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The Effectiveness of Diabetic Foot Care (DiFoCa) on the Foot Care Behavior of Diabetes Mellitus Patients : A Quasi-Experimental Study with a Control Group

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Abstract:
Diabetes Mellitus (DM) is the second most common disease in Indonesia after hypertension. Diabetes Mellitus can cause complications, one of which is diabetic ulcer. Diabetic ulcer can lead to amputation of the extremities, especially the lower extremities. Prevention measures that can be taken to prevent diabetic ulcer include foot care therapy. Foot care consists of three preventive measures, starting with education on foot care, diabetic foot exercises, and management of foot injuries/wounds. Foot care training was conducted for five weeks. The study aimed to determine the effect of Diabetes Foot Care Training on the foot care behavior of D patients. Foot care behavior was assessed using the Nottingham Assessment of Functional Footcare (NAFF) tool. The research was conducted over 5 weeks. The study involved 60 respondents divided into an intervention group and control group. The results of the control group showed a p-value > 0,005 (0,647), indicating no difference in foot care behavior in the control group. The Wilcoxon test for the intervention group showed a p-value < 0,005 (0,002), indicating a difference in foot care behavior before and after the intervention. The Mann Whitney test showed a p-value < 0,005 (0,027). The conclusion of the study states that Difoca intervention has an effect on improving foot care behavior in DM patients.

Keywords : *Diabetes Mellitus, Education, Foot Care, Behavior Foot Exercises*

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INTRODUCTION

International Diabetes Federation (IDF) states that 415 million people suffer from diabetes mellitus. By 2040, this number is estimated to increase to 642 million people (Bekele & Berhanu, 2021). In 2018, 2% of the Indonesian population aged 15 years and diagnosed by a doctor had diabetes mellitus, this figure is higher than the 1.5% recorded in the same age group in 2013. Data in Indonesia in 2013 showed that there were around 12 million people with diabetes mellitus and only 3 million of them had been diagnosed. The prevalence of diabetes mellitus in Indonesia increased from 1,1% to 2,1% compared to 2007 (RI, 2020). Health data indicates that there were 18.823 people with diabetes in Surakarta City in 2022, or 16,67% of the population. This number places diabetes as the second most common disease after hypertension in Surakarta City.

Diabetes mellitus is a complex disease that requires a great deal of attention and effort in its treatment and prevention compared to other chronic disease (Firdaus & Jittanoon, 2021).Complications that occur in people with diabetes mellitus are divided into two types : acute complications and chronic complications. Diabetic foot issues are a frequent problem for people with diabetes. If the feet are not taken care of properly, they can get injured easily and may turn into serious sores called gangrene ulcers if not treated in time. (Elkashif et al., 2021; Monteiro-Soares et al., 2021; Perkeni, 2021). Every

year, more than one million people with diabetes lose one of their legs due to diabetes complications. These complications can lead to disability and carry a 15 to 40 times higher risk of amputation,with a prevalence of around 25% compared to non-diabetes mellitus patients, and can even result in death due to diabetic ulcers, with an incidence prevalence of around 16%. Amputations in patients with diabetes mellitus are caused by diabetic ulcers. The high incidence of diabetic ulcers is partly due to inadequate foot care in diabetes. (Goodall et al., 2020)(Tamiru et al., 2023)(Harli, 2022)(Brahmantia et al., 2020)

One of the causes of diabetic foot ulcers is the lack of knowledge among patients about prevention and treatment. Knowledge about health is one aspect of diabetes mellitus management. With knowledge, people with diabetes mellitus can learn about the disease and take care of themselves. Previous research on 57 respondents with type II DM showed that the majority of the respondents (64,9%) had insufficient knowledge, 71,9% of respondents had poor foot care behavior (Septia Ningrum & Imamah, 2022a). The impact of poor fot care in DM patients results in more widespread complication of the disease, so that the amount of costs incurred in DM care will continue to increase. Foot care is one form of prevention for ulcers in the feet of DM patients. DM patients can actively participate in the self-management of diabetes mellitus, ensuring optimal outcomes. Foot care and diabetic foot exercises are not only carried out independently by patients, but the involvement of the health team and family also plays an important role in accompanying patients to shape their attitudes and behavior. Diabetes management in preventing diabetic foot ulcers includes education or health education about foot care. The study uses the Health Belief Model (HBM) theory approach by conducting Diabetic Foot Care (Difoca) training. The HBM theory approach emphasizes behavioral changes in Type II diabetes mellitus patients, particularly foot care behavior.(Aalaa et al., 2021)(Sentana et al., 2023).

The study aimed to find out how using Difoca for diabetic foot care would change how patients with diabetes take care of their feet. The research was done by giving patients Difoca treatment along with education about it for a period of 5 weeks.. The study began with pre-treatment measurements. In the first week, the respondents began receiving the Difoca treatment, starting with measuring their foot care behavior, followed by education and diabetic foot exercise training. The next treatment involved education on how to manage foot wounds. Before and after the foot care therapy, a test called the Nottingham Assessment of Functional Footcare (NAFF) was used to check how well people were taking care of their feet. This therapy helps people with diabetes by improving blood flow, making their small foot muscles stronger, increasing the strength of their calf and thigh muscles, and helping them move more easily. This is expected to prevent the occurrence of diabetic ulcers ant prevent bone deformities in DM patients.(Bekele, Kelifa, et al., 2022; Bekele & Berhanu, 2021; Petersen et al., 2022; Şahin & Cingil, 2020).

METHODS

This study uses a research and development method. The study goes through three stages, namely the preparation stage, implementation stage and termination stage. In the preparation stage, the researcher conducts a literature review and related phenomena, prepares a letter of permission and then conducts a preliminary study. In the implementation stage, the researcher prepared and collected data (foot care materials, foot exercises and injury management) by providing foot care education and foot exercise training as well as foot care methods for patients with diabetes mellitus. In the termination stage, the researcher processed the data. Foot care behavior was assessed using the Nottingham Assessment of Functional Footcare (NAFF) tool. The research obtained ethical approval from the Research Ethics Committee of Universitas 'Aisyiyah Surakarta with ethics permission number 519/VII/AUEC/2025.

The study was conducted in the Ngoresan and Pajang Surakarta Community Health Centers. Data analysis was performed using univariate and bivariate analysis. Sampling was conducted on patients with type 2 diabetes using a two-group design, with a control group and treatment group. The study used a paired t-test for each group and an independent t-test to compare the two groupsThe method

used was to assess foot care behavior before and after foot care training. The sample used in this study consisted of 60 respondents, with 30 respondent in the control group and 30 in the treatment group. The treatment group received Diabetic Foot Care (Difoca) therapy, while the control group received standard therapy from the Community Health Center, namely Prolanis activities. The sampling technique used was purposive sampling. The inclusion criteria used in this study were : patients with type II diabetes mellitus; male or female DM patients; DM patients in the adult to elderly age category; DM patients who were willing to be respondents. The exclusion criteria were : DM patients with diabetic ulcer complications, patients who did not fully participate in the intervention or withdrew in the middle of the intervention.

RESULTS

Respondent Characteristic

The result of univariate analysis for characteristic of gender, education level, occupation, age of respondents and duration of DM are described in the following table :

Table 1. Respondent Characteristic

Variabel	Group	
	Intervention (N=30) (%)	**Control (N=30) (%)**
Gender	Male 6 (20.0)	Male 7 (23.3)
	Female 24 (80.0)	Female 23 (76.7)
Education	No Schooling 1 (3.3)	No Schooling 9 (30.0)
	SD 11 (36.7)	SD 13 (43.3)
	SMP 8 (26.7)	SMP 3 (10)
	SMA 8 (26.7)	MA 5 (16.7)
	University 2 (6.7)	University 0 (0)
Education	Not Working 23 (76.7)	Not Working 22 (73.3)
	PNS/TNI Polri 4 (13.3)	PNS/TNI/Polri 4 (13.3)
	Swasta/Other 3 (10)	Swasta/Other 3 (10)
Age	36-45 Years 1 (3.3)	36-45 Years 0 (0)
	46-55 Years 3 (10)	46-55 Years 2 (6.7)
	56-65 Years 13 (43.3)	56-65 Years 12 (40)
	>65 Years 13 (43.3)	>65 Years 16 (53.3)
Duration of Diabetes Mellitus	1-5 Years 14 (45.7)	1-5 Years 18 (60)
	6-10 Years 3 (10)	6-10 Years 9 (30)
	> 10 Years 13 (43.3)	> 10 Years 3 (3)

Based on table 1, it shows that in both the control and intervention groups, the majority of respondents were female, with 80% of respondents in the intervention group and 76,7% in the control group being female. Most of the people in the study had only finished elementary school. In the group that received the treatment, 11 people or 36.7% had that level of education. In the other group, which didn't receive the treatment, 13 people or 43.3% had the same. Most people in both groups were not working. In the treatment group, 23 people or 76.7% were unemployed. In the control group, 22 people or 73.3% were also unemployed. In the control group, 16 people or 53.3% were older than 65 years.

Foot Care Behavior

The result of the univariate analysis for foot care behavior among DMpatients in the intervention and control groups are as follows :

Table 2. Foot Care Behavior

Behavior	Intervention		Control	
	Pretest(%)	Posttest(%)	Pretest(%)	Posttest(%)
Good	10 (33)	20 (66.7)	3 (10)	2 (6.7)
Not Good	20 (66.7)	10 (33.3)	27 (90)	28 (93.3)

Based on the table 2, it can be seen that before the intervention, the majority of respondents 20 respondents or 66.7% had poor foot care behavior. After the intervention, there was an increase, with the majority of respondents (66.7%) in the treatment group having good foot care behavior. In the control group, the majority of respondents had poor foot care behavior, totalling 90% or 27 respondents. The posttest result showed that the majority of respondents still had poor foot care behavior, totalling 28 respondents (93.3%).

Difference in Foot Care Behavior

The bivariate analysis results for the difference in foot care behavior in the intervention group were obtained using the Wilcoxon test because the data were not normally distributed. The test for the difference in foot care behavior in the control group used the paired t-test. The bivariate analysis results are described in table below :

Table 3. Foot Care Behavior Before and After Intervention in the Intervention and Control Groups

Behavior	Intervention		Control		*P Value*
	Mean	SD	Mean	SD	
Pre-Test	46.000	5.044	41.1617	6.654	0.002
Post-Test	47.900	5.371	41.2667	6.564	0647

Table 3 shows that the average foot care behavior score among respondents before the Difoca intervention was 46 with standard deviation of 5.044. The Difoca intervention increased the average foot care behavior score among respondents in the interventions group to 47.900 with standard deviation of 5.371. The p-value in the intervention group was < 0.005 (p=0.002), indicating a significant difference in foot care behavior before and after the intervention. The control group showed a pretest mean value of 41.1617 with a standard deviation of 6.6554. The posttest mean value in the control group was 41.2667 with standard deviation of 6.564 and p-value > 0.005 (0.647), which means that there was no difference in foot care behavior in the control group.

Effectiveness of Diabetic Foot Care (Difoca) on Foot Care Behavior

The result of the bivariate analysis of the effectiveness of Diabetic Foot Care (Difoca) are illustrated in the following table :

Table 4. Effectiveness of Diabetic Foot Care (Difoca) in Improving Foot Care Behavior in DM Patients

	Intervention		Control		*P Value*
	Mean	SD	Mean	SD	
Pretest	46.000	5.044	41.166	6.654	0.027
Posttest	47.900	5.371	41.266	6.564	

Table 4 shows that there is a difference in the average foot care behavior scores between the intervention and control groups. The control group showed a difference in the average foot care behavior scores of DM patients of 0.1. Based on the standard deviation values in both groups, it can be seen that the intervention group has smaller standard deviation value than the control group, which means that the data in the intervention group is relatively similar and consistent. The effectiveness value obtained a p-value < 0.05 (0.027), indicating that Diabetic Foot Care (Difoca) is effective in improving foot care behavior in DM patients compared to the control group.

DISCUSSIONS

Based on the results of the study, it was found that the majority of respondents were female and the majority were aged > 65 years in both the control and intervention groups. This is in line with previous studies which stated that the majority of DM patients are female and elderly. This is influenced by the fact that insulin hormone production decreases with age, thereby affecting the body's glucose metabolism process. This is also reinforced by previous journals stating that type II DM patients are influenced by, among other things, being over 45 years of age because advanced age is one of the triggers for a decrease in insulin hormone function in stabilizing blood sugar levels in the body (Imamah & Gati, 2022; Septia Ningrum & Imamah, 2022b). The results of the study also show that the majority of respondents, or more than 70% of respondents, are unemployed. Previous studies have stated that when a person is unemployed, their activity levels decrease. This triggers a decrease in the body metabolism, leading to fat accumulation, which in turns causes a decrease in insulin function. Research also shows that not working has an impact on a person's socioeconomic status, so that in their food consumption patterns, people trend to eat foods high in glucose to quickly feel full. This triggers an increase in blood sugar levels because insulin production in the pancreas is not sufficient to metabolize glucose.(Firdaus & Jittanoon, 2021; Imamah & Gati, 2022; Petersen et al., 2022).

The results showed that the majority of respondents in the intervention group had poor foot care behavior before receiving treatment, and after receiving Difoca treatment, the majority of respondents had good foot care behavior. The study also showed that there was a difference in foot care behavior before and after receiving Difoca intervention. This matches what earlier research found, which showed that people's behavior regarding foot care changed before and after they received foot care. Diabetic Foot Care is one of the management treatments for DM patients in the prevention of diabetic foot disease, namely by increasing the awareness of DM patients to perform foot care. DM patients will experience unstable blood glucose levels, which can reduce the supply of oxygen and nutrients to the capillaries. Circulatory disorders experienced by DM patients are influenced by blood flow being blocked by increased blood viscosity. Foot care performed by DM patients will improve blood circulation to the peripheral areas. Diabetic foot care, which is carried out by providing education, simulation and diabetic foot exercises once a week for 5 weeks, has been proven to make a difference in the foot care behavior of DM patients. This is in line with existing behavioral theory that repeated activities will change a person's behavior. Another factor that supports behavioral change is support, both from family and the immediate community. Group interventions will have psychological effect on DM patients, who will feel supported by their immediate community .(Galandjindjinay et al., 2024; Kurnia et al., 2022; Mulyaningsih; Ardika, Noviana Ayu; Wahyuni, Wahyuni; Hermawati, 2025; Sartika et al., 2023). Diabetes mellitus management aims to control glucose levels, prevent complications, and improve quality of life. The pillars of diabetes mellitus management include education, diet, physical activity, pharmacological therapy, blood sugar monitoring, and foot care.

Based on the results of the study, it was found that Diabetic Foot Care (Difoca) had an effect on the foot care behavior of DM patients compared to the control group. The Difoca intervention, which consisted of providing education, simulating foot care techniques and diabetic foot exercise, reduced peripheral perfusion problems in DM patients. The education provided to patients increased their knowledge and with increased knowledge, their attitudes improved. The factors behind behavioral change are knowledge and attitude. Simulation of care techniques will be easier for patients to

remember, so that appropriate foot care activities that are easy for patients to remember will always be carried out. Proper foot care can prevent peripheral perfusion problems in patients, because foot care stimulates nerve points on the soles of the feet that are connected to the pancreas. Stimulation of these points will stimulate the pancreas to increase insulin production. Another related factor is diabetic foot exercises. Activities such as foot exercises will tense the leg muscles and compress the surrounding veins. This will help return blood to the hearth and reduce nenous pressure. The stretching performed during foot exercise also improves blood circulation to peripheral areas. This enhances insulin function and dilates blood vessels. (Ayu et al., 2024; Latipah & Apriyanti, 2023; Ningsih et al., 2025)

CONCLUSIONS

The study results indicate that Diabetic Foot Care (Difoca) influences improved foot care behavior in patients with Diabetes Mellitus (DM) compare to the control group. Future research should utilize both qualitative methodologies to support foot care behavior among DM patients.

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CONFLICT OF INTEREST

The authors confirm that there are no conflicts of interest in publishing this article.

AUTHOR CONTRIBUTION

INI : Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft, Project Administration, and Funding acquisition
EDP :Investigation, Writing – Original Draft, Writing - Review & Editing
DIM :Investigation, Writing – Original Draft, Writing - Review & Editing

DATA AVAILABILITY STATEMENT

The data used in this research to draw conclusions are not public because they are protected by privacy or ethical rules. However, the data can be shared if someone makes a proper request to the main author.

WRITING AND LANGUAGE QUALITY

The writing in this manuscript has been carefully improved to make it clear, easy to follow, and meet academic standards. Grammarly translation helped make the language smoother and more consistent without changing the original meaning. The manuscript keeps technical terms, specialized words, and a scholarly tone to ensure it is understood by professionals in the field.

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