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The Investigation of Cardiac Functions and Blood Lipid Levels in Obese Men and Elite Athletes

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ABSTRACT

The aim of this study is to investigate the cardiac functions and blood lipid values of obese individuals and individuals engaged in elite sport by comparing with healthy subjects. 20 obese subjects, 20 elite athletes and 20 healthy sedentary men between 20-35 years old were included into the study. Subjects' heights, weights, body mass indexes (BMI), resting heart rates (HR_{rest}), systolic blood pressures (SBP), diastolic blood pressures (DBP), basal metabolic rates (BMR), energy requirements (ER), body fat percentage (% BF), body fat mass (FM), fat free mass (FFM), mid-arm circumferences (MAC) were recorded. As echocardiographic measurements, left ventricular diastolic diameters (LVEDd), left ventricular end-systolic diameters (LVESd), left ventricular posterior wall diastolic diameters (LVPWd), interventricular septum diastolic diameters (IVSd), shortening fractions (SF), ejection fractions (EF), early filling velocities (MITRAL E) and late filling velocities (MITRAL A), myocardial performance indexes (MPI) were evaluated. Blood lipids, total cholesterol, triglyceride, high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL) were evaluated. One-Way ANOVA test was applied for the significance between the groups and Tukey test was applied as Post Hoc in order to determine between which groups there is significance. When LVEDd, LVESd and IVSd were statistically compared, the significance was observed in favor of athlete group between athlete and obese groups and in favor of sedentary group between sedentary and obese groups. There was a significance in SF parameter in favor of athlete group between athlete and obese groups. Significance was detected in the mean EF in favor of athlete group between athlete and obese groups; in favor of sedentary group between sedentary and obese groups. There was no significance between groups in Mitral E, Mitral A, Mitral E / A parameters. There was a significance in MPI parameter in favor of athlete group between athlete and obese groups; in favor of athlete group between athlete and sedentary groups; in favor of sedentary group between sedentary and obese groups. In total cholesterol, HDL, LDL, Triglycerides and VLDL cholesterol parameters, there was a significance in favor of athlete group between athlete and obese groups; in favor of sedentary group between sedentary and obese groups. As a result, it was introduced that regular exercise and sport affected cardiac parameters and blood lipids positively and caution should be taken in mind in advancing ages when obesity values increased by thinking the risk which they could cause cardiovascular diseases, hypertension and different complications.

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INTRODUCTION

Obesity is an important metabolic disorder which emerges under the influence of genetic and environmental factors, are characterized by the accumulation of excessive body fat tissue and may have social, psychological and medical complications (Alikasifoğlu, A., N. Yordan, 2000). It is seen that obesity causes various complications in adults. Metabolic - hormonal complications, hormonal factors and other circulatory abnormalities, cardiovascular system diseases, coronary heart disease, hypertension, respiratory diseases, digestive system diseases, reproductive system abnormalities, immune system dysfunction, skin diseases, eye diseases, surgical complications, cancer, mechanical complications of obesity, and various psychological problems are complications observed in obesity (Uzun, A., 2011).

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Today, obesity is considered as major cardiovascular risk factor increasing the risk of cardiovascular morbidity and mortality (Troiano, R.P., 1996; Seyfeli, E., 2008). Obesity, high blood pressure, blood glucose and blood lipid levels and body weight changes are associated with cardiovascular disease (Hubert, H.B., 1983).

It was reported that ventricular arrhythmias can be thought as possible mechanism of sudden cardiac death in obese individuals and obese individuals are at risk 30 times more than individuals with normal weight with respect to ventricular extra systole (Messerli, F.H., 1982). "Dyslipidemia" previously called hyperlipidemia is nowadays defined as changes in rates and levels of blood fats (increase in lipoprotein levels) to disrupt health are defined as (Altay, U., 2009). Dyslipidemia associated with obesity and metabolic syndrome is one of the central features which causes the increase in the risk of cardiovascular disease (Franssen, R., 2011).

Dyslipidemia associated with obesity is characterized by elevated triglyceride levels, decreased HDL levels and abnormal LDL composition. Although weight loss, exercise, and the normalization of body weight cause the improvement of dyslipidemia, they can reduce cardiovascular disease (CVD) risk (Howard, B.V., 2003). Positive health is not just the absence of disease, also to develop capacity to withstand the challenges by taking pleasure in life (U.S. Department of Health and Human Services, 1996). It is known that cardiac risks decrease in athletes and on the contrary, these risks increase in obese individuals.

The aim of this study is to investigate the effects of possible changes developing with sports in the autonomic nervous system in athletes and to reveal the effects to the cardiovascular system of the possibilities which can be occurred with sedentary life in obese individuals by comparing cardiac parameters and blood lipids' analysis of athletes and obese individuals with healthy individuals.

MATERIALS AND METHODS

Selection of Experimental Group:

This study was started after approval of Clinical Research Ethics Committee of the University of Gaziantep. 60 male voluntary subjects were detected by asking age, height, weight, participation status to sports, the frequency and level of participation to sports if participation is there to different individuals between 20-35 ages from different occupational groups in province of Gaziantep. Subjects were explained with the history and subject information sheet in detail for how the study is realized. The study group was divided into three sub-groups as 20 elite athlete, 20 obese and 20 control and enrolled into study. Athlete group was chosen from the elite competition athletes making sports for at least 4 days a week and studying in School of Physical Education and Sport of University of Gaziantep. Obese group was selected from individuals with BMI over 30 from different professions in province of Gaziantep by learning their heights and weights. Control group was selected from sedentary individuals with normal BMI values not doing heavy sports according to heights and weights.

Data Collection:

Measurements and Tests Applied in the Study:

Application of medical history and anthropometric measurements was studied in physiology laboratory of School of Physical Education and Sport in University of Gaziantep. Subjects' body compositions were measured by the method of Bioelectrical Impedance Analysis (BIA) (Tanita Body Fat Analyser, model BC - 418). Body weight, height, BMI, BMR, ER, SBP, DBP, MAC, % BF, FM and FFM of 60 people included in the study were measured and recorded (Ellis, K.J., 1999; Mcardle, W.D., 1996).

Echocardiography:

Subjects' echocardiography studies (ECHO) was realized in Department of Cardiology of School of Medicine Research Hospital in University of Gaziantep. All individuals participating in the study were taken into transthoracic echocardiography laboratory after being rested for about 15 minutes. Subjects' echocardiography studies (ECHO) were done using ECHO device (Brand of SIEMENS) at supine or slightly left lateral decubitus positions by the same cardiologist. Necessary measurements were taken with the apical approach with parasternal as echocardiographic. During parasternal long axis examination of the subjects with ECHO, the M-mode method was used for taking parameters in accordance with the recommendations of the American Society of Echocardiography (Jaroudi, W.A.I., 2012; Pascual, M., 2003).

Collection and Analysis of Blood Samples:

Whole blood and blood lipid levels were analyzed by taking blood of the subjects in Central Laboratory of Faculty of Medicine Research Hospital in University of Gaziantep. About 8-10 mL of blood of the subjects involved to the study was taken into the purple cap with EDTA and normal red cap biochemistry tubes when they are in fasting period and at sitting position. Results were obtained by studying samples taken into the tubes in COBAS C 311/501 Analyzer.

Statistical Analysis:

Before the statistical procedures, it was examined whether data is normally distributed and whether it is homogeneous and statistical techniques appropriate for these were used. One-Way ANOVA test was applied for the significance between the groups and Tukey test was done as Post Hoc to determine between which groups there was significance. All calculations related to the research and analyses were conducted utilizing SPSS 16.0 package program. To determine whether the results are statistically significant or not, $p < 0.05$ significance level was got on.

Results:

A total of 60 male subjects were participated in the study. There were 20 athletes, 20 obese and 20 sedentary people in groups. All in athlete group participating in the study were people who exercised for at least 3-4 days a week, had history of participation in national and international competitions and contests. The medical history of the group members were so; 1 of them had history of obesity in the family (5%), 1 of them had onset heart disease in the family history (5%), there was relationship between parents of 1 of them (5%), none of them had palpitation and chest pain, there was an early age of death in the family of 1 of them (5%), there was diabetes in the family of 1 of them (5%), 1 of them had family history of hereditary disease (5%), there was no drug user in athletes' group and there was 4 smokers (20%).

There was no one making sport in obese group, it was determined that 6 of them had obesity history in the family (30%), 5 of them had early onset heart disease in the family (25%), there was relationship between parents of 1 of them (5%), 5 of them had palpitation and chest pain (25%), there was an early age of death in the family of 1 of them (5%), there was diabetes in the family of 4 of them (20%), 3 of them had family history of hereditary disease (15%), 3 of them used any drug (15%) and 12 of them were smokers (60%).

It was detected in sedentary group that 2 of them had obesity history in the family (10%), 3 of them had early onset heart disease in the family (15%), there was relationship between parents of 2 of them (10%), 1 of them had palpitation and chest pain (5%), there was an early age of death in the family of 1 of them (5%), there was diabetes in the family of 2 of them (10%), 2 of them had family history of hereditary disease (10%), there was no one making sport and 10 of them were smokers (50%).

Table 1: Comparison of Anthropometric Measurements of the Groups.

Variables		Sum of Squares	df	Mean Square	F	p	Sig.
Age (year)	Between Groups	224.433	2	112.217	13.624	0.000*	1-2, 2-3
	Within Groups	469.500	57	8.237			
	Total	693.933	59				
Height (cm)	Between Groups	98.233	2	49.117	1.635	0.204	-
	Within Groups	1711.950	57	30.034			
	Total	1810.183	59				
Weight (kg)	Between Groups	22050.937	2	11025.469	92.121	0.000*	1-2, 2-3
	Within Groups	6822.00	57	119.684			
	Total	28872.937	59				
BMI (kg/cm ²)	Between Groups	2724.727	2	1362.363	174.149	0.000*	1-2, 2-3
	Within Groups	445.909	57	7.823			
	Total	3170.636	59				
% BF	Between Groups	4389.850	2	2194.925	100.624	0.000*	1-2, 2-3
	Within Groups	1243.352	57	21.813			
	Total	5633.202	59				
FM (kg)	Between Groups	7717.391	2	3858.696	106.794	0.000*	1-2, 2-3
	Within Groups	2059.531	57	36.132			
	Total	9776.922	59				
FFM (kg)	Between Groups	3665.164	2	1832.582	43.070	0.000*	1-2, 2-3
	Within Groups	2425.280	57	42.549			
	Total	6090.444	59				
MAC (cm)	Between Groups	944.233	2	472.117	63.178	0.000*	1-2, 2-3
	Within Groups	425.950	57	7.473			
	Total	1370.183	59				
HRrest (beat/min)	Between Groups	7712.425	2	3856.212	43.812	0.000*	1-2, 2-3, 1-3
	Within Groups	5016.987	57	88.017			
	Total	12729.412	59				
DBP (mm/Hg)	Between Groups	1454.358	2	727.179	12.896	0.000*	1-2, 2-3
	Within Groups	3214.188	57	56.389			
	Total	4668.546	59				

SBP (mm/Hg)	Between Groups	1899.100	2	949.550	8.369	0.001*	1-2, 2-3
	Within Groups	6467.250	57	113.461			
	Total	8366.350	59				

*p<0.05; Groups: 1.Athlete, 2.Obese, 3. Sedentary

There was no significance in height parameter between groups ($p>0.05$). Body weight in obese group was seen as higher than those of the other groups significantly. Significance wasn't detected in BMI, %BF, FM, FFM, MAC, HRrest, DBP, SBP parameters ($p<0.05$).

Table 2: Comparison of Basal Metabolic Rate and Energy Requirements of the Groups.

Variables		Sum of Squares	df	Mean Square	F	p	Sig.
BMR (met)	Between Groups	5606729	2	2803364	49.785	0.000*	1-2, 2-3
	Within Groups	3209641	57	56309			
	Total	8816370	59				
Energy Requirement (kcal)	Between Groups	4340378	2	2170189	37.111	0.000*	1-3, 2-3
	Within Groups	3333259	57	58478			
	Total	7673637	59				

*p<0.05; Groups: 1.Athlete, 2.Obese, 3. Sedentary

Because of the fact that basal metabolic rate is measured in proportion to the weight, it was found significantly higher in obese group than athlete and sedentary groups ($p=0.000$). Although the mean energy requirement was not so much different between athlete and obese individuals, their values were significantly higher than those in sedentary individuals ($p=0.000$).

Table 3: Comparison of Left Ventricular Diastolic and Systolic Functions of the Groups.

Variables		Sum of Squares	df	Mean Square	F	p	Sig.
LVEDd (cm)	Between Groups	0.444	2	0.222	5.566	0.006*	1-2, 2-3
	Within Groups	2.271	57	0.040			
	Total	2.714	59				
LVESd (cm)	Between Groups	1.141	2	0.570	16.902	0.000*	1-2, 2-3
	Within Groups	1.923	57	0.034			
	Total	3.064	59				
LVPWd (cm)	Between Groups	0.035	2	0.017	1.663	0.199	-
	Within Groups	0.594	57	0.010			
	Total	0.629	59				
IVSd (cm)	Between Groups	0.509	2	0.254	15.649	0.000*	1-2, 2-3
	Within Groups	0.926	57	0.016			
	Total	1.435	59				
SF (%)	Between Groups	241.637	2	120.818	7.763	0.001*	1-2
	Within Groups	887.096	57	15.563			
	Total	1128.733	59				
EF (%)	Between Groups	164.933	2	82.467	14.015	0.000*	1-2, 2-3
	Within Groups	335.400	57	5.884			
	Total	500.333	59				
MITRAL E (cm/sn)	Between Groups	0.083	2	0.042	1.314	0.277	-
	Within Groups	1.805	57	0.032			
	Total	1.889	59				
MITRAL A (cm/sn)	Between Groups	0.010	2	0.005	0.145	0.865	-
	Within Groups	1.944	57	0.034			
	Total	1.954	59				
MITRAL E/A	Between Groups	0.310	2	0.155	1.232	0.299	-
	Within Groups	7.179	57	0.126			
	Total	7.489	59				
MPI	Between Groups	0.238	2	0.119	126.534	0.000*	1-2, 2-3, 1-3
	Within Groups	0.054	57	0.001			
	Total	0.292	59				

*p<0.05; Groups: 1.Athlete, 2.Obese, 3. Sedentary

Significance was found in LVEDd, LVESd, IVSd, SF, EF, MPI parameters ($p < 0,05$). There was no significance in LVPWd, Mitral E, Mitral A, Mitral E/A parameters.

Table 4: Comparison of Blood Lipid Parameters of the Groups.

Variables		Sum of Squares	df	Mean Square	F	p	Sig.
Cholesterol	Between Groups	152589	2	76294.517	9.819	0.000*	1-2, 2-3
	Within Groups	442907	57	7770.301			
	Total	595496	59				
HDL (mg/dl)	Between Groups	1571.033	2	785.517	9.210	0.000*	1-2, 2-3
	Within Groups	4861.300	57	85.286			
	Total	6432.333	59				
LDL (mg/dl)	Between Groups	30058.433	2	15029.217	20.553	0.000*	1-2, 2-3
	Within Groups	41680.550	57	731.238			
	Total	71738.983	59				
Triglyceride	Between Groups	439787	2	219893	21.357	0.000*	1-2, 2-3
	Within Groups	586884	57	10296			
	Total	1026671	59				
VLDL	Between Groups	17398.300	2	8699.150	21.213	0.000*	1-2, 2-3
	Within Groups	23374.950	57	410.087			
	Total	40773.250	59				

* $p < 0,05$; Groups: 1.Athlete, 2.Obese, 3.Sedentary

In total cholesterol, HDL, LDL, triglycerides, VLDL parameters, significance was found in favor of the athlete group between athlete and obese groups; in favor of the sedentary group between sedentary and obese groups ($p < 0,05$).

Discussion and Conclusion:

When evaluated in terms of its pathogenesis and components, obesity is a fact that the effect of hereditary and genetic factors cannot be denied (Xia, Q., 2013; Bell, C.G., 2005; Stunkard, A.J., 1986).

Stunkard AJ *et al.* examined the effects of the genetic factors on obesity on 540 families in Denmark and revealed that genetic factors had an important role in determination of overweight in adults in their study (Stunkard, A.J., 1986). In the study concerning the association between obesity risk and genetic predisposition and taking unsweetened and sweetened drinks in 6934 women, Qibin Qi *et al.* evaluated three different generations and found genetic predisposition score as 29.1% between the generations (Qibin Qi, 2012). In our study, obesity history in the family was identified 1 person in athlete group (5%), 6 persons in obese group (30%), and 2 persons in control group (10%), in totally 9 persons (15%) in a total of 60 male individuals forming groups. The fact that obesity history in the family was 30% in obese group may be caused by that group number is insufficient or questioning contains only parents, rates can change if group number is increased.

Jung H.K. *et al.* a significant difference was not observed with respect to BMI between smokers and non-smokers and more metabolically negative fat distributions were detected with increased amount of smoking in the study with 283 participants assessing the relationship between the different types of smoking and obesity in South Korea. This finding means that smoking is not useful to control weight (Jung Hwan, K., 2012). In the study conducted on 4296 Finnish of which 566 were twin, Saarni Suoma S *et al.* identified 35.7% of smokers as obese and overweight. It was expressed that smoking caused abdominal obesity among adolescents and young adults and prevention of smoking in adolescence was a very effective tool in preventing the risk of metabolic diseases and CVD (Saarni, S.E., 2009).

In our study, 4 persons in athlete group (20%), 12 persons in obese group (60%) and 10 persons in athlete group (50%) were smokers. When smoking and obesity are considered separately, they decrease the quality of life in general and when obesity and smoking are coupled with the same body, the risk of morbidity and mortality may increase.

Slentz *et al.* investigated the effect of eight-month exercise program on body weight and body composition in overweight and obese individuals and observed a significant decrease in body weight and on other body compositions in the individuals having significantly high average body weight, body fat mass, waist, abdomen and hip region in the study realized with high, medium and low intensity exercises during eight-month exercise (Slentz, C.A., 2004). Lichtash *et al.* found in the cohort study conducted on 698 men and women that height, weight, waist circumference, hip circumference, BMI, body adiposity index (BAI), body fat percentage (%BF), and other anthropometric measurements was high, these results were consistent with the risk of BMI and cardiometabolic disease and had more meaningful relationship with waist circumference, excess weight and body adiposity index (Lichtash, C.T., 2013).

In our study, anthropometric characteristics was statistically found significantly higher in means of BMI, %BF, FM, FFM and MAC in obese individuals than athlete and sedentary groups. When looked at the athlete and sedentary groups, %BF and FM were found high in sedentary individuals although there was no difference in BMI and also FFM and MAC were found high in athletes. This can be explained by the level of physical activity and exercise among the groups.

Pascual *et al.* observed that EF and SF values increased in mild to moderate obese individuals and there was no difference in high-grade obese individuals in this study conducted on 48 obese and 25 normal-weight individuals. Ramhamadany *et al.* found that there was a significant fall in EF values after a 4-week diet and a decrease in LV internal dimensions and SF value after weight loss in the study done on 34 obese subjects. Grossman *et al.* detected that LVEDd, LVESd, and LV wall thickness values in obese patients were more than normal patients (Grossman, E., 1991). Chadha DS *et al.* found that LVEDd and LVESd values increased in obese patients according to non-obese patients in their study conducted on 239 obese patients (Chadha, D.S., 2009). Wong CY *et al.* identified that there was an association of BMI with LV mass and wall thickness and also left ventricular systolic and diastolic functions decreased in severe obese individuals and EF parameter was normally stated in their study realized with transthoracic echocardiography and myocardial Doppler in 109 obese subjects (Wong, C.Y., 2004). Hacıhamdioğlu *et al.* detected an increase in LVEDd, LVESd, IVSd, LVPWd, values in their study conducted on 104 obese patients aged between 5 -16. When compared to control group, any statistically significant difference wasn't identified in EF and SF values. There was no significance in Mitral E, Mitral A and Mitral E/A rates. They found that MPI value calculated with PW doppler and tissue doppler was significantly increased in obese patients (Hacıhamdioğlu, B., 2007). Kossaify *et al.* reported that diastolic dysfunction, LV mass, LV mass index and septal wall thickness was significantly high in overweight and obese individuals in echocardiographic measurements in groups constructed as normal, overweight and obese in 99 cases. They found significant differences between E and A groups. They detected an increase in LVEDd parameter of obese patients (Kossaify, A., N. Nicolas, 2013).

According to the results of our study, LVEDd and LVESd was significantly higher in the obese group than the other groups and this was consistent with the literature. In means of LVPWd, there was no statistically significant difference between athlete, obese and control groups. IVSd was found significant in favor of athlete group between athlete and obese groups and in favor of control group between control and obese groups. In SF and EF values, any statistically significant difference wasn't detected between athlete and sedentary groups and there was a significance in favor of athlete group between athlete and obese groups. No statistically significant difference was found in Mitral A, Mitral E and Mitral E/A values. Means of MPI values were found high in obese individuals and the significance was found in favor of athlete group between athlete and obese groups, in favor of sedentary group between sedentary and obese groups and in favor of athlete group between athlete and sedentary groups in a parallel direction with the literature.

Gremaux *et al.* observed a significant improvement in total fat mass, body fat mass, triglycerides, and lipid profile as a result of lipid measurements realized at the end of nine months with two to three exercises a week in their study on 62 obese patients. Decrease in triglycerides and total cholesterol and rise in HDL cholesterol have been seen (Gremaux, V., 2012). Costa *et al.* detected that total cholesterol, triglycerides, and LDL was in a positive relationship with BMI in direct proportion, on the contrary; HDL cholesterol levels have tended to be lower in obese patients in obese individuals inside 1805 patients between the ages of 18-79 (Costa, L.A.D., 2012). Howard *et al.* expressed that raised triglycerides, decreased HDL levels and abnormal LDL composition played important roles in the development of dyslipidemia, atherosclerosis and CVD in obese patients, also; the risks of dyslipidemia and CVD would decline with weight loss, exercise, and lipid-lowering therapy. Ruberg *et al.* didn't find differences between total cholesterol and LDL in obese and control groups in the study on 28 obese individual and 18 individuals in the control group. Levels of triglycerides increased and HDL-cholesterol levels decreased in obese group and they were in normal level in control group (Ruberg, F.L., 2010). Considered the studies on the physiology of lipids in obese patients, it was seen that the results were similar in the studies.

In our study, when we compared the blood lipids in obese, athlete and control groups, total cholesterol, triglycerides, LDL and VLDL were observed higher in obese patients severely and all values showed significance in favor of athlete group in the comparison of sedentary and athlete groups. Significance was in favor of the control group between the obese group and the control group. The lowest value in HDL parameter was found in obese group. HDL was found higher in athletes than that of control group. The fact that total cholesterol, triglycerides, LDL and VLDL were low and HDL was high in athletes showed that exercise and training were significantly correlated with blood lipid parameters. Our results are compatible with the literature data on blood lipids.

As a result, it is presented in this study that regular exercise and sport has a positive effect on cardiac parameters and blood lipids so obese patients should be taken caution considering the risk of that advancing ages, when values rise, can cause cardiovascular disease, hypertension and different complications.

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