AEROBIC EXERCISE DECREASE CHOLESTEROL LEVELS IN TYPE 2 DIABETES MELLITUS PATIENTS

Cecep Triwibowo[1], Evi Nurjannah[2], Ikha Fitriyana[3], Yulia Fauziyah[4*]

[1]Lecturer of Nursing Program, Health Polytechnic, Health Ministry of Republic Indonesia, Medan
[2]Student of Nursing Program, College of Health Sciences Mahardika, Cirebon
[3] Lecturer of Nursing Program, College of Health Sciences Mahardika, Cirebon
[4*]Doctoral Student, Medical Faculty, Universitas Gadjah Mada, Yogyakarta, 087839553465
Corresponding author email address: yulfah23@gmail.com

ABSTRACT

Elevated cholesterol level is one of the risks for cardiovascular disease in diabetes mellitus. Exercise is one of therapy in patients with diabetes mellitus. The purpose of this study is to determine the effect of exercise on decrease cholesterol levels in patients with diabetes mellitus. This study used pre-post test one group design. Twenty-two patients with diabetes mellitus followed the intervention which is a twice a week exercise for 4 weeks. Cholesterol levels were measured before and after exercise. Data were analyzed by dependent T-test. Cholesterol levels in patients with diabetes mellitus before the exercise reached 261.18±49.013 mg/dL and after intervention decreased to 224.41±26 mg/dL. Dependent t-test showed differences in cholesterol levels before and after exercise in patients with diabetes mellitus ($p<0.05$). Exercise can lower cholesterol levels in patients with diabetes mellitus.

Keywords: cholesterol, diabetes Mellitus, exercise

ABSTRAK

Peningkatan kadar kolesterol merupakan salah satu risiko untuk penyakit kardiovaskuler pada diabetes mellitus. Olahraga merupakan salah satu terapi pada pasien diabetes mellitus. Tujuan dari penelitian ini yaitu untuk mengetahui pengaruh olahraga dalam menurunkan kadar kolesterol pada pasien diabetes mellitus. Penelitian ini menggunakan rancangan pre-post test 1 kelompok. Dua puluh dua pasien diabetes melitus mengikuti intervensi yaitu olahraga setiap 2X/minggu selama 4 minggu. Kadar kolesterol diukur sebelum dan sesudah olahraga. Data dianalisis dengan dependent T-test. Kadar kolesterol pasien diabetes melitus sebelum olahraga mencapai 261,18±49,013 mg/dL dan setelah olahraga mencapai 224,41±26 mg/dL. Dependent t-test menunjukan terdapat perbedaan kadar kolesterol sebelum dan sesudah olahraga pada pasien diabetes mellitus (p<0.05). Olahraga dapat menurunkan kadar kolesterol pada pasien diabetes melitus.

Kata kunci: kolesterol, diabetes Melitus, olahraga

BACKGROUND

Diabetes is a chronic metabolic disease whose prevalence continues to increase. According to Shaw et al. (2010), the prevalence of diabetes in 2010 reached 6.4% and is expected to increase 7.7% by 2030. More than 80% of deaths in patients with diabetes mellitus occur in countries with low to medium income per capita. This death is expected to double by 2030. In 2010, Indonesia ranks as the ninth largest

number of diabetics in the world (age range between 20-79 years). The sequence above is Japan, Pakistan, Germany, Brazil, Russia, United States, China, and the top order is in India. By 2030, it was predicted that the prevalence of diabetes in Indonesia will increase and occupies the sixth largest number of diabetics in the world (Shaw et al., 2010). Furthermore, based on Riskesdas in 2013, the prevalence of diabetes mellitus in Indonesia tends to increase by 1.1% in 2007 to 2.4% in 2013 (Kementerian Kesehatan Republik Indonesia, 2013). Data from the Cirebon District Health Office (2012) stated that the number of DM patient visits in 2010-2012 has increased to 6989 visits, with the highest DM patient visit rate in 2012 was in Suranenggala Community Health Centers which reaching 974 visits. The prevalence of type 2 diabetes mellitus is greater than type 1 diabetes mellitus. The prevalence of type 2 diabetes mellitus reaches 90-95% of all people with diabetes mellitus. Thus, people with diabetes mellitus type 1 only range 5-10% (Sachdev, 2009)

Type 2 diabetes mellitus tends to develop in people with obesity with sedentary life. Accumulation of lipids is increasing because it is not used as energy for skeletal muscle movement. The accumulation of lipids activates secretion of chemical mediators, leptin, which is detrimental to the function of insulin receptors and decreases the number of insulin receptors resulting in insulin resistance. Failure of insulin action causes glucose cannot be processed into energy and stimulates the occurrence of lipolysis in adipose tissue that affects the increase in cholesterol levels (Kelner, 2003; Nathan, 2010)

Excess cholesterol is a risk factor for cardiovascular disease (Femlak et al., 2017; Gylling et al., 2004). Excess cholesterol can form deposits in blood vessels resulting in narrowing of the blood vessels called atherosclerosis. Further, it leads to complications in diabetes mellitus (Kelner, 2003). Several studies have successfully proven that cholesterol levels in patients with diabetes mellitus was higher than in healthy individuals (Menik et al., 2005; Mohamed et al., 2004). Normal cholesterol levels is below 200 mg/dL, but in diabetic patients cholesterol levels reached >200 mg/dL. Keeping cholesterol levels within normal range is very important for diabetic patients to lower their risk of cardiovascular disease (Shepherd et al., 2006).

Exercise is one of therapy regiment for diabetes mellitus patient. Several studies have shown that exercise can reduce hyperglycemia in diabetes (Casman et al., 2015; Colberg et al., 2010). Exercise has also been found to increase insulin production and improve insulin resistance in diabetes mellitus (Way et al., 2016). Furthermore, exercise can also decrease body weight, body fat percentage, and cholesterol levels in obese adolescents (Utomo et al., 2012; Wahyu, 2008). The purpose of this study is to determine the effect of exercise in lowering cholesterol levels in patients with diabetes mellitus.

METHOD

This research was a quasi-experimental research with a one-group pretest-posttest design. The aerobic exercise given to participants was adopted from Sari (2012) and Ilyas (2005). Aerobic exercise was performed 2 times/week for 4 weeks with mild-moderate intensity which is 60-70% of the maximum heart rate (MHR). MHR is obtained with a calculation of 220 minus

age (220-age). Next, the heart rate target (THR) is calculated at 60% of MHR.

The aerobic exercise consists of 3 stages of the warm-up, the main program, and the cool-down with a total duration of 30 minutes. Warming-up session aims to adapt the heart, launch blood circulation, and relax the muscles of the body for relaxation. In the main program, the pulse is targeted to achieve THR. Cooling down session aims to prevent the accumulation of lactic acid. In cooling-down session, the pulse should reach the resting pulse of 80-100 times/min.

Twenty-two diabetic patients, taken from a Community Health Centre in Suranenggala Cirebon, volunteered to be participants in the study. The inclusive criteria were willing to be a respondent by signing informed consent, having diabetes mellitus for more than 1 year, compos mentis, and having cholesterol level above 200 mg/dL. Cholesterol measurement was done before and after intervention by using cholesterol test, easy touch GCU brand. Dependent t-test was performed to determine the differences. It was indicated by p-value<0.05.

RESULTS

Table 1 showed the characteristics of respondents. The majority of respondents is male, aged between 41-50 years old, and is junior high school educated.

Table 1. Characteristics of Respondent (n=22)

Characteristics	N (%)
Age	
31-40	5 (22,7)
41-50	11 (50)
51-60	6 (27,3)
Sex	
Male	13 (59)
Female	9 (40,1)
Education	
Elementary School	7 (31,8)
Junior High School	9 (40,9)
Senior High School	6 (27,3)

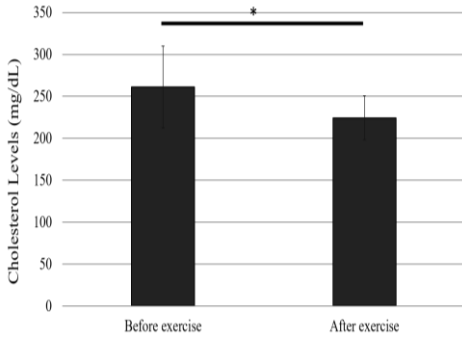

Figure 1. Effect Aerobic Exercise on Cholesterol Levels in Type 2 Diabetes Mellitus Patient. *shows statistical test results P <0.05.

Cholesterol levels of patients with diabetes mellitus were shown in Figure 1. The results of Shapiro-Wilk test, data were normally distributed. Dependent t-test showed p-value<0.05 (0.000). Therefore, cholesterol levels after aerobic exercise (224.41±26) were significantly lower than before aerobic exercise (261.18±49.013) (p <0.05).

DISCUSSION

In this study, the majority of respondents is male, aged between 41-50 years old, and is junior high school educated. Based on the Riskesdas of 2013, the prevalence of diabetes mellitus increases with age, but at age ≥ 65 years it tends to decrease. The prevalence of diabetes mellitus is highest at age between 55-64 years old and lowest at 15-24 years old. Meanwhile, the prevalence of diabetes between the ages of 45-54 is in the third rank (Kementerian Kesehatan Republik Indonesia, 2013). The increasing rate of prevalence of diabetes in developing countries is higher than in developed countries. Furthermore, epidemiological studies in 2011 showed the majority of diabetics are at productive age of 40-60 years. While in the developed world, the

majority of diabetics are at age ≥60 years (Shaw et al., 2010; Whiting et al., 2011).

The prevalence of diabetes in most Indian populations was at the age of 60-69 years, while in Chinese population, the prevalence of diabetes was highest at the age of 79-89 years. Nevertheless, the prevalence of diabetes in young adulthood will continue to increase. In Chinese population, the prevalence of diabetes at age 35-44 increased sharply by 88%. While in Indian population the prevalence of diabetes at age under 44 years increased by 11% (Ramachandran, 2012). This shift is caused by several factors including lifestyle changes such as sedentary life, lack of exercise, and obesity (Ramachandran, 2012; Shaw et al., 2010; Whiting et al., 2011). According to Riskesdas 2013, the prevalence of diabetes mellitus in women is higher compared with men. The prevalence of diabetes mellitus tends to be higher in individuals with higher education levels and with high ownership index quintiles (Kementerian Kesehatan Republik Indonesia, 2013). Those are contrary to the results of this study.

Respondents in this study were found to have high total cholesterol levels. Several studies have found similar results. Elevated cholesterol levels was found in diabetes mellitus patients (Clarkson et al., 1996; Menik et al., 2005; Mohamed et al., 2004; Wahyudi et al., 2015). However, research by Gylling *et al*. (2004) states that cholesterol levels in patients with diabetes mellitus did not differ significantly with healthy individuals.

Hyperglycemia causes abnormal lipid metabolism characterized by elevated levels of cholesterol and triglycerides in the blood. Insulin in adipose tissue serves to inhibit lipolysis. However, but insulin resistance in diabetes mellitus causes insulin fail to enter adipose tissue which later affects triglyceride lipolysis and produces excess free fatty acids. Free fatty acids then enter the liver tissue and re-formed into triglycerides and trigger the secretion of VLDL (very low-density lipoprotein) that is rich in triglycerides. VLDL-rich triglycerides exchange with HDL (high density lipoprotein)-cholesterol that produces HDL with high triglycerides and low cholesterol. HDL-rich triglycerides were easy to be catabolized by kidneys, thus the amount of HDL in the plasma is reduced. Reduced HDL in plasma causes a failure of cholesterol transport process into the liver resulting in an increase in total cholesterol levels in the blood (Adiwijono & Ahmad H., 1993; Krauss, 2004; Price, 2005; Sudoyo, 2009). High cholesterol in diabetes mellitus causes various complications such as micro-macro vascular disease, coronary heart disease, atherosclerosis, myocardial infarction, cardiac arrest, and stroke (Bays, 2014; Shepherd et al., 2006). Decreased cholesterol levels would improve those complications (Mohamed et al., 2004).

In this study, it was found that aerobic exercise could reduce cholesterol levels in patients with diabetes mellitus. Diabetic patients showed lower cholesterol levels following aerobic exercise 2X/week for 4 weeks. However, it has not reached normal range. Thus, to lower cholesterol levels to the normal range, longer-term aerobic exercise would be probably needed. Gordon et al. (2008) had proven that aerobics for three months succeed in lowering cholesterol levels of patients with diabetes mellitus. Honkola et al. (1997) confirmed that cholesterol levels of diabetic patients

after doing exercise for 5 months was lower than before exercise. On the other hand, Maiorana et al. (2001) found exercise for 8 weeks has no significant effect on cholesterol levels in patients with diabetes mellitus.

Exercise improves insulin resistance through the use of lipids as an energy source, thus insulin can enter the cells and prevent lipolysis (Colberg et al., 2010). Exercise had also been found to increase HDL production that affects the process of transporting cholesterol in the blood, thus it lowers blood cholesterol levels (Ahn and Kim, 2016; Hayashino et al., 2012; Zoppini et al., 2006). Finally, exercise can alter the structure of protein cholesterol carrier particles to be not easily oxidized. In diabetes, LDL was easily oxidized (Kelley and Kelley, 2007).

CONCLUSION

The conclusion of this study was aerobic exercise decrease cholesterol levels in patients with diabetes mellitus.

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