ABSTRACT

Type 2 diabetes mellitus (DM) and coronary heart disease (CHD) are metabolic diseases that cause a lot of complications. Regular physical exercise and programmed to prevent or delay the onset of type 2 diabetes and CHD. Previously, the preferred dose of physical exercise is the duration and frequency but now attention shifts to the intensity because the intensity determines the metabolic pathways. But the intensity of physical exercise effective influence is still much debated. Physical exercise of high intensity (anaerobic) and low intensity physical exercise (aerobic) is still done separately. Aerobic physical exercise is primarily to improve the functional capacity of cardiorespiratory system and improve blood circulation, including coronary artery so as to reduce the risk of CHD. Type 2 diabetes may increase the prevalence of CHD of about 2-4 times compared to non-DM. DM patients decreased insulin receptor sensitivity and a decrease in T4 Glu (Glucose Transporters) that resulted in carbohydrate and lipid metabolism disorders. Exercise regular intervals can help control blood glucose levels and dyslipidemia in order to prevent the occurrence of CHD, it can even prevent or delay the onset of type 2 diabetes in people who have risk factors. This review aims at finding an effective intensity of physical exercise to reduce the risk of type 2 diabetes and CHD. Effective physical exercise is interval training is an anaerobic/aerobic, with work/rest ratio of 1:1. In conclusion, the anaerobic and aerobic physical exercise are combined in interval training is an effective physical exercise to reduce the risk of type 2 diabetes and CHD.

Keywords: type 2 diabetes, CHD, interval training

INTRODUCTION

Patients with type 2 diabetes who often do physical exercise experience less coronary heart disease (Coronary Heart Disease, CHD) Rothenbacher (2006) reported that physical exercise can prevent CHD regardless of age. According to research Pan XR et al (1986) in Da Qing China, diet and physical exercise in individuals who have impaired glucose tolerance (impaired glucose tolerance, IGT) can reduce the incidence of type 2 diabetes and reduce the incidence of CHD complications. The dose of physical exercise consists of frequency, duration, intensity and mode. Among the four components of exercise dose, the intensity is an important factor because it is a measure of the strength or energy stressor to the body to cause adaptation and determine the metabolic pathway (Bompa 1990). According to Abdul Rahman (2007) Aerobic exercise (low-medium intensity) were performed every day for 30-60 minutes with the intensity of 60-70 percent of HR max can increase the functional capacity of cardio respiratory system. This resulted in reducing the manifestations of type 2 DM and CHD. Jansen (2002) reported anaerobic exercise (high intensity) to increase the sensitivity of insulin receptors. This shows that the priorities that are focused on physical exercise among low-medium intensity (aerobic) with high intensity (anaerobic) is still much debated.

Manifestations and complications of type 2 diabetes control levels of CHD is caused by decreased blood glucose and dyslipidemia (Hammoud 2000: Heyden 1995). Has long been known, triad type 2 diabetes treatment consisted of diet, medication and physical exercise (Abdul Rahman 2007). In some studies, regular physical exercise and programmed with a good diet in patients with type 2 diabetes mellitus is to control blood sugar levels without medication (WHO 1994) Low-intensity physical exercise - moderate (aerobic) to control dyslipidemia. Aerobic physical exercise can increase the burning of body fat, lose weight, and prevent atherosclerosis, which can reduce the manifestations of type 2 diabetes and CHD (Sagiv 1994, Elwod 1997). Physical exercise of high intensity or anaerobic reserves will deplete muscle glycogen,
enhance glucose uptake thus increasing the control of blood sugar that results can prevent the manifestation of type 2 diabetes mellitus and CHD (Jansen 2002). The second difference of opinion between the high-intensity exercise (anaerobic) with low-intensity physical exercise (aerobic) has not received the meeting point so that physical exercise has not produced an effective effect. The number of patients with type 2 diabetes mellitus in Indonesia is always increasing. If the intensity of physical exercise effective influence can be found, the manifestation of type 2 diabetes and CHD can be prevented or reduced at once to save on the cost of medication type 2 diabetes and CHD.

Leon AS (1997) reported 70% of the adult population in the United States has CHD due to inactivity. Physical exercise is intended primarily to enhance endurance and cardiorespiratory fitness system with a frequency of 4-5 times per week and duration of 30-60 minutes, not to pay attention to the intensity. Sesso (2000) reported the influence of the intensity, duration and frequency of physical exercise on CHD. The intensity of exercise direct influence with the total energy used, while the duration and frequency did not influence directly. These data indicate the first duration and frequency but the main attention now shifts attention to the intensity, because intensity directly influences the path of energy system.

The intensity of physical exercise with a duration of <3 minutes predominantly anaerobic energy is used to form ATP or ATP-PC-PC-LA. Energy source that is used primarily carbohydrates. If more than 3 minutes duration or low-medium intensity exercise, predominant energy comes mainly from the aerobic process with lipid energy sources. In DM patients decreased insulin receptor sensitivity and a decrease in T4 Glu (Glucose Transporters) that resulted in carbohydrate and lipid metabolism disorders (Tuo Mileh 2001). Based on this fact combined anaerobic and aerobic physical exercise in interval training is more effective to control blood sugar and blood lipids. According to Nieman (1993) CHD is most often caused by arteriosclerosis. Many causes of arteriosclerosis such as hypertension, smoking, inactivity, age, and hyperlipidemia (Sagiv 1994). In type 2 diabetes mellitus is the most frequent cause of arteriosclerosis hyperlipidemia. Risk factor for type 2 diabetes mellitus and its complications is mainly due to hyperglycemia and hyperlipidemia. The intensity of physical exercise is primarily intended to lose weight and improve fitness. According to Elwood et al (1997) Physical exercise can reduce the risk of CHD through two mechanisms which reduce the tendency of blood clotting and thrombolytic blood. The research concluded, the diet effect lowering LDL cholesterol and also lowers HDL cholesterol, whereas physical exercise can increase HDL cholesterol and lowering LDL cholesterol. Based on this description of the most optimum to prevent atherosclerosis (CHD) is the combination diet with physical exercise. The effectiveness of physical exercise depends on the working interval (high intensity) and the intervals of rest (low intensity).

According to Hammoud et al (2000) found weight loss is greater in diet and physical exercise of high intensity physical exercise than diet and low intensity. Results of other studies, weight loss is very effective when the ratio of interval work/rest balance. Based on this description it is to prevent the onset of type 2 diabetes and CHD most effective is to combine aerobic exercise with anaerobic physical in interval training with work/rest ratio of 1: 1.

**DISCUSSION**

**Interval Exercise Effects on Type 2 DM and CHD**

Interval training is a physical exercise that consists of periods of work interspersed with periods of rest (Fox 1984, Smith 1983), or interval training is a series of physical exercises which are repeated periods of work interspersed with periods of rest (Fox & Mathew 1981). Period of work done with high intensity (anaerobic) and performed with periods of rest or low intensity aerobic (Hallozy et al 1986). Comparison of time between work periods with rest periods are stated with comparative figures for example 1: ½: 1; 1: 3 ff. Ratio 1: 3 shows the time period of rest 3 times the period of employment. Comparison of the time period of work with periods of rest is adjusted with the aim of the exercise program (Fox, Bowers and Foss 1984). According to Sagiv (1994) interval exercise program for weight loss best use the Work/Rest Ratio 1: 1. means the time period of cooperation with periods of rest. Lee IM (1995) reported the intensity of interval training can be measured by the frequency of heart beats per minute (HR), speed and blood lactate threshold. According to The American College of Sports Medicine (ACSM), the intensity is not based on Heart Rate (HR) max. but based on the Heart Rate Reserve (rate recovery). Intensity> 40-60% recovery was for> 150 minutes per week or> 60% recovery was for> 90 minutes per week to reduce CHD. According to Caspersen et al (1985) to prevent the complications of type 2 diabetes mellitus on the cardiovascular system of physical exercise dosage type 2 DM patients as follows: frequency of 3-4 times per week, 20-60 minutes duration and intensity of VO2 max 50-85. Complications of Type 2 diabetes is caused by blood glucose levels are not controlled and hyperlipidemia (Price & Wilson 2005, Ganong 1998).
Physical exercise of high intensity, short duration (anaerobic) metabolic pathway taken through the ATP-PC-LA or enhance anaerobic glycolysis. Low-intensity physical exercise is a long-term (aerobic) metabolic pathway taken is improving lipid metabolism. Impaired lipid metabolism in type 2 diabetes may increase CHD about 2-4 times compared to non-DM (Hammoud 2000). The most common cause of CHD is atherosclerosis (American Diabetes Association 1994), and the most common cause of coronary artery atherosclerosis was dyslipidemia (Goraya et al 2002, Heyden 1995). Based disorders that are less good glucose control and dyslipidemia are the anaerobic and aerobic physical exercise are combined in interval training is an effective physical exercise to reduce the risk of type 2 diabetes and CHD.

**High Intensity Physical Exercise Effects (anaerobes) in the interval exercise on type 2 diabetes and CHD**

The dose of physical exercise consisted of exercise per week frequency, intensity, type or mode and duration. Among the four of the most decisive components of the metabolic pathway is the intensity. Physical exercise is anaerobic exercise with high intensity, lasted less than 3 minutes, using ATP-PC energy source, ATP-PC-LA or LA-O2 (Caspersen 1985, Bompa 1990, Foss 1998), which used energy source is carbohydrate.

Effects of anaerobic exercise on muscle, increasing glycolytic enzyme activity resulting in increased muscle glycogen solution. Muscle glycogen depletion would be balanced plasma glucose entry into cells that result in decreased plasma glucose levels. In patients with type 2 diabetes mellitus decreased insulin receptor sensitivity and a decrease in Glu T4, causing disruption of carbohydrate and lipid metabolism (Tuo Mileh 2001). Anaerobic physical exercises regularly will increase the sensitivity of insulin receptors and increased Glu T4 (Glucose Transporters) on the surface of the cell membrane, resulting in increased glucose entry into cells and result in lower levels of plasma glucose (Tuo Mileh 2001, Laughlin 1994). Decrease in blood glucose levels will prevent hyperglycemia, so that when blood glucose levels can be controlled properly, can prevent the manifestation type 2 diabetes and its complications. Effects of anaerobic exercise on the heart muscle is thickening of the heart septum interventricular, thickening of the back wall of the heart and the addition of left ventricular muscle mass. As a result of this anaerobic exercise will increase the strength of heart muscle contraction, improve blood circulation thus improving general fitness.

**Physical Exercise Effects of Low-Moderate Intensity (Aerob) on interval exercise on type 2 DM and CHD**

Physical exercise is aerobic exercise Fisk with low-medium intensity, place in a period of more than 3 minutes, predominant energy using oxygen, with a source of lipid energy. Aerobic physical exercise is primarily to improve the functional capacity of cardiorespiratory system (Cooper 2001, Kannel 1993). Aerobic physical exercise will improve blood circulation, including coronary artery so as to reduce the risk of CHD aerobic physical exercise causes blood flow to active muscles to grow, especially members of the upper and lower. The blood vessels leading to the active muscle vasodilatation, resulting in prisoners edge down, blood pressure decreased (Foss 1998, Abdul Rahman 2007) type 2 diabetes may increase the prevalence of CHD of about 2-4 times compared to non-DM (Hammoud 2000) Diabetes is a risk factor for CHD. The most common cause of CHD is atherosclerosis. Stacked LDL is oxidized by oxidant compounds. Oxidized LDL is cytotoxic and damage endothelial cells and foam.

Lightly oxidized LDL trigger gene for Cell Adhesion Molekule (CAM), a variety of chemokine genes and various growth factor genes. The cause of atherosclerotic coronary artery approximately 49% for DM and 33% for non-DM (Goraya et al 2002, Narayan 2000). The most common cause of atherosclerosis is dyslipidemia. Heyden (1995) reported type 2 diabetes who have dyslipidemia disorders by 80% and CHD by 74%. Lipid profile in CHD, especially an increase in LDL-C and decrease HDL-C. Kanel WB et al (1993) reported that CHD patients with DM and an increase in total cholesterol, LDL-C, VLDL and triglycerides. According Katzel et al (1995) treatment for DM and CHD is primarily intended to address dyslipidemia aerobic physical exercise increases fat burning, lowering LDL-C, increased HDL-C, reduce atherosclerosis, weight loss, lowering blood pressure so as to reduce the risk of CHD ( Laughlin 1994, Tanasescu 2002, Thomson 2003). Aerobic physical exercise that predominantly uses energy body fat is low impact aerobic moderate intensity, duration approximately one hour (Sagiv 1994). Physical exercise can reduce anxiety so it does not increase steroid hormones. Increased steroid hormone will increase blood glucose levels. The manifestation of the common causes type 2 diabetes is obesity, so weight-loss program is the main target.
CONCLUSION

Exercise intervals have prospects to prevent or delay onset of type 2 DM and CHD because of anaerobic interval training can effectively control blood sugar levels and aerobic interval training can effectively control blood lipid levels, so need to study empirically.

REFERENCES