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The Influence of Diabetic Foot Exercises on the Risk of Diabetic Ulcers in Patients with Diabetes Mellitus

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Abstract:
Diabetes Mellitus is a non-communicable disease that continues to experience an increase in the number of cases with high mortality and morbidity rates, expected to triple by the year 2030. In the long term, it can lead to microvascular, macrovascular, and neuropathic complications such as peripheral vascular disease, indicating abnormalities in the lower limbs, manifested as diabetic ulcers. The research aims to determine the Influence of Diabetic Foot Exercises on the Risk of Diabetic Ulcers in Patients with Diabetes Mellitus at Sukosari Community Health Center in Babadan Subdistrict, Ponorogo Regency. The research design is a pre-experimental study with a One Group Pretest-Posttest approach. The study was conducted from June to August 2023. The population consisted of all Diabetes Mellitus patients at Sukosari Community Health Center in Babadan. Sample of 30 respondents was selected using purposive sampling. The independent variable was the risk of diabetic ulcers, and the dependent variable was diabetic foot exercises. The observation instrument used was Inlow's 60-second diabetic foot screening tool. Statistical analysis was performed using the Wilcoxon signed-rank test through SPSS with α = 0.05. The research results showed that the risk of diabetic ulcers before diabetic foot exercises, more than half of the respondents (63.3%), had a moderate category, and 43.3% had a mild category. There is an influence of Diabetic Foot Exercises on the Risk of Diabetic Ulcers in Patients with Diabetes Mellitus at Sukosari Community Health Center in Babadan Subdistrict, Ponorogo Regency, with a p-value of 0.000 ≤ α 0.05. Diabetic foot exercises can be performed independently, without the need for equipment, and at no cost. It is hoped that patients with Diabetes Mellitus can perform them regularly, systematically, and continuously, with the expectation of reducing the risk of diabetic ulcers.

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INTRODUCTION

Diabetes mellitus is a chronic disease caused by the pancreas not producing insulin, or the body not being able to effectively use the insulin produced by the pancreas (Kurniyawan et al., 2023). Diabetes mellitus is one of the non-communicable diseases with a fairly high incidence rate in the world (Dafriani, 2021). Diabetic patients often experience circulatory disorders associated with peripheral vascular diseases. Such circulatory effects cause damage to the nerves so that abnormal blood flow occurs; thus, the autonomy of neuropathy causes the skin to become dry and anhidrosis, leading to the death of body tissue. So, the feet of the sufferers are vulnerable to skin tissue membrane damage. Blood flow on the skin can cause diabetic ulcers (Said, 2021).

Diabetic foot ulcer (DFU) is an erosion of the skin that extends from the dermal layer to deeper tissue due to various factors and is characterized by the inability of wounded tissue to

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repair in time. But over time, the wound on the leg developed into a hard-to-heal tumor. If the diabetic wound is not properly treated, there is wider damage to the integrity of the skin and tissue necrosis that can lead to infection and amputation (Dercoli, 2019).

The prevalence of diabetes mellitus (DM) globally continues to increase to triple by 2030 to 21.3 million. The IDF has predicted that by 2045 the number of patients with DM will be 16.7 million (Perkeni, 2021). Diabetes Mellitus in East Java Province in 2019 was 841,994 people (Dinas Kesehatan Provinsi Jawa Timur, 2020). Diabetes mellitus sufferers in Puskesmas Sukosari Babadan Ponorogo in 2021 a total of 205 people with details men 63 people and women 142 people. The incidence of foot ulcers reaches about 15% of all people with diabetes mellitus. The record states that in the course of the disease, about 14-24% of those with diabetic legs require amputation. 8 main causes of amputation of lower limbs 85% contributed to because of diabetic foot ulcers, or more than a person without ulcer (Sukatemi, 2013).

The long-term goal of DM enforcement is to prevent and inhibit the progressivity of microscopic and macroangiopathy. Physical exercise is one of the attempts to prevent the occurrence of diabetic ulcers because of the increase in blood flow, then more capillary nets will be opened so that more available insulin receptors and receptors become more active that will affect the decrease in blood glucose in patients with diabetes (Sunaryo & Sudiro (2014). Physical exercise is an important part of comprehensive diabetes management. Exercise is one of the mainstays of DM disease management. Lack of physical activity can lead to poor metabolic control and increase complications, morbidity, and mortality from diabetes. Lack of physical activity can cause your blood sugar to get out of control and cause problems (Rondhianto et al., 2023). One of the recommended physical exercises is diabetic foot exercise. Exercise is recommended to be performed with moderate intensity (60-70 maximum heart rate), duration 30-60 minutes, with a frequency of 3-5 times a week and no more than 2 consecutive days do not exercise (Ruben, dkk, 2016). Lack of physical exercise can cause not only physical but also mental problems. Exercise can reduce anxiety and depression levels. Physical exercise is important for improving body immunity and mental health (Sari et al., 2022).

METHOD

The study uses pre-experimental (pretest posttest design) with the population of patients with DM in Puskesmas Sukosari district of Babadan Ponorogo a total of 205 patients and sample criteria such as readiness to be respondents, cooperative, no diabetic ulcers, as well as HbA1c test results greater or equal to 6.5% taken with non-probability sampling technique. The research was carried out at the Puskesmas Sukosari district of Babadan in Ponorogo from March to August 2023. The independent variables in this study are diabetic foot gymnastics, and the dependent variables are the risk of diabetes ulcers in patients with Diabetes Mellitus in Puskesmas Sukosari Babadan Ponorogo Prefecture. Data analysis was used to find out the impact of Diabetic Leg Gymnastics on Diabetes Ulcers Risk in Diabetes mellitus patients in Pusksesmas Sukosari Babadan district of Ponorego with Wilcoxon signed rank test through the program SPSS 23 for Window with a level of strength ($p \leq 0.05$).

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Table 1. Operational Definition

Variable Research	Operational Definition	Parameter	Measurement	Measurement Result	Scale
Independent Variable					
Diabetic leg gymnastics	The foot movement activity according to the Standard Operational Procedure with a duration of 30-60 minutes, with a frequency of 3-5 times a week and no more than 2 consecutive days do not exercise	1. Patient preparation 2. Tools preparation 3. Execution 4. Evaluation	Observation		
Dependent Variable					
Risk of Diabetic Ulcer	Risk of skin damage (dermis and/or epidermis) or tissue damage (mucous membranes, cornea, fascia, muscles, tendons, bones, cartilages, joint capsules and/ or ligaments)	1. skin condition 2. nail condition 3. no deformity 4. foot quality 5. cold feet temperature 6. hot feet temperature 7. movement range 8. foot sensation test with monofilament 9. foot sensing test with 4 questions 10. no pulse in the legs 11. no momentary redness in the feet 12. no erythema	*Inlow's 60-second diabetic foot screening tool.*	Min-max=0-25	Ordinal

RESULT

The demographic data of respondents with the highest percentage score in Puskesmas Sukosari Babadan Ponorogo June-August 2023 are (60%) aged 50-60 years, (53.3%) of the sex female, (43.3%), last education of elementary school, (43,3%) work as a housewife, (100%) have never received information about diabetic foot gymnastics, (70%) have suffered from diabetes mellitus for 6-10 years, and (100%) live with family.

Based on the observation item, inlaw's 60-second diabetic foot screening tool obtained, averages of monofilament sensation test scores, and question sensation tests are in the top two positions, namely sensation testing with monofilament and sensation examination with a question. While the results of pre-training diabetic foot exercise Diabetic feet exercise obtained 63.3% of respondents had a risk of diabetes ulcers in the category of moderate risk of diabetic ulcer after exercising Diabetics in Puskesmas Sukosari Babadan Ponorogo based on the foot observation item inlow's 60-second diabetic foot screening tool obtaining an average test score sensai monofilament and question sensation test are in the top two positions namely sensation testing with monofilament. While the research results after foot exercise Diabetics before diabetic foot exercise obtained 43.3% had a risk of diabetes ulcer in the mild category.

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Diabetic ulcer risk reduction based on in low's 60-second diabetic foot screening tool observations found that after diabetics' foot exercise, they obtained an average decrease in monofilament sensation test items that were very significant. The result can be seen according to the chart below.

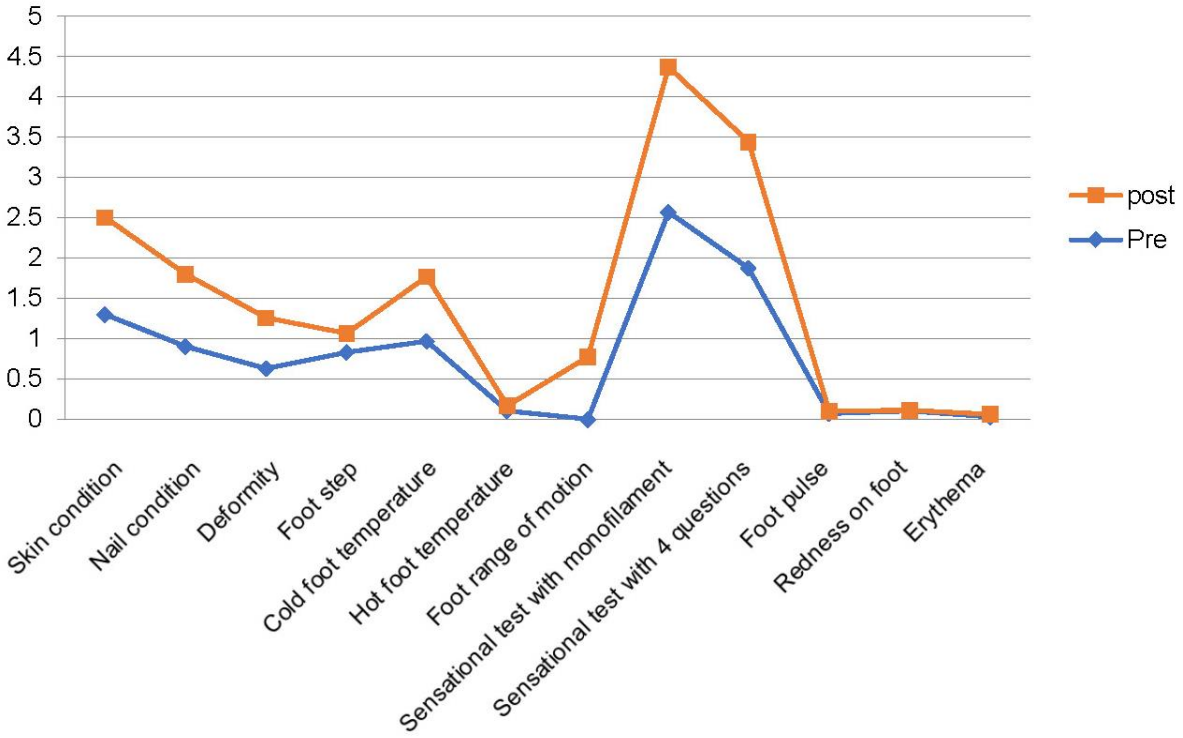

Figure 1. Diabetic Ulcer Risk Reduction

Reduced risk of diabetic ulcers based on cross tabulation was obtained by more than half, i.e. 3 respondents (60%) before performing Diabetic foot workout at risk of severe diabetical ulcer, after performing dietetic foot exercises at risk of Diabetes ulcer at category moderate. Out put SPSS, at the 95% confidence level (α=0,05), p-value or Sig. (2-tailed) on the table wilcoxon signed ranks test is 0,000, this figure is smaller than α=0.05 (0,000<0,05) which means there is an effect of diabetic foot exercises on the reduction in the risk of diabetes ulcers in Puskesmas Sukosari Babadan Ponorogo. These results can be seen according to the table below.

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Table 2. Cross Tabulation of Foot Gymnastics Against Risk of Diabetic Ulcers

Risk of Diabetic Ulcer			Post Diabetic Foot Gym				Total
			Lightweight	Weighing	Heavy	Very Heavy	
Pre Diabetic Foot Gymnastics	Lightweight	Count	5	0	0	0	5
		% within pre	100.0%	0.0%	0.0%	0.0%	100.0%
	Weighing	Count	9	10	0	0	19
		% within pre	47.4%	52.6%	0.0%	0.0%	100.0%
	Heavy	Count	0	3	2	0	5
		% within pre	0.0%	60.0%	40.0%	0.0%	100.0%
	Very Heavy	Count	0	0	1	0	1
		% within pre	0.0%	0.0%	100.0%	0.0%	100.0%
Total		Count	14	13	3	0	30
		% within pre	46.7%	43.3%	10.0%	0.0%	100.0%
α= 0.05			p-value 0.000				

DISCUSSION

Risk of Diabetic Ulcers before performing diabetic foot exercises in Puskesmas Sukosari Babadan Ponorogo prior to obtaining diabetical foot exercise more than half of respondents (63.3%) had a risk of diabetics ulcers in the moderate category. Diabetic foot ulcer (DFU) is an erosion of the skin that extends from the dermal layer to deeper tissue as a result of a variety of factors and is characterized by the inability of wounded tissue to repair in time. But over time, the wound on the leg developed into a hard-to-heal tumor. If the diabetic wound is not properly treated, there is wider damage to the integrity of the skin and tissue necrosis that can lead to infection and amputation (Dercoli, 2019).

All respondents have not been informed and exercised in foot exercises, so they do not do foot exercise even though some respondents do simple physical activity. Physical activity performed by respondents is routine daily activity beneficial to physical fitness, but has not focused on the lower extremities especially the legs so there is still peripheral perfusion disorder in the leg.

In diabetes mellitus suffered respondents mostly 6-10 years so the risk of diabetic ulcers experienced category moderate because there have been microangiopathic disorders in the extremities on the impact of increased blood sugar levels.

Risk of Diabetic Ulcers after performing diabetic foot exercises in Puskesmas Sukosari Babadan Ponorogo obtained less than half of respondents (43.3%) had a risk of diabetical ulcers in the mild category. Diabetic foot ulcer is one of the complications of diabetes mellitus where infection, stinging, or destruction to the deepest skin tissue in the legs is found due to nerve abnormalities and peripheral arterial vascular disorders. DFU in people with diabetes mellitus is caused by motor, sensory and autonomous neuropathy or ischemia, and is often complicated by infection (Merawa, 2017).

DM foot exercises (diabetes melitus) for two weeks, can improve the sensitivity of the feet. DM foot exercise is a type of physical exercise designed specifically to help diabetic patients keep their feet healthy. Movements performed in the DM foot exercise will contract the leg muscles, increasing the sensitivity of the cells to blood glucose, which in turn increases the blood sugar levels in cells. With smooth blood circulation, oxygen and nutrients go to cells and nerve tissues.

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This changes the Schwann cell metabolism so that axon function can be restored. In DM patients, optimal nerve cell function will maintain the sensibility of the legs (Sesdetri, 2023).

The age of most respondents is in the range of 50-60 years, this allows respondents to easily receive information and publish information in the form of diabetic foot workout. Diabetic feet workout activities with medium-sized guide posters that can be carried by respondents and hanged in shared places facilitates respondents doing foot workouts with guidance from the posters. Not all respondents have gadgets so these posters are very helpful respondents do foot exercises in order and correctly.

The influence of foot gymnastics on the risk of diabetic ulcers in Puskesmas Sukosari Babadan Ponorogo based on cross tabulations obtained more than half of it is 3 respondents (60%) before doing diabetics foot gymnastika risk of severe diabetical ulcer, after doing doing dietary foot gymnasium risk of diabetes ulcer category moderate. Out put SPSS, at the 95% confidence level (α=0,05), p-value or Sig. (2-tailed) on the table wilcoxon signed ranks test is 0,000, this figure is smaller than α=0.05 (0,000<0,05) which means there is an effect of diabetic foot exercises on the risk of diabetes ulcers in Puskesmas Sukosari Babadan Ponorogo.

The long-term goal of DM enforcement is to prevent and inhibit the progressivity of microscopic and macroangiopathy. Physical exercise is one of the attempts to prevent the occurrence of diabetic ulcers because of the increase in blood flow, then more capillary nets will be opened so that more available insulin receptors and receptors become more active that will affect the decrease in blood glucose in patients with diabetes (Sunaryo & Sudiro (2014). One of the recommended physical exercises is diabetic foot exercise. Exercise is recommended to be performed with moderate intensity (60-70 maximum heart rate), duration 30-60 minutes, with a frequency of 3-5 times a week and no more than 2 consecutive days do not exercise (Ruben, dkk, 2016).

Diabetic patients often experience circulatory disorders associated with pheripheral vascular diseases, such circulatory effects cause damage to the nerves so that abnormal blood flow occurs thus the autonomy of neuropathy causes the skin to become dry and antidrosis leading to the death of body tissue. So the feet of the sufferers are vulnerable to skin tissue membrane damage. Blood flow on the skin can cause diabetic ulcers (Said, 2021).

If foot exercises are not done frequently, it increases the risk of neuropathic diseases, which can cause problems in the legs of people suffering from type 2 diabetes such as dry skin, tenderness, the inability to feel the sensation when the paws are touched, and muscle stiffness. Leg exercises enhance a process known as a "venous pump", in which blood is pumped to the heart because the pressure of the surrounding veins is reduced due to the movement of the membrane muscles. This mechanism will improve blood circulation in the legs, strengthen small muscles, prevent foot abnormalities, increase the strength of the ankle and thigh muscle, and overcome joint constraints.

Foot exercises can help improve blood circulation and strengthen the small muscles of the legs as well as prevent the formation of foot abnormalities (Kemenkes, 2017). Leg exercises have been shown to have an effect on neuropathic status. The results show that by performing intensive foot exercises (at least 3 times a week) for 3 months, it can reduce the risk of neuropathy by almost 80% of patients with diabetes mellitus. Exercise can be used as part of the treatment of diabetes mellitus. When exercising (including weight-holding activities) it is recommended to do as it can improve glycemic control (DiLiberto, 2016).

Foot exercises performed by respondents over a period of 4 weeks at an average frequency of 5-7 times a day showed a significant impact in reducing the risk of diabetic ulcers. The respondents exercised according to the posters given by the researchers so that the foot exercises

were performed in accordance with the guidelines, routine, continuous and continuous. Different types of job respondents, but foot exercises are still being carried out in spite of the busy respondents.

CONCLUSION

There is an influence of Diabetic Foot Exercises on the Risk of Diabetic Ulcers in Patients with Diabetes Mellitus at Sukosari Community Health Center in Babadan Subdistrict, Ponorogo Regency. Diabetic foot exercises can be performed independently, without the need for equipment, and at no cost. It is hoped that patients with Diabetes Mellitus can perform them regularly, systematically, and continuously, with the expectation of reducing the risk of diabetic ulcers.

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