, pulmonary disease, orthopedic or neurological disorders were excluded from the study.

Equipments:

A. Assessment equipment:

Cardiopulmonary exercise test unit (CPET): (Zan 800; made in Germany). It consists of breath gas (O_2 and CO_2) analyzer, electronic treadmill, 12 channels electrocardiogram, (ECG) monitor, gas bottle and mask with a diaphragm to analyze gas. The speed and the inclination of treadmill were controlled by pre-selected soft ware (Bruce standard protocol)[1]. The final test results were printed out by the printer. This unit was calibrated daily.

B. Monitoring equipment:

1- Mercury sphygmomanometer: (Diplomat, Presameter made in Germany) and stethoscope (Riester, duplex, made in Germany); it was used to measure blood pressure before, and after exercise training sessions.

2- Pulsometer: (Tunturt TPM-400, made in Japan) it was used to detect pulse rate before, during and after exercise.

C. Training equipment:

Electronic Treadmill: (RAM CE, made in Germany) its speed and inclination and timer are adjustable, and it also provided with control panel to display the exercise parameters.

Procedures of the study:

The procedures of this study were divided into two main types:

1- Evaluation procedures:

Before starting the study, a consent form was signed from each participant as an agreement to be included in the present study. Each subject was examined medically by a physician in order to exclude any abnormal medical problems which previously mentioned. A detailed description had been given about the tasks expected during the test.

Cardiopulmonary exercise test procedure (CPET):

Before conducting the exercise tolerance test, all subjects had to visit the laboratory to be familiarized with the equipment in order to be familiar cooperative during conducting the test. Each subject underwent continuous progressive exercise tolerance test according to Bruce standard protocol which consists of warming up phase and five active phases and recovery phase.

Measurements included systolic blood pressure, diastolic blood pressure, heart rate, minute ventilation (VE), and waist - hips ratio.Measurmentst were taken before and after 12 weeks at the end of the study.

2- Training procedures:

Group (1): Patients received aerobic exercise training for 12 weeks in addition to low caloric diet regimen as following:

A- Warming up: at the beginning of the exercise program, include walking on the treadmill for 5 minutes at speed 1.5 km/h with zero inclination.
B- Active phase: It was gradually increased from 20 to 40 minutes in the form of walking/running on electric treadmill with zero inclination four times per weak for twelve weeks, its intensity gradually from 60 to 80 % of maximum heart rate.
C- Cooling down: Included walking on the treadmill for 5 minutes at speed 1 km/h with zero inclination and gradually decreased speed until reach zero[11].

Group (2): Patients in this group received anaerobic exercise training for 12 weeks in addition to same low caloric diet regimen as following:

1- Warming up: as group (1).
2- Active phase: Started with 2 minutes gradually increased 5 second each session until reach 3 minutes then rest for 2 minute this bout was repeated 5 times each session

in the form of running on electric treadmill gradually from 85% to 93% of maximum heart rate with frequency of two times per weak for twelve weeks gradually from 85% to 93% of maximum heart rate[8].

3- Cooling down: as group (1).

Statistical Analysis

The paired t-test was used to compare between pre and post test in both groups, where the independent t- test was used for the comparison between the two groups (P<0.05).

RESULTS

This study comprised 40 obese adult subjects selected from Cairo University personnel. The data were collected from subjects and classified into pre and post test values. The subjects were divided into 2 groups: Group (I) received aerobic exercise in addition to diet regimen and group (II) received anaerobic exercise in addition to same diet regimen.

Table (1) and figure (1) show the difference of mean and standard deviation values of waist-hip ratio between both groups before and after the exercise program.

Table (1): Statistical analysis of waist-hip ratio between both groups before and after the exercise program.

	Aerobic group	Anaerobic group	t-value	Significance
Pre	1.02±0.014	1.02±0.012	0.43	Non sig.
Post	0.99±0.02	1.001±0.01	0.75	Sig.
t-value	6.2	6.4		
Significance	Sig.	Sig.		

Level of significance p<0.05

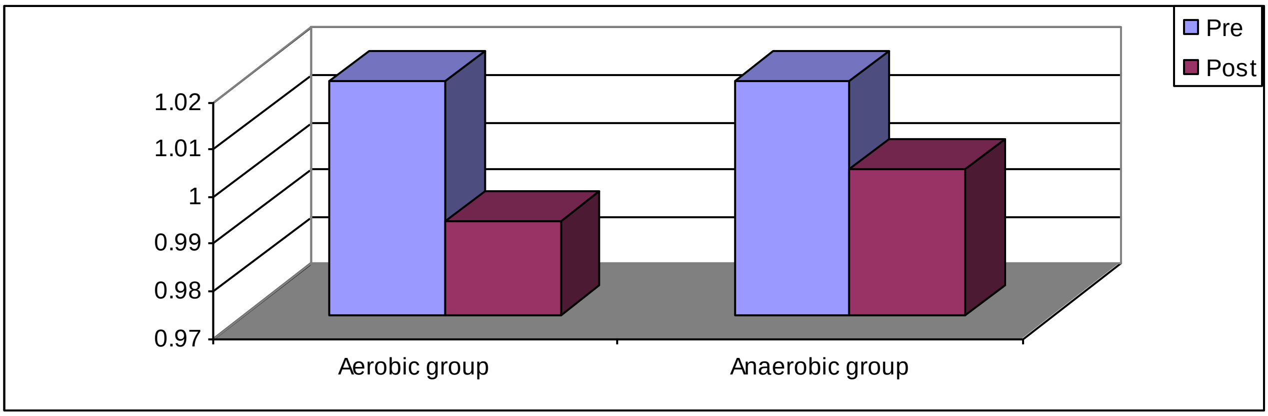

Fig. (1): Statistical analysis of waist-hip ratio between both groups before and after the exercise program.

Table (2) and figure (2) show the difference of mean and standard deviation values of minute ventilation between both groups before and after the exercise program.

Table (2): Statistical analysis of minute ventilation between both groups before and after the exercise program.

	Aerobic group	Anaerobic group	t-value	Significance
Pre	106.01±7.6	104.1±10.7	0.5	Non sig.
Post	129.3±11.8	134.3±16.5	8.2	Sig.
t-value	8.2	12.2		
Significance	Sig.	Sig.		

Level of significance $p<0.05$

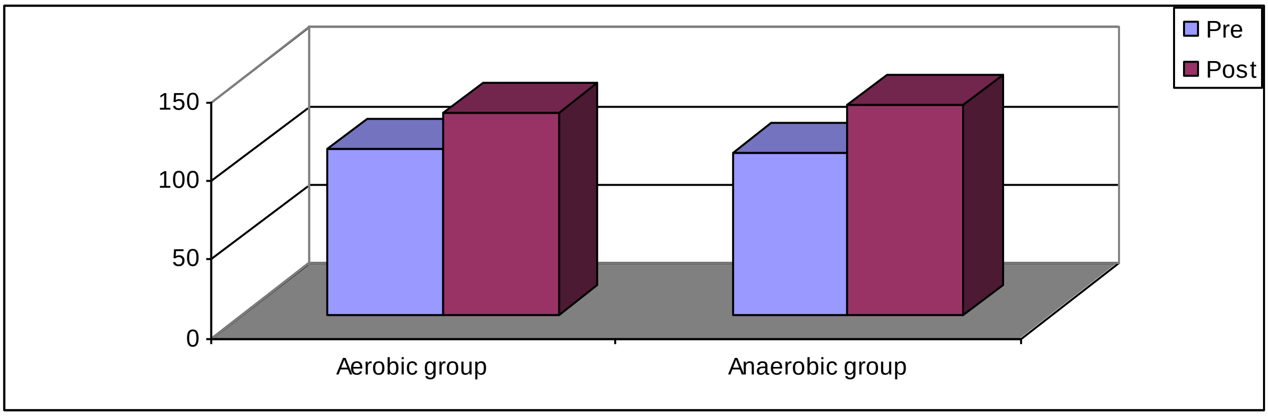

Fig. (2): Statistical analysis of minute ventilation between both groups before and after the exercise program.

Table (3) and figure (3) show the difference of mean and standard deviation values of heart rate between both groups before and after the exercise program.

Table (3): Statistical analysis of heart rate between both groups before and after the exercise program.

	Aerobic group	Anaerobic group	t-value	Significance
Pre	82.1±2.7	81.6±3.6	0.5	Non sig.
Post	74.3±3.8	82±4.6	4.6	Sig.
t-value	8.801	0.479		
Significance	Sig.	Non sig.		

Level of significance $p<0.05$

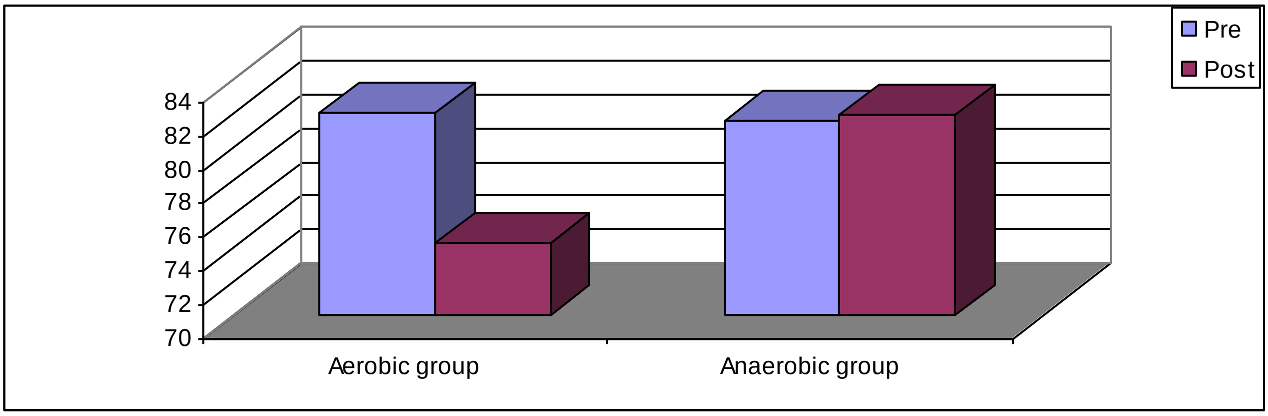

Fig. (3): Statistical analysis of heart rate between both groups before and after the exercise program.

Table (4) and figure (4) show the difference of mean and standard deviation values of systolic blood pressure between both groups before and after the exercise program.

Table (4): Statistical analysis of systolic blood pressure between both groups before and after the exercise program.

	Aerobic group	Anaerobic group	t-value	Significance
Pre	136±5.9	136.5±4.8	0.25	Non sig.
Post	124.5±6.8	136.5±5.8	7.7	Sig.
t-value	5.2	0.01		
Significance	Sig.	Non sig.		

Level of significance $p<0.05$

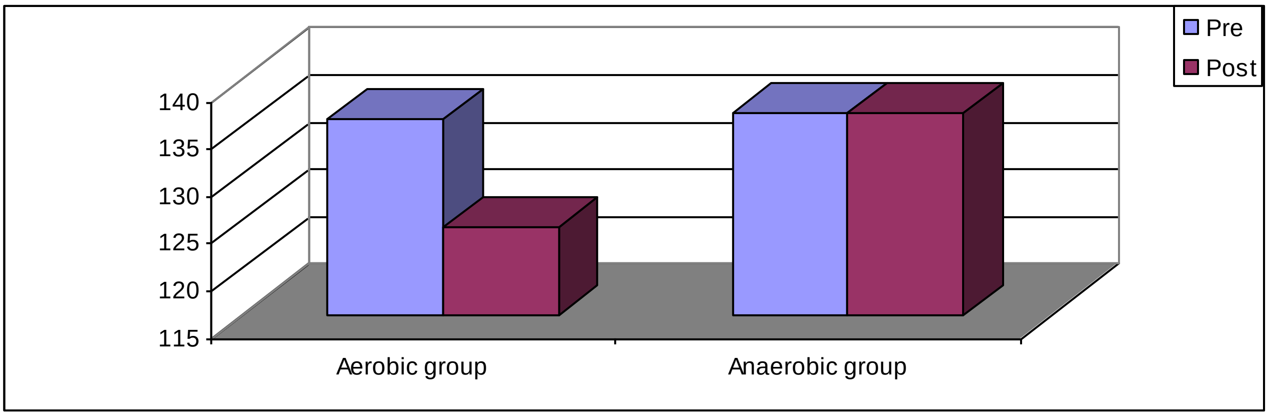

Fig. (4): Statistical analysis of systolic blood pressure between both groups before and after the exercise program.

Table (5) and figure (5) show the difference of mean and standard deviation values of diastolic blood pressure between both groups before and after the exercise program.

Table (5): Statistical analysis of diastolic blood pressure between both groups before and after the exercise program.

	Aerobic group	**Anaerobic group**	**t-value**	**Significance**
Pre	87.5±4.4	88±4.1	0.37	Non sig.
Post	84±5.02	88.5±3.6	3.3	Sig.
t-value	8.5	1.1		
Significance	Sig.	Non sig.		

Level of significance $p<0.05$

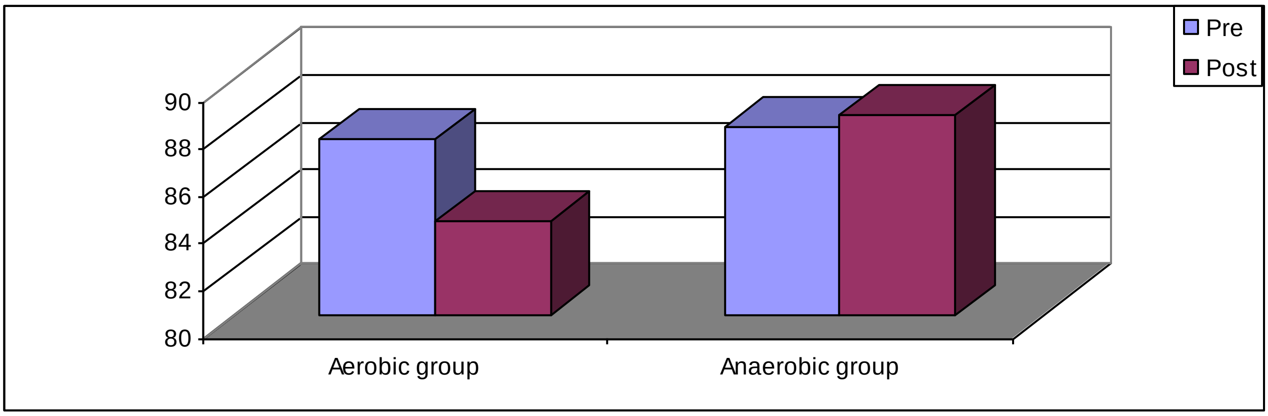

Fig. (5): Statistical analysis of diastolic blood pressure between both groups before and after the exercise program.

DISCUSSION

The aim of this study was to analyze the changes in cardio pulmonary functions after aerobic and anaerobic exercise program in adult obese subjects.

The measures in this study were waist to hips ratio (WHR) and cardiopulmonary functions which are maximum oxygen consumption (VO_2 max), and minute ventilation. (V.E), heart rate, systolic and diastolic blood pressure. A comparison was made between the effect of aerobic exercise and the anaerobic exercise.

The results indicated that there was a significant reduction in waist to hips ratio in both aerobic and anaerobic exercise group.

These results were supported by studies indicated that aerobic exercise induce significant reduction in waist to hips ratio which is associated with subsequent cardiovascular risk factors so this reduction will reduce the risk of cardiovascular disease in this subjects[12,17].

Aerobic or anaerobic improve the respiratory function as vital capacity, inspiratory reserve volume and expiratory reserve volume of the lungs, also the stroke volume of the heart increase by regular exercise. These respiratory adaptations facilitate oxygen supply to tissues and add further evidence of the respiratory fitness improvement[2,16].

The results also indicated that there was a significant increase in minute ventilation in both aerobic exercise group and anaerobic exercise group.

Also the results indicated that there was significant change in minute ventilation (VE) after exercise program between the two groups as VE in aerobic exercise group is higher than VE in anaerobic exercise program.

This result is supported by a study reported that aerobic training induces significant physiological adaptations in the cardio-respiratory system of middle-aged men. The best markers of these adaptations were the smaller sympathetic tachycardia at comparable workloads and the improvement of oxygen transport, as documented by the increase in the anaerobic threshold and VO_2 peak during dynamic exercise[3].

This result also supported by a study compared the cardio-pulmonary function between moderate exercise program and severe exercise program and they reported that there is significant improvement in vo2 max and minute ventilation after both types of exercise[6].

The results also indicated that there was a significant reduction in heart rate, systolic and diastolic blood pressure in the aerobic exercise group at the end of aerobic exercise program.

Regular aerobic training induces significant adaptations both at resting and during maximum exercise in a variety of dimensional and functional capacities related to the cardiovascular and respiratory regulation system; enhancing the delivery of oxygen into active muscles these changes include decreases in resting and maximal exercise heart rate, enhanced stroke volume and cardiac output[5,14].

The reduction of resting heart rate, maximum heart rate, resting systolic and diastolic blood pressure and maximum systolic and diastolic blood pressure in the aerobic exercise group after aerobic training is due to Nitric oxide seems to be an important and potent endothelium-derived relaxing factor that facilitates blood vessel dilatation and decreases vascular resistance[9].

The results also indicated that there are no significant changes in resting heart rate, maximum heart rate, resting systolic and diastolic blood pressure and maximum diastolic blood pressure in the anaerobic exercise group after finishing the program of anaerobic exercise. But there is significant reduction in maximum systolic blood pressure after exercise program.

This reflects an increased cardio respiratory load related to the prolonged duration of aerobic training session from 20 to 30 minutes. However, the greater blood flow under the influence of the rise in heart rate and systolic blood pressure did not satisfy the increased oxygen requirements during anaerobic exercise. This explains the significant augmentation of pulmonary ventilation and ventilation capacity in a trial to satisfy the expanding oxygen transport requirements during maximal exercise.

Participation in heavy resistance anaerobic training over extended period of time increase cardiac work and thus it couldn't be sustained over extended period of time[4].

Conclusion

From the previous discussion and according to the reports of the investigators in fields related to the present study, it can be concluded that aerobic exercise improves cardiorespiratory fitness in obese subjects with less cardiac work as evidenced by the low myocardial oxygen consumption. While anaerobic exercise increases cardiac work and is difficult to be maintained for extended periods of time, Moreover low-intensity aerobic exercise is less difficult; more easily tolerated and can be practiced daily over an extended period of time.

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الملخص العربي

تأثير برنامج تمرينات هوائية مقابل تمرينات لاهوائية على الوظائف القلبية الرئوية فى الأشخاص البدناء

هدف البحث هو دراسة تأثير التمرينات الهوائيه والتمرينات الاهوائيه علىالوظائف القلبيه الرئويه. أجرى البحث على 40 شخص من البدناء وتم تقسيمهم إلى مجموعتين متساويتين : المجموعة الأولى تلقت تمرينات هوائيه لمدة اثنى عشر اسبوعا بمعدل اربعة جلسات اسبوعيا بالاضافة الى نظام غذائى . المجموعة الثانية تلقت تمرينات لاهوائيه وكانت مدة التمرينات اثنى عشر اسبوعا بمعدل جلستان اسبوعيا بالاضافة الى نظام غذائى . وقد تم قياس الوظائف الرئويه القلبيه قبل بدء البرنامج وبعد الانتهاء من البرنامج. وقد أظهرت النتائج وجود فروق ذات دلالة إحصائية تشير إلى وجود تحسن ملحوظ في الوظائف الرئويه في المجموعتين . وأظهرت مجموعه التمرينات الهوائيۜ فروق ذات دلالة إحصائية فى الوظائف الرئويه القلبيه فى حين لم تظهر مجموعه التمرينات الاهوائيه اية فروق ذات دلالة إحصائية فى الوظائف الرئويه القلبيه مما يضع حملا على عضلة القلب اثناء ممارسة هذه التمرينات لذلك يوصى بلستخدام برنامج تمرينات هوائيه مع برنامج غذائي مناسب لتخفيض الوزن وتحسين الوظائف القلبيه الرئويه .