Effect of Physical Activity on Fasting Blood Sugar Level, HbA1c and Total Cholesterol among Type 2 Diabetes Mellitus Patients in Medan City, Indonesia

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Abstract: Physical activity is an important role in diabetic patients. Physical activity done regularly and enough will help patients to blood sugar control and prevent complications and control the body weight. The aim of this study was to analyze the effect of physical activity on Fasting Blood Sugar Level, Hba1c and Total Cholesterol among Type 2 Diabetes Mellitus (T2DM) patients in Medan City. The study design was analytic with cross sectional approach. The study population was T2DM patients in Medan City with the number of samples is 87 people who have fulfilled the inclusion and exclusion criteria. Data collection is done by interviewing and patient blood test. Assessment of physical activity of diabetic patients using a global questionnaire physical activity instrument that is a valid and reliable questionnaire. Fasting Blood Glucose Level and Total Cholesterol examination done by Spectrophotometer Colorimeter + Full Automatic and HbA1c examination using Doronad affinity + Modified HPLC method. The data analyzed using one way ANOVA statistic test and processed data using SPSS. The results showed there was a relationship of physical activity to fasting BGL, HbA1C levels and Total cholesterol of Diabetes Mellitus Type 2 patients in Medan City.

1 INTRODUCTION

The increased prevalence of diabetes mellitus has influenced by changes in lifestyle and lack of physical activity. Adults who have less physical activity will experience an increased risk of death by 20-30% compared with people who perform enough physical activity or routine each week (Ricther and Hargreaves, 2013). Physical exercise is any body movement produced by skeletal muscle contraction that increases energy expenditure above the basal level (Centre for Disease Control and Prevention, 2011). Physical activity is a movement of the body due to skeletal muscle activity resulting in energy expenditure, including activities while working, playing, doing housework, travel, and recreation. Physical activity is not the same as exercise or physical exercise, where exercise is a subcategory of planned, structured, a repetitive physical exercise to improve and to maintain physical fitness (World Health Organization, 2015)

Physical activity together with diet and drug modifications has recommended one of four components for diabetes therapy, in which the study found that exercise can reduce hyperglycemia and body fat and increase protection against the development of cardiovascular complications (Indonesia, 2015). Regular physical exercise reduces dyslipidemia and increases insulin sensitivity. By increasing the concentration of GLUT-4 receptors on the plasma membrane or sarcolemma, insulin resistance affects the transport of glucose into cells. The glycemic control reduced visceral fat and decreased plasma triglycerides can be achieved

without loss of body weight (Kennedy et. al., 2012; Amelia, 2017). Aerobic exercise increases glucose uptake of muscle by up to five times through an insulin-independent mechanism. After exercise, glucose uptake continues to increase with an insulin-independent mechanism for 2 hours and insulin-dependent for up to 48 hours if prolonged exercise (Colberg et al., 2010; Paramitha, 2014; Ramadhanisa, 2013; Amelia et al., 2017). Structured physical activity like aerobic exercise, resistance training, or a combination of both has been shown to decrease HbA1c levels in diabetic patients; besides, moderate intensity exercise for more than 150 minutes per week is also closely related to decreased HbA1c (Cavero-Redondo et al., 2017). Regular exercise of mild intensity for more than 150 minutes per week proved to be more effective than those who exercised less than 150 minutes per week. This situation is indeed in line with the theory since HbA1c is a valid glycemic blood marker in the last three months. Regular exercise of mild intensity for more than 150 minutes per week proved to be more effective than those who exercised less than 150 minutes per week (Cavero-Redondo et al., 2018; Boniol et al., 2017; Amelia et al., 2018; Harahap et al., 2018). The aim of this study was to analyze the effect of physical activity on glycemic control (FBGL and HbA1C and Total Cholesterol) of T2DM patients in Medan City.

2 MATERIAL AND METHOD

The study design was analytic with a cross-sectional approach, in which the assessment of physical activity and glycemic control has performed at one time only. After the collection of observational data on diabetes patients continue to assess the complications experienced by patients. The conducted data has done in April-May 2018. The study population was DM Type 2 patient in Medan City. Sampling is type2 Diabetic patients from several community health centers in Medan City and General Practice doctors serving outpatient diabetes patients. Determination of the sample size done by using the formula of population proportion estimation by using a single simple formula for the proportion of population hypothesis so that the number of samples is 85 people who have fulfilled the inclusion and exclusion criteria. The inclusion criteria in this study were: Patients DMT2 aged 35-55 years, had no contraindication to doing physical exercise, willing to follow the research and the patient came independently to the place of service and independent in performing daily activities. While Exclusion

Criteria are: Patients with severe complications, type 1 Diabetes mellitus patients, another type, and gestational, type 2 diabetes mellitus patients accompanied by other comorbidities.

Data collection is done by interviewing and taking blood. Before the research, this research protocol has been approved by the research ethics committee at the Faculty of Medicine Universitas Sumatera Utara, and all participants who are willing to participate in the research have signed written informed consent. The source of research data is primary data, namely patient characteristics data, nutritional status, data physical activity and glycemic control data. Assessment of the physical activity of diabetic patients using a global physical activity questionnaire instrument that is a valid and reliable questionnaire, for each patient answer will get a predetermined score, physical activity in diabetes patients divide to three categories, namely physical activity is less/low, enough/ excellent and high/excessive. Assessment of glycemic control includes fasting blood glucose level, hbA1C levels and Total cholesterol by direct blood venous removal from diabetes patients. Fasting blood glucose level ad Total Cholesterol examinations were done by Spectrophotometer Colorimeter + Full Automatic and HbA1c examination using Doronad affinity + Modified HPLC method. After the data collected then analyzed by using one way ANOVA statistical test and processed data using SPSS.

3 RESULT AND DISCUSSION

3.1 Baseline Characteristics of T2DM Patients in Medan City

Table 1: Basic Characteristics of T2DM patients in Medan City

Characteristics	Frequency (n)	Percentage (%)
Gender		
Man	16	18.8
Woman	69	81.2
Age Group		
Late adolescent (36-45 years old)	12	14.1
Early elderly (46-55 years old)	73	85.9
Ethnic		
Batak	4	4.7
Mandailing	8	9.4
Padang	10	11.8
Jawa	52	61.2

Melayu	10	11.8
Banjar	1	1.2
Work		
Civil Servants	7	8.2
Private Servants	23	27.1
Retired	3	3.5
Policemen	2	2.4
Entrepreneurs	8	9.4
Housewives	42	49.4
Duration of Illness		
1-5 years	52	61.2
6-10 years	20	23.5
11-15 years	11	12.9
> 15 years	2	2.4
Diabetes History		
Father	15	17.6
Mother	15	17.6
Father and Mother	8	9.4
No one	47	55.3
Use of Anti-Diabetic Drugs		
Glibenclamide	68	80.0
Metformin	7	8.2
Combination (Glikenklamid+ Metformin)	5	5.9
Traditional drug	3	3.5
Use of Insulin		
Present	2	2.4
Not Present	83	97.6
BMI		
Less Weight	8	9.4
Normal Weight	43	50.6
Obesity	34	40
Blood Pressure		
Hypertension	68	80.0
Not Hypertension	17	20.0
Physical Activity (PA)		
High PA	19	22.4
Medium PA	13	15.3
Low PA	53	62.4

Table 1 explains that based on gender it is known that most patients are women (81.2%), based on age known to most elderly patients are Early elderly (46-55 years old) (85.9%). Based on the ethnic, majority is Java as many as 52 people (61.2%). The most patient work is a housewife as much as 42 people (49.4%). Based on the duration of diabetes known to the majority of diabetes for 1-5 years as many as 52 people (61.2%), most patients with diabetes. Based on the family history known most diabetic patients have a family history of diabetes suffered by the mother as

much as 47 people (55.3%). The majority of diabetic patients consume glibenclamide as an anti-diabetic drug as much as 68 people (80%) and only 2 people who have a history of using insulin 83 people (97.6%). Nutritional status of diabetes patients most normal nutritional status as many as 43 people (50.5%). The majority of patients experienced an increase in blood pressure as much as 68 people (80%). Based on physical activity it is known that the majority of diabetic patients have a less physical activity / low as much as 68 people (80%).

3.2 Fasting Blood Glucose Level, HbA1C, and Total Cholesterol of T2DM Patients in Medan City

Table 2: Glycemic and Total Cholesterol Control Data of T2DM Patients

Parameter	Mean	Median	SD	Min	Max
FBSL (mg/dl)	249.9	245.0	109.2	87.0	600.0
HbA1C (mg/dl)	9.4	9.1	2.8	6.0	15.8
Total Kolesterol (mg/dl)	232.5	229.0	196.0	110.0	456.0

Results of Table 2 showed that mean of FBSL was 249.9 mg/dl, and the hbA1C level was 9.4 mg/dl and the total cholesterol level was 232.5 mg/dl.

3.3 Relationship of Physical Activity with Fasting Blood Glucose, HbA1C, and Total Cholesterol in T2DM Patients in Medan City

Table 3: Relation of Physical Activity with Fasting Blood Glucose, HbA1C, and Total Cholesterol in T2DM Patients in Medan City

Parameter	Physical Activity (PA)	F	Sig
BGL (mg/dl)	High PA	3.518	0.025
	Medium PA		
	Low PA		
HbA1C (mg/dl)	High PA	3.403	0.038
	Medium PA		
	Low PA		
Total Kolesterol (mg/dl)	High PA	3.710	0.045
	Medium PA		
	Low PA		

Table 3 is the result of ANOVA test. The results of table 2 show that there are differences in the average

levels of FBGL, HBA1C, and total cholesterol based on the physical activity of T2DM patients.

Diabetes is one of the metabolic diseases, in the metabolic syndrome, regular physical exercise will lower blood sugar, HbA1c, triglycerides, blood pressure, and insulin resistance. Insulin work on the muscles and the liver can be modified either by physical exercise that is acute or physical exercise regularly (Meenu and Jayendrasinh, 2013; Rusdiana et al., 2018; Nurmawati and Kusmiyati, 2008). Accordingly, aerobic exercise increases the uptake of glucose up to five muscles fold through the insulin-independent mechanism After exercise, and glucose uptake continues to rise with a 2-hour insulin-independent and insulin-dependent mechanism for up to 48 hours if prolonged exercise (Colberg et al., 2010). Improvement of insulin work can last up to 24 hours after a short physical exercise (about 20 minutes) if the intensity has increased close to the maximum. Even low-intensity aerobic exercise can improve insulin work in obese patients, and insulin resistance for 24 hours. Increased entry of glucose into muscle cells lasts for several hours after physical exercise. Regular or regular physical exercise may also increase prolonged insulin sensitivity (Guelfi et al., 2007). During physical exercise, the entry of glucose into the skeletal muscle will increase. This situation is due to an increase in the number of glucose transporters in the muscle cell membrane of GLUT-4 (glucose transporters-4). In addition to being found in muscle cells, GLUT-4 is also present in fatty tissues and other tissues. Physical activity extends the capillary collateral area of muscle and blood flow, where the GLUT4 expression (skeletal muscle glucose transporter protein 4) will increase as well; increased glucose synthesis, reduced release as well as increased clearance of free fatty acids. With the least amount of blood glucose available, the process of glucose binding to heteroprotein hemoglobin will reduce so that HbA1c levels are also decreased (Amelia et al., 2017; Cavero-Redondo et al., 2017; Boniol and Dragomir, 2017; Amelia et al., 2018).

The rate of reduction of BGL, HBA1C, and Total cholesterol depends on the type of physical activity performed. The Surgeon General's Report on Physical Activity and Health recommends that all adult individuals should have the moderate physical activity for at least 30 minutes almost every day of the week) (Cavero-Redondo et al., 2017; Boniol and Dragomir, 2017). In general, a physical activity carried out is aerobic and nonaerobic (resistance training) and mixed physical exercise between aerobic and resistance training. Aerobics and prisoners have their respective advantages and disadvantages in maintaining BGL and HbA1c levels, but by doing a combination of both types of physical activity, it will get better results. One of the famous trial studies in examining the relationship between physical activity and HbA1c levels was a trial DARE (The Diabetes Aerobic and Resistance Exercise Study) examined and compared the effects of physical exercise resistance training, aerobic, and a combination of both for six months. Once examined, the combination of physical exercise is the most effective physical activity in controlling HbA1c compared to a physical activity other singles: were found to decrease by 0.46% larger in the couch damping aerobic exercise alone and 0.59% greater than the resistance exercise only. Besides, it can presume that participants with baseline HbA1c lower than 7.5% had only a 'down' effect through combination physical exercise; participants with HbA1c levels> 7.5% independent of the type of physical activity selected, although combination physical exercise provides more benefits (Byrne et al., 2017). For good results, physical activity must meet the requirements that are done at least 3 to 4 times a week with and at least 30 minutes in a continuous activity for at least eight weeks. The duration of physical activity affects the fraction of BGL decrease, HbA1c, and Total Cholesterol.

A prospective study in 16 patients with T2DM aged 50-54 who underwent aerobic physical exercise for eight weeks obtained improved blood glucose control with decreased fasting blood glucose levels and significant HbA1c levels with value $p < 0.05$ (Maiorana et al., 2001; Huang et al., 2014). In moderate exercise intensity for more than 150 minutes per week proved to be more effective than those who exercised less from 150 minutes per week. HbA1c is a valid glycemic marker of blood in the last three months. The authors themselves acknowledge the variation of physical activity intervention is one of the factors that trigger the variation in quality and heterogeneity of data in this meta-analysis.

Another study showed that the mean decrease of blood sugar, HbA1c, cholesterol, LDL, HDL, and triglyceride levels were found in moderate physical activity with duration $\geq$ 150 minutes/week. Besides, mean BGL, HbA1c, cholesterol, LDL, HDL and triglyceride levels were found to decrease in intensive physical activity for $\geq$ 75 minutes/week and $\geq$ 150 minutes/week (Carral Fet al., 2013).

4 CONCLUSIONS

Physical activity has an essential role in controlling BGL, HbA1 C and total cholesterol in addition to diet and drug consumption. Education and motivation need to be given to patients so they can perform the regular physical activity and continue to avoid complications of diabetes.

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