

# The Relationship between Sensory Neuropathy and Self-efficacy and the Degree of Diabetic Foot Injuries in Type 2 Diabetes Mellitus Patients

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**Keywords:** Neuropathy, Self-Efficacy, Diabetic Foot Injury.

**Abstract:** Introduction: Diabetes Mellitus (DM) is a hyperglycemia condition caused by inadequate insulin, insulin action, or both. Clients experience foot injuries that have serious complications and affect the lower extremities. The purpose of this study was to identify the relationship between sensory neuropathy and self-efficacy with the level of diabetic foot wounds. Method: This research design is cross sectional and data are collected using a cluster sampling technique. The population of the study were 63 diabetic patients who suffered diabetic foot injuries. Data analysis was conducted using the Spearman rho statistical test with a significance level  $p < 0.05$ . Results: the result was  $p = 0.027$ , which means there is a correlation between sensory neuropathy and self-efficacy with levels of diabetic foot wound at  $p = 0.000$  with  $r = -0.681$ , which means there is a strong correlation of negative direction or crosses. Conclusions: Most respondents had positive sensory neuropathy, the self-efficacy of respondents was moderate, and the level of diabetic foot injuries was the highest at level 1. The support from a patient's family was beneficial in improving self-efficacy and was instrumental in increasing the patient's confidence in controlling behavior and adapting to the conditions experienced.

## 1 BACKGROUND

Diabetes Mellitus (DM) is a chronic condition that occurs when the body cannot produce enough insulin or cannot use insulin and has increased blood glucose levels. High levels of glucose in the blood (hyperglycemia) cause damage to many body tissues, leading to the development of life-threatening complications (International Diabetes Foundation, 2017). DM is also one of the leading causes of health problems and appears in almost every country (Bakker, van Houtum, and Riley, 2005; Fujiwara et al., 2011). Around 15% of all diabetics have foot ulcers that cause serious complication and have impact on lower extremity amputations (Apelqvist et al., 2008). Diabetic foot injuries are one of the most important chronic complications of DM in the world of health and also of social aspects; these complications have a significant effect on the quality of life of the patient and are associated with higher health care costs (Tresierra-Ayala & García Rojas, 2017). The rate of ulcers on the feet may occur over a

five-year time span of 70% (Bharat Kotru, Kotru and Joshi, 2015).

During the preliminary study, interviews were conducted with research nurses of the Poly General Taliwang Health Center in the West Sumbawa district. As many as 659 people were diagnosed with DM between January and September 2017, and data from the ER reported that 10.77% or 71 people were diagnosed with diabetic ulcers. Interviews with six clients determined that no checks were done to detect the risk of diabetic foot injuries; the only test conducted was controlled blood glucose screening at least once a month or according to complaints from clients. Some clients who had been diagnosed with diabetic injuries said they could not avoid the occurrence of diabetic foot injuries due to their inability to control blood sugar due to inability to avoid injury in an activity as well as a lack of knowledge regarding the risks of diabetic foot wounds.

The International Diabetes Federation (IDF) states that Indonesia is the seventh most prevalent country in the world for diabetes with as many as 10

million people. The estimation of people suffering from DM in 2040 in Indonesia is 16.2 million (International Diabetes Foundation, 2017). Riskesdas (2013) adds that the increase occurred in accordance with age, but from the age of  $\geq 65$  years it tends to decline, is higher in women than in men, and higher in urban than in rural areas. The IDF states that this incidence indirectly increases the prevalence of diabetic injury in 1%–4% of DM patients (Amin & Doupis, 2016).

The results of the study of diabetic foot injury in Semarang in 2015 indicate that 85.7% of people with neuropathy have a high risk of foot injuries. People with DM, who suffer diabetic injuries, are at risk of amputation. In Indonesia, diabetic ulcers are the most common cause of amputation relating to a non-traumatic event (Lazzarini et al., 2015).

One of the measures used in accordance with the recommendations of the American Diabetes Association (2016) are interdisciplinary multidisciplinary team services, involving several fields of science, including nursing (Aalaa et al., 2017). In general, there are four main purposes in the provision of services such as health promotion, disease prevention, patient care, and patient needs (Aalaa et al., 2017). Therefore, the role of health practitioners, especially nurses, in the early detection of diabetic foot wound risk are important. (Aalaa et al., 2012). Nurses should be more active in providing treatment and prevention in diabetic neuropathy.

One form of prevention is to perform neuropathy detection. This examination is very important to prevent the worsening incidence of neuropathy that impacts on diabetic wounds. Early detection of high-risk foot is very important to reduce mortality and morbidity. An interprofessional approach (i.e. doctors, nurses, and foot care specialists) is often needed to meet the patient's needs (Alavi et al., no date; Alavi et al., 2014).

The purpose of this research is to understand the relationship of sensory neuropathy and self-efficacy with the level of diabetic foot wounds in patients with Type 2 diabetes. The study will conduct sensory neuropathy screening and assess DM patients' confidence and self-ability levels in reducing the risk of injured diabetic feet.

## 2 METHODS

The design of this study is a description of correlation with a cross sectional approach with the independent variables: sensory neuropathy and self-efficacy, and the dependent variable: the level of diabetic foot

wounds. The population in this research were all pasien DM from the area of health office of kab, West Sumbawa with a total sample of 75 respondents chosen according to inclusion criteria using an accidental/convenience sampling technique. Data were collected by conducting sensory neuropathy and kuisoner examination, which were then analyzed using a Spearman rho statistical test and a significant level ( $p = 0.000 < 0.05$ , which means H1 was accepted.

## 3 RESULTS

The table of respondent characteristics in this study shows that most (32) respondents (50.8%) are aged 50–59 years, 20 respondents (31.7%) are aged 40–49 years, and 11 respondents are aged 60–69 years 17.5%. There were 52 female respondents (82.5%), which was more than the male population of 11 (17%). Regarding the length of time suffering with DM, the largest number of respondents (31) were in the range of 6–10 years (49.2%), 26 respondents (41.3%) had suffered <5 years, and 6 respondents (9.5%) had suffered with DM for more than 10 years. Smoking history was dominated by male respondents (11 people or 17.5%). On examination of blood sugar, the result of 200–400 mg/dl applied to 44 respondents (69.8%). There were 35 respondents (55.6%) with a presence of comorbidities (hypertension). Forty-eight respondents (76.2%) had never experienced diabetic foot injuries and 15 respondents (23.8%) had suffered diabetic foot injuries. Most of the respondents had never experienced amputation (57 people or 90.5%). There were six (9.5%) respondents who had experienced amputation.

Based on the Table 2 54 respondents or 85.7% showed positive neuropathy, while nine respondents (14.3%) showed negative results regarding neuropathy. The respondent's distribution for self-efficacy was mostly 43 respondents (68.3%), followed by low self-efficacy as much as 18 respondents (28.6%) and only 3.2% or 2 respondents who had high self-efficacy.

Based on the Table 3, the level of diabetic foot injury showed that 23 people (36.5%) (most respondents) had suffered Level 1 (superficial ulcer limited to skin) followed by 14 respondents (22.2%) who had suffered at Level 3, 13 respondents (20.6%) who had suffered at Level 2, seven respondents (11.1%) who had suffered at Level 4 and six respondents (9.5%) had not suffered foot injuries at Level 0.

Table 1: Distribution of DM type 2 respondents' relationship between sensory neuropathy and self-efficacy with the level of diabetic foot injury within the district health office.

Characteristic of respondents	n	%
Age		
40-49 years	20	31.7
50-59 years	32	50.8
60-69 years	11	17.5
Total	63	100
Gender		
Male	11	17.5
Female	52	82.5
Total	63	100
Length of time with DM		
1-5 tahun	26	41.3
6-10 tahun	31	49.2
>10 tahun	6	9.5
Total	63	100
Smoking		
Yes	11	17.5
No	52	82.5
Total	63	100
Blood glucose result		
< 200 mg/dl	9	14.3
200-400 mg/dl	44	69.8
>400 mg/dl	10	15.9
Total	63	100
Hypertension		
Yes	35	55.6
No	28	44.4
Total	63	100
Diabetic foot ulcer history		
Yes	15	23.8
No	48	76.2
Total	63	100
Amputation history		
Yes	6	9.5
No	57	90.5
Total	63	100

Table 2: Distribution of independent variables (sensory neuropathy and self-efficacy) in DM type 2 patients in the work area of the district health office West Sumbawa.

Characteristic	n	%
Neuropathy sensory		
Positive	54	85.7
Negative	9	14.3
Total	63	100
Self efficacy		
Low	18	28.6
Moderate	43	68.3
High	2	3.2
Total	63	100

Table 3: Distribution dependent variable of level of diabetic foot injury in DM type 2 patient in the work area of the district health office. West Sumbawa.

Characteristic	N	%
Level of diabetic foot ulcer		
Level 0	6	9.5
Level 1	23	36.5
Level 2	13	20.6
Level 3	14	22.2
Level 4	7	11.1
Total	63	100

Based on the relationship of sensory neuropathy with the level of diabetic foot wounds in the area of the district health office, West Sumbawa, results were obtained. Fifteen (23.8%) respondents had experienced positive neuropathy at Level 1, 14 respondents (22.2%) had experienced Level 3, 12 respondents (19%) had experienced Level 2, seven respondents (11.1%) had experienced Level 4, and six respondents (12.7%) indicated Level 0. Regarding the negative results of neuropathy, 8 respondents (12.7%) indicated Level 1, one respondent (1.6%) indicated Level 2. The total number of respondents who indicated positive neuropathy was 54 (85.9%) and 9 respondents (14.3%) indicated negative neuropathy.

The results of the statistical test using the Spearman rho test obtained a significant level equal to  $p = 0.027$  with set significant level  $\alpha \leq 0.05$ , which suggests that there is a relationship between sensory neuropathy and the level of diabetic foot wounds. In the correlation coefficient we achieve the result  $r = -0.279$ , which indicates that the variables of sensory neuropathy and the level of diabetic foot wounds have low correlation (0.2– 0.399) with a negative or directional correlation.

Based on the table referring to the relationship between self-efficacy and the level of diabetic foot wounds it is evident that obtained the results of self-efficacy level in the medium category, there are at 1st level as much as 20 respondents or 31.7%, then level 2 as many as 12 respondents (19%) and at levels 0 are 6 respondents or 9.5%. Then followed by low level of self-efficacy is found in level 3 as many as 9 respondents (14%) and level 4 are 7 respondents (11.1%). High self-efficacy level found in respondent with level 1 in which consist of 2 respondent (3.2%). Total respondents with self-efficacy were 43 respondents or 68.3%, then the low self-efficacy were 18 respondents (28.6%) and only 2 respondents (3.2%) who had high self-efficacy (Table 2).

The results of the Spearman rho statistics test showed significant level of  $p = 0.000$  with significant level of  $\alpha \leq 0.05$ , indicating that there is correlation

between self-efficacy and the level diabetic foot wound. The correlation coefficient obtained  $r = -0.681$  which means the correlation was strong (0.6–799) but the correlation direction was negative or in the opposite direction, which means that higher self-efficacy was evident in patients with lower levels of diabetic foot injury.

## 4 DISCUSSION

The neuropathy sensory identification found that most respondents had a positive result. This assessment used Semmes-Weinstein's monofilament 10g (Martinez-Hervás et al., 2017). The results indicated that most respondents who experienced sensory neuropathy were from the age group 50–59 years. These results support the study by Aalaa et al., 2012; Hutapea, Kembuan and P.S., 2016 who report that the percentage was between 72.3% and 91.4%. This percentage is supported by Solomon et al. (2016) who states that the event arises at the age of >38. This is due to changes in the blood vessel walls where there is thickening of the intima layer. These changes cause stiffness of the blood vessels so that the transport of oxygen and nutrients to the tissue decreases resulting in ischemia, then, over a long period, neuropathy will occur. Neuropathy is more common in people with diabetes who have GDS above 200 mg/dl. Hyperglycemia can make the blood flow so small that it can damage the nerves in the soles of the feet, reduce sensitivity in the legs. Results of research conducted by Ardiansyah Muhammad (2012) indicate that higher levels of GDS raise the risk of neuropathy. The statement was supported by Suri, Haddani, and Sinulingga, (2015) who state that people with hyperglycemia GDS above 200 mg/dL and people with diabetes are at greater risk of fibular damage, especially in the distal nerves. Most respondents results from the blood glucose examination in this study, were 200–400 mg/dl, but the results of blood glucose at this time cannot be interpreted because the blood glucose check and the examination were not taken at the same time. The examination was done randomly during the morning, day and night at the time of data retrieval.

For self-efficacy, it was identified that most respondents, predominantly women, were in the moderate category, followed by low category and there are two respondents with high self-efficacy level. The self-efficacy assessment combined three aspects: magnitude, generality, and strength. Self-efficacy was found more in women than men. These results also support research conducted by Wendling

and Beadle (2015) and Bandura (1997) who said that women have a higher level of self-efficacy than men and women are more efficacious in managing their roles. Housewives and career women have higher self-efficacy than an employed man.

Suffering long periods of diabetes may affect patients' self-efficacy; respondents who have suffered for a long time recognize the symptoms and can be more confident in overcoming the encountered problems. Bandura's theory states that success is strongly influenced by the function of affection to which self-belief will give individuals the ability to cope and overcome stress and depression experienced in difficult and pressing situations. It will also affect the level of individual motivation. Most respondents were unable to regulate their diet when feeling stressed and could not implement the diet treatment. Respondents felt they were able to control blood glucose, but on each examination, respondents' blood glucose was high.

Respondents who have high self-confidence in controlling stress, anxiety, having better glycemic control, and some psychosocial factors such as self-confidence related to health, social support, problem-solving strategies, and personality strongly influence their quality of life, either directly or through their ability to deal with the negative effects of diabetes (Porojan, Poantă & Fodor, 2009). Most respondents in this study are still unable to improve aspects of magnitude, strength, and generality. Lack of respondents' self-confidence influenced the results and assessment in this study.

Respondents diabetic ulcer identification was mostly within Level 1 (superficial ulcer is limited to the skin), followed by Level 3 then Level 2. Most female respondents suffered diabetic foot wounds. The duration of diabetes occurs over a range of >5 years, and more blood glucose screening results at 200–400 mg/dl. The results determined that most respondents that have levels of diabetic foot wounds are aged 50–59 years. These results are in line with Whittemore, Melkus and Grey (2005) who determined that the average age of respondents who experienced diabetic ulcers were 57.6 years old. In another study, around 6% of individuals were aged 45–64 years and 11% were over 65 years (Donna, Ignatavicius and Workman, 2018). Also, in this study, it was determined that most respondents who suffered diabetic injuries were women which similar with Huang et al., (2014) research, in which 364 people suffered with DM Type 2 and most were women. It can be concluded that diabetic mellitus Type 2 is more common in women than in men. This opinion is in line with the results of research conducted by Ortiz

et al., 2010 who explain that men are more likely to do physical exercise regularly. Regular exercise can stimulate the sensitivity of cells to insulin and reduce central fat and muscle tissue development (Kriska, 2000).

The research found that some respondents, at the time of activity, have not been able to check and maintain that no injuries have occurred. This is because respondents cannot feel pain, so only severe injuries are felt. The presence of neuropathy causes a loss of sensation in the leg that results in an unrecognizable trauma, especially in areas of repeated pressure. This results in many traumatic injuries that the patient are not aware of. This situation further exacerbates the development of ulceration. Neuropathy develops due to the accumulation of glucose products resulting in increased activation of aldose reductase and sorbitol dehydrogenase enzymes. This causes the conversion of glucose into sorbitol and fructose. In addition, there is an increase in oxidative stress in nerve cells and increased vasoconstrictors, which result in nerve cell ischemia.

The results of injury level identification was determined by respondents' assessment, directly based on the Wagner scale accompanied by family and researchers. It was found that most of the respondents had previous diabetic scars so the assessment was based on the wound conditions that occurred during the study.

The correlation of sensory neuropathy with diabetic foot ulcer levels has largely been positive and mostly occurs at Level 1 (superficial ulcers confined to the skin). The occurrence of this in female respondents is higher than with males. It was found that the longer diabetes was suffered, the more neuropathy occurred, in which the longest survivor was within a range of 5–10 years. This is in accordance with research conducted by Hutapea, Kembuan, and P.S. (2016) who said that most neuropathy occurs in respondents who suffer from DM within a period of 1–10 years. This is because the longer DM is suffered, greater the chances of chronic hyperglycemia. Chronic hyperglycemia can lead to complications of DM, i.e. retinopathy, nephropathy, coronary heart disease, and diabetic ulcers. Research conducted by Vincent et al., (2004) says that the severity of neuropathy may increase with the duration of DM.

Another finding was that smoking history had no relation to the occurrence of neuropathy. It is in contrast to Keith R's (2016) finding that smoking can cause the risk of diabetic foot wounds. The results are diverse due to the more woman respondents with no

smoking history while than male respondents which only one-third of the total respondents.

The results of Criqui and Aboyans, (2015) show that PAD (peripheral arterial disease) is associated with the incidence of diabetic ulcers. PAD is one factor that causes diabetic ulcers. Ischemia that occurs causes red and dry feet often coincides with neuropathy, causing an increased risk of diabetic ulcers. The non-fluid blood flow in the leg causes the wound to heal and causes the risk for greater amputation. In addition, there is less oxygenation to the affected area, meaning it is difficult for antibiotics to distribute causing bacteria to breed rapidly. The study found that history of comorbidities, such as hypertension, has no relationship with the incidence of neuropathy. This is because most respondents have never had complete checks such as blood pressure measurements. Respondents only attended blood glucose checks, so the results of this study cannot describe the relationship between the history of accompanying diseases with diabetic wounds.

It was also determined that age was not the main causal factor of neuropathy and diabetic injury. Some respondents in this study, aged 60–65 years, were still able to control blood sugar and perform foot care independently so the incident of diabetic foot ulcer was minimized.

The statistical analysis showed that neuropathy detection had a low correlation with the level of diabetic foot wounds within negative correlation. This is because the examination of sensory neuropathy found some respondents with diabetic foot wounds can still feel the sensation of the instrument used by researchers. So, the results of this sensory neuropathy examination affected the outcome between sensory neuropathy and diabetic foot wounds.

The statistical test for correlation result regarding self-efficacy towards diabetic foot ulcer levels shows that the higher the self-efficacy of respondents, the lower the level of diabetic injuries experienced. Low confidence of respondents was due to severe ulcers needing amputation. The wound-healing process is felt for so long that respondents feel desperate and stressed because of the pain. This is in line with the theory of Bandura, who discusses self-ability, which is one of the factors that affects self-efficacy. Individuals will have a high self-efficacy if they feel they are making positive progress, while individuals with low self-efficacy experience negative self-progress. Most of the respondents have moderate self-efficacy because their actions are correct according to their diabetic treatment. After the investigation it was

found that it appertained with their confidence in self treatment

Respondents with high self-efficacy experienced support and motivation of their spouses and family to control blood sugar, regular exercise, and regulatory diet to ensure they are highly prepared, even though they had a history of diabetic wounds (Level 3) and took several months to recover. This is also in line with the theory of Bandura, who states that high self-efficacy is often formed from events that have been experienced directly, promoting higher confidence levels. A person who has gained mastery experience (experience of success) will demonstrate increased self-efficacy, while failure reduces self-efficacy. If the success of a person is due to outside factors, this will usually not affect self-efficacy levels. However, if the success of carrying out a task and outcome expectations (a belief that the behavior applied will be in accordance with the wish or the initial goal), and both will affect the balance of one's behavior (Bandura, 1997)

Most participants in this study were women who worked as housewives and had moderate self-efficacy. These respondents were unable to do any activity due to foot ulcers and this delayed the healing process. Cognitive theory explains that when individuals feel helpless regarding stressful challenges, anxiety rises when considering the next challenge (Bandura in Nevid, Rathus, & Greene, 2011). Conversely, if individuals can cope better, the haunted anxiety will be gone, and the challenges can be solved.

Quality of life is a concept that relates to the welfare of patients, in terms of physical, psychological, social, and environmental aspects. The quality of life of diabetics is the primary goal of care; a quality of life that is as good as possible should be maintained in diabetics, because a poor quality of life and psychological problems can aggravate metabolic disorders, either directly through hormonal stress or indirectly through complications (Mandagi, 2010). The quality of life of diabetic patients can be improved by improving glycemic control, therefore a strong belief that the patient will be able to self-manage is required so their quality of life can be maintained and improved (Ariani, Sitorus, Gayatri, 2012). An important aspect that affects patients' psychological factors is self-efficacy (Lange et al., 2010).

The increase in blood sugar can trigger the occurrence of diabetic foot wounds. This increase illustrates that most respondents are less adherent to self-care activities such as dieting, daily activities, exercise, lifestyle activities such as smoking, taking

diabetes drugs, and insulin use, and stress experience (Smeltzer and Bare, 2001).

Lack of respondents' belief in facing diabetic wounds causes difficulties in controlling behavior and adapting to conditions. This level of difficulty (magnitude) is strongly influenced by the psychological factors of respondents. The inability to behave and the limitation of activity prevents the respondent maintaining and increasing self-management regarding the disease.

## 5 CONCLUSIONS

Most of the respondents in this study were tested positive regarding sensory neuropathy. Most respondents' self-efficacy level was in the medium category. The level of diabetic foot injuries found in respondents were within Level 1 (superficial ulcers confined to the skin). Sensory neuropathy with degrees of diabetic foot wounds is associated with a low correlation coefficient. For self-efficacy, there is a strong relationship with the direction of negative correlation, which means the greater the value of one variable, the smaller the value of another.

It is hoped that an overall neuropathic examination can be formed, not only for sensory neuropathy but also for motor and autonomic neuropathy. Nurses can provide support for patients' self-sufficiency in managing and modifying lifestyles by involving the families' active role in patient care; family support and people close to them play a significant role in improving patients' self-efficacy and prevent the onset of depressive symptoms in patients with Type 2 DM.

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