

THE EFFECT OF WALKING AND STEP AEROBIC EXERCISE ON PHYSICAL FITNESS PARAMETERS IN OBESE WOMEN

YÜRÜME VE STEP AEROBİK EGZERSİZLERİNİN OBEZ KADINLARIN FİZİK PARAMETRELERİ ÜZERİNE ETKİSİ

Hülya AKDUR*, Ahmet Bilge SÖZEN**, Zerrin YİĞİT***, Nadiye BALOTA*,
Özen GÜVEN****

ABSTRACT

Objective: The purpose of the study was to examine the effects of three different exercise regimens on physical and physiological fitness parameters in 60 sedentary obese female subjects without hypertension, diabetes, or cardiovascular disease.

Materials and methods: The study groups consisted of groups whose interventions were diet and step-aerobic exercise (trice weekly, 1 hour period for 10 weeks) (n=20), diet and walking exercise (trice weekly, 1 hour walk, 10 weeks) (n=20), and diet only. The cases were followed up for changes in body weight, body mass index, body fat percentage, circumference measurements, measures of flexibility, total cholesterol and other biochemical parameters before and after the interventions.

Results: Body weight, body mass index and total cholesterol changed significantly at the end of the study in step aerobic exercise and walking exercise groups. Circumference measurements and Low Density Lipoprotein (LDL) cholesterol were decreased without reaching statistical significance. Flexibility parameters increased in all groups including the controls without reaching statistical significance.

Conclusion: It was concluded that step-aerobic exercise with low caloric diet seemed the most effective treatment modality.

Key words: Obesity, step aerobic exercise

ÖZET

Amaç: Bu çalışmada İstanbul Üniversitesi Kardiyoloji Enstitüsü Obezite polikliniğine başvuran diabet, hipertansiyon ve kalp hastalığı olmayan 60 sedanter orta yaş ve genç obez kadın olguya 3 farklı yöntem uygulayarak fiziksel ve fizyolojik değişimlerini araştırmayı amaçladık.

Gereç ve yöntem: Olgular üç gruba ayrılarak 1. gruba (n=20) diyet ile step aerobik egzersizi 2. gruba (n=20) diyet ile yürüyüş egzersizi verildi, 3. gruba ise sadece diyet uygulandı. 1. gruba 10 hafta süresince, haftada 3 gün bir saat step aerobik egzersiz programı ve diyet, 2.gruba haftada 3 gün, bir saat yürüme egzersizi ile diyet uygulandı. Olguların vücut ağırlığı ve boy, vücut yağ yüzdesi, vücut kitle indeksi (VKİ), çevre ölçümleri, esneklik ölçümleri, total kolesterol ve kan değerlerinin ölçümleri alındı. Olgulara uygulanan tüm ölçümler ve testler, antrenman programı başlamadan önce ve antrenman programı bittikten sonra olmak üzere iki kez yapıldı.

Bulgular: Çalışmamızın sonunda; 1. ve 2. grubumuzdaki olguların vücut ağırlığı, vücut yağ yüzdesi, VKİ'nde, total kolesterolde istatistiksel açıdan anlamlı fark bulundu. Çevre ölçümlerinde ve LDL kolesterolde de azalma olduğu saptandı. Fakat istatistiksel açıdan anlamlı bulunamadı. Esneklik ölçümlerinde ise her üç grupta da artış gözlemlendi. Fakat sonuçlar istatistiksel açıdan anlamlı bulunmadı.

Sonuç: Çalışmamızın sonuçlarına dayanarak kilo vermede kullandığımız yöntemlerden en etkili tedavi yönteminin düşük kalorili diyetle uygulanan step-aerobik yöntemi olduğunu söylenebilir.

Anahtar kelimeler: Obez kadınlar, step aerobik egzersiz

Date received/Dergiye geldiği tarih: 23.02.2007

* Eastern Mediterranean University, Faculty of ARTS and SCIENCES, Gazi Magosa, Kuzey Kıbrıs TC

** University of Istanbul, Istanbul Faculty of Medicine, Department of Internal Diseases, Çapa, Istanbul, Turkey
(İletişim kurulacak yazar: absozen@istanbul.edu.tr)

*** Istanbul University, Istanbul Faculty of Medicine, Cardiology Institute, Çapa, Istanbul, Turkey

**** Istanbul University, Istanbul Faculty of Medicine, Department of Cardiology, Çapa, Istanbul, Turkey

Table 1. The effect of Step-aerobic exercise and low-calorie diet on anthropomorphic and biochemical parameters

	1. measurement	2. measurement	Difference	P value
Mean Age (Year)	34.5 ± 11.49			
Height (cm)	1.65 ± 0.08			
Weight (kg)	93.1 ± 10.55	85.13 ± 8.52	5.24 ± 3.41	0.0156
BMI	34.25 ± 5.13	30.98 ± 4.43	1.90 ± 1.26	0.045
Fat %	43.28 ± 3.57	40.11 ± 3.67	2.24 ± 1.22	0.022
Shoulder (cm)	114.09 ± 7.44	108.82 ± 7.25	5.27 ± 4.2	NS
Chest circumference (cm)	109.58 ± 10.32	104.88 ± 8.52	3.57 ± 2.56	NS
Arm circumference (cm)	34.86 ± 3.05	32.36 ± 3.33	2.5 ± 1.36	NS
Waist (cm)	96.39 ± 12.48	91.13 ± 10.07	4.71 ± 4.10	NS
Hips (cm)	120.03 ± 8.08	114.19 ± 5.87	3.18 ± 1.68	0.021
Waist/Hip(cm)	0,803 ± 0,87	0,798 ± 0,09		NS
Leg circumference (cm)	67.94 ± 4.18	64.00 ± 4.17	3.29 ± 2.16	0.043
Elasticity -a(cm)	74.33 ± 7.02	75.19 ± 7.60	0.79 ± 0.8	NS
Elasticity -b(cm)	86.18 ± 5.85	86.31 ± 5.29	1.07 ± 1.21	NS
Total Cholesterol	175.57 ± 20.32	152.14 ± 10.75	23.43 ± 14.54	0.024
HDL-Cholesterol	43.71 ± 10.21	49.86 ± 10.27	6.14 ± 10.51	NS
LDL-Cholesterol	115.8 ± 27.31	101.20 ± 3.96	14.6 ± 15.56	NS
Triglycerides	134.71 ± 13.44	74.71 ± 18.6	60.0 ± 29.73	NS
Fasting Glucose	97.14 ± 32.36	84.29 ± 7.74	12.86 ± 31.49	NS

BMI: Body Mass Index, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein

INTRODUCTION

With the advent of mechanical devices simplifying our daily house chores, widespread transport systems, television and computers seriously limited physical activity and daily caloric expenditure. Increasing age also contributes to decreased physical activity and energy requirements.

Sedentary lifestyle threatens the health of every individual in every walk of life. In middle aged and senior persons such lifestyle promotes or increases the risk of hypertension, obesity, muscle weakness, postural deficiencies, diabetes and coronary heart disease (17). Therefore, one of the main problems of sedentary lifestyle, obesity, is a public health problem which requires intervention and treatment.

The aim of the study was to compare the antropometric, biochemical and exercise test parameters of the three groups. This study, undertaken in 60 sedentary obese women, was designed to encourage lifestyle changes promoting exercise and diet. The intervention groups had diet and step-aerobic exercise (trice weekly, 1 hour periods for 10 weeks) (n=20), diet and walking exercise (trice weekly, 1 hour walk, 10 weeks) (n=20), and diet only. Physical and physiological parameters of fitness were followed.

MATERIALS and METHODS

This study was undertaken on 60 sedentary obese women (mean age 34 ± 11 years) followed at the obesity outpatient department in University of Istanbul, Cardiology Institute. Patients with diabetes, hypertension and cardiovascular diseases were excluded. The intervention groups had diet and step-aerobic exercise (trice weekly, 1 hour periods with an aerobic instruc-

tor for 10 weeks) (n=20), diet and walking exercise (trice weekly, 1 hour walk as a home program, 10 weeks) (n=20), and diet only.

Details of the exercise program: The study group in the step-aerobic class were exercised thrice weekly for 10 weeks by an aerobic instructor targeting for a heart rate of 60-70% of maximal heart rate for the age. The exercise program consisted of muscle loosening exercises, step-aerobic activities, flexibility and other exercises accompanied by music. The walking group was encouraged to walk thrice weekly for 1 hour increasing their heart rate to 60-70% of maximal for their age. The third group was given a low calorie diet without an exercise program..

The parameters collected during the study: Data collection in all study patients were done before and at the end of the intervention. Parameters sought were, height and weight, body mass index, total body fat percentage, shoulder, chest, arm, waist, hip, leg circumferences measured as centimeters, body left and right flexibility measured in centimeters, total cholesterol, triglycerides, HDL and LDL cholesterol.

Exercise testing: All patients were examined with symptom limited treadmill test with speed and inclination increased according to modified Bruce protocol. Inability to cooperate, serious atrial and ventricular arrhythmias were grounds for stopping the exercise early. Pretest ECG was recorded with patients standing on treadmill at rest.

Statistical Analysis:

All numerical data are reported as mean ± standard deviation. Statistical comparisons between groups for numerical data were done with unpaired Student's t test and one-way ANOVA test. P value less than 0.05 was accepted as significant.

Table 2. The effect of walking exercise and low-calorie diet on anthropomorphic and biochemical parameters

	1. measurement	2. measurement	Difference	P value
Mean Ages (Year)	36.67 ± 6.28			
Height (cm)	1.59 ± 0.05			
Weight (kg)	89.2 ± 10.94	81.27 ± 7.00	3.82 ± 2.25	0.046
BMI	35.45 ± 3.46	32.74 ± 2.51	1.55 ± 0.54	0.03
Fat %	41.29 ± 3.71	38.7 ± 2.58	1.43 ± 0.65	0.046
Shoulder (cm)	112.8 ± 6.64	107.73 ± 6.1	4.45 ± 2.46	NS
Chest (cm)	109.93 ± 8.68	106.04 ± 7.9	3.53 ± 2.42	NS
Arm circumference (cm)	34.86 ± 3.05	32.91 ± 3.12	1.95 ± 0.57	NS
Waist circumference (cm)	96.33 ± 11.23	94.08 ± 10.09	3.08 ± 2.29	NS
Hip circumference (cm)	118.87 ± 5.83	116.14 ± 5.23	3.18 ± 1.68	NS
Waist/Hip ratio	0,81 ± 0,09	0,812 ± 0,09		NS
Leg circumference (cm)	67.47 ± 4.16	66.15 ± 4.3	2.15 ± 0.8	NS
Elasticity -a(cm)	75.33 ± 7.26	76.54 ± 7.93	0.77 ± 0.6	NS
Elasticity -b(cm)	85.57 ± 5.89	85.69 ± 5.31	0.77 ± 1.01	NS
Total Cholesterol	216.67 ± 34.41	187.54 ± 21.53	22.38 ± 28.31	0.012
HDL- Cholesterol	48.93 ± 10.21	50.54 ± 11.25	3.54 ± 8.51	NS
LDL- Cholesterol	148.4 ± 34.43	119.46 ± 21.75	23.77 ± 39.12	0.013
Triglycerides	96.6 ± 20.7	96.77 ± 38.53	0.46 ± 37.83	NS
Fasting Glucose	94.33 ± 12.75	92.31 ± 11.44	3.08 ± 9.71	NS

BMI: Body Mass Index, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein

Table 3. The comparison of the effect of step aerobic and walking exercise with low calorie diet on anthropomorphic and biochemical parameters

	Step aerobic	Walking	P value
Mean Ages (Year)	34.5 ± 11.49	36.67 ± 6.28	NS
Height (cm)	1.65 ± 0.08	1.59 ± 0.05	0.0033
Weight loss	5.24 ± 3.41	3.82 ± 2.25	NS
% weight change	5.79 ± 3.68	4.49 ± 1.44	NS
Decrease in BMI	1.90 ± 1.26	1.55 ± 0.54	NS
Decrease in Fat %	2.24 ± 1.22	1.43 ± 0.65	0.051
Decrease in Shoulder circumference measurement	5.27 ± 4.2	4.45 ± 2.46	NS
Decrease in Chest circumference measurement	3.57 ± 2.56	3.53 ± 2.42	NS
Decrease in Arm circumference measurement	2.5 ± 1.36	1.95 ± 0.57	NS
Decrease in Waist circumference measurement	4.71 ± 4.10	3.08 ± 2.29	NS
Decrease in Hip circumference	3.18 ± 1.68	3.18 ± 1.68	NS
Waist/Hip % change	2,14 ± 2,7	0,64 ± 0,16	NS
Decrease in Leg circumference measurement	3.29 ± 2.16	2.15 ± 0.8	0.086
Flexibility-a change	0.79 ± 0.8	0.77 ± 0.6	NS
Flexibility-b change	1.07 ± 1.21	0.77 ± 1.01	NS
T. Cholesterol change	23.43 ± 14.54	22.38 ± 28.31	NS
HDL change	6.14 ± 10.51	3.54 ± 8.51	NS
LDL change	14.6 ± 15.56	23.77 ± 39.12	NS
Triglycerides change	60.00 ± 129.73	0.46 ± 37.83	NS
Fasting Glucose	12.86 ± 31.49	3.08 ± 9.71	NS

BMI: Body Mass Index, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein

Table 4. The comparison of the effect of step aerobic exercise plus low calorie diet and low calorie diet only on anthropomorphic and biochemical parameters

	Step aerobic	Diet only	P value
Year	34.5 ± 11.49	36.93 ± 6.6	NS
Height (cm)	1.65 ± 0.08	1.59 ± 0.07	0.02
Weight loss	5.24 ± 3.41	1.33 ± 0.98	0.00036
% weight change	5.79 ± 3.68	2.03 ± 0.75	0.001
Decrease in BMI	1.90 ± 1.26	0.52 ± 0.39	0.0006
Decrease in Fat %	2.24 ± 1.22	0.67 ± 0.62	0.000057
Decrease in Shoulder circumference measurement	5.27 ± 4.2	2.00 ± 2.17	0.033
Decrease in Chest circumference measurement	3.57 ± 2.56	0.79 ± 0.7	0.0014
Decrease in Arm circumference measurement	2.5 ± 1.36	1.41 ± 0.49	0.027
Decrease in Waist circumference measurement	4.71 ± 4.10	1.07 ± 0.73	0.0057
Decrease in Hip circumference measurement	3.18 ± 1.68	1.71 ± 0.99	0.011
Waist/Hip % change	2.14 ± 2.7	0.37 ± 0.84	0.0045
Decrease in Leg circumference measurement	3.29 ± 2.16	0.79 ± 0.7	0.00084
Flexibility-a change	0.79 ± 0.8	0.69 ± 0.75	NS
Flexibility-b change	1.07 ± 1.21	0.38 ± 0.65	0.078
T.Cholesterol change	23.43 ± 14.54	35.12 ± 20.78	NS
HDL change	6.14 ± 10.51	2.82 ± 11.13	NS
LDL change	14.6 ± 15.56	23.95 ± 23.6	NS
Triglycerides change	60.00 ± 129.73	33.36 ± 85.77	NS
Fasting glucose change	12.86 ± 31.49	8.45 ± 23.88	NS

BMI: Body Mass Index, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein

RESULTS

All parameters measured for the step aerobic exercise group, walking exercise group are given on Tables 1 and 2. In step-aerobic group and walking groups there was a significant decrease in weight, body mass index, cholesterol levels and body fat content after the interventions. These parameters were largely unaffected in diet only group with the exception of total cholesterol and LDL-cholesterol levels which were significantly decreased ($p=0.041$, $p=0.013$).

Step aerobic group had better weight loss, body mass index decrease and total body fat percent decrease when compared to only diet group (respectively $p=0.00036$, $p=0.0006$, $p=0.000057$). Circumference measurements also showed that decreases in step aerobic group were more significant than diet only group. Flexibility change was more prominent in step aerobic group without reaching statistical significance ($p=0.078$) (Table 4).

DISCUSSION

There are numerous studies on the combined effect of exercise and caloric restriction on body weight. Savage et al (13) reported that cardiac rehabilitation exercise training, as currently structured, burns surprisingly few calories and has little impact on the short term (3 months) measures of obesity and lipid risk factors. Alternative training programs should be considered to maximize caloric expenditure and modify specific risk factors such as obesity and dyslipidemia. Savage (13), Garrow and Summerbell (4) found that 5 to 16 week of caloric restriction (<1000 cal/day) when combined with exercise caused 1 to 5 kg

more weight loss. King and Tribble (6); reported on the long term consequences of at least 6 week interventions and found that while only caloric restriction and only exercise caused a mean of 4.0 and 4.9 kg weight loss respectively, when combined they caused 7.2 kg weight loss. Wing et al (16) reporting on the weight losses at 1 year found that diet and exercise caused greater sustained weight loss compared to diet alone. In another study, 3 month intervention on 52 obese patient resulted in a 1.3 kg more weight loss when exercise and diet were combined ($P=0.03$) (12).

In our study, the effect of 3 different 10 week intervention programs were examined and step-aerobic exercise and diet program caused a mean 5.2 kg loss, walking exercise and diet program 3,8 kg loss and diet alone caused 1.3 kg loss. These results are in line with the studies of Kravitz et al (7), Mc Card et al (9) and Carol et al (1) who reported a decrease in body weight and fat composition after 8 to 12 week step aerobic exercise and dance program. Other studies also reported loss of body fat, and weight and gain in lean body mass with varying intensity exercise programs (10).

In our study, flexibility index increased in all study groups without reaching statistical significance. Heyward et al (3) reported an increase in flexibility after an exercise program of active and passive stretch exercises of 10 to 30 minutes three weekly for at least 4 weeks.

According to our data, walking and diet group and only the diet group had no amelioration in circumference studies whereas the diet and step aerobic exercise group had statistically significant decrease in hip and leg circumference at the end of the

Table 5. The comparison of the effect of walking exercise plus low calorie diet and low calorie diet only on anthropomorphic and biochemical parameters

	Walking	Diet only	P value
Year	36.67 ± 6.28	36.93 ± 6.6	NS
Height (cm)	1.59 ± 0.05	1.59 ± 0.07	NS
Weight loss	3.82 ± 2.25	1.33 ± 0.98	<0.0001
% weight change	4.49 ± 1.44	2.03 ± 0.75	0.00015
Decrease in BMI	1.55 ± 0.54	0.52 ± 0.39	<0.0001
Decrease in Fat %	1.43 ± 0.65	0.67 ± 0.62	0.0065
Decrease in Shoulder circumference measurement	4.45 ± 2.46	2.00 ± 2.17	0.016
Decrease in Chest circumference measurement	3.53 ± 2.42	0.79 ± 0.7	0.00061
Decrease in Arm circumference measurement	1.95 ± 0.57	1.41 ± 0.49	0.026
Decrease in Waist circumference measurement	3.08 ± 2.29	1.07 ± 0.73	0.009
Decrease in Hip circumference measurement	3.18 ± 1.68	1.71 ± 0.99	0.0087
Waist/Hip %	0,64 ± 2,16	0,37 ± 0,84	NS
Decrease in Leg circumference measurement	2.15 ± 0.8	0.79 ± 0.7	<0.0001
Flexibility-a change	0.77 ± 0.6	0.69 ± 0.75	NS
Flexibility-b change	0.77 ± 1.01	0.38 ± 0.65	NS
T. Cholesterol change	22.38 ± 28.31	35.12 ± 20.78	NS
HDL change	3.54 ± 8.51	2.82 ± 11.13	NS
LDL change	23.77 ± 39.12	23.95 ± 23.6	NS
Triglycerides change	0.46 ± 37.83	33.36 ± 85.77	NS
Fasting Glucose	3.08 ± 9.71	8.45 ± 23.88	NS

BMI: Body Mass Index, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein

Table 6. Exercise test results of the groups

	Step aerobic	Walking	Diet only
Exercise time (1)	8.18 ± 1.40	8.96 ± 1.66	8.63 ± 1.82
Exercise time (2)	11.71 ± 1.89	11.5 ± 2.15	10.2 ± 3.27
% change	41.09 ± 41.08	31.75 ± 14.21	20.49 ± 13.40
P value	0.014	0.013	NS
MET (1)	6.5 ± 1.17	7.31 ± 2.11	6.56 ± 1.18
MET (2)	7.86 ± 1.66	7.58 ± 1.58	7.4 ± 1.67
% change	14.32 ± 9.48	6.92 ± 23.23.00	12.85 ± 10.25
P value	NS	NS	NS

MET: Metabolic equivalent

exercise program. We also found a significant fall in total cholesterol levels in all 3 groups, fall in the LDL cholesterol in diet only and walking and diet groups. We also found an increase in treadmill time in all groups tested, maximum increase being in the step aerobic exercise group.

The effect of exercise on lipid levels was not consistent: none in one study (5) and decreased LDL cholesterol in another study (14). Most of the studies reported an increase in maximum VO₂ after exercise programs which is in line with our data (1, 2, 5, 15).

Energy consumption of the aerobic step exercise group was higher compared to walking or sedentary group. For example during a moderate aerobic step exercise a 98kg and 47 kg we-

ight individuals consume 10.1 and 4.8 Kcal/min respectively; while the persons with the same weights consume 7.3 and 3.6 Kcal/min respectively during a 3mph walk (8). Step aerobics, Bodycombat (ie. Taebo) and, spinning had significantly higher caloric expenditures than running at 8.05 km/h. Step aerobics was also found to be equally as effective as jogging between 8.05 and 8.37 km/h. (11).

Hence, in our study better results were obtained in the aerobic step exercise group.

In conclusion, the 3 methods tested yielded amelioration in physiologic and physical parameters in obese subjects with maximum effect seen in the step aerobic exercise and diet group.

REFERENCES

1. Carol E G, Julie S, McKinney MS, Richard A, Carleton MD. Is Aerobic Dance an Effective Alternative to Walk-Jog Exercise Training. *J Sports Med Physical Fitness* 1992; 32: 136-141.
2. Clearly MLI, Moffatt RJ, Knutzen MK. The Effects of Two-Three Days-Weeks Aerobic Dance Program on Maximal Oxygen Uptake. *Res Quart Enec Sport* 1984; 55: 172-174.
3. Elousa R, Molina L, Fito M, Arquer A. Response Of Oxidative Stress Biomarkers to a 16 Weeks Aerobic Physical Activity Program and to Acute Physical Activity in Healthy Young Man And Women. *Atherosclerosis* 2003;167: 327-334.
4. Garrow JS, Summerbell CD. Meta-Analysis: Effect of Exercise With or Without Dieting on the Body Composition of Overweight Subjects. *Eur J Clin Nutr* 1995; 49:1-10.
5. Hata K, Hata T, Miyazaki K, Kunishi HI, Masuda J. Effects of Regular Aerobic Exercise on Cerebrovascular Tone in Young Women. *Ultrasound Med* 1998; 17:133-136.
6. King AC, Tribble DL. The Role of Exercise in Weight Regulation in Nonathletes. *Sports Med* 1991; 11:331-349.
7. Kravitz L, Cisar JC, Setterlund SJ. The Effects of Low Impact Dance Training on Aerobic, Submaximal Heart Rate and Body Composition of Collage Aged Females. *J Sports Med Physical Fitness* 1991; 29:184-188.
8. McArdle WD., Katch, FI, & Katch, VL. (1991). *Exercise physiology: Energy, nutrition, and human performance* (3rd ed). Philadelphia: Lea & Febiger.
9. McCord P, Nicholas JC, Setterlund SJ. The Effects of Step Training With and Without Hand Weights. *J Sports Med Physical Fitness* 1993; 33:348-358.
10. Nindi BC, Harman EA, Marx JO, Gotshalk LA. Regional body Composition Changes in Women after 6 Months of Periodized Physical Training. *J Applied Physiol* 2000; 88:2251-2259.
11. Rixon KP, Rehor PR, Bemben MG. Analysis of the assessment of caloric expenditure in four modes of aerobic dance. *Journal of Strength and Conditioning Research* 2006; 20:593-596.
12. Saris WHM. Exercise With Or Without Dietary Restriction And Obesity Treatment. *International Journal Of Obesity* 1995; 19:5113-1163.
13. Savage PD, Brochu M, Scott P, Ades PA. Low Caloric Expenditure in Cardiac Rehabilitation. *Am Heart J* 2000;140:527-533.
14. Tomaszewski M, Charchar FJ, Crawford L, Zukowska-Szczehowska E, Grzeszczak W, Sattar N, Dominiczak AF. Serum C-reactive Protein and Lipids in Ultra-Marathon Runners. *Am J Cardiol* 2004; 94:125-126.
15. Williford NH, Blessing DL, Barksdale MJ, Smith FH. The Effects of Aerobic Dance Training on Serum Lipids, Lipoproteins and Cardiopulmonary Function. *J Sports Med Phys Fitness* 1988; 28: 151-157.
16. Wing RR. Physical Activity in the Treatment of the Adulthood Overweight and Obesity: Current Evidence and Research Issues. *Med Sci Sport Ex* 1999; 31:5547-5552.
17. World Health Organization Report. Obesity; Priority and Managing the Global Epidemic, 2004.