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Cardiopulmonary Adaptation to Exercise Training among Obese Subjects

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Abstract

Background: Cardiopulmonary fitness among obese subjects is severely impaired with a multitude of complications; however exercise training was proved to improve the physical fitness and overall quality of life.

Objective: The aim was to measure cardiopulmonary adaptation to exercise training among obese subjects.

Material and Methods: Sixty adult obese male subjects, the range of their age was 32 to 45 years and was enrolled in two groups: group (A) performed treadmill aerobic exercise training, where group (B) performed anaerobic exercise training three sessions/week for three months. Cardiopulmonary functions were measured for all participants before and after three months at the end of the study.

Results: Both aerobic and anaerobic exercise training produced different responses in the cardiopulmonary functions, where aerobic exercise group indicated a significant improvement in the cardiopulmonary functions but the anaerobic exercise program indicated no significant changes in the cardiopulmonary functions. Moreover, investigated parameters means values were significantly different between both groups at the end of the study ($P<0.05$).

Conclusion: Aerobic exercise is better than anaerobic exercise training in improving cardiopulmonary fitness among obese subjects.

Keywords: Aerobic Exercise; Anaerobic Exercise; Cardiopulmonary Adaptation; Obesity

Abbreviations: CPX: Cardio-Pulmonary Exercise stress test; VC: Vital Capacity; MVV: Maximum Voluntary Ventilation; SaO_2: Arterial Oxygen Saturation; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; MHR: Maximum Heart Rate; BMI: Body Mass Index; HDL-C: High-Density Lipoprotein- Cholesterol; TC: Total Cholesterol

Introduction

Obesity is an epidemic worldwide medical problem that is characterized with excess energy intake than energy output, however, obesity usually associated with many co-morbidities [1,2]. There are many risk factors for obesity as hormonal disturbance, environmental factors, genetic predisposition and behavioral factors [3-6].

Obesity may be named as the mother of diseases as it is usually associated with number of many medical complications as cardiovascular disorders as hypertension, stroke and thrombosis as well as pulmonary disorders as obstructive sleep apnea in addition to musculoskeletal disorders as osteoarthritis in weight bearing joints, however poor psychological wellbeing is common among obese subjects [7-10]. Moreover, diabetes and metabolic syndrome are common among obese individuals [11,12].

Aerobic exercise was proved to induce functional adaptation in both pulmonary and cardiovascular systems during rest as well as during training [13,14]. In the other hand, anaerobic exercise training was proved to improve cardiopulmonary fitness than low intensity exercise training although intensive exercise training couldn't be tolerated for long time [15]. Therefore, the aim was to measure cardiopulmonary adaptation to exercise training among obese subjects.

Material and Methods

Subjects

Sixty healthy obese untrained non-smoking males were randomly selected from King Abdul-Aziz University, Jeddah, Saudi Arabia and did their training in fitness time health club, Jeddah, Saudi Arabia, were included in the study between the period of October 2014 and April 2015. Their age ranged from 32 to 45 (38.54 ± 5.32) years and their BMI ranged from 30-35 kg/m^2. Initially, all participants were medically examined at King Abdulaziz University Out-patient Clinics. Subsequently, their medical history was taken to collect information about general condition, physical activity and current medications if any. All subjects with any cardiovascular conditions (those with a known history of uncontrolled hypertension, congenital and rheumatic heart diseases), any pulmonary disease (obstructive or restrictive lung diseases), orthopedic or neurological abnormality were excluded from the study. Research Ethical Committee of Faculty of Applied Medical Sciences, King Abdulaziz University approve the procedures of our study, in addition all participants signed a consent form prior to their participation in training. Participants were enrolled in two groups: group (A) performed treadmill aerobic exercise training program, where group (B) performed anaerobic exercise training program. However, both programs continued for three successive months, three times per week.

Procedures

A. Measured parameters: Cardiopulmonary exercise stress test (CPX) was conducted using CPX unit (Zan 800; made in Germany) in order to measure the maximal oxygen consumption (VO_{2max}) that followed the Bruce standard protocol. In addition, Spirometer (Schiller-Spirovit Sp-10, Swizerland) was used to measure vital capacity (VC) and maximum voluntary ventilation (MVV) with a special sensor to measure the arterial oxygen saturation (SaO_2). However, pulse rate was measured with pulsometer (Tunturt TPM-400, Japan). Moreover, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured with mercury sphygmomanometer (Diplomat Presameter, Germany) and stethoscope (Riester duplex, Germany) before the study and after 3 months at the end of the study.

B. Aerobic treadmill exercise training program: Participants of group (A) started exercise training with warming up before the exercise program, included walking on the treadmill for 5 minutes at speed 1.5 km/h, with zero inclination. Mode of walk/run on the treadmill for 30 minutes with zero degree inclination, the frequency was three times weekly; for three successive months. The intensity was increased gradually from 60 to 80% of maximum heart rate (MHR) [16].

C. Anaerobic exercise training program: Participants of group (B) started exercise training with warming up before the exercise program, including walking on the treadmill for 5 minutes at speed 1.5 km/h with zero inclination. The duration was a short period of high-intensity anaerobic exercise, started with 2 minutes that was gradually increased to 3 minutes that was repeated five times every sessions with 2 minutes interval between each 2-3 minutes of training, the frequency was three times weekly; for three successive months. The frequency was three times per week; for three months. The intensity was increased gradually from 85 to 93% MHR [17]. Finally, cooling down procedure for all subjects following exercise training included treadmill walking for 5 minutes at speed of 1 km/h, with zero inclination and gradually decreasing speed until reaching zero.

Statistical Analysis

The investigated parameters of both groups were compared with student's paired "*t*" test. However, the differences between mean values of investigated parameters at the end of the study of both groups were detected with independent "*t*" test (P<0.05).

Results

Table 1: Demographic variables of all participants.

	Mean + SD		t- value	Significance
	Group (A)	Group (B)		
Age (year)	38.42± 6.63	37.64 ± 6.23	1.23	P >0.05
BMI (Kg / m^2)	31.28 ± 3.76	30.19 ± 3.41	1.87	P >0.05
Fasting glucose (mg/dL)	96.14 ± 8.48	95.78 ± 7.92	1.11	P >0.05
Triglycerides (mg/dL)	130.26 ± 11.22	129.43 ± 10.15	1.03	P >0.05
HDL-C (mg/dL)	46.13 ± 6.51	47.28 ± 5.76	1.37	P >0.05
TC (mg/dL)	197.54 ± 12.34	195.12 ± 13.27	1.58	P >0.05
SBP (mm Hg)	134.18 ± 7.12	131.89 ± 5.91	1.74	P >0.05
DBP (mm Hg)	87.26 ± 6.15	85.14 ± 4.83	1.16	P >0.05

Regarding the demographic variable, both groups were homogeneous (Table 1). The mean age for group, (A) was 38.42± 5.63 years, and the mean age of the group (B) was 37.64 ± 6.23 years. There was no significant differences in body mass index (BMI), fasting glucose, triglycerides, high-density lipoprotein-cholesterol (HDL), total cholesterol (TC), systolic and diastolic blood pressure between both groups. The mean values of heart rate, SBP, and DBP were significantly decreased, where the mean values of MVV, VO_{2max} and SaO_2 were significantly increased in group (A) at the end of the study (Table 2). The mean values of heart rate, SBP, DBP and VO_{2max} were not significantly changed and the mean values of MVV, VC and SaO_2 were significantly

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increased in group (B) at the end of the study (Table 3). Moreover, investigated parameters means values were significantly different between both groups at the end of the study (P<0.05) (Table 4).

BMI: Body mass index; HDL-C: High density lipoprotein cholesterol; TC: Total cholesterol; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure (Table 2).

Table 2: Mean values and significance of group (A) measured parameters before and at the end of the study.

	Mean + SD		t- value	Significance
	Before	After		
Heart Rate (beat/min.)	83.27 ± 5.63	76.14 ± 4.11*	7.26	P <0.05
SBP (mm Hg)	134.18 ± 7.12	125.26 ± 5.19*	6.18	P <0.05
DBP(mm Hg)	87.26 ± 6.15	79.27 ± 4.18*	7.24	P <0.05
MVV (L/min.)	94.14 ± 7.10	121.32 ± 10.12*	8.15	P <0.05
Vital capacity (L.)	3.23 ± 0.82	4.51 ± 0.97*	6.13	P <0.05
$VO_{2\ max}$. (L./min./Kg)	2.97 ± 0.51	4.15 ± 0.72*	5.75	P <0.05
SaO_2 (%)	93.18 ± 3.16	97.48 ± 2.01*	6.89	P <0.05

SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; MVV: Maximum Voluntary Ventilation; BMI: Body Mass Index; VO_{2max}. : Maximal Oxygen Consumption; SaO_2: arterial oxygen saturation; (*): indicates a significant difference, P < 0.05 (Table 3).

Table 3: Mean values and significance of group (B) measured parameters before and at the end of the study.

	Mean + SD		**t- value**	**Significance**
	Before	**After**		
Heart Rate (beat/min.)	82.15 ± 4.17	83.78 ± 4.36	1.12	P >0.05
SBP (mm Hg)	131.89 ± 5.91	133.19 ± 6.15	1.37	P >0.05
DBP(mm Hg)	85.14 ± 4.83	88.37 ± 5.12	1.45	P >0.05
MVV (L/min.)	95.26 ± 6.25	103.85 ±8.73*	3.47	P <0.05
Vital capacity (L.)	3.27 ± 0.79	3.94 ± 0.85*	3.51	P <0.05
$VO_{2\ max}$. (L./min./Kg)	2.89 ± 0.62	3.34 ± 0.75	2.14	P >0.05
SaO_2 (%)	92.52 ± 3.47	94.21 ± 3.65*	3.35	P<0.05

SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; MVV: Maximum Voluntary Ventilation; BMI: Body Mass Index; VO_{2max}. : Maximal Oxygen Consumption; SaO_2: arterial oxygen saturation; (*): indicates a significant difference, P < 0.05 (Table 4).

Table 4: Mean values and significance of group (A) and group (B) measured parameters at the end of the study.

		Mean + SD	**t- value**	**Significance**
	Group (A)	**Group (B)**		
Heart Rate (beat/min.)	76.14 ± 4.11*	83.78 ± 4.36	5.13	P >0.05
SBP (mm Hg)	125.26 ± 5.19*	133.19 ± 6.15	4.86	P >0.05
DBP(mm Hg)	79.27 ± 4.18*	88.37 ± 5.12	5.14	P >0.05
MVV (L/min.)	121.32 ± 10.12*	103.85 ±8.73	4.27	P <0.05
Vital capacity (L.)	4.51 ± 0.97*	3.94 ± 0.85	3.56	P <0.05
VO2 max. (L./min./Kg)	4.15 ± 0.72*	3.34 ± 0.75	3.42	P >0.05
SaO2 (%)	97.48 ± 2.01*	94.21 ± 3.65	3.51	P >0.05

SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; MVV: Maximum Voluntary Ventilation; BMI: Body Mass Index; VO2max. : Maximal Oxygen Consumption; SaO2: arterial oxygen saturation; (*): indicates a significant difference, P < 0.05.

Discussion

Previous studies confirmed that both aerobic and anaerobic exercise training effectively improved functional adaptation of the cardiopulmonary system [13-15], however, for the best of our knowledge there is no clear discrimination between both exercise training programs, this study aimed to measure differentiate between aerobic and anaerobic exercise training on cardiopulmonary adaptation among obese subjects. Our results proved that aerobic exercise is better than anaerobic exercise training in improving cardiopulmonary fitness among obese subjects. These findings agreed with many previous studies [18,19]. While, *Joyner and Tschakovsky* stated that releasing endothelium-derived relaxing factor as Nitric oxide induced by

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aerobic exercise led to reduction of vascular resistance, arterial blood pressure and heart rate [20]. In the other hand, our results showed that anaerobic exercise resulted in non-significant changes in arterial blood pressure and heart rate, these results means that intensive exercise training resulted in more cardiac work which couldn't be sustained for long time [21].

Regarding ventilator function, aerobic and anaerobic exercise training significantly improved MVV and VC. However, aerobic exercise resulted in greater changes in MVV and VC than anaerobic exercise; these results agreed with *Juel et al*. stated that adult men who enrolled in aerobic exercise training induced significant improvement in maximal oxygen consumption and other variables of cardio-respiratory system adaptations during dynamic exercise [22]. Also, *O'Donovan et al*. compared the cardio-pulmonary system response to moderate exercise training and severe exercise training and they reported that there was significant improvement in VO_{2max} and maximum voluntary ventilation after both types of exercise [23].

Regarding results of arterial oxygen saturation, both aerobic and anaerobic exercise training significantly increased value of SaO_2. However, aerobic exercise resulted in greater changes in SaO_2 than anaerobic exercise, our results agreed with a study of Frisbee and Delp proved that adult men had significant cardio respiratory system adaptation following aerobic exercise that was evident by improvement in anaerobic threshold and VO_{2max} [24].

Our study has important strengths and limitations. The major strength is the random selection of the participants; hence, we can extrapolate adherence to the general population. In the other hand, the major limitations are the relatively small sample size in both groups may limit the possibility of generalization of the findings in this study. Finally, within the limit of the present study, aerobic exercise training is recommended for appropriate cardiopulmonary adaptation to exercise training among obese male subjects. Further researches are necessary to study the influence of other exercise training programs on biochemical and physiological parameters in obese subjects.

Conclusion

Aerobic exercise is better than anaerobic exercise training in improving cardiopulmonary fitness among obese subjects.

References

1. Gondim OS, de Camargo VT, Gutierrez FA, Martins PF, Passos ME, et al. (2015) Benefits of Regular Exercise on Inflammatory and Cardiovascular Risk Markers in Normal Weight, Overweight and Obese Adults. PLoS One 10(10): e0140596.
2. Muhammad Khan, Frank Joseph (2014) Adipose Tissue and Adipokines: The Association with and Application of Adipokines in Obesity. Scientifica 2014: 328592.
3. John D Imig (2008) Eicosanoids and renal damage in cardio-metabolic syndrome. Expert Opin Drug Metab Toxicol 4(2): 165-174.
4. Druet C, Dabbas M, Baltakse V, Payen C, Jouret B, et al. (2006) Insulin resistance and the metabolic syndrome in obese French children. Clin Endocrinol (Oxf) 64(6): 672-678.
5. Newbold RR, Padilla-Banks E, Snyder RJ, Jefferson WN (2007) Perinatal exposure to environmental estrogens and the development of obesity. Mol Nutr Food Res 51(7): 912-917.
6. Pasarica M, Zachwieja JJ, Dejonge L, Redman S, Smith SR (2007) Effect of growth hormone on body composition and visceral adiposity in middle aged men with visceral obesity. J Clin Endocrinol Metab 92(11): 4265-4270.
7. David M Mutch, Karine Clément (2006) Unraveling the genetics of human obesity. PLOS Genet 2(12): e188.
8. Pasarica M, Dhurandhar NV (2007) Infect-obesity: obesity of infectious origin. Adv Food Nutr Res 52: 61-102.
9. Farooqi IS (2005) Genetic and hereditary aspects of childhood obesity. Best Pract Res Clin Endocrinol Metab 19(3): 359-374.
10. Hamilton MT, Hamilton DG, Zderic TW (2007) The role of low-energy expenditure and sitting on obesity metabolic syndrome, type II diabetes and cardiovascular disease. Diabetes 56(11): 2655-2667.
11. Poirier P, Giles T, Bray GA, Hong Y, Stern JS, et al. (2006) Obesity and cardiovascular disease: Pathophysiology, evaluation and effect of weight loss. Arterioscler Thromb Vasc Biol 26(5): 968-976.
12. Arthur H Rubenstein (2005) Obesity: A modern epidemic. Trans Am Clin Climatol Assoc 116: 103-111.
13. Skinner JS, Jaskolski A, Jaskolska A, Krasnoff J, Gagnon J, et al. (2001) Age, sex, race, initial fitness, and response to training: the heritage Family Study. J Appl Physiol 90(5): 1770-1776.
14. Lavie CJ, Arena R, Swift DL, Johannsen NM, Sui X, et al. (2015) Exercise and the cardiovascular system: clinical science and cardiovascular outcomes. Circ Res 117(2): 207-219.
15. Hunter GR, Weinsier RL, Bamman MM, Larson DE (1998) A role for high intensity exercise on energy balance and weight control. Int J Obes Relat Metab Disord 22(6): 489-493.
16. El-Sayed MS (2002) Exercise and training effects on platelets in health and disease. Platelets 13(5-6): 261-266.
17. Janssen P (2001) Training at anaerobic threshold: Lactate threshold training. Patricia, Julie and Myla eds, Human Kinetics, United States p. 25-41.
18. Fagard RH (2001) Exercise characteristics and the blood pressure response to dynamic physical training. Med Sci Sports Exerc 33(6 Suppl): S484-S492.
19. Skinner JS, Jaskólski A, Krasnoff J, Gagnon J, Leon AS, et al. (2001) Age, sex, race, initial fitness, and response to training: the heritage Family Study. J Appl Physiol (1985) 90(5): 1770-1776.
20. Joyner MJ, Tschakovsky ME (2003) Nitric oxide and physiologic vasodilatation in human limbs: where do we go from here?. Can J Appl Physiol 28(3): 475-490.
21. Deschenes MR, Kraemer WJ (2002) Performance and physiologic adaptations to resistance training. Am J Phys Med Rehabil 81(11 Suppl): S3-16.
22. Juel C, Klarskov C, Nielsen JJ, Krustrup P, Mohr M, et al. (2004) Effect of high-intensity intermittent training on lactate and H+ release from human skeletal muscle. Am J Physiol Endocrinol Metab 286(2): 245-251.
23. O'Donovan G, Owen A, Bird SR, Kearney EM, Nevill AM, et al. (2005) Changes in cardio-respiratory fitness and coronary heart disease risk factors following 24 wk of moderate- or high-intensity exercise of equal energy cost. J Appl Physiol (1985) 98(5): 1619-1625.
24. Frisbee JC, Delp MD (2006) Vascular function in the metabolic syndrome and the effects on skeletal muscle perfusion: Lessons from the obese Zucker rat. Essays Biochem 42: 145-161.

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