

Original Research Article

Non-Weight-Bearing Exercise on Type 2 Diabetic Patients with Neuropathy

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ABSTRACT

Introduction: exercise can regulate blood glucose but it's can risk of injury on type 2 diabetic patients with neuropathy.

Materials and Methods: aim of the study to analysis effect of non-weight-bearing exercise on glycemic control of type 2 diabetic patients with neuropathy. Design of study was use quasi experiment with one group pre and post test design. The study was conducted at Mengwi III Public Health of Badung, Bali 2015. The experiment was static bicycling 30 minutes 3 times a week for 4 weeks. Size of samples was 30 respondents that collected by using purposive sampling. Glycemic control was measured by fasting blood glucose, total cholesterol and blood pressure.

Result: age of respondents was ranged 45-59 years old with mean 56.43 years old. Which suffered diabetic neuropathy in 3-5 years? Mean of indicator of glycemic control before exercise fasting blood glucose level 181.63 mg%, total cholesterol 214.63 mg/dl, blood pressure 143.33/90.53 mmHg. After exercise fasting blood glucose level 164.63 mg%, total cholesterol 189.43 mg/dl, blood pressure 137, 93/85, 83 mmHg.

Discussion: there are decrease of mean of indicator of glycemic control after exercise, fasting blood glucose 17.00 mg%, ($p = 0.001$), total cholesterol 25.20 mg/dl, ($p=0.001$) and blood pressure 5.40/4.70, ($p=0.001$). It means there is significant effect of non-weight-bearing exercise on glycemic control of type 2 diabetic patients with neuropathy.

Keywords: Diabetes Mellitus, Non-Weight-Bearing Exercise, Glycemic Control.

INTRODUCTION

Diabetes mellitus (DM) is a heterogeneous group of disorders characterized by increased levels in the blood or hyperglycemia glucose. ^[1] Diabetes is one of the non-infectious diseases that will increase in the future. ^[2] The prevalence of DM in five areas of special regional capitals (DKI) Jakarta is 12.1% with diabetes mellitus were detected by 3.8% and diabetes mellitus were not detected at 11.2% within 30 years of Indonesia's population will rise by 40 % with an increase in the number of diabetics are much greater,

namely 86.13%. ^[2] The prevalence of DM in Bali in 2010 was 3735 people, with as many as 1297 DM type 1 patients (34.73%) and type 2 DM patients as much as in 2438 (65.27%). ^[3]

High incidence of diabetes associated with life style factors. Cases of type 2 diabetes usually have a background in disorders such as insulin resistance. Management of type 2 diabetes is focused on controlling the pattern of life of people with diabetes through the four pillars of the management of DM Education, hypoglycemic agent, exercise and diet. The

main goal of diabetes management is to achieve good glycemic control. Indicators of glycemic control in patients with diabetes are fasting blood glucose, A1C, total cholesterol and blood pressure. [4] In order to achieve glycemic control one of them is by exercise.

Exercise on Type 2 diabetes play a major role in regulating blood glucose levels. The main problem in type 2 diabetes mellitus is a lack of response from insulin receptors to insulin, so insulin can't enter to the cells of the body except the brain. Exercise-induced muscle contraction does not require insulin for glucose to enter to the cells, due to active muscle insulin sensitivity is increased. [2]

The recommended exercise is aerobic. Exercise aims to improve the fitness of patients with diabetes mellitus type 2. The fitness (VO₂ max) of patients with type 2 diabetes is lower than in non-DM. [5] The combination of aerobic exercise with resistance exercise can improve glycemic control (A1C). After the exercise A1C decrease of 0.34% on patients with type 2 diabetes. [6] Aerobic exercise may improve glucose tolerance on pre-diabetic patients. [7] A1C decline in of 0.51% on aerobic exercise, the exercise by 0.38% and 0.46% of combination exercise for 26 weeks. [8]

Aerobic exercise also has side effects. One side effect is the injury. Especially in patients who have neuropathy. Musculoskeletal injuries can occur until the occurrence of foot infections on diabetic patients with neuropathy. It is recommended aerobic exercise without burdening the body weight (non-weight-bearing exercise). PERKENI recommended exercise is aerobic exercise with mild to moderate intensity. [4] DM patients with neuropathy should avoid exercise that could injure his/her leg. Advised to exercise stationary bike to reduce the risk of injury.

Aerobic exercise can decreasing of HbA1C 8.31%. [9] Regular exercise once a week for three months combined with a diet can decrease the risk of type 2 diabetes in

patients with impaired glucose tolerance. [10] All of these studies illustrate aerobic weight bearing exercise wit. The exercise is a risk of injury in people with diabetes who have neuropathy. Exercise aims to control blood glucose levels, but exercise can also cause injury to patients with neuropathy.

MATERIALS AND METHODS

The design of this experiment is a quasi-experimental with one group pre and post test design. The experiment is non-weight-bearing exercise which is a stationary bike. This treatment is done 30 minutes, 3 times a week for 4 weeks. Exercise intensity is moderate with a target heart rate of 70%. Exercise begins with warming up and cooling up for 15 minutes. Pre-test was done in the morning. Post test done after the package is completed treatment (4 weeks) in the morning as well. Exercise conducted in the afternoon alternately. Measurement of indicator of glycemic control are fasting blood glucose levels in mg%, total cholesterol levels in mg/dL and blood pressure in mmHg.

The study was conducted at the health center Mengwi III, Badung Bali. The research was conducted from January to November 2015. Data collection and treatment carried out from June to August 2015. The number of samples was 30 type 2 diabetes patients with neuropathy and takes hypoglycemic agent and diet DM type 2. Samples were taken by purposive sampling method. Respondents of this study are Type 2 Diabetic Patients.

RESULTS

Characteristics of respondents found that aged between 45-59 years with an average of 56.43. Male 25 people (83.3%) and 5 women (16.7%). Older type 2 diabetes mellitus between 3 to 5 years with an average of 4.37 years, indicating that the respondent has suffered long enough with type 2 diabetes.

Indicator of glycemic control as measured pre and post test that fasting blood

glucose, total cholesterol and blood pressure (systolic and diastolic).

Table 1: Indicator of Glycemic Control of Respondents

Variable	Pre test	Post test	Different of mean	p
Fasting blood glucose	181.63	164.63	17.00	0.001
Total cholesterol	214.63	189.43	25.20	0.001
Systolic blood pressure	143.33	137.93	5.40	0.001
Diastolic blood pressure	90.53	85.83	4.70	0.001

Fasting blood glucose levels pre test of respondents in the category of poor glycemic control (greater than 126 mg%). Total cholesterol levels in the category of moderate glycemic control (200-239 mg/dl). Systolic blood pressure in the category of bad glycemic control. Diastolic blood pressure in the systolic blood pressure control category glycemic medium (above 80-90 mmHg).

Fasting blood glucose levels of post test in the category of poor glycemic control (greater than 126 mg%). Total cholesterol levels in the category of good glycemic control (below 200 mg/dl). Systolic blood pressure in category glycemic medium (above 130-140 mmHg). Diastolic blood pressure in category glycemic medium (above 80-90 mmHg).

DISCUSSION

Glycemic control is an indicator of the success of management or the management of DM. [2] The results showed that glycemic control before being given a workout or exercise stationary bike three times a week for 4 weeks in the category of moderate to poor. Fasting blood glucose levels of 130-189 with an average of 164.63. This indicates the category of poor glycemic control. Categorize of glycemic control based on fasting blood glucose levels into 3 good when 80-fasting blood glucose levels < 100 mg%, while when the fasting blood glucose levels 100- < 125 mg% and worse when fasting blood glucose levels ≥ 126 mg%. [4]

Fasting blood glucose levels are high or hyperglycemia characteristic of DM. Type 2 diabetes occurs as a result of chronic hyperglycemic so insulin is not able to perform its function properly. Type 2 diabetes mellitus experienced two major

problems associated with insulin, namely insulin resistance and impaired insulin secretion. In a state of physiological (normal) pancreatic insulin secreted be bound by specific receptors on the cell surface. As a result of insulin bound to the receptor, there is a series of reactions in the metabolism of glucose in the cell.

Insulin resistance in type 2 diabetic is accompanied by a decrease in intracellular reactions. Ineffective insulin to stimulate glucose uptake by the tissues. Insulin resistance and prevents the formation of glucose in the blood, there must be an increase in the amount of insulin secreted. Beta cells are not able to offset the increase in the need for insulin, the glucose levels will rise and occur diabetes type 2. As a result of glucose intolerance that is slow (for years) and progressive, then the onset of type 2 diabetes may go undetected. [1] When the body is deficient which may in relative terms, an increase in blood glucose levels and cause hyperglycemia. Increasing levels of insulin resistance can be seen from the increase in fasting blood glucose and postprandial. [11]

High levels of total cholesterol are associated with hyperglycemic diabetic patients. Chronic hyperglycemic causes gluconeogenesis namely the breakdown of fat and protein into glucose. The breakdown caused big fat metabolism. This will lead to an increase in total cholesterol levels in the blood. [12] Patients with type 2 diabetes, dyslipidemia commonly found, if not in good glycemic control. High insulin and insulin resistance in type 2 diabetes mellitus have a variety of effects in metabolism: (1) a decrease in the activity of LPL resulting in decreased catabolism of chylomicrons and VLDL, (2) an increase in the release of free fatty acids from adipose tissue, (3) an

increase in fatty acid synthesis in liver, (4) an increase in hepatic VLDL production. Patients with type 2 diabetes have lipid abnormalities, including elevated plasma triglycerides (associated with increased VLDL and remnant lipoprotein), LDL, and decreased HDL-cholesterol. [13]

Hypertension caused by endothelial dysfunction is an important factor in the high incidence of vascular disease in individuals with both the above conditions. Insulin resistance and hyperinsulinemia is closely related to an increase in plasma triglyceride levels, low HDL, and LDL-cholesterol levels in total. Hyperinsulinemia is also associated with atherosclerosis by affecting fibrinolysis. The effects of insulin are allegedly associated with atherosclerosis is to stimulate the proliferation of subintimal smooth muscle and fibroblasts, enhancing uptake and esterification lipoprotein-cholesterol by smooth muscle, increase the release of platelet-derived growth factor and insulin-like growth factor, increase the synthesis of connective tissue, Lowers disposal of cholesterol from foam cells in the blood vessels subintimal area. [14] Hypertension is also related to the characteristics of the respondents that the average age of respondents 56.43 which is the life of older adults. Gender mostly male. Both age and gender is a risk factor for hypertension.

Glycemic control measured twice before and after exercise with a stationary bike. These results indicate that there is a decline of the indicator of glycemic control. The indicator is a fasting blood glucose, total cholesterol and blood pressure (systolic and diastolic). A decrease in blood glucose of 17.00 mg% (9.36%), a decrease in total cholesterol by 25.20 mg/dl (11.65%), decreased systolic blood pressure by 5.40 mmHg (3.77%) and a decrease diastolic blood pressure by 4.70 mmHg (5.19%). Of the five indicators that showed that total cholesterol levels were most substantial losses and fewest blood pressure declines. This is related to the characteristics of the respondents, including the age and sex of

the final adult male. Both are risk factors for hypertension.

Results of the data analysis shows that there are significant differences mean indicator of glycemic control (fasting blood glucose, total cholesterol and blood pressure) before and after exercise. Decline in fasting blood glucose, total cholesterol and blood pressure after exercise is done periodically in patients with type 2 diabetes mellitus with neuropathy. [15] A significant decrease of the fasting blood glucose, HbA1c, total cholesterol and blood pressure in patients with type 2 diabetes mellitus after walk scheduled at intervals of 3 minutes of brisk walking and a 3-minute walk slowly. [16]

Physical exercise causes local adaptations in the muscles, especially the increase in the activity of several enzymes of oxidative changes of the level of enzyme activity together with increase of the muscles active capillarity. Capillarity rising and short diffusion time associated with an increase in insulin sensitivity. Should exercise intensity and time sufficient to cause a change in the circulation and muscle. [4]

Regular exercise can facilitate glycemic control with insulin stimulating activity and the amount of the glucose transporter Glut 4 in the plasma membrane resulting in increased insulin sensitivity, increase muscle glycogen synthesis and storage. Insulin is a hormone that affects the dominant regulation of glucose metabolism in the human body. In the working muscles more sensitive to insulin than muscle does not move actively. Number of insulin receptors in the muscles that work more and more sensitive than the rest so that the muscle glucose uptake more. Sensitivity increase of muscle to insulin and increasing blood flow to the muscles work, the size of the capillary perfusion, the number of insulin receptors (Glut 4 factors) and sensitivity also increased so that ultimately in patients with type 2 diabetes mellitus these muscles can utilize glucose during exercise although insulin production in the

pancreas decreased. [2] At the time of exercise will be a contraction of muscle. Muscle contraction during exercise can improve insulin sensitivity and glucose uptake by muscle cells. Besides, it can also increase the flexibility of peripheral blood vessels, which in turn can reduce peripheral resistance so that blood pressure also decreased. [17]

Another glycemic indicator also declined among HbA1C, blood glucose 2 hours after a meal, LDL cholesterol, HDL, triglycerides and BMI both in DM patients with and without neuropathy. A significant decrease of total cholesterol, triglycerides after exercise regularly, lower post-exercise activity of lipoprotein lipase (LPL) to decrease the impact on serum lipid profile of patients with type 2 diabetes. [18] Decreasing mean of HbA1C and resting pulse after the exercise in type 2 diabetes patients with neuropathy. Found also that the decline neuropathy symptoms including pain and symptom scores neuropathy. [19]

HbA1C is hemoglobin bound to glucose through a process of non-enzimatic and is irreversible. HbA1c formation occurs slowly that for 120 days, which is the life span of red blood cells. HbA1 consists of three molecules; HbA1a, HbA1b and HbA1c by 70%, in the form of 70% HbA1c glycosylated (absorb glucose). Terglikolisasi amount of hemoglobin depend on the amount of glucose available. If the increased blood glucose levels over a long time, the red blood cells will be saturated with glucose produces glikohemoglobin. A1C is a long-term glucose control, describing the condition of 8-12 weeks earlier, because of part-time erythrocytes 120 days because they reflect the state of glycemic for 2-3 months then. [14] Results of this research is still in line with the study because of HbA1C is also an indicator of glycemic control.

This study has several limitations, not able to control the activities of the respondents outside the scheduled exercise. Respondents only do cycling three times a week for 4 weeks. Activities outside the

specified schedule can also affect glycemic control of respondents. Researchers are not able to control the quality and compliance of respondents to the diet. Diet and food consumption can affect glycemic control of type 2 DM patients.

CONCLUSIONS AND RECOMMENDATIONS

The mean of indicator of glycemic control prior to exercise is when blood glucose: 181.63 mg%, total cholesterol: 214.63 mg/dl, systolic pressure: 143.33 mmHg and diastolic: 90.53 mmHg. The average indicator of glycemic control after exercise when the blood glucose: 164.63 mg%, total cholesterol: 189.43 mg/dl, systolic pressure: 137.93 mmHg and diastolic: 85.83 mmHg. There is a sport without loading effect on glycemic control in type 2 diabetes patients with neuropathy ($p = 0.001$).

From the recommended for the nurses to provide non-weight bearing exercise for the patients type 2 diabetes with neuropathy to prevent injuries. Researchers are not able to control some confounding variable in this study, for it to further research in order to control the activities of the respondents outside the structured schedule in the treatment and control diet during treatment lasts respondents. Because these two variables can affect directly the indicators of glycemic control such as fasting blood glucose, total cholesterol and blood pressure.

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