

Original Research

The Influence of Diabetic Foot Exercise on Foot Sensitivity in Type 2 Diabetes Mellitus Patient



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Article Info	Abstract
Article history: Received: 15 March 2023 Accepted: 29 October 2023	<i>Introduction:</i> Decreased or missing insulin causes glucose to be retained in the circulation, increasing blood sugar levels while depleting the glucose required for cell survival and function. In type 2 DM patients, complaints of neuropathy are typical. The aim of this study was to evaluate the impact of diabetic foot exercise on patients with Type 2 Diabetes Mellitus at the Selemadeg Timur II Health Center.
Keywords: Type 2 Diabetes Mellitus, foot sensitivity, diabetic foot exercise	<i>Methods:</i> Pre-experimental research is the type of study being conducted. From December 2022 to January 2023, the study was conducted at the Selemadeg Timur II Health Center. A total of 34 people were included in the sampling method with purposive sampling. The Wilcoxon signed-rank test was used for analysis. <i>Results:</i> This study included 34 samples, and convenience or accidental sampling was used to choose the samples. The Wilcoxon test's Asymp. Sig. (2-tailed), which is 0.02 or 0.05, reveals the significance value. The results of the research show that before intervention the most sensitivity is moderate with 18 (61,2%) after treatment, data show that the most sensitivity is good with 16 (47%); p-value 0,02<0,05. <i>Conclusion:</i> Patients with Type 2 Diabetes Mellitus at the East Selemadeg II Health Center have sensitive feet, which is influenced by diabetic foot exercise. It is important for families and communities to give motivation to diabetes mellitus patients to do diabetic foot exercise as one of the alternative therapies to prevent foot complications and increase foot sensitivity.

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INTRODUCTION

A chronic metabolic illness known as Diabetes Mellitus (DM) results in hyperglycemia, or elevated blood sugar, which is brought on by an insufficient amount of insulin in the body. Decreased or absent insulin causes glucose to be retained in the blood, increasing blood sugar, while cells become deficient in glucose, which is essential for cell survival and function. Eyes, kidneys, nerves, and the vascular system are only a few of the tissues and organs that would be harmed by chronic hyperglycemia and other metabolic abnormalities associated with diabetes mellitus. Numbness and tingling are the initial symptoms of diabetic ulcers, which are consequences of diabetes mellitus in the integumentary system [1].

Particularly in emerging nations, urbanization is to blame for the drastic changes in lifestyle, a rapid transition, and an increase in the risk factors for noncommunicable diseases like diabetes mellitus [2]. Acute and chronic problems are possible in type 2 DM patients. Peripheral vascular disease, and sensory and motor neuropathy are examples of chronic consequences. About 75% of people experience these problems. The most recent data indicates that some of the patients at the East Selemadeg Community Health Centre, Tabanan lamented the tingling and ache they were feeling in their feet. Complications from microangiopathy and macroangiopathy would result in a stoppage of blood flow to all of the organs. DM patients who have active gangrenous wounds run the risk of needing an amputation. Lower limb amputations are 15

times more likely to occur in people with DM than in people without the condition.

According to the International Diabetes Federation (IDF), diabetes will affect at least 463 million individuals worldwide between the ages of 20 and 72 in 2019 [3]. This prevalence rate equates to 9.3% of the world's population at that age. About 537 million persons (20-79 years old), or 1 in 10, are estimated to have diabetes, including both type 1 and type 2 diabetes as well as diagnosed and undiagnosed diabetes, according to IDF data for 2021. According to the 2018 Indonesian Basic Health Research (Riskesdas) report, the prevalence of diabetes mellitus among people over the age of 15 in Indonesia rose from 6.9% in 2013 to 8.5% in 2018. Just 25% of diabetics, according to this statistic, are aware that they are diabetic [4]. According to the 2018 Bali Riskesdas report, there are roughly 20,560 persons in Bali who have been diagnosed with diabetes, or 1.33% of the population overall. A total of 2,127 people in Tabanan Regency, or 1.19%, have diabetes [5]. Based on data from the East Selemadeg II Health Center, Diabetes Mellitus ranks sixth among the top 10 non-communicable diseases at the East Selemadeg II Health Center, with as many as 128 patients reported seeking treatment there in 2021.

Long-term elevated blood sugar levels can result in problems and other metabolic illnesses. Both acute and chronic complications from uncontrolled DM are possible. Peripheral vascular disease, as well as sensory and motor neuropathy, are persistent complications that frequently occur [6]. Blood artery abnormalities could reduce the blood flow from the leg to the foot,

which puts patients with DM at an increased risk of foot issues. It is the primary reason that the number of gangrenous cases and amputations among DM patients is rising [7].

To avoid, treat, and manage the incidence of complications in DM care, numerous interventions have been made. Patients with diabetes should take care of their feet to reduce their risk of developing diabetic feet [8]. One method of treatment for reducing diabetic neuropathy consequences is educating patients and their families about the progression of the disease, its prevention, complications, and management [9]. How to perform foot examinations, engage in foot protection activities, and take care of your feet are all things that can be taught. Diabetic foot exercise is one of the foot care procedures necessary for early detection [10].

The number of amputations might be cut in half with routine foot care. Gymnastics is in line with the goals of Indonesia's national program to control diabetes mellitus, which includes reducing risk factors to lessen DM-related morbidity, disability, and death. DM foot care involves performing a foot inspection, washing the foot properly, drying it off, using moisturizers, wearing footwear, and administering first treatment to the injured. This prevents wounds on the DM patient's feet [11]. According to Bayu Brahmantia's research, the experimental group's average foot sensitivity before performing the DM foot exercise was 1.67, as determined by his study's findings in 2020. Leg workouts are performed twice a week. The average foot sensitivity increased by 2.36 in the experimental group. Improved sensitivity following foot exercises (p-value

0.001). So, it can be said that diabetic foot exercise has an impact on DM patients' feet's sensitivity at the Parungponteng Health Center in Cibalong District, Tasikmalaya Regency's.

METHODS

Study Design

This research method uses a pre-experimental with one group pre-test post-test design. From December 2022 to January 2023, the study was conducted at the East Selemadeg II Health Center.

Participant

The research received ethical approval from the ITEKES Bali Number 04.0389/KEPITEKES-BALI/VIII/2023. The respondent consists of type 2 diabetes mellitus patients aged 30-55 who attended East Selemadeg II Health Center in one month; 34 samples were chosen using the convenience sampling method with inclusion requirements: 1) Patients with type 2 diabetes mellitus who are willing to be respondents, 2) Type 2 DM patients who did not have lower extremity disorders such as diabetic ulcers 3) Blood glucose levels were less than 600 mg% when the sample selection process was being carried out, 4) suffering from diabetes mellitus for less than five years. The exclusion criteria: 1) Patients with type 2 diabetes mellitus who also have various disease problems, including ulcers and gangrene in the feet, 2) having a chronic disease.

Instrument and Data Collection

Diabetic patients perform foot workouts by exercising the type of feet movement for 30 minutes three times each week. Stimulation of sensitivity on the lower extremity (end sole), alternately use a needle (lancet), a rubber reflex hammer, and cotton. The scoring consists of 1) Good: if cotton is used, the answer is positive with Grade 3, 2) Moderate: hammer reflex reaction is measured using rubber 40 with Grade 2, and 3) There is less that is analyzed utilizing a needle no response with Grade 1. The researcher documented the rating of foot sensitivity on the observation sheet.

Data Analysis

The data was analyzed using the Wilcoxon signed-rank test. If the calculation results show a sig. p-value (0.05), there is an effect of diabetic foot exercise on foot sensitivity in Type II Diabetes Mellitus.

RESULTS

Following the data collection on up to 34 individuals who met the inclusion criteria at the East Selemadeg II Health Center work area, the following overview of the respondents' characteristics was obtained: identification of foot sensitivity prior to diabetic foot exercise; identification of foot sensitivity following diabetic foot exercise.

Table 1 shows the characteristics of the most respondents, namely 18 (52.9%) aged 51 to 55 years, 2 (5.8%) of the respondents aged 30 to 35 years, 22 (64.7%) female, secondary education level (SMP) as many as 16 (47%), working as farmers as many as 10 (29.4) and have long suffered from type 2 diabetes mellitus for 1-2 years as many as 15 (44.1%). Table 2 shows that out of the 34 respondents, the most foot sensitivity was moderate (lower touch sensitivity and discomfort), as many as 18 people (61.2%), and the least foot sensitivity was good, as many as 6 people (17.6%).

Table 3 shows that out of the 34 respondents, most of them had good foot sensitivity, namely 16 people (47%) and the least had less foot sensitivity, namely 8 people (23,5%). Table 4 shows that before receiving the foot exercise treatment, the highest foot sensitivity was moderate sensitivity, 18 people (61,2%) and the least sensitivity was good sensitivity, 6 people (17,6%). This data has a significant value after treatment. Data show, that the most sensitivity after intervention is good sensitivity, namely 16 people (47%), and the least is less sensitivity, namely 8 people (23,5%). It may be deduced that there is a relationship between foot exercise and foot sensitivity in patients with Type 2 Diabetes Mellitus at the East Selemadeg II Health Center based on the significance value derived from the Wilcoxon test above, which is $0.02 < 0.05$.

Table 1

The Frequency Distribution of Respondents with Type 2 Diabetes Mellitus at the East Selemadeg II Health Center.

Variable	(f)	(%)
Age		
30-35 years old	2	5,8
36-40 years old	3	8,8
41-45 years old	4	11,7
46-50 years old	7	20,5
51-55 years old	18	52,9
Sex		
Male	12	35,2
Female	22	64,7
Education		
Elementary School	8	25,3
Junior high School	16	47
Senior high School	5	14,7
Bachelor	5	14,7
Work		
PNS/TNI/Polri	3	8,8
Farmer	10	29,4
Privat Sector	6	17,6
Self Employed	9	26,4
Doesn't work	6	17,6
Type 2 diabetes mellitus has long caused suffering		
< 1 year	8	25,3
1 - 2 year	15	44,1
3-<5 year	11	32,3

Table 2

Foot Sensitivity Before Intervention (pre-test).

Foot Sensitivity	f	%
Less	10	29,4
Moderate	18	61,2
Good	6	17,6
Total	34	100

Table 3

Foot Sensitivity After Intervention (post-test).

Foot Sensitivity	f	%
Less	8	23,5
Moderate	10	29,4
Good	16	47
Total	34	100

Table 4

A Study on the Impact of Foot Activity on Foot Sensitivity in Type 2 Diabetes Mellitus Patients.

Parameter	Category	Pre-test	%	Post-test	%	p
Foot Sensitivity	Less	10	29,4	8	23,5	0.02
	Moderate	18	61,2	10	29,4	
	Good	6	17,6	16	47	
Total		34	100	34	100	

DISCUSSION

Characteristics of Respondents with Type 2 Diabetes Mellitus

Sex

According to the results, which included 34 respondents, 22 of whom were women (or 62,7%) and twelve of whom were men (or 12,2%), the majority of respondents were female. The researchers at the East Selemadeg II Health Center discovered a large number of samples during the data collection process, and among those who met the inclusion criteria, there were more female respondents than male respondents, which led to an uneven distribution of respondents by gender in this study. Women are more likely than men to develop type 2 diabetes mellitus. This statement is consistent with Jarvis's study with the result that after a woman enters menopause, her estrogen levels may drop, which can contribute to this. Women's lower estrogen levels can raise their chance of developing insulin resistance[12].

Age

According to the study, there were 9

respondents who experienced a decline in foot sensitivity with a score of 2 (moderate), the majority of them belonged to the age range of 51-55 years (52,9%), based on data collected from 34 respondents. According to Black and Hawks (2005), type 2 DM is a kind of diabetes that is not insulin-dependent. Adults over the age of 40 are most commonly diagnosed with this condition.

Education

As many as nine people (47%) of those with diabetes mellitus have completed junior high school. The prevalence of diabetes mellitus is influenced by one's level of education. Most people with high levels of education are knowledgeable about health, and they are also conscious of the need to keep their health [13].

Work

Farmers make up the majority of the respondents' workforce, which totals 10 individuals or 29,4%. Type 2 diabetes mellitus predominately affected respondents who worked as farmers. Because East Selemadeg II Health Center's operational region is situated in a rural area, this may also be because the

sample the researchers discovered consisted of more farmers. According to [14] farmers who engage in high levels of physical activity should have a low risk of developing Type 2 DM. However, there are a number of risk factors, including family history, BMI, energy intake, and thiamine intake, which affect the likelihood of developing Type 2 DM in farmers.

Long-Term Diabetes Mellitus

Fifteen respondents reported poor foot sensitivity, and fifteen of these respondents had Type 2 DM for three to five years, according to research findings. According to [15], foot sensitivity is one of the indications and symptoms of complications in Diabetes Mellitus, and the longer a person has DM, the greater the risk they have of problems beginning with normal signs and symptoms.

Pre-exercise Foot Sensitivity at the East Selemadeg II Health Center

The most foot sensitivity of the 34 respondents before they received diabetic foot exercises was moderate sensitivity, as many as 18 (61,2%). The findings of this study allow for numerous reasons, including the fact that patients state they rarely undertake leg movements and treatment to preserve healthy feet. Patients frequently decrease their activities to avoid being hit by potentially harmful things around them. This statement is con congruent with Schreiber's result that people with diabetes mellitus exhibit reduced sensitivity in the motor, autonomic, and sensory spheres of the nervous system. Due to blood vessel issues,

patients with diabetes mellitus are more likely to experience issues with their feet. Nerve diseases, which lower blood circulation in the legs, also reduce the ability of the feet to perceive sensation. A novel, easy way without instruments is needed to perform a neurosensory assessment of diabetic feet in diabetics. It involves employing a cotton ball, rubber on the hammer reflex, and a lancet needle [16].

According to Theresia [17], it was found that the average foot sensitivity before (pre-test) treatment was 1.67 with a standard deviation of 0.577, the results of this study are consistent with that finding. According to the above study's findings, patients with diabetes mellitus had decreased foot sensitivity as seen in the results of the initial assessment taken prior to the foot exercise intervention. The results of the data analysis revealed that the group before the foot exercise had sensitivity values of 2 and 3 which were the lowest and greatest. Statistics revealed that 45% of respondents had a sensitivity value between 2.31 and 2.79.

Post-exercise Foot Sensitivity at the East Selemadeg II Health Center

Based on the results of data processing it is known that after the (post-test) treatment, the most foot sensitivity score of type 2 diabetes mellitus patients was good sensitivity with 16 (47%). Some of the reasons why the result is significantly different from before treatment is that patients report feeling more at ease after treatment. There is no tingling and a calm sensation because the feet are easier to move.

Patients no longer fear practicing leg movements and relaxing leg muscles. This finding is similar to Mkaouer's that gymnastics is a set of routine, purposeful, and planned movements performed either individually or in groups with the goal of improving the body's functional capacities [18]. One of the workouts or activities that people with diabetes can do to prevent injuries and enhance blood circulation is walking legs. Exercises for the feet can strengthen the leg muscles, increase blood flow to the legs, and help prevent foot abnormalities. In addition, it can strengthen the calf and thigh muscles and help people overcome joint movement restrictions[9];[19].

The findings of this study concur with studies by [20] on the impact of diabetic foot exercise on foot sensitivity in patients with type 2 diabetes mellitus. The findings revealed that the post-test measurement had a standard deviation of 1.244 and an average score of 3.38. The average sensitivity of the feet of diabetes mellitus patients has increased after they performed foot workouts, as may be inferred from the study's results as shown above. Foot exercise can help to increase the blood flow in the legs, which will modify the foot sensitivity score. This demonstrates that the respondents followed the researcher's instructions when performing their foot exercises.

Influence of Diabetic Foot Exercise on Patients with Type 2 Diabetes

Mellitus at the East Selemadeg II Health Center

According to the study's findings, before treatment, the most foot sensitivity was moderate sensitivity. But after treatment, the data was changed, the most sensitivity is good sensitivity. Also, the data show that the p-value is $0,02 < 0,05$. According to the research's findings, there is a difference in sensitivity of the feet prior to and following the intervention. After performing foot workouts, the average level of sensitivity is higher than before.

This shows that respondents who received the intervention experienced an increase in foot sensitivity. This was due to the fact that the respondents were compliant and consistently engaged in the diabetic foot exercise activities, which were performed three times for a total of 30 minutes. The results of this study suggest that diabetic foot exercise has an impact on patients with Type 2 Diabetes Mellitus at the East Selemadeg II Health Center. The statistical test (Wilcoxon signed-rank test) used in this study yielded a significance value seen from the Asymp. Sig. (2-tailed), namely $0.02 < 0.05$.

According to a study by [21] foot sensitivity before foot exercises had an average sensitivity of 1.67 and after doing foot exercises had an average sensitivity of 2.36, better sensitivity after being given foot exercises (p-value 0.001). So, it can be said that diabetic foot exercise has an impact on DM patients. Insensitivity results in dryness and edema of the feet. Less sensitivity can lead to ulcers, infections, and other foot issues, making the prevention of complications in

those with diabetes mellitus crucial. Adequate exercise intensity can significantly increase foot sensitivity. There are three reasons why people with diabetes mellitus are more likely to experience foot issues. First, sufferers of neuropathy with diminished pain perception may not be aware that they frequently fail to notice injuries since they cannot be felt. Second, diminished sensitivity in the feet and legs as well as injury to the vascular endothelium, both of which increase the risk of injury, particularly to the legs. Finally, the body becomes less resistant to infections. Reduced blood flow and oxygen delivery to the nerve fibers due to impaired sensitivity will lead to nerve fiber degeneration. Neuropathy will result from this circumstance. Diabetic foot is one of the problems that persons with diabetes mellitus are extremely terrified about.

Exercise, including foot exercises, is a first step in avoiding, controlling, and overcoming diabetes. Foot exercise helps boost blood circulation and blood flow, which allows more capillary nets to open and more insulin receptors to become active and available [22]. This situation will facilitate the delivery of nutrients and oxygen to neuron 66, which can enhance nerve function [23].

This foot exercise is quite beneficial for diabetics who have poor blood flow and neuropathy in their legs, but it is tailored to the individual's body and conditions [24]. Blood circulation in the feet can be improved by engaging in diabetic foot exercises, such as those demonstrated at the 3rd National Diabetes Educators Training Camp in 2005 [25]. Reducing sensory neuropathy symptoms include tingling, grinding, and

soreness in the foot. Other diabetic foot exercises have the advantages of strengthening tiny muscles, preventing foot deformities, boosting calf and thigh muscle strength (gastrocnemius, hamstring, quadriceps), and overcoming joint motion restrictions. Exercises such as diabetic foot workouts can cause the muscles in the moving portions to contract [26].

LIMITATION

The researcher is aware that this study has a number of restrictions that should be taken into account for future work. These restrictions include the study's design and the small number of samples.

CONCLUSION AND RECOMMENDATION

Based on the findings of a study done on 20 participants with Type 2 Diabetes Mellitus at the East Selemadeg II Health Center regarding the impact of diabetic foot exercise on Type 2 Diabetes Mellitus patients, it can be said that: The majority of respondents are women, 50-55 years old, have junior high school education, work as farmers and planters and entrepreneurs, and have had Type 2 Diabetes Mellitus for three to five years at the East Selemadeg; Pre-exercise Foot Sensitivity is moderate sensitivity; Post-exercise Foot Sensitivity is good sensitivity; Foot exercise have a significant effect to increase foot sensitivity of diabetic mellitus patients.

Diabetic foot exercise is advised for nursing services and can be employed as a standard of nursing care in nursing services, both in hospitals and the community. Diabetic

foot exercise is one of the nursing care techniques for people with diabetes mellitus that is taught to students at educational institutions. To get a deeper understanding of independent nursing interventions, educators and students might use the study's findings as a source of information or new references. It is intended that the findings of this study will be used as research material for similar studies in the future. Other researchers should be able to do further in-depth studies on how diabetic foot exercise affects foot sensitivity, taking into account other variables that influence foot sensitivity.

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CONFLICT OF INTEREST

All of the authors of this manuscript have no conflict of interest to declare.

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