Decreased Foot Sensitivity as a Predictor of Diabetic Foot Ulcers

Wayunah[1], Wiwin Nur Aeni[2], Martin Kuncoro[2], Muhammad Saefulloh[3]

[1]*Universitas Bakti Tunas Husada Tasikmalaya, West Java, Indonesia*
[2]*STIKes Indramayu, West Java, Indonesia*
[3]*Universitas Muhammadiyah Tasikmalaya, West Java, Indonesia*

Correspondence author: Wayunah

Email: wayunah@universitas-bth.ac.id

Address: Jl. Let. Jen. Mashudi Kec. Cibeurem Kota Tasikmalaya; HP 087727309382

ABSTRACT

Introduction: Diabetic foot ulcers are a complication that often occurs in people with diabetes mellitus. This complication begins with a decrease in foot sensitivity which leads to neuropathy, resulting in frequent trauma to the feet. Decreased foot sensitivity in the form of decreased sensation of heat, cold, and pain is a dangerous complaint because it has a very high risk of causing foot ulcers or neuropathic foot ulcers. **Objective**: This study aimed to determine the relationship between the level of foot sensitivity and the incidence of dibetic foot ulcers in diabetes mellitus patients. **Method**: The type of research is a descriptive correlation with a cross-sectional approach. The population, all DM pstients at Internal Medicine Clinic 1 and 2 Indramayu District Hospital. The sample was 48 people taken by accidental sampling. Data collection tools used observation sheets and 10 G monofilament, while data analysis techniques used the Chi-square test. **Result**: The research results obtained from 44 respondents showed that 22 respondents (%) experienced neuropathy. Of these, 21 (95.5%) had ulcers. Meanwhile, of the 26 respondents who did not have neuropathy, 21 (80.8%) did not have ulcers. The results of further analysis obtained a p-value of 0.000 and an OR value of 88.2. **Conclusion**: The conclusion from this study is that there is a relationship between the level of sensitivity and the incidence of diabetic foot ulcers. DM patients who experience neuropathy are 88.2 times more likely to develop ulcers than those who do not experience neuropathy. Suggestions are given to nurses to continue making efforts to prevent diabetic foot ulcers by checking the sensitivity of the patient's feet regularly, at least once a year.

Keywords: diabetes mellitus, diabetic foot ulcers, foot sensitify

Introduction

Diabetes Mellitus (DM) is a metabolic disorder characterized by increased blood glucose levels (hyperglycemia). This condition is caused by insulin failure. As a result of chronic hyperglycemia, causes damage to blood vessels, both macrovascular and microvascular, which can cause disruption of blood flow to the periphery (*American Diabetes Asosiation*, 2017).

According to the International Diabetes Federation (IDF), in 2021, diabetes will be one of the fastest-growing global health emergencies. In 2021, it is estimated that 537 million people suffer from diabetes, and this number is projected to increase to 643 million in 2030, and 783 million in 2045. In addition, in 2021, it is estimated that more than 6.7 million people aged between 20 and 79 will die from diabetes-related causes.

Meanwhile, Riskesdas data for 2018 shows that the number of DM sufferers in Indonesia increased from 6.9% in 2013 to 8.5% in 2018. Based on this data, it shows that there has been an increase in the prevalence of the number of DM sufferers in Indonesia by 1.6%. The number of DM sufferers in West Java in 2018 was 1.3% or 186,809 people (Indonesian Ministry of Health, 2018). According to Indramayu Health Service data for 2021, there were 9,362 DM sufferers out of a population of 1,737,625 (Dinkes Kabupaten Indramayu, 2021).

The most common cases of DM are type I DM and type II DM. Type I DM is characterized by increased blood glucose levels due to inadequate insulin production. Meanwhile, type 2 DM occurs because the pancreas does not produce enough insulin, so the body's cells cannot respond to insulin's work properly. However, type 2 DM is the most common type of DM, accounting for 90% of the total DM patients found (LeMone, Burke, & Bauldoff, 2016).

A complication that often occurs due to DM is peripheral neuropathy (Smeltzer & Bare, 2013). Peripheral neuropathy usually occurs in the lower extremities. Peripheral neuropathy is the cause of muscle weakness, cramps, tingling, numbness, and decreased sensitivity, which has the risk of causing leg ulcers (Tandra, 2017).

Diabetic foot ulcers are infections of the skin tissue that occur on the soles of the feet as a result of peripheral arterial disease and peripheral neuropathy in DM sufferers (Rosyid, 2017). Diabetic foot ulcers can occur due to impaired blood circulation flowing to the feet and because high levels of glucose in the blood can trigger nerve damage in the feet, which causes the feet to go numb, making it easy to cause injuries to the feet (Tholib, 2016).

Symptoms of diabetic foot ulcers include reddish skin, pain, leg edema, changes in leg color, and foul-smelling discharge (Tholib, 2016). However, diabetic foot ulcers can be prevented by controlling blood glucose levels, doing physical activity, and taking care of the feet (Black & Hawks, 2014).

Based on the results of a preliminary study, data on DM patients visiting internal medicine clinics in 2021 amounted to 658 DM patients with an average monthly number of 55 patients. The author has carried out foot sensitivity checks on four DM sufferers. From the results of examinations using the monofilament test on four patients, two patients had diabetic foot ulcers, when the sensitivity of their feet was checked, one patien person had it and one other patien did not experience neuropathy. And two patients did not have ulcers, one patien had and one other patien did not experience neuropathy. This shows that diabetic neuropathy occurs in both diabetes patients who have ulcers and those who do not.

Objective

This study aimed to determine the relationship between the level of foot sensitivity and the incidence of diabetic foot ulcers.

Method

This research is quantitative research with a descriptive correlation method with a cross-sectional approach. The population of this study was all DM patients who visited the internal medicine polyclinic at Indramayu District Hospital with an average of 55 patients visited per month. The sample was 48 respondents taken using a purposive sampling technique. The criteria are for being willing to be a respondent, being able to communicate well, and having both legs intact (no amputation). The instruments used were observation sheets and 10G monofilament.

Univariate analysis includes analysis of foot sensitivity obtained from examining the respondent's foot sensitivity at 10 points, with a neuropathy category if the score is 0–3 and no neuropathy if the score is 4–10.

Bivariate analysis to analyze the relationship between the level of foot sensitivity and the incidence of diabetic foot ulcers using the Chi-Square test.

Results

The research was carried out in July 2022 at the internal medicine clinic at Indramayu Regional Hospital. The total sample was 48 diabetes patients.

Respondent characteristics include gender, education, and employment at the Internal Medicine Polyclinic at Indramayu District Hospital.

Table 1. Respondent characteristics

No.	Respondent characteristics	F	%
1	Gender Kelamin		
	Male	22	45,8
	Female	26	54,2
	Total	48	100
2	Study		
	Low education (SD)	30	62,7
	Midle educationh (SMP/SMA)	13	270
	High education (PT)	5	10,4
	Total	48	100
3	Work		
	Work	27	46,2
	Doesn't work	21	43,8
	Total	48	100

Based on Table 1, it can be seen that of the 48 respondents (100%), 26 respondents (54.2%) were female, 30 respondents (62.7%) had low education (not attending school/primary school), and 27 respondents (46.2%) worked.

Univariate Analysis

By the results of this study, foot sensitivity categories, and ulcer incidence categories were obtained. The research results were obtained in the foot sensitivity category, which can be seen in the following table:

Table 2. Frequency Distribution of Respondents' Foot Sensitivity

No.	Score Monofilament	F	%
1.	Neuropathy	22	45,8
2.	No neuropathy	26	54,2
	Total	**48**	**100**

Based on Table 2, it is known that 26 (54.2%) respondents had neuropathy. Based on the results of research on 48 respondents, the results of the foot ulcer incidence categories were obtained, which can be seen in the following table:

Table 3. Frequency Distribution of Respondents' Foot Ulcers

No.	Incident Foot Ulcers	F	%
1.	Foot ulcers	26	54,2
2.	No foot ulcers	22	45,8
	Total	**48**	**100**

Based on Table 3, it is known that 26 (54.2%) respondents had foot ulcers.

Bivariate Analysis

The results of the bivariate analysis can be seen in the following table:

Table 4. Relationship between the level of foot sensitivity and the incidence of diabetic foot ulcers at Indramayu District Hospital

Foot Sensitivity Level	Foot Ulcers						P-Value	OR
	Ulcers		No Ulcers		Total			
	F	%	F	%	F	%		
Neuropathy	21	95.5	1	4.5	22	100.0	0.000	88,200
No Neuropathy	5	19.2	21	80.8	26	100.0		
Total	**26**	**54.2**	**22**	**45.8**	**48**	**100.0**		

Based on Table 4, it can be seen that of the 22 respondents who experienced neuropathy, 21 (95.5%) had ulcers, and of the 26 respondents who did not experience neuropathy, 21 (80.8%) did not experience ulcers. The statistical test results obtained a P-value = 0.000 (α = 0.05) so it can be concluded that Ho is rejected, meaning that there is a relationship between the level of foot sensitivity and the incidence of diabetic foot ulcers in the Indramayu District Hospital.

Based on the OR value of 88.200, this means that DM sufferers who experience neuropathy are 88.2 times more likely to develop ulcers than DM sufferers who do not experience neuropathy.

Discussion
Foot Sensitivity

DM disease can cause several complications in the form of abnormal blood glucose levels, disorders of blood vessels, damage to the eyes, kidneys, nerve cells, and even death. A complication that often occurs due to DM is peripheral neuropathy (Smeltzer & Bare, 2013).

Peripheral neuropathy is the cause of muscle weakness, cramps, tingling, numbness, and decreased sensitivity. Decreased sensitivity, namely in the form of a decrease in feelings of heat, cold, and pain, is a dangerous complaint because it has a very high risk of causing foot ulcers or neuropathic foot ulcers (Tandra, 2017).

From the research results, it was found that 26 (54.2%) respondents had neuropathy, and 22 (45.8%) respondents did not have neuropathy. According to the results of Suyanto's research (2018), the average sensation score of respondents was 8, with the highest score being 10. Other research results stated that patients who experience diabetic peripheral neuropathy have significantly reduced foot sensation, which leads to an increased risk of injury to the feet. There is a relationship between abnormal skin response and a history of foot ulceration in diabetes patients (Gerawarapong, 2015).

Another theory states that damage to sensory nerve function will result in sufferers not feeling light touch or other sensations given to the soles of their feet. This is in accordance with the theory, which explains that an increase in oxidative stress will disrupt the transmission of impulses, so people with diabetes will lose foot protection. The symptoms that arise will make some parts of the foot not feel any touch or pressure on the soles of the feet (Rosyida, 2016).

Overview of Diabetes Foot Ulcers

Peripheral neuropathy is the cause of muscle weakness, cramps, tingling, numbness, and decreased sensitivity. Decreased sensitivity, namely in the form of a decrease in feelings of heat, cold, and pain, is a dangerous complaint because it has a very high risk of causing foot ulcers or neuropathic foot ulcers (Tandra, 2017).

Diabetic foot ulcers are infections of the skin tissue that occur on the soles of the feet as a result of peripheral arterial disease and peripheral neuropathy in DM sufferers (Rosyid, 2017). The classification that is still used to determine the degree of ulcers is the classification according to Meggit-Wagner, the degree of ulcers consists of 5 levels. Grade 0 has no lesions, only pain in the feet, grade 1 ulcers on the surface of the skin, grade 2 ulcers on ligaments, tendons and joint capsules without abscesses, grade 3 ulcers involving the bones, grade 4 gangrene on part of the leg, grade 5 gangrene on all legs. Usually, DM foot ulcer sufferers who are treated in hospital have reached grade 2 (Tholib, 2016).

Diabetic foot ulcers are one of the most common complications of patients suffering from poorly controlled DM. Generally, diabetic foot ulcers are the result of poor glycemic control, neuropathy, peripheral vascular disease, and poor foot care. Diabetic foot ulcers are also a common cause of osteomyelitis and lower extremity amputation. In addition, ulcers occur due to repeated trauma and pressure on the feet (Singer, Tassiopoulos, & Kirsner, 2018).

From the research results, it was found that 26 (54.2%) respondents had foot ulcers and 22 (45.8%) respondents did not have foot ulcers. In line with the results of Suyanto's research (2018), it showed that the majority, or as many as 8 people (57.1%) experienced foot ulcers. In line with other research, the incidence of diabetic foot ulcers is influenced by many factors, including foot deformity, peripheral vascular disease,

smoking history, feeling numb in the feet (diabetic peripheral neuropathy), using inappropriate footwear (Norwood, 2011).

The relationship between the level of foot sensitivity and the incidence of diabetic foot ulcers

Peripheral neuropathy usually occurs in the lower extremities. According to Mariam, et al (2017), diabetic peripheral neuropathy is one of the factors causing diabetic foot ulcers. According to relevant research results, it is stated that diabetes mellitus patients have a relatively high tendency to experience diabetic peripheral neuropathy (Kiani, Moghimbeigi, Azizkhani, and Kosarifard, 2013).

The research results showed that of the 22 respondents who experienced neuropathy, 21 (80.8%) had ulcers. Of the 26 respondents who did not experience neuropathy, 21 (95.5%) did not experience ulcers. The statistical test results obtained a P-value = 0.000 (α = 0.05). The results of this study show that there is a relationship between the level of foot sensitivity and the incidence of diabetic foot ulcers. Based on the OR value of 88.2, this means that DM sufferers who experience neuropathy are 88.2 times more likely to develop diabetic ulcers than DM sufferers who do not experience neuropathy.

The results of this study are in line with research by Suyanto (2018), which shows a p-value of 0.017 (α < 0.05) with an OR value of -0.626, meaning there is a relationship between decreased foot sensation and the incidence of diabetic foot ulcers. Meanwhile, the OR value of -0.626 shows that the higher the degree of diabetic ulcer, the lower the value of foot sensation felt by the patient. According to Parisi et al. (2016), patients who experience diabetic foot ulcers are more likely to experience diabetic peripheral neuropathy compared to other ischemic foot disorders.

The causes of diabetic foot ulcers are genetic factors, metabolic disorders, decreased sensitivity, trauma, and infection. Diabetic foot ulcers can occur due to impaired blood circulation flowing to the feet and because high levels of glucose in the blood can trigger nerve damage in the feet, which causes the feet to go numb, making it easy to cause injuries to the feet (Tholib, 2016). Prevention of diabetic foot ulcers includes controlling blood glucose levels, doing physical activity, and taking care of the feet, especially to increase blood circulation to the feet so that neuropathy does not occur (Black & Hawks, 2014).

Apart from that, based on the research results of Naemi et al. (2020) found that neuropathy was the main parameter for the occurrence of diabetic foot ulcers in the future in diabetes patients (p-value 0.000; OR 2.926). From the results of this study, it is recommended that monitoring foot sensitivity using monofilament or checking sensitivity to warm and cold stimuli be carried out in assessing the risk of developing diabetic foot ulcers. Apart from neuropathy, the presence of ingrown nails and dry skin also increases the risk of ulcers on the front. Therefore, it needs attention from health workers.

Conclusion
1. Of the 48 respondents, 22 (45.8%) experienced neuropathy.
2. Of the 48 respondents, 26 (54.2%) experienced diabetic foot ulcers.
3. There is a relationship between the level of foot sensitivity and the incidence of diabetic foot ulcers in the Indramayu District Hospital (P value = 0.000 < α = 0.05) and the OR value is 88.200.

Suggestions for nurses are to provide interventions for DM patients to prevent foot ulcers in DM sufferers by controlling blood glucose levels, doing physical activity, checking foot sensitivity, and carrying out foot care to increase foot sensitivity..

Suggestions for further research. It is hoped that the results of this research will provide basic data for conducting further research on other factors that influence the occurrence of diabetic foot ulcers, with a larger number of respondents and better research methods.

Acknowledgement

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