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## RESEARCH ARTICLE

### THE EFFECT OF DIABETIC FOOT EXERCISE ON NEUROPATHY SCORES BASED ON THE LENGTH OF TIME SUFFERING FROM TYPE 2 DIABETES MELLITUS CLIENTS

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#### ABSTRACT

**Introduction:** Long suffering from diabetes is often associated with complications such as neuropathy. Complications usually begin to arise after the client has suffered from DM for more than 10 years. Diabetes mellitus clients who have long been diagnosed with diabetes have a higher risk of developing diabetic ulcers. Blood sugar levels that are not controlled from time to time can lead to hyperglycemia, which can lead to complications associated with diabetic neuropathy in which diabetes mellitus patients will lose their sense of taste and are not aware of the appearance of injury. Foot exercise is an exercise for diabetics or non-sufferers to prevent injuries and help blood circulation in the legs. Foot exercises can help improve blood circulation and strengthen the small muscles of the legs and prevent foot deformities. Effective treatment will reduce the complication rate so that there are no further complications that can harm people with mellitus. The aim of this study was to identify the effect of diabetic foot exercise on neuropathy scores based on the length of time a client suffered from type 2 diabetes mellitus. **Method:** The research design used was a quasy experiment to identify the effect of diabetic foot exercise on neuropathy scores based on the length of time a client suffered from type 2 diabetes mellitus. This research was conducted at the Padangsidempuan City Hospital. Population in this study was all of the type 2 diabetes mellitus clients in Padangsidempuan City Hospital. The sampling technique used was consecutive sampling with a sample size of 16 people based on power analysis tables. The measuring instrument used is Diabetic Neuropaty Symptom (DNS), and data analysis was carried out using the Wilcoxon test. **Results:** Data analysis was carried that after a significant test using the Wilcoxon test on the comparison of neuropathy scores before and after diabetic foot exercise in the group with DM <6 years duration, there was a significant change with p value = 0.038 (p <0, 05) which means that there is an effect of diabetic foot exercise on the reduction of neuropathy in type 2 diabetes patients. Likewise with the neuropathy score before and after diabetic foot exercise in the group with a duration of DM > 6 years, there was a significant change with p value = 0.011 (p <0.05) which means that there is an effect of diabetic foot exercise on decreasing neuropathy in people with type 2 diabetes. **Conclusions:** Neuropathy scores in respondents decreased when compared between before and after diabetic foot exercises in both groups. This shows that there is an effect of diabetic foot exercise on reducing neuropathy in people with type 2 diabetes mellitus. In accordance with the results of the research obtained, it is hoped that all people with type 2 diabetes mellitus will always try to do physical exercise in the form of diabetic foot exercises to reduce the risk of neuropathy in people with type 2 diabetes mellitus.

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## INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders characterized by high blood glucose levels. A person with diabetes has an increased risk of experiencing a number of serious life-threatening health problems that requiring high medical care costs, decreased quality of life and increased mortality (Baena-Díez et al., 2016). According to the (Cho et al., 2018) the prevalence of DM in the world reaches 424.9

million people and is estimated to reach 628.6 million in 2045. Indonesia is the country with the sixth most DM sufferers in the world with the number of DM sufferers reaching 10.3 million inhabitants. It is estimated that this number will continue to increase until it reaches 16.7 million people in 2045. The incidence of diabetes mellitus sufferers in 2015 worldwide reaches 415 million, and it is estimated that by 2040 the number of people with diabetes mellitus will be 642 million people.

Diabetes mellitus can cause various complications, namely hypoglycemia, hyperglycemia, macrovascular disease of large blood vessels, coronary heart disease, microvascular disease of small blood vessels, retinopathy and nephropathy, sensory neuropathy or an effect on extremity. Other complications are also frequent pathological changes in the lower limbs called diabetic feet. In this condition, the condition of the diabetic foot that occurs is structural changes, skin protrusions, skin and nail changes, injuries to the feet, infections, abnormalities in blood vessels, and neuropathic innervation disorders that can cause diabetes patients to experience decreased sensitivity, and loss of sensation is one of the main risk factor for diabetic ulcers (Yulita et al., 2019).

Diabetes mellitus clients who have long been diagnosed with diabetes have a higher risk of developing diabetic ulcers. Blood sugar levels that are not controlled from time to time can lead to hyperglycemia, which can lead to complications associated with diabetic neuropathy in which diabetes mellitus patients will lose their sense of taste and are not aware of the appearance of injury (Purwanti & Maghfirah, 2016). Effective treatment will reduce the complication rate so that there are no further complications that can harm people with mellitus. Handling actions taken by the health / medical team include: pharmacological treatment, giving drugs and non-pharmacological treatment such as routine metabolic control, vascular control, evaluation of ulcers, foot care, and other exercise such as foot exercises. People with diabetes mellitus are encouraged to do foot exercises. This procedure is very suitable for clients with diabetic neuropathy because it is easy for everyone to do, and this exercise aims to help improve blood circulation and strengthen the small muscles of the legs and prevent foot deformities (Sembiring et al., 2018).

The duration of suffering from diabetes does not describe the actual condition of the disease because usually the new client is diagnosed after experiencing real complications, while the disease process has been going on for a long time before the client is diagnosed. The client generally explains the length of suffering from diabetes based on the time the diagnosis was enforced, so this does not describe the length of suffering from diabetes (Simamora & Antoni, 2018). Long suffering from diabetes is often associated with complications. Complications usually begin to arise after the client has suffered from DM for more than 10 years. Study by (Simamora & Siregar, 2019) shows that the majority of clients with long sufferings are less than 10 years, only a few respondents are around 10-15 years, so there are still no clients with complex complications. Based on the description above, there are problems related to physical exercise that need to be developed to reduce neuropathy in DM clients. In this case, researchers are interested in examining the effect of diabetic foot exercise on reducing neuropathy in people with Type 2 Diabetes Mellitus. The aim of this study was to identify the effect of diabetic foot exercise on neuropathy scores based on the length of time a client suffered from type 2 diabetes mellitus.

## METHODS

**Study Design:** The quantitative research design used in this study was a quasi-experimental design with a non-equivalent group design. This research was conducted at the Padangsidempuan City Hospital.

**Population, Samples, and Sampling:** The population in this study was all of the type 2 diabetes mellitus client in Padangsidempuan City Hospital. The sampling method in this study was consecutive sampling. The sample size in this study was calculated using power analysis tables. The degree of consistency ( ) to estimate the sample size is 0.05 with a power (1- ) of 0.80. Furthermore, based on the power analysis table with a power of 0.80, the number of samples taken was 16 people, 8 people each in the group with a duration of DM <6 years and 8 people in the group with a duration of DM >6 years.

**Instruments:** Data collection tools used were observation sheet neuropathy score assessment with Diabetic Neuropathy Symptoms (DNS). These are all interview-based assessments of sensory, motor, and autonomic deficits, with moderate sensitivity and specificity.

**Procedure:** The data collection procedure was carried out by conducting a pretest by assessing the neuropathy scores of respondents in both groups. Then performed diabetic foot exercises in both groups for 3 times a week. Then after a week a post test was carried out to reassess the neuropathy scores in the two groups after diabetic foot exercise. After that, data analysis was performed to compare the neuropathy scores in the two groups after diabetic foot exercise.

**Data Analysis:** The univariate analysis in this study identified neuropathy scores before and after the intervention by describing the mean, and standard deviation. Before the bivariate analysis was carried out, the data normality test was carried out using the analytical method, namely the Shapiro-Wilk test, the data were not normally distributed so data analysis was carried out using the Wilcoxon test.

**Ethical Clearance:** This research has gone through an ethical test conducted at the health research ethics commission of the Faculty of Nursing, University of North Sumatra and has obtained permission to obtain research number 2232/IV/SP/2020.

## RESULTS

**Univariate Analysis:** Description of the demographic characteristics of the respondents consisted of age and gender. Distribution of Clients Based on Demographic Data; Gender of type 2 diabetes mellitus sufferers in General Hospital of Padangsidempuan City (n = 16). The results showed that the gender of the respondents in general were 12 women (75%) and 4 men (25%). The composition of men and women in the group with DM duration <6 years and the group with DM duration > 6 years showed the same number. The average age of respondents in the group with a duration of DM <6 years was 49.2 years, while the average age of respondents in the group with a duration of DM > 6 years was 53.8 years.

**Bivariate Analysis:** The bivariate analysis will describe whether there is a difference in the mean score of neuropathy before and after diabetic foot exercise, the difference in mean neuropathy score before and after diabetic foot exercise in the two groups. Before the bivariate analysis was carried out, the data normality test was conducted first with the Shapiro-Wilk test on the pre and post neuropathy scores after diabetic foot exercise was carried out in the respondent group.

Characteristics		DM duration group <6 years		DM duration group > 6 years	
		F	%	f	%
Gender	Male	2	25	2	25
		6	75	6	75
		Mean	SD	Mean	SD
Age		49,2	5,1	53,8	4,3

  

Variable	Group	Mean	Z scor	p Value
Neuropathy Score	Group A			
	pre	2,63	-2,070	0,038
	Post	1,75		
	Group B			
	Pre	3,00	-2,53	0,011
	Post	2,00		

This test aims to determine that changes in neuropathy scores that occur are not due to variations in respondents, but because of the effect of diabetic foot exercises performed on respondents. If the p value is  $> 0.05$ , the data is homogeneous. The results of the shapiro-wilk test can be concluded that the average neuropathy score before doing diabetic foot exercise in the group with a duration of diabetes mellitus  $< 6$  years is 2.63 and after doing diabetic foot exercise the average neuropathy score is 1.75. While the average neuropathy score before diabetic foot exercise in the group with a duration of diabetes mellitus  $> 6$  years was 3.00 and after doing diabetic foot exercise the average neuropathy score was 2.00. After the data normality test was carried out with the Shapiro-Wilk test on the average neuropathy score before and after diabetic foot exercises, the value of  $p = 0.000$  was obtained for the pre-test group with DM duration  $< 6$  years, and  $p = 0.056$  for the post-test group with DM duration.  $< 6$  years,  $p = 0.05$  for the pre-test group with DM duration  $> 6$  years, and  $p = 0.05$  for the post-test group with DM duration  $> 6$  years. It means that the mean score of neuropathy before and after diabetic foot exercise was not normally distributed.

**Wilcoxon Test:** The difference in the average neuropathy scores of Type 2 DM clients before and after the intervention. The results of the analysis above can be concluded that after a significant test was carried out using the Wilcoxon test on the comparison of neuropathy scores before and after diabetic foot exercise in the group with DM  $< 6$  years duration, there was a significant change with p value = 0.038 ( $p < 0, 05$ ) which means that there is an effect of diabetic foot exercise on the reduction of neuropathy in type 2 diabetes patients. Likewise with the neuropathy score before and after diabetic foot exercise in the group with a duration of DM  $> 6$  years, there was a significant change with p value = 0.011 ( $p < 0.05$ ) which means that there is an effect of diabetic foot exercise on decreasing neuropathy in people with type 2 diabetes. There was a similar decrease in neuropathy scores between the two different groups. So it can be concluded that there is no effect of the long-suffering factor (duration of diabetes) on the neuropathy score in type 2 DM patients.

## DISCUSSION

The results showed that the gender of the respondents in general were 12 women (75%) and 4 men (25%). The composition of men and women in the group with DM duration  $< 6$  years and the group with DM duration  $> 6$  years showed the same number. This is in accordance with the theory which states that there are more neuropathy in people with diabetes than men.

This is associated with the hormone estrogen. Normally, estrogen will cause more women to develop neuropathy due to disturbed absorption of iodine in the intestine so that the formation of nerve myelin fibers does not occur (Yulita et al., 2019). The results showed that the average age of the respondents was 51.6 years with diabetes mellitus about 6 years old. This is in line with (Simamora & Siregar, 2019) which states that type 2 diabetes is the most common type of DM, which is around 90-95% of all DM sufferers and many are experienced by adults over 40 years. This is because insulin resistance in type 2 diabetes tends to increase in the elderly (40-65 years), in addition to a history of obesity and the presence of heredity. Age affects the risk and incidence of type 2 diabetes. Age is closely related to an increase in blood sugar levels, so that the increasing age, the higher the prevalence of type 2 diabetes. The relevant results of (Suyanto & Susanto, 2016) state that physiological age affects changes in the condition of blood vessels in connection with atherosclerosis. Atherosclerosis will result in obstructed blood flow, so that it will have an impact on tissue hypoxia which will affect the function of nerve cells. Decreased nerve cell function can reduce foot sensation in the elderly. According to the study by (Purwanti & Maghfirah, 2016) although the results of the study were not significant, the longer the patient suffered from diabetes, the greater the risk of developing chronic complications (diabetic foot). This is because the respondents on average suffer from diabetes  $< 8$  years. The results showed that after a significant test was carried out using the Wilcoxon test on the comparison of neuropathy scores before and after diabetic foot exercise in the group with a duration of diabetes mellitus  $< 6$  years, there was a significant change with a value of  $p = 0.038$  ( $p < 0.05$ ) which means that there is The effect of diabetic foot exercise on the reduction of neuropathy in type 2 DM patients. Likewise with the neuropathy score before and after diabetic foot exercise in the group with a duration of diabetes mellitus  $> 6$  years, there was a significant change with p value = 0.011 ( $p < 0.05$ ) which means that there is an effect of diabetic foot exercise on the reduction of neuropathy in people with type 2 diabetes. Symptom score with a high predictive value for screening polyneuropathy in diabetes. Symptoms of unstable walking, neuropathic pain, paresthesia or a thick feeling felt by people with diabetes mellitus. This is in line with the research of (Yulita et al., 2019) which showed that there was a decrease in the average neuropathy score in the group that was given foot exercises, so it can be concluded that diabetic foot exercise can reduce neuropathy scores. in the intervention group, while in the control group who did not do foot exercises, the mean neuropathic score did not change.

The results showed that after a significant test was carried out using the Mann Whitney test on the comparison of neuropathy scores after diabetic foot exercises in the group with a duration of diabetes <6 years and the group with a duration of diabetes mellitus > 6 years, the value of  $p = 0.393$  ( $p > 0.05$ ) was obtained. This means that there is no difference in the change in neuropathy scores after diabetic foot exercise in the group with a duration of diabetes <6 years and the group with a duration of diabetes > 6 years. There was a similar decrease in neuropathy scores between the two different groups. So it can be concluded that there is no effect of the long-suffering factor (duration of diabetes) on the neuropathy score in type 2 DM patients. This is in line with research by (Suyanto & Susanto, 2016) which states that there is no relationship between age and duration of suffering from diabetes with the incidence of diabetic peripheral neuropathy ( $p$  value > 0.05).

So it can be concluded that the age and duration of suffering from diabetes are risk factors that are not related to the occurrence of diabetic peripheral neuropathy. For this reason, further research is needed to look at other factors such as age and low blood sugar control. Neuropathic disorders in diabetes require several distinctive signs and symptoms, including impaired sensation. If a person with neuropathy does not move, the sensations in the nerves in the feet will die, but if there is movement or exercise, stimulation of peripheral blood flow increases so that the neuropathy does not worsen the level of neuropathy to decrease. The most appropriate type of exercise for people with diabetic neuropathy is foot exercises. , with foot exercises able to increase the use of glucose in the muscles, many cell capillaries are opened so that the insulin receptors become more active. This can affect controlled blood glucose levels (Sembiring et al., 2018). State Research (Negara et al., 2019) showed that the average ABI and DPN values before foot exercise in the treatment group were 0.8724 and 8.47, while the control group was 0.8735 and 8.12. After exercising, the average ABI and DPN values were 0.9259 and 4.24 in the treatment group, 0.8765 and 7.82 in the control group. The results of the ABI and DPN data analysis using the independent t-test obtained  $p = 0.000 < \hat{I} \pm (\hat{I} \pm = 0.05)$  and  $p = 0.000 < \hat{I} \pm (\hat{I} \pm = 0.05)$ . There is a significant effect on the provision of diabetic foot exercises on the Ankle Brachial Index (ABI) and Diabetic Peripheral Neuropathy (DPN). Based on the results of this study, it is recommended that patients with type II diabetes mellitus can routinely do diabetic foot exercises to increase the ABI value and reduce the incidence of DPN. Diabetic foot exercise is one of the 4 pillars of diabetes mellitus management, namely physical exercise. This is done to improve self-care abilities and prevent complications due to diabetes mellitus such as neuropathy. The need for DM patients to carry out self-care is related to the developmental processes and conditions that occur during the life cycle. Two categories of developmental self-care are maintaining conditions that support life processes and promote development, and preventing harmful effects on human development and providing care to overcome these effects (Simamora & Antoni, 2018).

## Conclusion

Neuropathy scores in respondents have decreased when compared between before and after diabetic foot exercises.

This shows that there is an effect of diabetic foot exercise on reducing neuropathy in people with type 2 diabetes mellitus. In accordance with the results of the research obtained, it is hoped that all people with type 2 diabetes mellitus will always try to do physical exercise in the form of diabetic foot exercises to reduce the risk of neuropathy in type 2 diabetes mellitus sufferers. Thank you to all respondents who are willing to participate in the research. This, and thanks to all the parties that I cannot mention one by one. Hopefully this research can provide great benefits for all of us.

## Conflict of Interest

No conflicts occurred as long as the research and research were running smoothly.

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