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The effect of exercises on left ventricular systolic and diastolic heart function in sedentary women: Step-aerobic vs core exercises

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ABSTRACT

The purpose of this study is to investigate the effect of 16 weeks step-aerobic exercises and core exercises on left ventricular structure and function with some physiological parameters in sedentary women.

Methods: To achieve the purpose of this study, a total of 45 volunteers including (step-aerobic group (SAG, n = 25), core exercise group (CEG, n = 20) were selected as participants. Two different exercises were applied for 4 days a week, throughout 16 weeks, within 60 minutes for each exercise with the intensity of heart rate (HR) 60-70 percent. The HR was measured using a heart rate monitor for each subject. The physical, biochemical and echocardiographic characteristics of the women were measured before and after the exercise.

Results: During the exercise periods, there were a meaningful decrease in the body weight, BMI, value of waist region and hip circumference of the women in both intervention groups as well as in the values of HR, DBP, SBP ($p < 0,05$). In addition, serum homocysteine (Hcy) and high-sensitivity C-reactive protein (Hs-CRP) levels decreased and the VO_{2max} and left ventricular diastolic end-diastolic dimension increased in both SAG and CEG ($p < 0.05$). The left ventricular diastolic functions of the SAG improved more than CEG. Left ventricular systolic ejection time and fractional shortening meaningfully improved in both SAG and CEG ($p < 0.01$).

Conclusion: 16 weeks of step-aerobic and core exercise showed significant changes of inflammatory and lipid markers with cardiac dimensions and had favorable effects on both left ventricular systolic function. Left ventricular diastolic function had more improved in SAG than the CEG.

1. Introduction

An increasing number of factors making life easier have brought have brought about an increased physical inactivity globally.[1] Sedentary life is one of the biggest public health problems in the 21st century.[2] There is strong evidence that physical weakness caused by inactivity decreases resistance to various diseases, increases risk of many diseases such as type 2 diabetes and obesity, and that coronary heart disease and hypertension are among the most important causes of death and disability.[3,4] The importance of regular physical activity is emphasized in order to maintain a healthy life and to have both preventive and healing effects for many diseases.[5,6] It is known that cardiovascular risk factors are greatly improved through the cardiovascular changes that occur with regular and long-term exercise.[3,7]

Many studies have shown that structural and functional changes in the left ventricle during exercise are greater than other parts of the heart.[8,9] Long-term exercises leading to morphological adaptation in the left ventricle may vary according to the type of sport being performed, its severity and extent. Regular endurance training can cause different changes in the structure and function of the heart and skeletal muscle.[10,11] Using conventional echocardiographic methods, both left ventricular (LV) diastolic and systolic functions have been shown to develop with training.[12–14]

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Many people who want to do sports practice in different exercises under the leadership of sports trainers. But what kind of cardiovascular exercise is more effective than it is important to clearly specify.

The present study determined whether step-aerobic or core exercises are more effective in left ventricular cardiac function development and reducing cardiovascular risk factors in middle-aged women.

2. Material and methods

2.1. Participants

Forty-five healthy sedentary women participated voluntarily in this study. We asked face to face all candidates self-reported. They did not attend regularly sports activities (more than one hour per week), before this study. All participants underwent health exams to ensure that they were not taking any medications and cigarettes or anti-pregnancy drugs and were free of any kind of heart disease, respiratory, metabolic or inflammatory disorders. All selected participants were randomly divided into two groups as step-aerobic group (SAG, $n = 25$, age 34.04 ± 3.74), core exercise group (CEG, $n = 20$, age 35.15 ± 6.25) years. The Clinical Research Ethics Committee in Medical Faculty of Ondokuz Mayis University approved the study (2012/141) in accordance with the policy statement of the Turkey Ministry of Health. The principles set out by the Declaration of Helsinki and national and local ethical guidelines for research were also followed. All participants completed a medical questionnaire and check up in the hospital then they were informed about the possible risks and discomfort involved before giving their written consent to participate.

3. Experimental procedure

3.1. Exercise intervention

The exercise program for two groups was undertaken 4 days of each week during 16 consecutive weeks. In both exercise group performed the exercise program in the gym under the leadership of sports trainers. Training intensity was calculated with Karvonen methods separately for each participant.[15] The target heart rate (THR) was controlled using a heartbeat monitor for each subject (Polar, made in Finland), and throughout the 16-week, exercise intensity was increased progressively from HR 60% to 70 % (between 1st and 4th week was HR 60%, between 5th and 8th week was HR 65% and 9th and 16th was HR 70%). Each exercise session was of 1h duration and consisted of warm-up exercises (10min), primary exercises (30-40min, basic movements step-aerobic) and cold-down (10 min). CE; warm-up exercises (10 min), primary exercises (30-40 min core exercises provide basically more strength for lower and upper extremities include 3 sets/day, 10 repetitions/set, 1–2min resting interval) and cold-down (10 min).[16,17]

3.2. Procedure and measurement

Height was measured to the nearest 0.1cm on a stadiometer when the participants were shoeless. Body weight of subjects in bare feet, t-shirts and tights was measured by the weighing instrument in kilograms ±0.01 kg. Body height of participants in bare feet was measured by the ruler in centimeters ±0.01 cm. Body mass index (BMI) was calculated as weight/height2 (kg/m2). The fat mass to determine Bodystat 1500 MDD equipment was used. The participants were asked to breathe out for measurement of their waist circumference (WC), which was measured to the nearest 0.1cm at the iliac crest. When viewed from the side, hip circumference (HC) was evaluated at the level of the maximum extension of the thigh, and waist-hip ratio (WHR) equals the waist circumference (WC) divided by the hip circumference (HC); WC (cm)/height (m).

3.2.1. Resting heart rate

12-lead electrocardiogram, and blood pressure (BP) were recorded in the sitting position. The participants were told to sit upright in a straight backed chair. Both feet were placed flat on the floor and the right arm was resting on a table with the elbow in a flexed position. BP at rest was obtained from the right arm by auscultation using a mercury sphygmomanometer and the resting heart rate (HR) was recorded from a 12-lead electrocardiogram with the subject sitting in an armchair just before the upright exercise test.

3.2.2. Maximal oxygen uptake

Maximal oxygen uptake (VO_{2max}) was determined by 20 m shuttle run test. For this aim, Powertimer PC 1.9.5 Version Newest device was used. This consisted of shuttle running between two met alters placed 20m apart at increasing fast speeds. Two photocells has been placed on the starting and ending at the 20 meters running distance.

3.2.3. Blood sample analyses

Blood was drawn from the deep arm vein in the morning after overnight fasting at the pre and post 16 weeks. Total cholesterol (TC), High density lipoprotein-cholesterol (HDL-C), triglyceride (TG) was assessed by the enzymatic colorimetric test (Roche diagnostics Moduler P 800).

Low density lipoprotein-cholesterol (LDL-C) was calculated by the formula TC2 (HDL-C1TG/5).

Serum Homocysteine (Hcy) and high-sensitivity C-reactive protein (Hs-CRP) were measured using immunodiffusion (ELİZA Perkın Elmer Vıctor).

3.3. Echocardiography

The participants underwent a standard echocardiographic examination M-mode, two-dimensional echocardiographic and pulse Doppler studies were performed using (Vivid 7 scanner with a 2.5 MHz transducer (GE Vingmed Ultrasound, Horten, Norway) with a 2.5 MHz transducer. Examinations were performed by one experienced cardiologists, who is blinded to the group intervention, with subjects resting in the left lateral supine position.

Two dimensional echocardiography was performed at the time of the baseline assessment and at 16 weeks. Echocardiograms were performed by experienced cardiologists and repeated by the same technician within each center wherever possible, with care taken to obtain similar serial images. Images were videotaped at the end of the expiration phase of normal respiration. A standard protocol was used based on apical four and two-chamber views according to the recommendations of the American Society of Echocardiography.[18,19] The following variables were measured or derived: LV end-diastolic dimension (LVDD), end-systolic dimension (LVSD), interventricular septum thickness (IVS), left ventricular posterior Wall (LVPW), MDT = mitral deceleration time, left ventricular ejection fraction (LVEF), left ventricular Fractional shortening (LVFS).

(LVEF) was calculated as quotient $LVEF = (LVEDV - LVESV)/LVEDV \times 100$

(LVFS) was calculated as the quotient $LVFS = (LVEDD - LVESD)/LVEDD \times 100$

Pulsed Doppler mitral flow was recorded in an apical two