The Effect of Diabetic Foot Exercise on Peripheral Perfusion and Fall Risk in Elderly with Diabetes Mellitus: Case Report

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Abstract

Diabetes mellitus (DM) in the elderly can be caused by the aging process and decreased physical activity, and risk of experiencing complications such as peripheral neuropathy. Diabetic foot exercises are an intervention to control blood sugar levels and reduce the risk of complications and limited study have been found that support the intervention on the risk of further falls. This study aims to determine the effect of foot exercises on peripheral perfusion and fall risk in elderly with DM. The research employed a case report methodology, utilizing a nursing care approach for an elderly individual aged 65 years. The client experienced peripheral neuropathy and the assessment showed that the client was in the moderate fall risk category. The intervention was given for 7 days in the morning and evening for 10–15 minutes, and evaluation was conducted daily through observation, interviews, physical examinations, and objective assessment using questionnaires Tinetti Assessment Tool. Complaints of tingling and stiffness in the feet had decreased, acral temperature became warm, CRT was 2 seconds, SpO_2 in the toes increased to 96%, GDS was 136 mg/dL, and the Tinetti Assessment Tool score was 5 with an interpretation of low fall risk. The findings of this study indicate that practicing diabetic foot exercises can improve peripheral perfusion and reduce the risk of falls in the elderly. Further research is expected to be conducted with a larger sample size and a longer intervention duration to observe its long-term effects.

Keywords: Diabetic Foot Exercise, Diabetes Mellitus, Elderly

Introduction

Diabetes Mellitus (DM), known as 'sugar disease' in the community, is one of the non-communicable diseases (NCDs) with a high prevalence in Indonesia. According to the results of the Indonesian Health Survey (IHS) in 2023, it was found that people with diabetes in Indonesia reached 11.7% of the total number of Indonesians with the possibility of continuing to increase (Kementerian Kesehatan RI, 2025). Indonesia is ranked seventh out of ten countries with the most diabetes mellitus patients in the world and is expected to increase from year to year (Widiasari et al., 2021). Based on the statement of the International Diabetes Federation (IDF), the prevalence of people with diabetes in Indonesia is expected to almost double by 2030 (Kementerian Kesehatan RI, 2025). In the elderly age group of 60 years, as many as 6.5% have diabetes (Kementerian Kesehatan RI, 2018).

Lifestyle factors, genetics, aging, decreased physical activity, obesity or excess weight and diseases suffered such as hypertension, are some of the factors that can cause diabetes (Alfreyzal et al., 2024; Widiasari et al., 2021). In the elderly group, the most prominent risk factors are aging and decreased physical activity which causes a decrease in insulin production by pancreatic beta cells (Arna & Hasanah, 2022). As age increases, the risk of suffering from glucose intolerance also increases, so aging becomes an unmodifiable risk factor for diabetes mellitus (Perkumpulan Endokrinologi Indonesia, 2021). While a decrease in physical activity is usually accompanied by other factors such as lifestyle changes and obesity, this has an impact on increasing the reformation of adipose tissue which can lead to type 2 diabetes mellitus (Darmawati et al., 2022).

Elderly people with DM are at risk of experiencing prolonged elevated blood glucose levels which can cause complications including retinopathy, disruption in the work of the heart, damage to nerves, stroke, and peripheral neuropathy (Arna & Hasanah, 2022). Peripheral neuropathy is a complication where almost all DM patients experience it with a percentage of more than 90% (Rahman et al., 2021). Decreased peripheral perfusion occurs as the beginning of tissue hypoxia and causes peripheral area tissue damage (Arna & Hasanah, 2022). Peripheral neuropathy will cause mild symptoms such as tingling, and worsen such as numbness, weakness, gait disturbance, balance disturbance paresthesia, and sometimes pain (Margaretta, 2017).

Prevention of peripheral neuropathy can be done with a DM diet to control blood sugar levels, regular drug consumption, and exercise (Rahman A. et al, 2021). Physical activity that can be done by the elderly with diabetes mellitus is light aerobic exercise, including walking, physical exercise, and foot exercises. One of the exercises that can be done by the elderly with DM is foot exercises with the benefits of improving blood circulation, strengthening the small muscles in the feet, preventing deformation of the feet, preventing damage to blood vessels, nerves, and foot structures (Margaretta, 2017). Furthermore, by increasing blood flow and strengthening the small muscles of the feet, diabetic foot exercises can ultimately reduce the risk of falls in the elderly. Based on the results of research by Arna & Hasanah (2022), it was found that the implementation of foot exercises in the elderly with DM for five days of therapy showed a decrease in blood sugar levels, complaints of tingling and stiffness in the feet were reduced, and the level of risk of falling was reduced. However, not many other studies have been found that support the implementation of DM foot exercises on the risk of further falls.

This case report was made to add information about the effect of DM foot exercises on the risk of falls in the elderly living in institutions. Based on the results of interviews with clients, it was found that clients tend to avoid physical exercise involving the feet for fear of increasing complaints and do not know that foot exercises can reduce complaints and prevent further peripheral neuropathy conditions. Therefore, this study aims to determine the effect of providing foot exercises on foot sensitivity and the risk of falls in the elderly with diabetes mellitus.

Reserch Method

Research Study

This research was conducted using the case report method which allows researchers to gain a detailed and in-depth understanding of the subject under study.

Case Description

The subject in this study is one elderly person (Mrs. A) aged 65 years who lives in Wisma Aster UPTD PPSGL Ciparay. The subject was taken to UPTD PPSGL Ciparay by the client's workplace supervisor in 2023. When the assessment was carried out, the client's general condition was neat, clean, with a hunched posture. The client reported a history of diabetes mellitus for the past three years, accompanied by numbness, stiffness, and pain in both legs. There was no history of hypertension, stroke, heart disease, or other comorbidities. Vital signs examination obtained blood pressure 123/61 mmHg, respiratory rate 18x/min, heart rate 74x/min, temperature 36.5°C, and SpO2 94% measured on the toes. Anthropometric examination of the client obtained body weight 52 kg, height 138 cm, upper arm circumference 25 cm, and BMI 27.3 (Obesity). Based on the results of the assessment, it was found that the main problem experienced by the client was a decrease in blood circulation to the peripheral area. Physical examination results showed that there was decreased sensitivity in the ring finger and little finger on the right and left feet, stiffness in both feet, and limited range of motion of the lower extremities. Muscle strength was assessed at 5/5 in the upper extremities and 3/3 in the lower extremities. Based on observation, it was found that the client walked slowly with an unbalanced condition and was not straight in a line. Based on the examination of balance and the risk of falling using the Tinetti Assessment Tool questionnaire, a total score of 7 was obtained, indicating a moderate risk of falling, with the following details:

Table 1. Tinetti Assessment Tool Results Before Intervention

Score	Assessment Item	Deviation Condition of Assessment Item
0	Get up from the chair	Not getting up from sitting immediately, hands moving to push the body up or not getting up immediately but first moving to the front of the chair
0	Sitting into a chair	Dropping into a chair, sitting not in the center of the chair, or holding on to it
0	Get up from chair with eyes closed	Does not get up from sitting directly in one motion, hands move to push the body up or do not get up immediately but move to the front of the chair first
0	Sit into the chair with eyes closed	Sitting with a falling motion into the chair, sitting position not in the center of the chair, or holding on to it
0	Resist pushing on the sternum	Unable to resist pushing by moving legs, holding objects for support, or legs not touching the sides
1	Resist pushing on the sternum with eyes closed	Unable to resist pushing by moving legs, holding an object for support, or legs not touching the sides
1	Neck rotation	Moves legs, holds other objects for support, complains of dizziness, vertigo, or appears unstable
1	Reaching movements	Unable to reach for items with fully flexed shoulders, standing on tip toes, holding objects for support due to unsteadiness when standing up
0	Bending	Unable to bend down to pick up a small object on the floor, so holding another object to stand up again, and struggling to stand up
0	Gait	Hesitates, stumbles, holds objects for support
1	Height of footsteps	When stepping, feet cannot step consistently, foot movements appear to be shifting/dragging, feet are raised high (>5 cm)

1	**Continuity of footsteps**	**The initial footfall is inconsistent, so that one foot lifts while the other touches the floor**
0	**Symmetry of stride**	**Foot strides are not equal/symmetrical, often occurring on the affected foot**
1	**Path deviation**	**Walking deviates from side to side, not in a straight line**
1	**Turning**	**Stopping before turning, walking unbalanced, or holding an object before turning for support**

Data Analysis

The research instrument used in this study is the Tinetti Assessment Tool instrument as an assessment of balance in the elderly. This instrument is one of the measuring instruments used to assess dynamic balance including sitting, standing, and walking, especially in the elderly. Based on the results of the study, it was found that the results of the Intraclass Correlation Coefficient (ICC) reliability test of the Tinetti Assessment Tool questionnaire were 0.941 for interrater reliability, and 0.948 for intrarater reliability. These results mean that the Tinetti Assessment Tool is reliable for measuring dynamic balance in the elderly (Sousa, 2016). In addition, as supporting information about the general condition of the study subjects, researchers collected data on acral temperature, blood sugar and SpO2. Interventions carried out by researchers are blood sugar checks and diabetic foot exercises, given for 7 meetings in the morning and evening with 10 - 15 minutes each meeting. This exercise is done with the aim of improving blood circulation, especially to peripheral areas and controlling blood sugar levels in clients. The steps of diabetic foot exercises include (Tumiwa & Pondaa, 2023; Widiawati et al., 2020):

1. Sit on a chair with an upright position and feet touching the floor

2. Place the heels on the floor, the toes of both feet are raised up and bent down, do it 10 times

3. Place the heels on the floor, lift the soles of the feet upwards with the toes stretched upwards. Place the toes on the floor, lift the heel of the foot up. Perform simultaneously on the right and left legs alternately, repeat 10 times

4. Place the heel on the floor, lift the sole of the foot up and make a circular motion at the ankle, do on both feet 10 times

5. Place the foot on the floor with forward support on the toes, lift the heel and make a circular motion at the ankle, do it on both feet 10 times

6. Raise one knee and straighten it, stretching the toes forward and then lowering them. Do 10 times alternating between the right and left legs

7. Lift both legs and straighten them, maintain the position for 10 seconds.

Evaluation is carried out daily by means of observation, interview, and objective assessment using an instrument in the form of a Tinetti Assessment Tool questionnaire.

Research Process

Prior to the DM foot exercise intervention, the researcher conducted an assessment of the research subjects using the methods of interview, physical examination, observation, and measuring client balance using the Tinetti Assessment Tool questionnaire. Data collection was carried out for 2 days including supporting physical examinations in the form of acral temperature, oxygen saturation in the toes, CRT of the toes, and blood sugar checks at the time to provide an overview of the subject's peripheral perfusion conditions before receiving the intervention and as a comparison after the subject received the intervention.

Research Ethics

The ethical principles of nursing applied in this study include respecting client rights starting from research approval from clients using informed consent sheets, maintaining client data or anonymity, justice and inclusiveness, and avoiding harm and benefit. This research was conducted on a daily basis from March 25 - 27, and continued on April 8-12, 2025 at the UPTD PPSGL Ciparay.

Result

Based on the results of the assessment, it was found that the main problem experienced by the client was a decrease in blood circulation to the peripheral area. So that the nursing diagnosis raised include ineffective peripheral perfusion and the risk of falling (SDKI, 2017). Foot exercise intervention constituted a primary component of the nursing care plan provided to the client as a non-pharmacological approach. This intervention was accompanied by monitoring the client's metformin intake as part of the pharmacological therapy.

On the first day of the intervention, the client was able to follow the foot exercises from start to finish, did not ask for a break during the intervention, but it seemed that the client had difficulty following some movements, especially in circular movements that rested on the heel. After the intervention was carried out in the morning and afternoon, there were no complaints of pain, soreness, or cramps experienced by the client. On the second and third days of intervention, the client was not yet able to perform the foot exercises on her own without the author's direction, so the intervention was still accompanied by direction. The client was able to complete diabetic foot exercises from start to finish in the morning and evening, with no requests for breaks during the intervention. The client appeared to be able to perform each movement well without significant difficulty and there were no complaints after the intervention was carried out.

On the fourth day of intervention, the client had begun to memorize 5 of the 7 movements that should be done. The client said she was getting used to doing diabetic foot exercises twice a day and her complaints of numbness and tingling had begun to decrease. After the second intervention on the fourth day, a blood sugar test was conducted with the result of 143 mg/dL. On the fifth and sixth days of intervention, the client had memorized all the movements of diabetic foot exercises and could do them without direction from the author, but there was 1 movement that was done incorrectly, namely in the movement of turning the ankle that rested on the heel.

On the seventh day of intervention, the client was asked to perform the entire movement without direction and justification of inappropriate positions or leg movements. The client was able to perform the entire movement from start to finish without any obstacles and complaints after the intervention was carried out. After the second intervention on the seventh day, a blood sugar test was conducted with the result of 136 mg/dL. This shows a decrease in the client's GDS from time to time during the diabetic foot exercise intervention. Details of the intervention evaluation results on the research subjects are as follows:

Table 2. Daily Evaluation of Client's Condition After Diabetic Foot Gymnastics Intervention

Day-	Complaints	Acral	CRT (sec)	SpO2 (%)	Tinetti Score	GDS (mg/dL)
1	Foot stiffness, numbness in the ring and little fingers of both feet, frequent pins and needles	Cold	3	94	7	165
2	Foot stiffness, numbness in the ring and little fingers of both feet, tingling at night only	Cold	3	94	7	-
3	Less stiff legs, numbness in ring and little fingers of both feet, night tingling only	Warm	3	94	7	-
4	Legs feel stiff when waking up only, numbness in the ring and little fingers of both feet	Warm	3	95	6	143
5	Numbness of the ring and little fingers of both feet	Warm	2	95	5	-
6	Numbness of the ring and little fingers of both feet	Warm	2	95	5	-
7	Numbness of the ring and little fingers of both feet	Warm	2	96	5	136

The results of the client's blood sugar check on days 1, 4, and 7 after the intervention was carried out showed a significant decrease, accompanied by a reduction in the complaints felt by the client. Complaints of stiffness and tingling in the legs that were often felt by clients previously decreased starting on day 3 and were no longer complained of on day 5. Meanwhile, the numbness felt by the client on the ring finger and little finger of both feet is still felt. Based on the results of the physical examination, on day 3 of the intervention, it was found that the acral condition improved to warm, day 4 there was an increase in oxygen saturation examined in each toe with a value of 95%, and day 5 was found to have improved capillary filling characterized by a 2-second CRT.

Based on table 2, the results of the client's Tinetti balance assessment score on day 1 to day 4 showed a moderate risk of falling, but on day 4 showed a decrease in score by 1 point. On day 5 to day 7 there was an improvement in the client's condition indicated by a score of 5 with a low fall risk interpretation. This shows a decrease in the score during the 7 days of intervention given from a score of 7 (moderate risk of falling) to a score of 5 (low risk of falling).

Discussion

The Effect of Diabetic Foot Exercise on Blood Glucose Level

This study was conducted on one elderly (Mrs. A) aged 65 years with comorbidities of diabetes mellitus (DM) by giving seven days of diabetic foot exercise intervention. This study aims to determine the effect of giving foot exercises on peripheral perfusion and the risk of falls in the elderly with diabetes mellitus. The results showed a significant improvement in the client's condition after the intervention of diabetic foot exercises for seven meetings in the morning and evening for 10 - 15 minutes each session. This is characterized by a decrease in GDS values and remains within the normal range, a decrease in complaints related to stiffness and tingling in the feet, and a change in the risk of falling from moderate to low.

Patients with diabetes mellitus experience impaired function in the pancreas which is responsible for producing insulin, so that the role of insulin in controlling blood sugar levels is impaired (Magfirlah et al., 2024). In management to control blood glucose levels, it is not only done with drugs (pharmacology), but is supported by non-pharmacology, including regulating diet and physical activity training (Vira et al., 2023). Physical activities that can be done in the elderly are leisurely walks, physical exercises, and leg exercises,

which are adjusted back to the client's condition and ability to do so (Afzalena et al., 2024). Based on the case, Mrs. A experienced complications of peripheral neuropathy with complaints of decreased foot sensitivity such as stiffness, tingling, numbness or numbness in some toes, and sometimes pain.

The results showed that the results of the GDS examination obtained a significant decrease in three examinations, including day 1 of 165 mg/dL, day 4 of 143 mg/dL, and day 7 of 136 mg/dL. This is in line with the results of research conducted by Vira et al. (2023), where foot exercises given in a period of 3 days with a duration of 30 minutes obtained an increase in calf muscle strength, decreased numbness complaints, and decreased blood sugar levels from 230 mg/dL to 147 mg/dL. This diabetic foot exercise is included in moderate intensity in physical exercise with a large focus of benefits for people with DM is to prevent complications in the lower extremities (Mustofa et al., 2022). This diabetic foot exercise is recommended for the elderly because the movements are easy to do, use supporting equipment at home, and do not cause significant fatigue or waste a lot of energy (Mangiwa et al., 2017).

The Effect of Diabetic Foot Exercise on Increased Peripheral Perfusion

The decrease in blood sugar levels in clients is accompanied by a reduction in complaints felt from day to day. The evaluation on day 4 found that the tingling complaints that the client felt several times a day were no longer felt after doing foot exercises for four consecutive days. While complaints of stiffness in the feet, especially the fingers and ankles, are no longer felt after five days of doing foot exercises. The decrease in complaints felt by the client was accompanied by changes in acral conditions which were initially cold to warm on day 3, CRT to 2 seconds on day 5, and oxygen saturation in the toes reached 96% on day 7.

The results of this study are in line with research (Widiawati et al., 2020), which states that when doing foot exercises, clients feel a comfortable sensation, especially in the feet which previously felt numb and felt muscle stimulation. This happens because leg exercises consisting of relaxation movements and leg stretches are effective in improving blood circulation in the legs, widening blood vessels, and increasing leg muscle strength (Siwi et al., 2022). Increased blood flow can stimulate tissue opening and make receptors more active, so that glucose turns into energy (Waluyo & Binoriang, 2024). When foot exercises are done regularly, glucose metabolism will increase so that blood glucose levels will decrease (Vira et al., 2023). Patients with DM with controlled blood sugar levels can prevent macrovascular and microvascular complications such as heart disease, diabetic nephropathy, diabetic retinopathy, diabetic neuropathy, and other complications (Marbun et al., 2022; Vira et al., 2023).

Foot exercises can reduce the risk of decreased lower limb function in the elderly because it is useful to prevent changes in the shape or structure of the feet, strengthen leg muscles, and overcome the limited ability of the elderly to move joints (Arifahyuni & Retnaningsih, 2024). Increased foot sensitivity after doing foot exercises is due to smoother blood circulation, so that more oxygen and nutrients are delivered throughout the body, including the lower extremities. Thus, when foot exercises are done regularly, it can increase foot sensitivity accompanied by a decrease in the risk of falls in the elderly (Arna & Hasanah, 2022).

The Effect of Diabetic Foot Exercise on Reduced Fall Risk

The results also showed a decrease in the risk of falling on clients before and after the foot exercise intervention. At the initial assessment, a balance and fall risk assessment was carried out on the client using the Tinetti Assessment Tool and a score of 7 was obtained with a moderate fall risk interpretation. The client seemed to have difficulty at points related to balance and gait. Based on subjective data from the client's statement, this is related to the numbness, stiffness, and tingling felt in the toes, soles, and knees that are sometimes painful. After the foot exercise intervention, it was found that on day 5 there was a decrease in the score to 5 with the interpretation of low fall risk.

The results of this study are in line with previous research which states that the health work program in the form of diabetes mellitus foot exercises conducted on 30 elderly people obtained results in improving mobility balance in the elderly which had an impact on reducing the risk of falls and injuries (Awaliyah et al., 2024). The elderly are an age group with a risk of experiencing decreased lower limb function, decreased balance and increased risk of falls (Margaretta, 2017). In addition, elderly people with diabetes mellitus are at high risk of diabetic neuropathy. Loss of peripheral sensation is an early sign of the development of diabetic foot ulcers which are a common foot problem in the elderly with DM (Dafriani et al., 2019). Peripheral perfusion problems are also related to the fall risk rate, where the more sensitive the feet, the lower the risk of falling (Arna & Hasanah, 2022).

Implication and Limitation

Based on the results of this study, it has implications for nursing practice, including non-pharmacological interventions of diabetic foot exercises can be one of the recommended interventions in nursing care for the elderly with diabetes mellitus, nurses can integrate diabetic foot exercises into daily care plans with pharmacological therapy to help improve peripheral perfusion in the feet and reduce the risk of falls in the elderly, and in the implementation of foot exercises require assistance to ensure the intensity, frequency, and quality of movements are carried out correctly and get maximum benefits.

Although the results of the study found that there was an effect on peripheral perfusion and the risk of falls in the elderly, there are several limitations that need to be considered including only involving one object with an intervention duration of only 7 days, so further research is needed with a larger sample and longer duration of intervention to see the long-term effects on peripheral perfusion and the risk of falls in the elderly with diabetes mellitus.

Conclusion

This study shows that the application of diabetic foot exercises can improve peripheral perfusion and reduce the risk of falls in the elderly. Improved peripheral perfusion is characterized by no complaints of stiffness and tingling in the feet, warm acral, peripheral circulation evaluation, namely CRT to 2 seconds, and SpO2 measured at the toes increased to 96%. A decrease in the client's fall risk was characterized by a decrease in the Tinetti Assessment Tool score to 5 with a low fall risk interpretation. These findings support the application of diabetic foot exercise as part of nursing intervention for elderly with diabetes mellitus. Further research is needed with a larger sample size and a longer intervention duration to evaluate the long-term effects on peripheral perfusion and fall risk in older adults with diabetes mellitus.

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