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Effect of Aquarobic Dance on Lipid Profile in women with obesity

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Background:

The condition of the development of coronary heart disease to the top rank cause of death in the population of developing countries including in Indonesia over the age of 40 years, based on research results associated with higher total cholesterol and LDL cholesterol aquarobic dance training with low to moderate intensity intensity (Intermediate) 60- 85% of maximum HR, exercise duration 45-60 minutes with the frequency of exercise 3-5 times per week for 12 weeks granted in hopes of influencing lipid profile. This study aimed to determine the effect of aquarobic dance on the lipid profile (total blood cholesterol levels, blood LDL cholesterol levels, blood HDL cholesterol levels, and blood triglyceride levels). **Method:** This study experimental research, design using pre-test and post-test with the provision of treatment aquarobic dance workout, with low intensity to medium intensity 60-85% of maximum HR, exercise duration 45-60 minutes with the frequency of exercise 3-5 times per week for 12 weeks. The samples in this study were obese woman in the city of Semarang in Central Java province at the age of 40-55 years. **Result:** The results showed that low-intensity aquarobic dance to moderate intensity (Intermediate) 60-85% HR Max, duration 45-60 minutes with the frequency of exercise 3-5 times per week for 12 weeks can reduce total blood cholesterol levels, improving blood HDL cholesterol, lowering blood LDL cholesterol and to lower blood triglycerides. Statistically proven the existence of a significant effect of low-intensity dance aquarobic to moderate intensity 60-85% of maximal HR exercise duration 45-60 minutes with the frequency of exercise 3-5 times per week for 12 weeks on the lipid profile (total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides) which indicated the probability value ($p < 0.05$). **Conclusion:** the provision of dance aquarobic with low to moderate intensity intensity (Intermediate) 60-85% of maximal HR exercise duration 45-60 minutes with the frequency of exercise 3-5 times per week for 12 weeks, can lower total cholesterol, LDL cholesterol and triglyceride levels, and can increase HDL cholesterol levels.

Keywords: aquarobic dance, obesity, kolesterol total, kolesterol LDL, Kolesterol HDL, Triglicerida.

Introduction

Progress and improvement of the welfare and social status changes, unwittingly change a person's lifestyle, including daily patterns that tend to prefer foods rich in fat and meat than plant foods rich in fiber. The impact of these changes resulted in increased levels of cholesterol and decreased levels of HDL in the blood of a person, known as dyslipidemia. Cardiovascular disease (CVD) is one cause of death in the population of developing countries, including Indonesia. (Petersen & Pedersen 2005; Fernandez 2007) Indonesia's National Household Health Survey in 1972 showed PKV ranks 11, 1986 ranks 3rd, and Household Health Survey 1992 is the first cause of death for those above 40 years. (Wijayanti 2013) The proportion of patients with cardiovascular disease are hospitalized from the years 1990 to 1995 increased from 2.1% to 3.8%. One of cardiovascular disease is coronary heart disease (CHD). CHD is closely related to atherosclerosis, because 99% of the main cause is atherosclerosis. (Ali 2005) Epidemiological studies, and clinical laboratories that show an association between high total cholesterol and LDL (Low Density Lipoprotein) with the occurrence of cardiovascular disease.

The cause of abnormal blood vessels that lead to the heart of CHD is dyslipidemia or elevated blood triglyceride levels and decreased levels of high density lipoprotein (HDL) blood. Dyslipidemia is one risk factor for CHD. To avoid or reduce these risk factors is recommended to control blood lipid levels in order to always be in normal circumstances. The fat contained in the body and the food is cholesterol, triglycerides, phospholipids, and free fatty acids, when the levels of fat in the body so high then this condition can lead to calcification of blood vessels.(Saad & Gooren 2011)

Previous study reported related to the physical exercise program for the management of blood cholesterol shows the results still vary. In addition, there are researchers who noted that the program of physical exercise has not fully provide meaningful contributions to efforts to manage dyslipidemia, even a dose of physical exercise a certain weight can actually degrade the quality of blood vessels due to the possibility of exposure to oxidants are quite high. (Maloux et al. 2006) One factors that affect the result of physical exercise is exercise that includes dose intensity, frequency and duration of exercise. Unknown, studies relating to the method using the exercise intensity, frequency and duration of attention, manpower and enough time, can sometimes be an obstacle for some people.

Aquarobic dance is a form of physical activity that is rhythmic process is conducted continuously by combining some movement that aims to strengthen the heart, circulatory, muscle and burn fat so that the body requires more oxygen and pulse rate increased, done in the water. The term is often said to be the aquarobic dance workouts that aim to achieve freshness cardiorespiratory or aerobic fitness, which is indicated by the ability of the body's physiological work to produce the efficiency of the blood vessels, heart and lungs in a long time period. (Mukarromah et al. 2013; Mukarromah 2014; Colado et al. 2012; Katsura et al. 2010) The freshness cardiorespiratory also shown the ability respiratory and circulatory system to provide oxygen to the working muscles during rhythmic and continuous activity involving large muscle groups.(Kristiansen et al. 2008) Physiologically aquarobic dance performed regularly and measurable aims to improve the system and organ function in order to produce a better performance. It is also associated with a person's ability to use oxygen sufficient to meet the oxygen requirements at the time of exercise. At the time of the dance aquarobic oxygen system is pre-dominant energy source. (McConell et al. 1999) This exercise is stimulate the heart, blood vessels and lungs. The heart pumps blood more powerful, more and overall blood volume increases. In the implementation of aerobic gymnastic exercise should be guided by the dosage adjusted with the purpose of the exercise. Dosage is always associated with the intensity of exercise, repetition, frequency, and duration of exercise. Exercise intensity is defined as the amount of load that must be done during exercise with an indicator of increased pulse every minute or so-called heart rate (HR). (O'Donovan et al. 2005)

Intensity, repetition, frequency and duration of exercise are interrelated and influence, when a high intensity (85% HR maximum), duration of exercise 12-30 minutes. Conversely when low-intensity exercise should be a long time (30-60 minutes). To increase the durability of sufficient aerobic exercise for 30-60 minutes continuously. (Huang et al. 2013; Donnelly et al. 2009). The other research reported that aerobic exercise performed for 8-12 weeks continuously gave significant effects for physiological changes in the body. There are several forms of dance aquarobic movement, such as low Impact, mix impact, interval, step and slide, which gives a lot of advantages, which provides the benefits of health and fitness and help relieve stress.(Stults-Kolehmainen & Sinha 2014)

1 **Materials and Methods**

Participants

Twenty-four obese women aged of 46.49±1.41 years (Weight 76.41±3.11kg, Height 155.4±1.5 cm, body mass index (BMI) 32.8±0.92) voluntarily participated in this study in Semarang, a cut-off for obesity BMI ≥30kg/m², based on Asia-Pacific guidelines. (Tudor-Locke et al. 2004; Nuurad et al. 2003) Lipid profile serum, heart rate monitors and blood pressure were determined in order to exclude the patients with metabolic disease. Postmenopausal women were screened with regards to the mean age of natural menopause in Central Java Province Indonesia. In addition, the participants filled out questionnaires containing fields such as age, last menstrual day, menopausal status (e.g., last menstrual period occurred 6 months). All participants were informed the possible risk and the testing procedure of the trial before they signed the informed consent document. Participants were informed not to perform vigorous exercise one week before and during the trial. The study was approved by the by the Ethical and Research Committee of the Kariadi Hospitals (RSDK Semarang, Indonesia) before recruitment of the participants.

Experimental Design:The purpose of the study to investigate the effect of 12 weeks aquarobics dance program on lipid profile in women with obesity. Participants were randomly divided into two groups including control and aquarobic dance groups. Before and after the exercise training, anthropometric measurements were examined for all subjects. Height and body weight were recorded and body mass index (BMI) was calculated from the ratio of weight (kg)/height (m²). Body fat (%) was measured and blood pressure was measured on the right arm with the subjects in a sitting position, twice, after a 10 min rest, using a standard mercury sphygmomanometer. Lipid profile plasma were measured before and 1 hours after the aquarobic dance treatment, as well as immediately after exercise challenge.

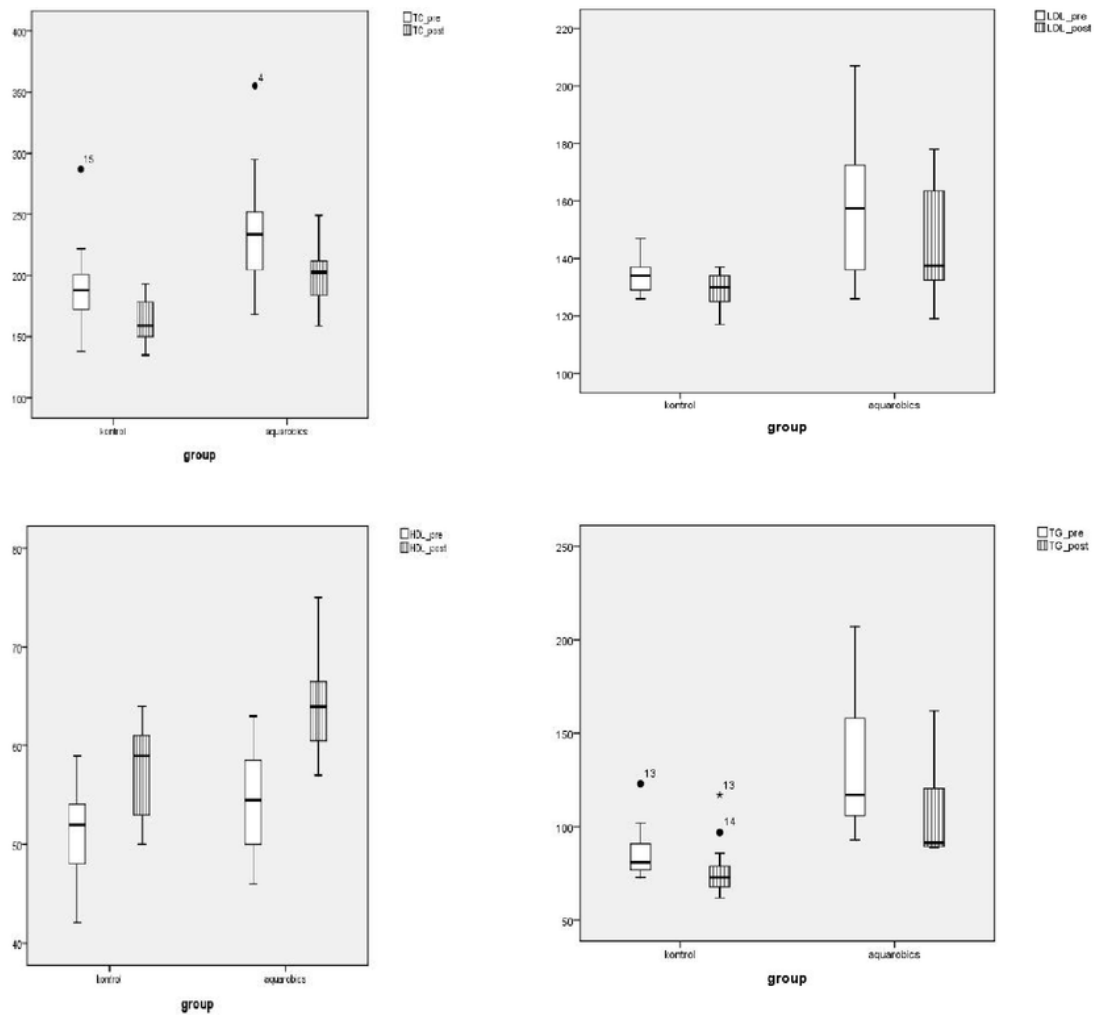
Aquarobic Dance:Before aquarobic dance each subject's maximal oxygen consumption (VO₂ max) was measured to establish their exercise training intensity. The subjects were then not familiarized with aquarobics exercises, after which they were told the requirements for the present experiment and their VO₂ max was determined following the Bruce Protocol. Metabolic data were collected using open circuit spirometry (Sensor Medics VO₂ max, USA). Aquarobics dance(Mukarromah et al. 2013; Georgia K 1980)supervised by experienced aquarobics instructors, was performed three days a week for 8 weeks. Each session consisted of a 10 min warm up session, a 40 min session of aquarobics exercises an intensity of 50-75% of the predetermined. The exercise intensity was controlled using a belt heart rate sensor (polar beat), and at the end of each session, there was a cool-down period consisting of stretching for 10 min.

Biochemical measurement:Blood samples for lipid profile (TG, total cholesterol, LDL and HDL) measurement were drawn into pre cooled glass tubes containing EDTA. The tubes were spun immediately at 2200 g for 15 min at 4°C. The plasma was stored at -80°C until analyses were performed. Blood lipid profile that meant in this study are lipid levels in the blood of respondents were taken intravenously contained in the form of total cholesterol, HDL cholesterol, LDL-C and triglyceride blood serum were examined as laboratory tests with the method of automatic analyzer (resistancy electronic / impedancy and volumetric metering), controlled by the simple method CHOD-PAP (computerized). Determination of cholesterol in the blood, we use the principle of cholesterol was determined after enzymatic hydrolysis and oxidation. Quinoneimin indicator formed from hydrogen peroxide and 4 - amino antipyrin in the presence of phenol and peroxide. On examination of HDL cholesterol, previously, the supernatant was first created, the samples of 200 mL added with 200 mL reagent HDL. The reagent will precipitate particles - other than HDL lipoprotein particle. After incubation and dicentrifuge, the supernatant was ready to be used in the examination of HDL. The principle of this experiment is the chylomicrons, VLDL (Very Low Density Lipoprotein) and LDL (Low Density Lipoprotein) is precipitated from the sum phosphotugistic acid and magnesium chloride. After the supernatant was centrifuged, the liquid consists of little HDL cholesterol while HDL is determined from the process enzymatis.Kadar obtained by our group was 10.912 mg / dl. These levels are classified in a high state. HDL woman is <50 mg / dl, male - male <40 mg / dL and high HDL levels> 60 mg / dl. (KANNAN1 et al. 2014)Examination LDL cholesterol levels obtained at 140, 635 mg / dl. In the examination of this figure LDL levels fall into the category of high LDL at 130 mg / dl. Optimal ie 100 mg / dl, the optimal approach is 100-129 mg / dl, the highest normal limit of 130-159 mg / dl, as high as 160-189 mg / dl

1 **Statistical analysis:** Statistical analysis of the data was performed for each group using the means and standard deviations. Then, the Kolmogorov-Smirnov test was used to ensure that the data were normally distributed. All data shown represent the means±the standard deviation (SD). Differences in various parameters before and after aquarobics exercises were performed using the paired t-test. To demonstrate the aquarobics exercises-induced changes in adiponectin levels, we adjusted for the change in body weight. Changes in body weight were determined by calculating the difference in the body weights before and after aquarobics exercises. Differences between weight loss and weight gain were performed using independent the t-test, one-way analysis of variance (ANOVA) was performed. (HSCIC 2014; Harriss & Atkinson 2009) To eliminate the possible influence of the baseline characteristics on the effects of exercise, adjustments for age, weight, BMI, body fat (%). All statistical analyses were performed using SPSS-PC for Windows (version 20.0, SPSS Inc., Chicago, IL, USA); p<0.05 was considered statistically significant. **Results:** Data were successfully summarized through procedures for gathering research data, including age, menopausal status, activities other than aquarobic dance. Blood lipids that consisting of total cholesterol, HDL, LDL and TG), then processed with descriptive statistics followed by a 't' test (t-test) between the time (short formula), while the results obtained as a series of tables and the following explanation:

1 Table 1. Physical, physiological and biochemistry variables in two group

Variabel	Aquarobic Dance	Control	p
	n=12 Mean ± SD	n=12 Mean ± SD	
Age (th)	46.74±1.30	46.79±1.35	0.225 ⁽¹⁾
Intake energi (kcal)	2125± 165.81	2134± 136.11	0.112 ⁽¹⁾
Intake protein (g)	44.91±1.63	45.38±1.78	0.608 ⁽¹⁾
Intakefat (g)	63.93±3.12	65.66±3.34	0.265 ⁽¹⁾
Height (m)	1.55 ± 0.05	1.52 ± 0.04	0.151 ⁽¹⁾
Weight (kg) <i>pre</i>	75.66±5.54	75.41 ±6.61	0.539 ⁽¹⁾
Weight (kg) <i>post</i>	73.16±4.60	75.41 ± 6.61	0.370 ⁽¹⁾
Total Cholesterol (mg/dL) <i>pre</i>	216.33±40.95	192.25 ±37.42	0.044 ⁽¹⁾
Total Cholesterol (mg/dL) <i>post</i>	190.75±35.43	164.00 ± 17.89	0.008 ⁽¹⁾
LDL(mg/dL) <i>pre</i>	137.75±17.82	134.00 ± 6.12	0.024 ⁽¹⁾
LDL (mg/dL) <i>post</i>	123.92±14.38	128.58 ± 5.76	0.012 ⁽¹⁾
HDL(mg/dL) <i>pre</i>	57.17±5,50	50.50 ±4.75	0.013 ⁽¹⁾
HDL(mg/dL) <i>post</i>	61.83±4.85	57.00 ± 4.55	0.003 ⁽¹⁾
TG(mg/dL) <i>pre</i>	119.17±35.14	82.75 ± 9.42	0.009 ⁽¹⁾
TG(mg/dL) <i>post</i>	99.33±29.95	73.92 ± 10.11	0.002 ⁽¹⁾



Picture 1. Lipid profile after Aquarobic dance

The mean of age of subject in the study, height, body weight before and after treatment in all groups was not statistically significant. Nutrient consumption rate calculation based on the nutritional needs according⁴ to Regulation 75 Year 2013 concerning the recommended RDA for Indonesia which is adjusted to the level of age and sex is the energy requirement for women aged 30-49 years is 2625kcal, protein 65g, 73g fat and energy requirements for women aged 50-64 is 2325kcal, 65g protein and 65g of fat. In this study, measurement of food intake using a 24-hour food recall, based on the calculation software nutrisoft note that⁴ the level of energy consumption, protein and fat in each groups was not significant ($p>0.05$; $p>0.05$; $p>0.05$).

The results showed that in all groups of food intake during the treatment is the same, so this result is not affected by food intake. Aquarobic dance has an effect on blood lipid profile, especially in the HDL and LDL cholesterol fractions. In this study, the mean levels of total cholesterol, LDL and TG decreased after aquarobic dance and HDL cholesterol levels increased. Exercise performed is aquarobic dance with intensity 75%-80% HR Max, frequency of exercise three times/week for 12 weeks, with an additional active rest for 5 minutes after exercise. Pre dominant energy system used in this exercise is the energy system aerobic.

Total cholesterol before aquarobic dance is 216.33 ± 40.95 higher than the total cholesterol level after aquarobic dance 190.75 ± 35.43 . Statistical test results obtained by value $t = 5.333$, $p > 0.05$. This is consistent with the results of a research report that after exercise of moderate intensity (60%-80% HR Max) of total cholesterol decreased 4% after exercise and then increase 5-8% after 48 hours. Aquarobic dance according to the dose the proper training can help protect the cardiovascular system in many ways, it can help decrease in total cholesterol kolesterol. As a result of a decreased in the consumption of high-fat foods that are high in cholesterol, causing a decrease in dietary cholesterol absorption from the digestive system, the levels of cholesterol in the blood is also decreased.

LDL cholesterol levels before aquarobic dance is 137.75 ± 17.82 higher than the levels of LDL-C after aquarobic dance 123.92 ± 14.38 . Statistical test results obtained by value $t = 6.456$, $p > 0.05$. This is consistent with the results of a research report that after exercise of moderate intensity (75%-80% HRmax) in LDL cholesterol decreased 4% after exercise and then increase 5-8% after 48 jam. decrease in LDL cholesterol levels is likely due to of the decline in total cholesterol by 9.67%, given the LDL cholesterol is low-density lipoprotein cholesterol and cholesterol ester in high concentrations, therefore, when the total cholesterol level in the blood serum levels of LDL cholesterol low, the serum also lower. it this is consistent with previous research which states that the granting of aerobic exercise can lower cholesterol levels LDL. The other studies have shown that after aerobic exercise for 9 months significantly decreased of LDL cholesterol levels.

HDL cholesterol levels after aquarobic dance is 61.83 ± 4.85 higher than HDL cholesterol before aquarobic dance 57.17 ± 5.50 . Statistical test results obtained value with the value $t = -4.629$, $p < 0.05$. This is consistent with results of previous studies that doing aerobic exercise regularly can affect blood pressure, increase HDL cholesterol, improve insulin sensitivity and balance glukosa. increase in HDL cholesterol is likely due the increase apoprotein A-1 which is a precursor to the formation of cholesterol HDL, resulting in increased catabolism of triglyceride-rich lipoproteins, thus speeding up the transfer of the components of the surface portion HDL. (KANNAN1 et al. 2014) Increased lipoprotein cholesterol to HDL cholesterol levels aquarobic dance caused due to the use of fat as an energy source, resulting in a decrease in total cholesterol and Very low Density Lipoprotein (VLDL), which eventually led to increased HDL cholesterol, (Quig et al. 1983; Ghouse et al. 1997) other possibilities due to the decreased activity of hepatic lipase (HL) and increased activity of the enzyme lecithin cholesterol acyltransferase (LCAT). The other studies have reported the existence are Some pa theories that try to explain the mechanism of the increase in HDL cholesterol due to physical exercise: (1) Physical exercise will increase the activity of the enzyme lipoprotein lipase (LPL) in the muscle tissue and fat tissue, which resulted in the catabolism of VLDL increased, so that ultimately will increase the levels of HDL cholesterol in plasma, because the components of the result is one of the VLDL catabolism of HDL cholesterol forming. Physical exercise will reduce the activity of Hepatic triglyceride-hydrolase enzyme in the liver, thus inhibiting the catabolism of cholesterol HDL.32 In general, an increase in the intensity of exercise (80% of the maximum DN) associated with HDL cholesterol tinggi.33 analysis of the dose-response exercise that shows that a volume of training with burning 1200-2200 calories/week is an effective exercise, may increase HDL cholesterol (2-8 mg/dL). (Nieman et al. 2002)

TG before aquarobic dance is 119.17 ± 35.14 higher than after aquarobic dance 99.33 ± 29.95 . Statistical test results obtained using a t-test value of $t = 2.668$ with $p < 0.05$. The results of this study support that a volume of training with burning 1200-2200 calories/week is an effective exercise can lower triglycerides (5-38mg/ dL).(Nieman et al. 2007, Donges et al. 2010) When the fat intake less then the TG secreted to the blood too little, so that the levels of triglycerides in the blood serum is lower. A decrease in total cholesterol and TG levels associated with a reduction in LDL cholesterol. LDL cholesterol is the result of metabolic waste that releases VLDL triglycerides and its density is reduced so that gradually turns into cholesterol LDL.(Halbert et al. 1999)

Discussion: Physical activity is an important determinant of energy expenditure and regular exercise is essential for weight control and weight loss. The awareness about complications of obesity and the significance of exercise in reduction of cholesterol levels are becoming popular amongst people that are obvious with increase in the number of people walking for health, moving towards gyms and various physical activities. The response of the lipid profile to an exercise session or training program is dependent on the type of exercise undertaken, its intensity and frequency, the duration of each session, and the time spent on such a program.

Lipoproteins are transport vehicles in the circulation plasma that are composed of various lipids such as cholesterol, phospholipids, triglycerides and proteins known as apoproteins. The major classes of lipoproteins are chylomicrons, very low-density lipoprotein cholesterol (VLDL-C), LDL-C, and HDL-C. Chylomicrons are the largest lipoproteins, consisting of approximately 85% triglycerides. Triglycerides are the main type of lipids found in adipose tissue and in the diet. Once the triglycerides are removed from the chylomicron at receptor sites in the body, the chylomicron remnant is returned to the liver for further metabolism. The principal lipid of VLDL-C is also triglycerides (60 - 70%). On the other hand, HDL-C has an inverse relationship with coronary heart disease, offering a protecting mechanism against the development of CHD (Kannel, Castelli, & Gordon, 1971) . HDL-C is considered to be the most powerful lipid parameter for predicting CHD in people of all ages (Gordon et al., 1977) . The primary function of HDL-C is to transport cholesterol from the tissues and blood to the liver for excretion from the body or synthesis into bile acids. HDL-C also prevents the uptake of LDL-C at receptor sites in the body and participates in the metabolism of other lipoproteins.

HDL-C is predominantly composed of phospholipids and is separated into several subclasses, based on size and particle density. The major subclasses are referred to as HDL2 and HDL3. It is known that females have a higher content of HDL2 than males, which helps to protect women from developing CHD (Wood & Haskell, 1979) . Women generally have lower total cholesterol and LDL-C values than men. After menopause, these values equal or exceed those of men, however (Heiss et al., 1980) . Women also tend to have higher HDL-C (mainly HDL2) and lower triglyceride concentrations than men. This may be partially explained by the relatively higher lipoprotein lipase activity in women (Haskell, 1984) . Also, estrogen seems to have a major role in lowering the risk of CHD for premenopausal women (Manson et al., 1992). However, female sex hormones, found in oral contraceptives or used in hormone replacement therapies have variable effects on lipoprotein profiles. Additionally, women who consume alcohol in moderation tend to have higher HDL-C levels than nondrinkers; while women who smoke have much lower levels than nonsmokers. The importance of exercise has been emphasised in our study and it has been suggested that exercise prescription should be based on the health and fitness levels of the individual. It should be progressively introduced to individuals who are relatively sedentary and overweight. Instead of using lifestyle modification as a treatment measure after the onset of the disease, approach to weight reduction and improvement in cardiovascular fitness should include physical activity and diet modification which was a limitation of this study. Long term studies are required to confirm these findings. High intensity intermittent exercise which can be done for 15 – 20 min for 3-4 days/week has produced a significant change in the HDL and TG.

Conclusion

Based on the results of statistical calculations, theoretical discussion and support a review of the above, the conclusion can be drawn as follows: 1) aquarobic exercise program with intensity of 60-85% HRmax, 3 times/week for 12 weeks turned out to be statistically have a significant effect on blood lipid profile and in particular lead to a decrease in total cholesterol, LDL cholesterol and TG; 2) exercise the same aquarobic dance also statistically affect increasing HDL cholesterol is another fraction in blood lipid profiles.

Aquarobic dance it was benefits to the health, increasing HDL and appearance characterized by decreased body fat percentage and skin fat lipolytic is more active than the fat from other deposits. Aquarobics exercise can be used as effective non-pharmacological treatment to prevent diseases. Program for management lipid profile or blood cholesterol with exercise aquarobic dance should pay attention to dose adequate exercise, and avoiding the imposition of self (out of the concept of exercise aerobic) while keeping the possibility of accumulation of lactic acid in the blood, which is less favorable to the formation of HDL cholesterol in the body.

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