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Combination of *diabetic self management education* (DSME) with diabetic foot exercises on blood sugar level in type II diabetes patients

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ABSTRACT

Background

Type II diabetes mellitus is a non-infectious disease that can cause death and have a high risk for complications involving the heart, kidneys, brain and vision and even blindness. Management of 4 pillars of type II diabetes includes education, medical nutrition therapy, physical exercise and pharmacological interventions. One of the non-pharmacological treatments is the combination of *Diabetic Self Management Education* (DSME) and diabetic foot exercises.

Method

The type of research used was the study *Quasy Experimentalwith the pretest-posttest control group design*. This study compiled two groups, namely the DSME combination intervention group with foot exercises and the control group with the *Range of Motion* (ROM). Technique *Non-probability sampling* with method *consecutive sampling* is used to get 48 respondents divided into 2 groups.

Results

Test results *Independent t test* shows *p value* 0.000 so that there is an effect of a combination of *Diabetic Self Management Education* (DSME) with foot exercises on blood sugar levels in type II diabetics between the intervention group and the control group.

Conclusion

The results of the study after being given treatment that the combination of DSME with diabetic foot exercises is effective in lowering blood sugar levels in type II diabetics.

Keywords: Diabetes Melitus, *Diabetic Self Management Education* (DSME), Diabetic foot exercises, Blood sugar levels.

INTRODUCTION

Diabetes mellitus (DM) is one of the most chronic diseases experienced by people in the world. DM is ranked 4th cause of death in developing countries. [1] One type of DM disease that is most experienced by people in the world is type 2 diabetes mellitus (85-95%) caused by disruption of insulin secretion and insulin resistance. [2] DM is a chronic metabolic disease caused by the inability of the body to produce insulin as needed or because of ineffective use of insulin or both. This disease is characterized by high blood sugar levels or hyperglycemia. [3] DM classification is divided into several parts, namely type 1 DM (IDDM = *Insulin Dependent for Diabetes Mellitus*), type 2 DM (NIDDM = *Dependent Non Insulin Diabetes Mellitus*), DM pregnancy and DM associated with other conditions. Among DM classifications, type 2 DM

is most commonly found in around 90-95% of DM patients. [4]

World Health Organization (WHO) estimates on in 2025 the incidence of DM increased to 300 million people. Indonesia is one of the countries that enter with countries whose DM prevalence also increased and estimated in the year 2025 DM in Indonesia becomes the order fifth (12.4 million people) than before seventh in 1995 (4.7 million person). [5] The number of insulin dependent DM cases in Central Java Province in 2013 was 9,376 cases, lower than in 2012 (19,493). The highest case occurred in Semarang City (1,095 cases). While the number of cases of non-insulin dependent DM is better known as type II DM, decreased from 181,543 cases to 142,925 cases. [6]

Preliminary study results in the Srondol Semarang Health Center Work Area on January 12, 2018 obtained the prevalence of DM patients from January to December 2017 as many as 661 DM were not insulin dependent and 2 were insulin dependent with an average monthly rate of 55 respondents. Insulin-dependent diabetes mellitus (Type II DM) ranks 2nd after hypertension of the 5 major non-communicable diseases in the Srondol Semarang Health Center. The number of type II DM patients in the area is quite high. Patients with type II diabetes were most commonly experienced by the elderly 45 years and above with a total of 598 patients from the total number of 661. Type II DM was more predominantly suffered by women than men, namely 211 men and 450 women. [7]

DM patients have the potential to suffer various complications, both acute and chronic complications. Acute complications include hypoglycemic coma, ketoacidosis, hyperosmolar non-ketotic coma, whereas chronic complications include macroangiopathy which affects the large blood vessels of the heart and brain. [8]

In PARKENI 2011 which included chronic complications were macroangiopathy, mikroangiopati and neuropathy. Neuropathy is a disorder of the nervous system in the legs and peripheral blood flow. This disorder is the starting point for diabetic foot (*diabetic foot*). [9]

Strategies that can be used to prevent the occurrence of ulcers, increased blood sugar levels and further complications in type 2 DM patients include patient education, multidisciplinary handling, strict monitoring, and prevention of foot care. [2] There are 4 main pillars in the management of type 2 DM, namely education, medical nutrition therapy, physical exercise, and pharmacological interventions. [9] One aspect that plays an important role in the management of type 2 DM is education. Education for type 2 DM patients is important as a first step in controlling type 2 diabetes. [2] One of the most commonly used forms of education and proven effective in improving clinical outcomes and quality of life for patients with type 2 is *diabetesDiabetes Self Management Education* (DSME). [10]

DSME is a process of health education for individuals or family in managing diabetes has been developed since the 1930s by Joslin Diabetes Center. [3] DSME uses guidance methods, counseling, and behavioral interventions to increase knowledge about diabetes and improve individual and family skills in managing DM. [3]

Research conducted in Jember entitled the effect *self management education* of diabetes onon the risk of diabetic ulcers in outpatients with type 2 diabetes in Dr. RSD. Soebandi Jember proves that there is a DSME influence on the risk of diabetic ulcers in outpatients with type 2 DM in RSD dr. Soebandi Jember. [2]

Besides giving education in the form of DSME, physical exercise is also very important in controlling blood sugar levels in patients with type II diabetes. Physical exercise is an initial effort to prevent, control, and overcome DM. One physical exercise is to do exercises on the feet with foot exercises. Foot exercises are activities or exercises carried out by DM patients to prevent injury and help to improve blood circulation in the legs. Foot exercises can improve blood circulation and strengthen the small muscles of the legs and prevent foot deformities. Besides that it can increase the strength of the calf muscles, thigh muscles and also overcome the limitations of joint movements. [11]

Disorders of blood flow in the legs can be detected by measuring the *brachial ankle index* (ABI) which measures the ratio of systolic pressure in the arm to the lower systolic pressure of the foot. [12] ABI is calculated by dividing the systolic pressure at the ankle with systolic blood pressure in the arm. ABI examination is very useful to determine the presence of peripheral artery disease (PAP). [13, 14]

Diabetic foot is one of the most feared chronic infections of DM, ending with disability

(amputation) and death. In Indonesia the mortality rate and amputation rate are still high at 16% and 25% respectively. The occurrence of diabetic foot begins with high glucose will damage the peripheral blood vessels of the feet, the onset of ischemia which can also cause *Peripheral Artery Disease* (PAD). [15]

Previous research that has been done on *Ankle Brachial Index* after diabetic foot exercises in type 2 diabetics proves that after doing diabetic foot exercises there is an increase in ABI value. [16] In addition similar studies have also been conducted on diabetic foot exercises effectively increasing *Ankle Brachial Index* of type II DM patients. [17] Other studies have also been conducted to reduce blood sugar levels by giving diabetic foot exercises to type II diabetes mellitus patients. [18] Foot exercises can increase ABI and reduce blood sugar levels, as well as prevent the risk of foot ulcers. [19]

Based on the description above, the researcher is interested in conducting research on the combination of *Diabetes Self Management Education* (DSME) with diabetic foot exercises on blood sugar levels in type II diabetics.

METHODS

This type of research uses research *Quasy-Experimental* with *Pretest-Posttest Control Group Design*. The researchers compiled two groups, namely the DSME combination intervention group with foot exercises and the control group given the *Range of Motion* (ROM). Examination of blood sugar levels is carried out twice, before treatment (*pretest*) and after treatment (*post test*).

The population in this study was all type II diabetes mellitus patients who were treated in the Srondol Health Center Semarang Work Area. Determination of the minimum number of samples using techniques *sampling non-probability* with *purposive sampling method* and based on inclusion and exclusion criteria is 48 respondents divided into 2 groups with 24 people in each group. In this study researchers conducted data collection by means of observation, identification, interviews and filling out questionnaires. The data collected was analyzed through the IBM SPSS program version 21.0, and continued with a different test, namely the parametric test (*Paired t test* and *Independent t test*). The processed data are used as a basis for the discussion of statement problems, which are then presented in table form so that conclusions can be draw

RESULTS

Table 1 Distribution of respondents frequency of intervention and control groups based on demographic characteristics (n=48)

Characteristic	Control (n = 24)	Intervention (n = 24)	*p*
Age	55.58±6.00	54.63±5.32	0.357
Gender			0.242
a. male	9 (37.5%)	7 (29.2%)	
b. Female	15 (62.5%)	17 (70.8%)	
education			0.843
a. elementary	9 (37.5%)	4 (16.7%)	
b. junior	4 (16.7%)	4 (16.7%)	
c. high school	8 (33.3%)	6 (25.0%)	
d. PT	3 (12.5%)	10 (41.7%)	
Work			0.006
a. Employee	-	4 (16.7%)	
b. Private	8 (33.3%)	8 (33.3%)	
c. IRT	16 (66.7%)	12 (50.0%)	
d. Other	-	-	
Length of DM			0.546
a. DM <5 years	16 (66.7%)	17 (70.8%)	
b. DM >5 years	8 (33.3%)	7 (29.2%)	
Smoking History			0.546

a.	There were	8 (33.3%)	7 (29.2%)
b.	no	16 (66.7%)	17 (70.8%)

Based on Table 1 it is known that the average age of each group is statistically equal or homogeneous (*p*=0.357) with the mean of the control group 55.58 (n=24) and the mean of the intervention group 54.63 (n=24) from the age of 45-65 years. Most of the respondents in both groups of women were 33 respondents (n=48), and had the highest statistical high school vulnerability as many as 14 respondents from both groups (n=48). In addition, most of them are housewives (IRT) as much as 28 respondents (n=48) and most respondents have had DM for <5 years with a total of 33 respondents (n=48) and a small proportion of respondents have had DM >5 years with the number of 15 respondents (n=48). Some respondents did not have a smoking history with a total of 33 respondents (n=48) and a small percentage of respondents had a smoking history with a total of 15 respondents (n=48).

Table 2 Distribution of frequency of blood sugar levels in the control group and intervention group based ondemographic characteristics

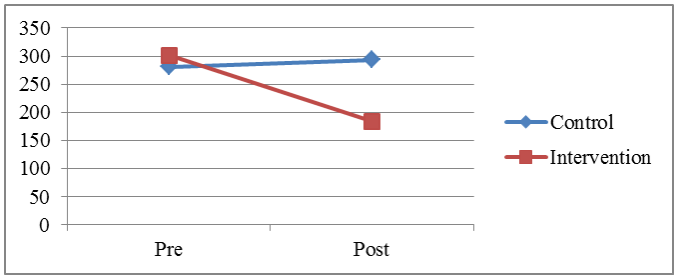
Blood Sugar Levels	Pre Test		Post Test	
	Control (n = 24)	Intervention (n = 24)	Control (n = 24)	Intervention (n = 24)
a. High	24 (100%)	24 (100%)	24 (100%)	7 (29.2%)
b. Medium	-	-	-	17 (70.8%)
c. Low	-	-	-	-

Based on table 2 that before treatment value Blood sugar levels in both groups before treatment included categories of high blood sugar levels (100%) and after treatment the blood sugar levels of each group differed, with the majority in the overall control group still in the category of high blood sugar levels of 24 respondents (100%) and in the intervention group included in the category of moderate blood sugar levels of 17 respondents (70.8%).

Table 3 Differences in mean blood sugar levels before and after treatment in the control group and intervention

Group	*Pre Test*	*Post Test*	*t*	*p*
	Mean±SD	*Mean±SD*		
Control	281.00±63.53	293.00±50.00	-1.074	0.294
Intervention	301.13±71.56	184.08±30.93	10.478	0.000

Table 3 is known that the mean value of blood sugar levels in the two groups before being treated was included in the category of high blood sugar levels >200 mg / dL. While the average blood sugar level after being treated in the control group was still in high blood sugar levels (*p*=0.294), but in the intervention group experienced a decrease in blood sugar levels included in the category of moderate blood sugar levels of 99-199 mg/dL (*p*=0.000).



Grafik 4 Kadar gula darah sebelum dan sesudah perlakuan antara kelompok kontrol dan intervensi

Based on graph 4 shows that there is an increase in sugar levels before and after treatment in the control group. But in the opposite intervention group, there was a decrease in blood sugar levels before and after treatment.

Table 5 Differences in the mean difference in blood sugar levels between the control and intervention groups

Variables	Control	Intervention	*t*	*p*
	Mean ± SD	***Mean ± SD***		
blood sugar levels	12.00±54.76	117.04±54.72	8.166	0.000

Table 5 shows that average value Blood sugar levels between the control group and the intervention group were significant differences *p*=0.000. When viewed from the difference in the mean value of blood sugar levels in the intervention group was higher than the control group. So it can be concluded that giving a combination of *Diabetic Self Management Education* (DSME) with diabetic foot exercises can effectively reduce blood sugar levels.

DISCUSSION

The results of the study it was found that before the combination of DSME and diabetic foot exercises the average blood sugar level for the control group was 281.00 mg / dL and the mean blood sugar level in the intervention group was 301.13 mg / dL. Statistically it has the same or homogeneous mean p = 0.688 which is included in the category of high blood sugar levels >200 mg / dL. Most type II diabetes mellitus patients before being given treatment had high blood sugar levels, this happened because respondents did not get enough information about how to control blood sugar levels and supported by the large number of respondents who did less physical exercise such as diabetic foot exercises, exercise, irregular eating patterns and obesity so that blood sugar levels in the body increase.

After being given treatment for the mean value of blood sugar levels in the control group experienced an increase of 293.00 mg/dL still in the category of high blood sugar levels (p=0.294). Conversely, in the intervention group there was a decrease in the average blood sugar level of 184.08 mg/dL which was included in the medium blood sugar level of 99-199 mg / dL (p=0.000).

Test results Independent t test showed that the average value of the blood sugar level between the control group and the intervention a significant difference p=0.000, which means that the combination of DSME with diabetic foot gymnastics effective in lowering blood sugar levels than the control group without DSME combination with diabetic foot exercises.

In this study, DSME and diabetic foot exercises were carried out routinely for 14 days (2 weeks) together with all study respondents. DSME education activities are given during the first and second weeks, then foot exercise activities are carried out together 1 time a day at 8:00 a.m. or afternoon at 4:00 p.m. Respondents can also do foot exercises independently in their homes with a leaflet containing foot exercises.

DM patients after being given a combination of DSME and doing diabetic foot exercises routinely respondents feel comfortable, reduce pain, prevent nerve damage and control blood sugar levels and improve blood circulation in the legs. [20]

Most patients with type II diabetes mellitus before being given therapy had high blood sugar levels, this happened because respondents did not get enough information about how to control sugar levels and how well respondents did not do physical exercise such as diabetic foot exercises, exercise, diet irregular and obese. The level of sugar in the body increases.

High blood sugar levels and continuously result in damage to blood vessels. Complex substances consisting of glucose in the walls of blood vessels cause blood vessels to thicken and leak. Poor blood circulation can lead to complications in the eyes, heart, kidneys, nerves and skin. [21]

There are two factors that cause an increase in blood sugar levels of respondents, namely the first factor is an irregular diet, many respondents whose diet is uncontrolled is what causes excessive intake of calories in the form of carbohydrates and sugar resulting in a buildup of blood glucose. The second factor that can cause an increase in blood sugar levels of respondents is lack of exercise. Exercise affects the action of insulin in people at risk of diabetes mellitus. Many respondents said that they

did not understand that exercise can reduce blood sugar levels.

Patients with type II diabetes should carry out 4 pillars of diabetes mellitus management, namely education (DSME), diet, physical exercise (diabetic foot exercises) and pharmacological interventions. Health workers especially nursing must be able to provide education in the form of DSME and teach how good and right diabetes foot exercises so that the blood sugar levels of respondents can be lowered and can improve the health status of type 2 diabetes mellitus patients even better. According to Badruddin et, all in Sutandi (2012) people with diabetes who is given education and guidelines in self-care will improve their life patterns that can control blood sugar levels well. Because high blood sugar levels and continuously can cause damage to blood vessels in. [3]

Chateau and Kaufman explained in Soegondo (2008) that indirect physical exercise can cause a decrease in blood glucose because physical exercise can cause an increase in the use of glucose by active muscles. [11] Furthermore, Ilyas in Soegondo (2008) explained that physical exercise will cause an increase in blood flow, causing more open capillary tissues so that more receptors become more active which will affect the decrease in blood glucose in diabetic patients. [11]

Diabetic foot exercises are the right way to improve circulation, especially the foot area. Foot exercises are one of the physical exercises whose variations in movements in the foot area meet the criteria for continuous, rhythmical, interval, progressive and endurance so that each stage of the movement must be carried out. The recommended exercise in patients with aerobic DM means that they need oxygen and can help blood circulation, strengthen the small muscles of the feet, prevent foot deformities that can increase the potential for diabetic wounds in the legs, increase the production of insulin used in transporting glucose to cells helps lower glucose in the blood. [22]

Diabetic foot exercises are used in patients with type 2 diabetes mellitus who have high blood sugar levels in the Srondol Semarang Health Center Work Area effective in lowering blood sugar levels. In carrying out sports activities the use of energy savings and metabolic pathways of energy that will be used to produce ATP molecules. Muscle cells store a limited amount of ATP. Because the muscles at the time of contraction always need ATP as energy, it requires energy metabolism in cells quickly to produce ATP. The heavier the muscle contraction the greater the amount of ATP needed. As a result, there is an increase in blood glucose depletion and produce large amounts of lactic acid in the blood. Increased blood flow to the muscles can trigger glucose into the muscle. Increases the number of insulin receptors and increases glucose transporters outside the cell into cells so as to increase insulin sensitivity (the ability of the insulin hormone decreases glucose levels by suppressing hepatic glucose production and stimulating the utilization of glucose in the skeletal muscle and adipose tissue) which causes insulin resistance (body condition does not respond to insulin, especially the role of insulin in carrying out its task of circulating glucose) decreases. Resulting in decreased blood sugar levels in the blood. This was also supported by respondents' awareness that increased in regard to eating patterns after being given DSME education so that blood sugar in the body did not increase again. [18]

In addition to the combination of DSME with foot exercises that other factors also play a significant role in lowering blood sugar levels during the study derived from the individual's ability to*self-care is* influenced by age, development status, life experience, socio-cultural orientation, health and available resources. Self-care is carried out because of health problems or diseases with the aim of preventing disease and improving health. [23]

Self care is very important to be done by type 2 DM patients to prevent the occurrence of other more severe complications. *Self care* carried out by patients is closely related to Orem's theory of nursing. Orem's conceptual nursing model is known as the *self care deficit theory of nursing* (SDCTN) which consists of three interconnected theories, namely self-care theory that describes why and how humans care for themselves, self care deficit theory that describes and explains why humans can be helped through nursing, and nursing systems theory that describes and explain how nursing care can be applied to patients. [24]

The need for *self care* that must be met within a certain period of time is called *therapeutic self care demand*. An individual has the power to carry out self care, this power is called a *self care agency*. *Self care agency* can change at any time, influenced

by a person's health condition. When there is an imbalance between *self care agency* and *therapeutic self care demand*, there is a *self care deficit.* [24] The ability of type 2 DM patients to perform independent care also refers to the theory. Each patient has the ability to self-care and the need for self care to each patient is different. This difference in the ability of self care in patients is what causes differences in blood sugar levels in patients. [2]

Related research conducted by Gusti Rusli (2015) entitled foot exercises reduce blood sugar levels of type 2 diabetes mellitus patients, this type of research is an experimental quasy with one-group pre-post design tests. This study shows the results of thestatistic Wilcoxon Signed Rank Test obtained the results of days 1, 2 and 3 (α count) = 0.000 and day 1 correlation Z = 3.202, day 2 correlation Z = 3.352 and day 3 correlation Z = 4.128 means that there is a strong influence on gymnastics diabetic foot with a decrease in blood sugar levels in patients with type 2 diabetes mellitus.calculated Cohen's effect size's that Gusti Ruslisresearch had a low effect with cohen's standard value of 0.17 (low). While thevalue effect size in the DSME combination study with foot exercises in lowering blood sugar levels is 2.6 (very strong).

The results of statistical tests conducted by Gusti Rusli were both significant differences ($p<0.05$) with the DSME combination study and foot exercises. However, if you see thecalculation size cohen's effect's that Gusti Ruslisresearch has effect size a smallerthan the DSME combination research with foot exercises which means that the combination of DSME with foot exercises is greater than the giving of foot exercises without combination. In addition to the value of the effect size, the mean difference between pre and post in the study conducted by Gusti Rusli who was only given foot exercises was smaller than the combination of DSME and foot exercises. The mean value of pre was 241.95 and post 211.15 so the difference was 30.8. Whereas in this study pre value 301.13 and post 184.08, the difference is 117.05.

CONCLUSION

Based on the research objectives obtained from the results of data analysis and discussion presented in the previous chapter, the researchers' conclusions are as follows: The

1. Mean blood sugar level of the intervention group before treatment was 301.13 mg/dL and after treatment there was a decrease of 184.08 mg/dL is included in moderate blood sugar level <200 mg/dL (p=0,000). While the average blood sugar level before treatment in the control group was 281.00 mg/dL and after treatment there was an increase of 293.00 mg / dL still in high blood sugar levels >200 mg/dL (p=0.294). Test results *Independet t test* statistically there were significant differences p=0.000, which means the intervention group was more effective in lowering blood sugar levels after being given a combination of *Diabetic Self Management Education* (DSME) with foot exercises rather than a control group that was not given DSME combination and foot exercises.
2. The results of the study after the treatment of the influence of a combination of *Diabetic Self Management Education* (DSME) with diabetic foot exercises on blood sugar levels in type II diabetics.

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