THE EFFECT OF INHIBITORY FACTORS ON THE HEALING OF DIABETIC ULCERS

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Article Info

ABSTRACT

Diabetic ulcers are a growing global health issue that is often exacerbated by poor blood sugar management. Physical activity and medication adherence play a crucial yet often overlooked role in wound management. This study examined factors hindering diabetic ulcer healing, such as medication adherence, physical activity, and nutritional status, among 22 Ranai Health Center respondents using a quasi-experimental design. The results suggest that modern wound care is effective in promoting the regeneration and healing of diabetic ulcers. Furthermore, there is a strong association between patients' nutritional status (measured by BMI) and their adherence to medication with wound healing rates. Therefore, in nursing practice and DM wound management, we cannot focus solely on wound care techniques. Nurses must monitor and actively manage patients' nutritional status and ensure they adhere to the treatment regimen. This is a critical step toward achieving optimal healing outcomes and preventing further complications.

Keywords: Confounding Factors, Diabetic Ulcers

ABSTRAK

Ulkus diabetikum merupakan masalah kesehatan global yang meningkat, seringkali diperparah oleh manajemen gula darah yang kurang optimal. Peran aktivitas fisik dan kepatuhan pengobatan sangat penting, namun seringkali terabaikan dalam penanganan luka. Studi ini menguji pengaruh faktor-faktor pengahambat penyembuhan ulkus diabetikum seperti kepatuhan farmakologi, aktivitas fisik, dan status gizi pada responden dengan teknik *Total Sampling* sebanyak 22 responden di Puskesmas Ranai dengan menggunakan desain *Quasy-Eksperimental*. Hasilnya menunjukkan bahwa perawatan luka modern sangat efektif dalam mendukung regenerasi dan penyembuhan ulkus diabetikum. Lebih lanjut, status gizi pasien (diukur dengan IMT) dan kepatuhan mereka dalam minum obat memiliki hubungan kuat dengan tingkat

kesembuhan luka. Ini berarti, dalam praktik keperawatan dan manajemen luka DM, kita tidak bisa hanya berfokus pada teknik perawatan luka saja. Sangat penting bagi perawat untuk juga memperhatikan dan secara aktif mengelola status gizi pasien serta memastikan kepatuhan mereka terhadap regimen pengobatan. Ini adalah langkah krusial untuk mencapai hasil penyembuhan yang optimal dan mencegah komplikasi lebih lanjut.

Kata Kunci: *Faktor Penghambat, Ulkus Diabetikum*

1. INTRODUCTION

Diabetes mellitus (DM) is a condition characterized by an increase in blood glucose levels above normal limits, namely fasting glucose levels between 80-90 mg/dL and non-fasting glucose levels between 140-160 mg/dL (Truong, 2020). If diabetes mellitus is not treated promptly, it can lead to various serious complications, such as vision impairment, cardiovascular disease, kidney damage, and skin and nervous system problems such as diabetic ulcers due to blood vessel atrophy. (Alfreyzal et al., 2024a).

DM can cause various complications, especially in the vascular and nervous systems (Mezil & Ahmed, 2021). Vascular complications include macrovascular and microvascular disorders, while neurological complications are known as neuropathy. Neuropathy is the loss of distal sensation, which is a significant risk factor for the development of diabetic foot ulcers. (Lestari, 2022).

There is a globally agreed target to halt the rise in diabetes and obesity by 2025. Around 830 million people worldwide have diabetes, most of whom live in low- and middle-income countries. More than half of those with diabetes do not receive treatment, whether they have been diagnosed or not (WHO, 2025).

According to the American Diabetes Association (ADA), there are nine key areas of focus in diabetes management: continuous care management, education and support in self-management of diabetes, medical nutrition therapy, physical activity, smoking cessation, immunization, management of psychosocial issues, comprehensive medical evaluation, and management of comorbidities. These nine aspects play an important role in helping patients manage their nutritional status, physical and psychological

health, and encourage healthier lifestyle changes. With a focused management approach, diabetes treatment can be evaluated and developed continuously through comprehensive care strategies (Subandi & Sanjaya, 2019).

DM is the leading cause of chronic disease and limb loss globally. The mortality rate due to gangrene ulcers in DM patients ranges from 17% to 32%, with amputation rates between 15% and 30%. Most amputations in DM patients originate from foot ulcers. Therefore, the role of nurses in preventing foot ulcers is very important. The annual incidence of diabetic ulcers reaches 2% of all DM patients, and increases to 5-7.5% in DM patients with peripheral neuropathy. Global epidemiological data shows that more than one million diabetes-related amputations occur each year, which means one case of diabetic foot amputation every 30 seconds. If DM is not properly managed, the incidence of diabetes in Indonesia will surge to 21.3 million people by 2030 (Lestari, 2022).

The prevalence of diabetes mellitus in Indonesia has increased significantly, from 5.7% in 2007 to 11.7% in 2023, based on data from the Indonesian Health Survey (SKI) conducted by the Ministry of Health of the Republic of Indonesia. This increase indicates the need for greater attention to diabetes management and prevention in the community, especially among people aged 15 years and older (Kemenkes RI, 2023).

Patient visit data in East Bunguran Regency, at the Ranai Community Health Center, recorded 366 people with DM. Percentage of Diabetes Mellitus Patients Receiving Standard Health Services: 89.76% (Health Office, 2024). The incidence of DM shows an upward trend every year, mainly due to limited public knowledge about this disease and barriers in accessing relevant health information (Alfreyzal et al., 2024a).

According to Edmonds et al., one-third of people with diabetes experience problems with their feet, especially diabetic wounds and slow healing. The duration of diabetic wound healing is influenced by many factors, such as wound care, infection control, blood circulation (vascularization), age, nutrition, and comorbidities (complications) (Edmonds et al., 2021).

The healing process of diabetic wounds is a multifactorial phenomenon influenced by various systemic variables such as vascularization, nutrition, and the presence or absence of

comorbidities. Wound care management plays a crucial role as one of the main determinants of the final outcome of healing. Modern therapeutic approaches, including the use of microbial cellulose, innovative wound dressings, and the use of vacuum systems as adjuvant therapy to optimize the tissue regeneration process (Fauziah & Soniya, 2020).

Diabetic wounds are difficult to heal if not treated properly. Diabetic wound healing is a complex and gradual process that involves the coordination of various types of tissues and cells to form epithelial tissue (Go et al., 2021). Wound healing can occur quickly, so additional therapies such as infrared therapy are needed in wound care. Infrared therapy can provide beneficial therapeutic effects, including pain or inflammation reduction, immune modulation, and promotion of tissue regeneration and wound healing (Tsagkaris et al., 2022).

A preliminary study conducted by researchers in the Ranai Public Health Center working area found that 22 people suffered from diabetic wounds and received conventional wound care. The effect of modern wound care on the healing of diabetic wounds and the identification of inhibiting factors, including pharmacological compliance, physical activity, and nutritional status (BMI). The hypothesis of this study is that modern wound care will show better effectiveness in healing diabetic wounds compared to conventional care, and that pharmacological compliance, physical activity, and nutritional status (BMI) have a significant correlation with the wound healing process.

2. RESEARCH METHODE

Research This study used a quantitative research method with a quasi-experimental design and a posttest-only approach. This design aimed to test the difference in diabetic wound healing between the experimental group and the control group after the intervention was given (Sugiono, 2018). This study was conducted from January to July 2025. The study population consisted of all diabetic wound patients at the Ranai Community Health Center. The sampling technique used in this study was total sampling, in which the entire population that met the inclusion criteria was used as the sample. To control for bias in the study, the researchers ensured that the inclusion criteria were stage 3-5 diabetic wounds and the exclusion

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criteria were diabetic mellitus patients treated in hospitals. To determine wound healing status, the BWAT questionnaire was used, consisting of 13 assessment items, each with a subscale score ranging from 1 to 5, which were then summed to produce a total score ranging from 13 to 65 (Alves et al., 2015). The BWAT measurement sheet was based on research conducted by (Dati & Yulistiani, 2020) on the Validity of the Modified Bates-Jensen TIME Wound Assessment Format, which found that this questionnaire was valid and usable with a Cronbach's alpha score of 0.85 and a reliability value of 0.82. The intervention group received adjuvant therapy such as infrared therapy in wound care with modern bandages, while the control group only received modern bandages.

3. RESULT AND ANALYSIS
Result

Table 1. The Effect of Inhibiting Factors on the Healing of Diabetic Ulcers

Group	Intervention				Control			
	N	Mean	SD	*P-value*	N	Mean	SD	*P-value*
Pre-Post Wound Healing	11	15.455	13.292	0.003	11	12.091	9.659	0.002
Confounding BMI	11	-1.609	1.698	0.010	11	-1.355	1.078	0.002
Confounding Physical Activity	11	0.091	0.302	0.341	11	.182	.405	0.167
Confounding Pharmacology	11	0.091	0.302	0.341	11	.455	.522	0.016

Based on the results of the analysis and statistical tests in Table 6 above regarding the effect of factors on the healing of diabetic wounds in both groups, namely the intervention group and the control group. The data includes changes in scores (pre-post) for wound healing (using BWAT) and changes in factors considered to be confounding factors, namely Body Mass Index (BMI), Physical Activity, and Pharmacology.

In terms of wound healing (measured by changes in BWAT scores before and after the intervention), both groups, namely the intervention group and the control group, showed statistically significant improvements. The intervention group had an average change in BWAT score of 15.455 with a standard deviation of 13.292 (p=0.003), while the control group showed an average change in score of 12.091 with a standard deviation of 9.659 (p=0.002). A p-value of less than 0.05 indicates that the decrease in BWAT scores (indicating wound improvement) in both groups was significant. For BMI (Body Mass Index), the change in score (pre-post) showed a decrease

in the mean in both groups, although the negative mean value indicates that the Post value is greater than the Pre value (meaning that BMI increased, if the 'inhibitor' is interpreted as a value that must decrease to support healing). The intervention group had an average change of –1.609 with a standard deviation of 1.698 (p=0.010), and the control group showed an average change of –1.355 with a standard deviation of 1.078 (p=0.002). Both of these changes were statistically significant (p<0.05).

For the Physical Activity variable, the mean change in score (pre-post) in the intervention group was 0.091 with a standard deviation of 0.302 (p=0.341), and in the control group it was 0.182 with a standard deviation of 0.405 (p=0.167). The p-values for both groups were greater than 0.05, indicating that there were no statistically significant changes in physical activity scores before and after the intervention in both groups.

In the Pharmacology factor, the intervention group showed a mean change in score of 0.091 with a standard deviation of 0.302 (p=0.341), which was not statistically significant. However, in the control group, the mean change in score was 0.455 with a standard deviation of 0.522 (p=0.016), indicating a statistically significant change in the pharmacology score in the control group.

Discussion

Based on the statistical test results, the p-value was <0.05 for wound healing in both groups. This study is also in line with research by Putra & Jasmin (2020), which explains that the use of wound care focused on the concept of moisture will accelerate the wound healing process compared to conventional care, with the treatment period reduced from 11 weeks to 7 weeks.

Statistical tests on the effect of the inhibiting factor, namely BMI, on diabetic wound healing showed that the p-value was < 0.05 in both groups. This study is in line with research (Bakri et al., 2023) which found that the frequency of BMI with obesity was 77 people (64.2%) compared to 43 people (35.8%) with normal BMI. This study revealed that individuals in the high-risk category (i.e., underweight, overweight, and obese) showed that the inability to control glycemia in diabetics was a predisposing factor for weight loss or gain. Inadequate dietary factors, such as high glucose intake and low fiber intake, significantly increased the prevalence of glucose intolerance.

Another study by Silalahi et al. (2022) found that 60 people had good nutritional status. Good nutritional status affects the nutritional status of respondents. Nutritional needs in people with DM can affect

wound healing. Nutrition plays an important role in wound healing; poor nutrition hinders wound healing because malnutrition causes a lack of protein, carbohydrate, and fat intake (Silalahi et al., 2022).

Nutrition plays a fundamental role in wound management. Optimal nutrition is essential to facilitate tissue regeneration in pressure wounds, iatrogenic wounds (post-surgery), traumatic wounds, and chronic wounds such as decubitus ulcers. Conversely, malnutrition can cause a decrease in the rate of anabolism, thereby hindering wound healing progress. Physiologically, normal wound healing is highly dependent on an adequate supply of nutrients, especially protein, vitamins (particularly vitamins A and C), and minerals. Collagen, a structural protein, is formed from amino acids absorbed by fibroblasts from dietary protein sources. It should be emphasized that vitamin C is an essential coenzyme in the collagen biosynthesis process (Huda et al., 2018)

Statistical tests of the effect of factors inhibiting physical activity on diabetic wound healing showed no effect/Ho was rejected because more respondents were bedridden. This study is not in line with research conducted by (Julia et al., 2022), which defines physical activity as body movements generated by skeletal muscles, resulting in energy expenditure. This activity is very important for maintaining physical and mental health and contributes to an overall improvement in quality of life.

Other studies state that physical activity plays a crucial role in the management of diabetes mellitus, particularly in blood glucose regulation and the improvement of cardiovascular risk factors. The mechanisms involved include a reduction in hyperinsulinemia, increased insulin sensitivity, a reduction in body fat mass, and a reduction in blood pressure. Regular physical activity is also significantly associated with a 45–70% reduction in mortality in populations with type 2 diabetes mellitus and is effective in lowering HbA1c levels to a level that prevents complications. In addition, exercising at least 150 minutes per week, whether in the form of aerobic exercise, resistance training, or a combination of both, has been shown to be associated with a reduction in HbA1c levels in individuals with type 2 diabetes mellitus (Arania et al., 2021).

Statistical testing of pharmacological factors that inhibit diabetic wound healing showed no effect in the intervention group and an inverse effect in the control group. Analysis of the intervention

group showed that 7 respondents (63.6%) had elementary school education. This study is not in line with (Bulu et al., 2019), which found that patients with optimal medication adherence were able to normalize blood glucose levels, contributing to the management of type 2 diabetes mellitus, with the Spearman test showing a p-value of 0.004, which is less than alpha 0.05.

Thus, there is a significant relationship between medication adherence and blood glucose levels in type 2 diabetes mellitus patients at the Dinoyo Community Health Center, Malang City, which explains that non-adherence to medication is one of the determinants of glycemic control failure in diabetes mellitus patients.

Treatment adherence refers to the consistency between patient behavior and medical advice regarding dosage, timing, and frequency of medication administration. The issue of non-adherence to diabetes mellitus therapy remains a significant challenge in clinical management.

Non-compliance is multifactorial and cannot be viewed solely in terms of education level. The multifactorial factors that influence compliance in this study are age, gender, knowledge, occupation, and the number of medications that must be taken. There are also various reasons why a person does not comply with instructions, including forgetting to follow instructions, fear of side effects, cost, long duration, and stigma (Maulidia, 2015).

Research Kusnanto et al., (2019) shows that knowledge or understanding of diabetes is very important in disease management. Patients who have little knowledge about diabetes tend to be non-compliant with the recommended diet and do not take their medication optimally. Increasing the knowledge of diabetic patients is key to disease management, especially in terms of education about good eating habits, regular medication intake, and comprehensive health education according to (Pharamita et al., 2023).

Research conducted by Alfreyzal et al., (2024b) states that 67% of respondents had low knowledge about diabetes mellitus, and after receiving health education, 75% of respondents had good knowledge. This situation shows that the quality of information before and after health education increased by 42%. These results prove that there was an increase in respondents' knowledge related to DM after receiving health education.

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Another study according to (Lestari, 2022) states that high blood sugar levels are caused by a combination of internal and external factors. Internal factors include diet, obesity, stress, physical activity, and insulin treatment. Meanwhile, external factors include education level, individual knowledge, and access to information. Both types of factors contribute to a spike in blood sugar levels.

4. CONCLUSION

Modern wound care has been proven to be highly effective in accelerating the healing of diabetic wounds with additional therapies such as infrared therapy, as evidenced by the decrease in BWAT scores in the intervention group (p<0.05), indicating a shorter healing duration and optimization of tissue regeneration.

This study also confirms that nutritional status, as measured by Body Mass Index (BMI), is an important factor in the wound healing process. Conversely, physical activity did not show a significant effect on most respondents due to their bedridden condition. Meanwhile, pharmacological compliance showed varying effects, suggesting the role of other factors such as education level in influencing patient compliance behavior.

These findings have important clinical implications, namely that future studies could use more rigorous research designs to control for confounding variables such as physical activity and factors affecting medication adherence.

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