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Diabetic Foot Exercises for Hyperglycemia in Diabetes Mellitus Patient: A Case-Study

Elia Nanda Wulan Sari[1]*, Eka Mei Dianita[2], Pepin Nahariani[2], Heri Yulianto[3]
[1] Study Program of Nursing, Institute of Health Pemkab Jombang, Indonesia
[2] Institute of Health Pemkab Jombang, Indonesia
[3] Dr. Soedono General Hospital Madiun, Indonesia

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ABSTRACT

Background: Diabetes Mellitus is a metabolic disease characterized by increased blood sugar levels which occurs because the pancreas is unable to secrete insulin. Symptoms of diabetes mellitus cases are increased blood glucose levels, one action to overcome this is diabetes foot exercises. **Objective:** To determine the effectiveness of diabetes mellitus foot exercises in reducing blood glucose levels. **Methods:** Descriptive with presentation of case studies using a nursing care approach, namely assessment, diagnosis, intervention, implementation and nursing evaluation. **Results:** After carrying out nursing actions for 3 x 24 hours, it was found that blood glucose levels had decreased as evidenced by subjective data: the patient said that the weakness and tingling in the legs had decreased, objective data: decreased weakness, GDA examination was 129 mg/dL. **Conclusions:** There was a decrease in blood sugar levels after diabetes mellitus foot exercise. There are differences in the development of decreased blood glucose levels in patients with diabetes mellitus before and after the application of diabetes mellitus foot exercise.

Keywords: Diabetic Foot Exercise, Diabetes Mellitus, Hyperglycemia

Corresponding Author:
Elia Nanda Wulan Sari
Institute of Health Pemkab Jombang,
Jl. Raya Pandanwangi, Kec. Diwek, Jombang, Jawa Timur 61471, Indonesia
Email: elianandaws@gmail.com

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1. INTRODUCTION

A chronic disease that is still a problem in Indonesia is diabetes mellitus. Diabetes mellitus (DM) is a non-communicable disease (NCD) characterized by increased blood sugar levels (hyperglycemia) and glucose intolerance which occurs due to the pancreas gland producing insulin inadequately or the body being unable to use the insulin produced effectively. The long treatment process and complications in DM patients can increase psychological problems, decreased physical function, and non-compliance with treatment or care (Febrinasari et al., 2020).

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According to the Who (2020), in 2020 it is estimated that around 422 million people worldwide suffer from diabetes mellitus and most of them come from low and middle income countries. According to the Ameican Diabetes Associa (2020) The number of cases and prevalence of diabetes continues to increase every year due to diabetes and there are 1.6 million deaths directly linked to diabetes itself (WHO, 2020). The International Diabetes Federation (IDF) revealed that the global (world) prevalence of diabetes is the number of diabetes mellitus sufferers throughout the world, 463 million people in 2019, which is expected to increase in 2030 to 578 million people and in 2045 to 700 million people. One of the causes of the increasing prevalence of diabetes mellitus in developing countries is changes in lifestyle, and Indonesia is one of the developing countries that has a relatively high incidence of diabetes mellitus. The prevalence of diabetes in Indonesia in 2019 was 10 million people, Indonesia was ranked 7th in the world. The countries with the highest prevalence of diabetes mellitus are China (109.6 million people), second India (69.2 million people), third United States (29.3 million people), fourth Brazil (14.3 million people), fifth Russia (12.3 million people) and sixth Mexico (11.5 million people). Based on data on diabetes mellitus in the Wijaya Kusuma C room at RSUD dr. Soedono, East Java Province, there were 38 cases in the last 3 months, in September 2023 there were 16 cases, in October 2023 there were 13 cases, and 9 cases in August.

High and uncontrolled increases in blood sugar levels for a long time can cause complications in diabetes mellitus sufferers. According to the results of Basic Health Research (2018), the increasing prevalence of chronic diseases is related to people's unhealthy lifestyles, such as smoking, consuming alcoholic drinks, lack of physical activity or exercise, and also lack of consumption of fruit and vegetables (Kemenkes, 2018). The complications of DM are short-term and long-term, short-term complications include: hypoglycemia, ketoacidosis. Meanwhile, long-term complications can include macroangiopathy and microangiopathy damage. Macroangiopathic damage includes: coronary artery disease, cerebral blood vessel damage, and peripheral blood vessel damage. The complications of microangiopathy include retinopathy, nephropathy and neuropathy (Kusnanto et al., 2019).

Management of diabetes mellitus by controlling glucose levels so that they are stable and remain within safe limits will

have an impact on improving the quality of life for diabetes mellitus sufferers and can be done as an effort to control diabetes mellitus. By doing physical activity, glucose use by muscles will also increase. Endogenous glucose synthesis will be increased to keep blood glucose levels balanced (Rochman, 2024). Therefore, when doing physical activity such as exercise for diabetes sufferers, blood glucose will be burned into energy. So that energy cells become more sensitive to insulin and blood circulation improves (Lubis & Kanzanabilla, 2021).

Foot exercises are given to people with diabetes mellitus, both type 1, type 2 and other types, and are also recommended as an early preventive measure from the first time the patient is diagnosed as suffering from diabetes mellitus. Foot exercises are classified as a light and easy sport or activity because they can be done indoors or outdoors, especially at home with a chair and do not require a long time, only around 10-20 minutes, which is useful for avoiding foot injuries and helping improve blood circulation in the legs (Ratnawati, Adyani and Fitroh, 2019).

2. METHODS

Design and sample

This type of research is a case study using nursing care method. The sample in the study was one diabetes mellitus patient in the Wijaya Kusuma C Room of Dr. Soedono Hospital Madiun with hyperglycemia. Data sources in the study were obtained from primary data, namely by taking action, observing, and answering questions from patients and families. Secondary data was obtained through patient's medical record data. The inclusion criteria in this sample were diabetes mellitus patients, cooperative, high blood sugar levels.

Variable and Analysis

The variables of this study were diabetic foot exercises, hyperglycemia and diabetes mellitus. The analysis in this study uses the nursing care process, which consists of nursing assessment, diagnosis, intervention, implementation, and evaluation.

Setting and Strategy

Patient are given nursing intervention in diabetic foot exercises for 30 minutes for three days, from October 31 to November 02, 2023. The evaluation was conducted after therapy, measuring blood sugar level using a blood sugar stick. Nursing intervention is given through the nursing process by directly teaching patients and families the right and appropriate techniques for adjusting the

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patient's condition. The evaluation was conducted after therapy and measuring blood sugar level using a blood sugar stick.

3. RESULTS

The patient is female, 49 years old, with complaints of weakness, tingling in the legs, cold sweat and pain in the right leg from the groin to the sole of the foot. The patient said he had suffered from diabetes mellitus for 10 years. Physical examination revealed that the patient's condition was compos mentis (conscious), the client's general condition looked weak, the results of vital signs examination showed BP: 108/65 mmHg, temperature 37.30C, pulse: 105 times/minute and respiration 19x/minute. SPO2 97%, CRT more than 2 seconds, no cyanosis, blood sugar level when the results were obtained was 345 mg/dL. Instability of blood glucose levels is the main nursing problem found in patients after a series of assessments.

After conducting a physical exercise educational intervention for Mrs. S, namely diabetic foot exercises, it was proven to be effective in overcoming the problem of unstable blood glucose levels. It was stated in the previous chapter that according to Mrs. S's subjective and objective evaluation, it was found that the blood sugar test results improved after the diabetic foot exercises were carried out compared to before the intervention was given. It can be seen from the results of the GDA examination that the result was 170 mg/dL on the first day of diabetic foot exercises, on the second day the result was 149 mg/dL, and on the third day it was 129 mg/dL.

Interventions to address nursing problems are adjusted to SIKI (The Standard Intervention of Indonesian Nursing) which refers to the right outcome goals to address existing patient problems and adapt to SLKI (The standard outcome of Indonesia Nursing). The interventions include observation, therapeutic, education and collaboration with other medical personnel. Nursing problem interventions also apply Evidence-based Nursing, which is by research journals. Interventions to address the problem of unstable blood sugar levels. Diabetic foot exercises play a major role in regulating blood glucose levels. Blood sugar levels in people who have diabetes mellitus tend to be controlled or lowered by doing activities, one of which is foot exercises. Foot exercises must be done regularly, in a measured manner, and done properly and correctly. Foot exercises that are done seriously, aimed at producing sweat, will be able to stimulate the pancreas to produce insulin so that over time blood glucose levels decrease (Pratiwi, 2020).

Based on the facts and theory above, the following results were obtained, after carrying out physical exercise educational interventions for Mrs. S, namely diabetic foot exercises, it was proven to be effective in overcoming the problem of unstable blood glucose levels. It was stated in the previous chapter that according to Mrs. S's subjective and objective evaluation, it was found that the blood sugar test results improved after the diabetic foot exercises were carried out compared to before the intervention was given. It can be seen from the results of the GDA examination that blood sugar decreased, indicating its stability from the first day of implementation to the third day.

Table 1. Monitoring of implementation

Day	Blood glucose levels	
	Before	After
Day 1 (31-Oct-2023: 15.20 pm)	Emergency Room: 345 mg/dL WK C (inpatient room): 210 mg/dL	170 mg/dL
Day 2 (01-Nov-2023: 15.20 pm)	170 mg/dL	149 mg/dL
Day 3 (02-Nov-2023: 15.20 pm)	149 mg/dL	129 mg/dL

4. DISCUSSION

Based on the study conducted on Mrs. S on October 31 2023 in Wijaya Kusuma Room C Dr Soedono Hospital, East Java Province, the nursing problem raised by students was the instability of blood glucose levels. The intervention carried out is by providing physical exercise education: diabetic foot exercises once a day to patients with the aim of helping lower blood sugar levels, preventing injuries, and helping improve blood flow. Diabetic foot exercises play a major role in regulating blood glucose levels. Blood sugar levels in people who have diabetes mellitus tend to be controlled or lowered by doing activities, one of which is foot exercises. Foot exercises must be done regularly, in a measured manner, and done properly and correctly. Apart from that (Megawati et al, 2020) this effort aims to strengthen small muscles, calf muscles and thigh muscles, as well as overcome the common problem of limited joint movement experienced by Diabetes Mellitus Sufferers. Foot exercise are movements carried out by both feet alternately to stretch the muscle in the

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lower leg area, especially in the ankles and toes (Damayanti, 2016).

Patients with diabetes mellitus often experience complaints of pain in the legs. Pain in the foot of diabetes mellitus can be caused by disorders of blood vessels, nervous disorders and infection (Zakiyah, 2023). Continuous hyperglycemia state, infection will have an impact on the ability of blood vessels not to contract and relaxation is reduced. This results in decreased body circulation of the body, especially the legs, there will be symptoms of pain in the legs when standing, walking and doing physical activities (Nopriani & Silvia, 2021). In the journal Suhertini & Subandi (2016) it is explained that the practice of foot exercises affects the condition of the foot, where the cold acral increases becomes warmer, stiff legs become flexible, numb legs become not numb, and atrophy legs slowly return to normal. From the statistical test it is found that foot exercises can help improve the small muscles of the foot in diabetes patients with neuropathy. In additions it can strengthen the calf muscles and thigh muscles, overcome the limitations of joint motion and prevent deformity. The limited number of insulin in patients with DM results in increased blood sugar levels, this causes damage to blood vessels, nerves, and other internal structures so that the supply of blood to the feet is increasingly inhibited, as a result DM patients will experience blood circulation disorders in their legs.

The main problem in type II DM is the lack of receptor response to insulin (insulin resistance). This disruption causes insulin to be unable to help transfer glucose into cells. Membrane permeability increases in contracting muscles, so that during physical exercise insulin resistance decreases while insulin sensitivity increases. So regular physical exercise can improve blood and cell glucose regulation (Saeedi et al., 2019). Foot exercises causes increased blood flow, resulting in more open capillary network. As a result, there is an increase in the availability and activation of insulin receptors, thereby contributing to a decrease in blood glucose levels in individuals diagnosed with diabetes. Physical activity has the potential to reduce blood glucose levels due to its ability to increase glucose utilization by active muscles (Juhanis & Hasmyati, 2024). Daily activities such as walking to the market, using stairs, gardening must still be done. Physical exercise in addition to maintaining fitness also lose weight and improve insulin sensitivity, so that it will improve blood glucose control (Nuraeni and Arjita, 2019).

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Based on the assumptions of (Yulita, Waluyo and Azzam, 2019) that in type 2 diabetes mellitus patients who were given foot exercises there was a decrease in blood sugar levels. And according to the author himself, he assumed that after being given intervention for 3 consecutive days, diabetes mellitus patients experienced improvements in their blood glucose levels. From the author's results and the theory above, the author is of the opinion that this is done foot exercises can help improve blood circulation feet in diabetic patients. There is a decrease in blood sugar levels after doing diabetes mellitus foot exercises. There is a difference in the development of decreasing blood glucose levels in diabetes mellitus patients before and after implementing diabetes mellitus foot exercises (Wulandari, Nooratri and Yuwono, 2023). In research conducted by (Putra et al., 2020), the focus was to investigate the effectiveness of diabetic foot exercises in improving the brachial ankle index in individuals with type 2 diabetes mellitus. The findings showed that incorporating diabetic foot exercises into the treatment program of individuals with diabetes type 2 mellitus can cause an increase in the ankle-brachial index (ABI). In research conducted by Ji et al (2015) Therapy combining music media and lower extremity movement significantly promotes the exercise compliance with elderly diabetics and improves blood circulation of the lower extremities.

So, the role of the family is also quite important in providing support and motivation to clients regarding diabetes mellitus patients in particular in complying with diet and therapy because the better the role played by the family in managing medical rehabilitation for patients, the faster the patient's healing process will be and changes in lifestyle will be better. healthy future for patients and families (Qurotulnguyun et al, 2023). Foot exercises can have an optimal affect if done routinely 3-4 times a week. The foot exercise needs to be understood correctly by the DM patients. To improve patient understanding, the method of delivering the material must be appropriate. The method that has proven to be effective in terms of increasing understanding is group support or a group approach to therapy. Group interventions can be carried out with the closest people to the patient and follow DM patient to allow to share their experiences and information (Faizah et al, 2020). Social motivation can be an important from of support when dieting, and in physical activity adherence, especially for DM patients (Juul et al, 2018).

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In research conducted by Ariyanto et al., (2024) foot exercises based on self-care can increase foot sensitivity and prevent significant complications, especially in the feet. One of the reasons behind the intervention is the use of significant leg exercises. One of the reasons behind the intervention of using foot exercises based on self-care is the possibility for diabetes sufferers to overcome complaints of foot sensitivity and reduce the risk of more important complications, especially in the feet and as a method of foot care. This study represents a control group that did not receive a foot exercise intervention on a self-care basis. did not experience a decrease in sensitivity in the feet. In research conducted by Nuraeni and Arjita (2019) the mechanism for changes in decreased blood glucose levels after doing foot exercises is caused by metabolic changes that are affected by the length of exercise, the weight of the exercise, the level of insulin plasma levels, blood sugar levels, ketone levels and the balance of body fluids. At the time of the body exercise the body needs energy, so that the muscles that were not active became active, because there was an increase in glucose needs.

5. CONCLUSIONS

Diabetic foot exercises is effective in reducing patient controlling blood sugar. Patients and their families received the implementation of the intervention quite well. Patient and families can carry out therapy themselves after being taught. The patient's blood sugar level also decreased from 345 to 129. The patient was still receiving pharmacological therapy, so the effect of diabetic foot exercises on reducing blood sugar levels still needed to be clarified.

This research also proves that diabetic foot exercises can be a non-pharmacological therapy that nurses can apply to overcome nursing problems and unstable blood sugar levels in diabetes mellitus patients. Diabetic foot exercises will cause an increase in blood flow, more capillaries will open so that more insulin receptors are available and the receptors will become more active, which will have an effect on reducing blood glucose in diabetes patients. Physical exercise can reduce blood glucose levels because physical exercise will increase glucose use by active muscles.

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AUTHOR CONTRIBUTIONS

Substantial contribution to conception, data collections, and analysis: Elia Nanda Wulan Sari, Eka Mei Dianita, Pepin Nahariani, Heri Yulianto. Writing Manuscript and revisions: Eka Mei Dianita and Elia Nanda Wulan Sari.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

DATA AVAILABILITY STATEMENT

The data are not publicly available due to privacy or ethical restrictions.

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