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The effect of active range of motion exercise on foot sensitivity in type II diabetes mellitus patients

Erliana Dwi Retna Asih[1], Agung Widiastuti[2*], Mursudarinah[3]

[1]Bachelor of Nursing Study Program, Faculty of Health Sciences, Universitas Duta Bangsa Surakarta, Indonesia;
[2]Nursing Study Program, Faculty of Health Sciences, Universitas Duta Bangsa Surakarta, Indonesia;
[3]Nursing Study Program, Faculty of Health Sciences, Universitas Aisyiah Surakarta, Indonesia.

*Corresponding author:
Agung Widiastuti;
Nursing Study Program, Faculty of Health Sciences, Universitas Duta Bangsa Surakarta, Indonesia;
agung_widiastuti@udb.ac.id

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ABSTRACT

Background: Diabetes Mellitus (DM) is a metabolic disease that can be characterized by the presence of high sugar levels in the blood, resulting in an imbalance between insulin demand and production in the human body. One of the complications is peripheral neuropathy nerve damage, which causes diabetic ulcers, so there is a risk of decreased sensitivity to diabetics. Active Range of Motion (ROM) exercises are one effort to overcome this. The objective is to determine whether the active ROM of the lower extremities affects foot sensitivity in type II DM patients.
Methods: The research used a pre-experimental quantitative research design with the one-group pre-test and post-test method. The sampling technique used purposive sampling with 22 respondents.
Results: The analysis using the Wilcoxon test obtained a p-value <0.005. This indicates an increase in foot sensitivity in type II DM patients.
Conclusion: There is an effect of active foot ROM on foot sensitivity in type II DM patients.

Keywords: Blood Sugar, Diabetes Mellitus, Foot Sensitivity, Foot Ulcers, Range of Motion.
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INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disease characterized by high blood sugar levels (hyperglycemia) caused by impaired insulin secretion and decreased insulin, resulting in an imbalance between insulin needs and production in the human body.[1] One of the complications in DM patients is peripheral neuropathy nerve damage, which results in the blood supply to the legs is not smooth and causing diabetic ulcers and is at risk of decreased sensitivity in the feet.[2,3]

According to WHO, 2018 Prediction of the increase in DM sufferers in Indonesia also increased by 8.4 million people in 2018 and will continue to increase by 21.3 million in 2030.[4] The increase in the number of type II DM patients is partly due to lifestyle changes, low level of knowledge, and lack of awareness to carry out early detection of DM, as well as lack of physical activity and changes in diet containing carbohydrates and fiber into unhealthy eating patterns due to the composition of overeating protein, fat, sugar, salt, and little fiber.[5] This unhealthy lifestyle change results in increased sugar levels so that the feet experience tingling and numbness, resulting in neuropathy and decreased foot sensitivity.[6]

The cause of neuropathy is microcirculation flow involving arteries, arterioles, capillaries, and post-capillary venules. Peripheral neuropathy is the most common complication in DM patients and affects 50% of type II DM patients. Using ROM exercises to minimize nerve damage or peripheral neuropathy is one treatment for diabetes.[7] This is supported by Purnamawati's research (2018), stating the effect of active ROM of the foot at foot sensitivity in type II DM patients. It is recommended that respondents always do an active ROM of the feet to maintain foot sensitivity. If not maintained, foot sensitivity will experience impaired sensitivity, which can cause diabetic ulcers.[8]

Leg Active ROM exercises are a basic form of motion that makes leg muscles contract, prevents thrombus formation, improves nerve function, increases sensation in DM patients, and prevents neuropathy.[9] Foot active ROM exercise is a form of physical exercise helpful in launching and facilitating blood flow into cells, especially in the feet; through active ROM exercise, the feet can be done at home inexpensively.[10]

The research of Silalahi et al., 2015 stated that an increase in blood sugar levels causes decreased foot sensitivity. Blood sugar levels in the legs are not smooth, characterized by tingling, a thick feeling on the soles of the feet, and not feeling sensations when the feet are in pain.[11] The soles of the feet do not feel the sensation when the feet are touched; reducing these signs and symptoms can be done by exercise.[12] To reduce these signs and symptoms, active ROM foot exercises. Active ROM of the foot can improve blood circulation and reduce blood sugar levels. Improve blood circulation and reduce blood sugar levels to increase foot sensitivity.[10]

Based on preliminary studies, patients have seen the significant prevalence of type II DM with decreased foot sensitivity as a manifestation of diabetic neuropathy and the need for nurses to intervene to improve the quality of life of patients and as an effort to prevent complications in patients suffering from DM. Seeing this phenomenon, the researcher is interested

in examining the effect of ROM on the lower extremities and foot sensitivity in Type II DM patients.

METHODS

This study used a pre-experimental quantitative research design with the One Group Pre-test and post-test methods. In this study, the population obtained at Girimarto Health Center included as many as 88 patients. This study used the *Wilcoxon* test with a sample of 22 respondents using a purposive sampling technique. The research was conducted from June to July 2023. This research was initially conducted by looking for data at the Girimarto Health Center. Then, the researcher came from one house to another to conduct pre-tests, interventions, and post-tests.

The inclusion and exclusion criteria in this study were willingness to be a respondent, elderly not experiencing hearing loss and being able to communicate well, and the patient suffering from type II DM while the patient has type II DM. Exclusion criteria are not being able to do physical activities, having a history of stroke, and Type II DM patients with diabetic foot ulcers. Efforts made to reduce the bias value of respondents who are still taking drugs are given a break when doing ROM exercises.

RESULTS

The characteristic data of respondents are mostly aged 56-65 years, with as many as 16 respondents (72.7%), and least aged >65, as many as six respondents (27.3%). The percentage of respondents of sex, primarily male, is nine (40.9%), and females are 13 (59.1%). The percentage of jobs obtained by the most data is farmers, which is as much as 20 (90.9%), and at least daily laborers as much as 2 (9.1%). The lowest level of education was not graduating from elementary school, with as many as one respondents (4.5%). The most recent education was graduating from elementary school as many as 18 respondents (81.8%), graduating from junior high school as many as two respondents (9.1%), and graduating from high school as many as one respondent (4.5%) shown in Table 1.

Table 1. Data on characteristics of respondents with type II diabetes mellitus at Girimarto Health Center

Variable	Frequency	Percentage
Age		
Late Elderly (56-65 years old)	16	72.7%
Seniors (>65 years old)	6	27.3%
Gender		
Male	9	40.9%
Female	13	59.1%
Occupation		
Farmer	20	90.9%
Day Laborer	2	9.1%
Education		
Never	1	4.5%
Elementary School	18	81.8%
Junior high school	2	9.1%
Senior high school	1	4.5%
Total	**22**	**100%**

Table 2. Respondent data on foot sensitivity before and after active range of motion (ROM) exercise in patients with type II diabetes mellitus

Foot sensitivity score	Frequency	Percentage	Median (min – max)	*P*-value
Before active ROM				
5	3	13.6	6.0	
6	12	54.6	(5-7)	
7	7	31.8		0.001
After active ROM				
8	1	4.6	10.0	
9	7	31.8	(8-10)	
10	14	63.6		

Most of the foot sensitivity data was 5 as many as 3 respondents (13.6%), 6 as many as 12 respondents (54.6%), and those worth 7 were seven respondents (31.8%) shown in Table 2. It was obtained that most of the foot sensitivity data was 8 as many as 1 respondent (4.6%), 9 as many as 7 respondents (31.8%) and 10 as many as 14 respondents (63.6%).

The results of the effect of foot sensitivity before being given active ROM using the Wilcoxon Signed Ranks Test obtained a *p*-value of 0.001 or < 0.05. It can be concluded that Ho was rejected. Ha was accepted, meaning there was a significant difference between foot sensitivity before and after active ROM intervention. So, it can be concluded that there was an active ROM effect on foot sensitivity in patients with Type II DM. The median score of sensitivity level before the intervention was 6.0, while the average after the intervention increased the sensitivity level to 10.0.

DISCUSSION

Of the 20 points that have been carried out using monofilament, the average sensitivity of respondents before treatment was 6.18, and after treatment, it increased to 9.59. The lowest value before treatment was five, and the highest was 7; after treatment, the lowest was eight, and the highest was 10. The results of the research analysis indicated an influence before and after active ROM. This is supported by research by Yulfa Intan Lukita (2018), which states that active ROM can increase foot sensitivity, so respondents are advised to do ROM movement exercises to prevent the onset of diabetic ulcers.[10]

The research results conducted by Hasyim (2017) said that ROM exercises performed as early as possible and carried out correctly and continuously will impact joint flexibility, muscle strength, and functional ability in type II DM patients. ROM exercises carried out continuously will significantly affect the healing of

diabetic ulcer sufferers, one of which is improving blood circulation. Blood vessels will experience compression and activate venous pumps. Blood flow will increase and experience a phase of contraction and relaxation so that blood flow becomes smooth. When the contraction of blood flow flows into the veins and is replenished from the arteries, during the relaxation phase, the return blood vessels will be more active in pumping blood to the heart so that arterial blood circulation that carries nutrients and oxygen to peripheral blood vessels becomes smooth.[10]

The level of foot sensitivity is measured using the Semme ses-Weistein Monofilament 10 g tool. This tool is recommended for checking protective sensation in the foot because it is noninvasive, easy, cheap, and fast. It has a very effective predictive ability for the risk of ulceration or amputation.[13] Patients who cannot sense 10g monofilaments on one or more plantar pedis surfaces can be categorized as losing protective nerve function.[14]

The sensitivity of the respondent's feet is influenced by high blood sugar levels, causing blood viscosity in the blood vessels to thicken so that blood circulation in the body is disrupted, especially in the feet. This can lead to diabetic ulcers with decreased foot sensitivity.[15] Diabetic foot conditions combine various causes, such as lack of foot sensitivity and neuropathy. The sensitivity of the feet of patients with type II DM is preceded by the risk factor of high glucose levels, which disrupts the body's metabolism. This problem can be overcome by increasing body activity, which causes active ROM therapy to improve foot sensitivity.[16]

Active ROM therapy of the foot is a fundamental movement to establish the presence of abnormalities to state abnormal joint boundaries. Active ROM therapy aims to prevent permanent disability, so it is recommended that patients carry out activities independently without the help of others.[17] This aligns with Priyanto's research (2019), which states that active ROM therapy aims to facilitate blood circulation. Active ROM therapy can strengthen the leg muscles and improve blood circulation, which is impaired in patients with neuropathy and disturbed in neuropathy patients.[15] This active ROM complementary therapy is very efficient because this complementary therapy is carried out using physical activities, and the movements are straightforward to apply.[18]

Decreased mobilization and movement results in significant musculoskeletal damage, with the main pathophysiological change being atrophy. Atrophy is a condition in response to disease and decreased daily activities such as immobilization and bed rest.[19] Decreased stability occurs due to loss of endurance, decreased muscle mass, atrophy, and actual joint abnormalities, so clients cannot move continuously and are at risk of falling.[20,21] Following Sherwood's theory (2017), which explains the effect of activity on foot sensitivity, the binding of myosin and active molecules in cross bridges causes muscle fiber contractions that require energy. Each active molecule has a specific binding site for the attachment of myosin cross bridges. If a muscle is unused, its actin and myosin content decreases, and its fibers become smaller, becoming atrophic (less mass) and weaker. In a relaxed muscle fiber, contraction does not occur; actin cannot bind to the cross-bridge due to the position of two other protein types - tropomyosin and troponin - within the thin filament.[22]

There are various research limitations in this study. For starters, the sample size was modest. Second, this was a one-group research with no control group. Suggestions for future researchers can be added to the number of respondents and control groups to assess the effectiveness of the effect of ROM on foot sensitivity.

CONCLUSION

There was an increase in foot sensitivity in the leg extremities, and it can be concluded that there was an influence before and after active ROM intervention on foot sensitivity in patients with type II DM at the Girimarto health center.

ETHICAL CLEARANCE

This research was conducted an ethical test at Wonosari Regional Hospital and declared ethically worthy with NO. 00.9/050/2023.

CONFLICT OF INTEREST

The author states there is no potential conflict of interest in connection with the research, authorship, and or publication of this article.

AUTHOR CONTRIBUTIONS

EDRA prepares study designs, collects data, processes data, and writes manuscripts. AW and M are directing data collection and revising the manuscript.

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