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DEPRESSION IN DIABETIC FOOT ULCERATION: THE ROLES OF HEALTH LITERACY, PERCEIVED WOUND SEVERITY, AND RESILIENCE

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ABSTRACT

Depression is a prevalent psychological comorbidity among patients with Diabetic Foot Ulcers (DFUs), significantly hindering wound healing and diminishing quality of life. This study aimed to analyze the influence of health literacy and patient perception of wound stage on depression, with resilience acting as a mediating variable. Employing a quantitative approach, the research utilized Partial Least Squares Structural Equation Modeling (PLS-SEM) for analysis. A sample of 102 DFU patients was recruited from wound care networks in the Central Java region. The findings revealed that health literacy significantly impacted resilience ($F^2 = 0.238$) and directly contributed to reduced depression levels ($F^2 = 0.205$). Patient perception of wound stage also demonstrated a moderate influence on resilience ($F^2 = 0.203$) and a strong influence on depression ($F^2 = 0.500$). Resilience itself exhibited a moderate effect on depression ($F^2 = 0.213$). Mediation analysis indicated that both health literacy and perception of wound stage indirectly affected depression through resilience, with a p-value < 0.05 for both mediation pathways. In conclusion, this study demonstrates that health literacy and the perception of wound condition significantly influence the level of depression in DFU patients, both directly and indirectly through the mediation of resilience. Enhancing health literacy and fostering a positive perception of the wound through psychosocial approaches can be crucial strategies in mitigating the risk of depression. Furthermore, interventions aimed at strengthening resilience should be integrated into DFU care programs to improve the mental well-being and overall quality of life of these patients.

Keywords: diabetic foot ulcer, depression, health literacy, wound stage perception, resilience

Introduction

Currently, diabetes affects more than 415 million people globally. The International Diabetes Federation (IDF) estimates that the number of global diabetes patients could reach 783.7 million by 2045[1,2]. Of the diabetes diseases, the most common, severe, and expensive problem is Diabetic Foot Ulcer (DFU). This condition has serious medical, monetary, and social impacts on the subject, family and society in general[1,3].

The majority of patients with diabetes with DFU complications experience stress, depression, and anxiety. This is due to financial burdens, feeling helpless, blaming themselves and feeling uncertain in their lives[4]. However, there is something interesting that happened in a study in South Korea where the long treatment period and unclear hope of recovery in DFU patients made amputation an option that reduced

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the level of depression in DFU patients[5]. Psychological stress such as depression, lack of social support and low compliance with treatment can affect the prognosis of DFU and interfere with the wound healing process[6,7].

Recent years have seen a growing emphasis on the mental health comorbidities associated with diabetes. Individuals with diabetes, particularly those with DFU complications, are twice as likely to experience anxiety and depression[8]. Alarmingly, the risk of mortality is significantly amplified by the presence of depression in individuals with type 2 diabetes (T2D). Studies show that while T2D alone increases the risk of death by 1.55 times, the co-occurrence of depression elevates this risk to 4.24 times [9].

Healing DFU is a dynamic process involving diabetes complications, wound characteristics, and treatment adherence. The wound stage serves as a key indicator of DFU severity and significantly affects a patient's psychological well-being, including the prevalence and severity of depression. Changes in the wound's condition, such as complications, infection, and the risk of amputation, have substantial psychological consequences, contributing to increased depression and anxiety in addition to physical health impacts[7].

Health literacy regarding ulceration plays a crucial role in managing DFU. Positive illness perception is linked to better treatment adherence and health behaviors, such as diet, foot care, and medication intake. Furthermore, knowledge about ulceration and perceived control are significant predictors of foot care practices, underscoring their importance in diabetes management and patient survival[6]**.** Patients with good health literacy tend to have a better understanding of their condition and are more capable of managing wound care, which, in turn, can reduce the rate of depression. Successful management of diabetic wounds requires adequate patient understanding, fostering awareness to seek appropriate help and adherence to treatment[10].

Patients with DFU complications may struggle to maintain a good quality of life, leading to a lack of enthusiasm and difficulty finding positive aspects in their situation[3]**.** Consequently, resilience is crucial for these patients to cope with the mental health impact arising from the severity of their DFU[11]. Individuals with high psychological resilience exhibit significantly greater self-efficacy, general health, vitality, social functioning, emotional role, and mental health compared to those with low psychological resilience[12].

Optimal management of DFU necessitates a complex, multidisciplinary approach. Unfortunately, individuals with DFU often encounter significant barriers to receiving the necessary care for their condition, including limitations in knowledge and education, insufficient family support, economic constraints, and a lack of motivation[13].

The variance in depression levels among patients with DFU, including the presence of non-depressed individuals, has motivated researchers to pursue more quantitative data. The goal is to substantiate the connections between depression in DFU patients and factors such as health literacy, wound stage, and resilience. This line of inquiry is particularly important because humans are holistic beings, and recognizing the links between their physical and psychological states is essential for facilitating recovery and achieving optimal health. The purpose of this study is to investigate the magnitude of the effect of health literacy and wound stage on depression among patients with DFU, considering the mediating role of resilience.

Methods

This study utilized a quantitative, non-experimental design with a cross-sectional approach to assess relationships between variables at a single point in time. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS software to test the complex direct and indirect relationships proposed by the model. The research was conducted from November 2023 to February 2024 at various wound care networks and centers located in the Central Java region, Indonesia.

The target population was all patients diagnosed with DFUs receiving treatment in the Central Java region. A total of 102 DFU patients were recruited using a non-probability,

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purposive sampling technique. Inclusion Criteria: Patients diagnosed with DFU, aged between 18 and 65 years old, able to communicate in Indonesian, and willing to participate by providing written informed consent. Exclusion Criteria: Patients diagnosed with severe cognitive impairment or a history of severe mental illness other than depression.

Data were collected using four validated instruments:

1. Depression: Measured using the Depression Subscale of the Depression Anxiety Stress Scales (DASS-42). The scale consists of 14 items measuring depressive symptoms. The reliability for the depression subscale in this study was high (Cronbach's Alpha=0.941).
2. Health Literacy (HL): Measured using the Indonesian Health Literacy Instrument (IHLI). This instrument assesses the patient's capacity to obtain, process, and understand basic health information and services. The reliability was excellent (Cronbach's Alpha=0.970).
3. Perceived Wound Severity (PWS): An adapted scale based on the Wagner Classification System was used to measure the patient's subjective perception of their current wound stage and severity. The reliability was very good (Cronbach's Alpha=0.959).
4. Resilience: Measured using the Connor-Davidson Resilience Scale (CD-RISC 25), a widely used instrument to assess the ability to cope with adversity. The reliability was high (Cronbach's Alpha=0.938).

Data analysis was performed using PLS-SEM (SmartPLS version 4). The analysis included evaluation of the measurement model (validity and reliability) and the structural model (testing path coefficients, R^2 values, and T-statistics from bootstrapping to determine significance). Mediation effects were specifically tested using the specific indirect effect analysis to confirm the role of resilience.

The study protocol was reviewed and approved by the Ethics Committee of the Faculty of Psychology, Semarang University. The ethical clearance number is 018/KEPK-F.Psi/EC/XII/2023. All participants provided written informed consent and were ensured of confidentiality and anonymity.

Results and Discussion

Demographic Characteristics

The sample consisted of 102 DFU patients. The majority were male (54.9%). The mean age of the participants was 54.12 years, and the average duration of having DFU was 3.12 years. These characteristics reflect a typical DFU population profile in chronic disease management settings.

Measurement Model Evaluation

Before testing the structural model, the measurement model (Outer Model) was assessed for validity and reliability. All constructs showed high internal consistency, with Composite Reliability (CR) values ranging from 0.959 to 0.972 (well above the 0.70 threshold). Convergent Validity was confirmed as the Average Variance Extracted (AVE) for all constructs was between 0.793 and 0.887 (exceeding the 0.50 threshold). Discriminant Validity was also confirmed using the Fornell-Larcker Criterion and Heterotrait-Monotrait Ratio (HTMT), ensuring the distinction of each construct.

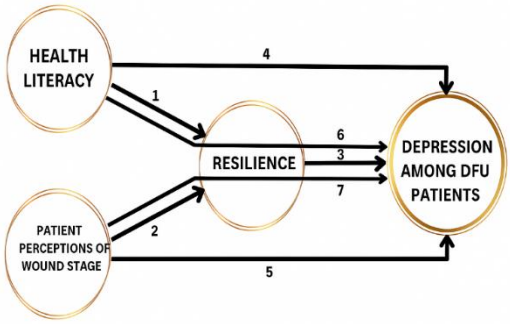

Figure 1. The Structural Model Diagram of Health Literacy, Perceived Wound Severity, Resilience, and Depression

Structural Model Evaluation

The structural model (Inner Model) shown in Figure 1 demonstrated high predictive accuracy. The R^2 value for Resilience was 0.540 (54.0% of variance explained), and the R^2 value for Depression was remarkably high at 0.810 (81.0% of variance explained).

The high explanatory power of the model (R^2=0.810 for Depression) confirms that these psychosocial factors are highly predictive of

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mental health outcomes in DFU patients. The analysis further clarifies the strength of these relationships through the F^2 effect size.

Antecedents of Resilience

From Table 1 shown that both HL (F^2=0.238, p=0.000) and PWS (F^2=0.203, p=0.000) demonstrated a moderate effect size and a significant positive influence on Resilience. This finding establishes that resilience is not a static trait but is actively influenced by the patient's cognitive resources and their subjective interpretation of their physical condition. A better understanding of the DFU condition (HL) enhances the patient's self-efficacy, a core element of resilience. Similarly, perceiving the wound in a manageable way (PWS) allows the individual to maintain psychological strength, reinforcing their adaptive capacity to cope with adversity. Good health literacy (HL) directly contributes to higher resilience, as understanding the illness allows patients to set realistic expectations and find adaptive coping mechanisms [1,2]. The patient's perception of their wound stage (PWS) also significantly influences their resilience, where a positive or manageable perception helps them maintain psychological strength despite the chronic nature of the DFU [1,2].

Table 1. Summarizes the effect size (F^2) and path significance using T-statistics, confirming the significance of all proposed direct paths.

Path	β (Path Coefficient)	F^2 (Effect Size)	T-Statistics	P-Value	Conclusion
HL → Resilience	0.488	0.238	5.234	0.000	Significant, Moderate Effect
PWS → Resilience	0.450	0.203	4.870	0.000	Significant, Moderate Effect
HL → Depression	-0.453	0.205	4.301	0.032	Significant, Moderate Effect
PWS → Depression	0.707	0.500	5.954	0.000	Significant, Strong Effect
Resilience → Depression	-0.462	0.213	4.582	0.027	Significant, Moderate Effect

The Direct Effect on Depression

` PWS has the Strongest Influence: PWS demonstrated the strongest effect size (F^2=0.500) on Depression, classifying its contribution as strong (based on Cohen's guideline: $F^2 \geq 0.35$ is large). This finding is crucial; it scientifically validates that the patient's subjective perception of their wound status—the chronic pain, physical burden, odor, and the fear of amputation—is the single most powerful factor driving depression. This impact is substantially stronger than the other variables, underscoring the necessity of psychological intervention to manage illness perception alongside physical wound care. This reinforces literature suggesting that physical pathology, when interpreted as catastrophic, directly translates to severe psychological distress [1,3,4].

HL as a Significant Protective Factor: HL exhibited a moderate effect size (F^2=0.205) on Depression. This suggests that while PWS is the primary stressor, HL provides a significant counterforce. High HL empowers patients with the knowledge to manage their condition effectively, turning a state of helplessness into one of control and self-efficacy. This sense of capability directly reduces depressive symptoms, acting as a crucial element in patient empowerment [4].

Resilience itself exerts a moderate negative influence (F^2=0.213) on Depression (p=0.027). As expected, individuals with high resilience are better equipped to navigate the chronic stress and morbidity of DFU, utilizing adaptive mechanisms that reduce the likelihood of a depressive episode. This crucial role of resilience aligns strongly with the established need for patients with chronic and life-altering conditions to possess high coping abilities for better mental health outcomes [2,8].

The specific indirect effect analysis confirmed that Resilience acts as a partial mediator for both antecedent variables, as detailed in Table 2. The significant Indirect Effect confirms that a substantial portion of Health Literacy's protective role is channeled through the development of Resilience. This mechanism suggests that acquiring knowledge about DFU management empowers the patient, fostering the self-efficacy and coping skills (resilience) necessary to deal with the illness's

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chronic demands. Crucially, the Total Effect of Health Literacy is the largest overall protective coefficient in the model. This high cumulative benefit indicates that HL is the most significant overall factor for achieving positive mental health outcomes, as it not only directly reduces distress but also builds the psychological resources needed to sustain well-being. This finding strongly supports the concept of patient empowerment in chronic care, where understanding and control are vital counter-forces against the feelings of helplessness common in DFU patients[2,4].

Table 2. Summarizes the effect size (F^2) and path significance using T-statistics, confirming the significance of all proposed indirect paths.

Path	β (Path Coefficient)	F^2 (Effect Size)	T-Statistics	P-Value	Conclusion
HL → Resilience → Depression	0.488	0.238	5.234	0.027	Significant, Moderate Effect
PWS → Resilience → Depression	0.450	0.203	4.870	0.034	Significant, Moderate Effect

The analysis confirmed a significant indirect effect, indicating that Resilience significantly mitigates a portion of the negative psychological impact derived from the patient's perception of wound severity. The fact that the Total Effect of PWS on depression is lower than the Direct Effect provides strong empirical evidence that the patient's existing psychological strength successfully dampens the acute emotional reaction to perceiving the wound condition as severe or catastrophic. This protective function is vital, allowing resilient individuals to successfully reframe chronic physical stressors and maintain adaptive coping, thereby reducing the direct translation of perceived pathology into severe psychological distress[1,2,7].

Conclusion

This study confirms that both HL and PWS are critical determinants of depression in DFU patients, with their influence significantly channeled through the partial mediation of Resilience. The findings provide clear scientific justification for adopting an integrated biopsychosocial approach, as the patient's subjective perception of the wound (PWS) acts as the most potent emotional trigger, while HL provides the most significant overall protective benefit. It is therefore recommended that DFU care protocols integrate mandatory psycho-educational modules to enhance HL and implement psychological support aimed at resilience-strengthening. For future practice, longitudinal studies are needed to evaluate the long-term effectiveness of these specific psychosocial interventions on both mental well-being and clinical wound healing outcomes.

References

1. Zhang H, Huang C, Bai J, Wang J. Effect of diabetic foot ulcers and other risk factors on the prevalence of lower extremity amputation: A meta-analysis. *Int Wound J*. 2023;20(8):3035-3047. doi:10.1111/iwj.14179

2. Ningsih ESP, Yusuf A, Fitryasari R, et al. Psychometric Evaluation of the Indonesia Version of Connor-Davidson Resilience Scale-25 among Diabetic Foot Ulcer Patients: A Confirmatory Factor Analysis. *Malaysian Journal of Medicine and Health Sciences*. 2023;19(May):79-87.

3. Brooks BM, Shih CD, Brooks BM, et al. The Diabetic Foot–Pain–Depression Cycle A Multidisciplinary Cohort Study. *J Am Podiatr Med Assoc*. 2023;113(3):1-9. doi:10.7547/22-126

4. Alfaqih MR, Kusnanto K, Padoli P. A Systematic Review: The Experience of Patient with Diabetic Foot Ulcers. *Jurnal Ners*. 2020;15(2 Special Issue):120-128. doi:10.20473/jn.v15i2.18995

5. Chun D Il, Kim J, Kang EM, et al. Does Amputation Negatively Influence the Incidence of Depression in Diabetic Foot Patients? A Population-Based Nationwide Study. *Applied Sciences*

@copyright author Journal of Applied Health Management and Technology

(Switzerland). 2022;12(3). doi:10.3390/app12031653

6. Graça Pereira M, Vilaça M, Pedras S, et al. Wound healing and healing process in patients with diabetic foot ulcers: A survival analysis study. *Diabetes Res Clin Pract*. 2023;198(December 2022). doi:10.1016/j.diabres.2023.110623

7. Hanlon M, McGuire B, MacGilchrist C, et al. Psychological factors and diabetic foot ulceration: a scoping review of the bi-directional relationship between diabetic foot ulcer healing and mental health factors. *HRB Open Res*. 2024;7:18. doi:10.12688/hrbopenres.13755.1

8. Woon LSC, Sidi H Bin, Ravindran A, et al. Depression, anxiety, and associated factors in patients with diabetes: Evidence from the anxiety, depression, and personality traits in diabetes mellitus (ADAPT-DM) study. *BMC Psychiatry*. 2020;20(1):1-14. doi:10.1186/s12888-020-02615-y

9. Khubchandani J, Banerjee S, Gonzales-Lagos R, Szirony GM. Depression increases the risk of mortality among people living with diabetes: Results from national health and nutrition examination survey, USA. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*. 2023;17(11):102892. doi:10.1016/j.dsx.2023.102892

10. Chen P, Callisaya M, Wills K, Greenaway T, Winzenberg T. Health Literacy predicts incident foot ulcers after 4 years – the SHELLED cohort study. *J Foot Ankle Res*. 2023;16(1):1-9. doi:10.1186/s13047-023-00644-w

11. Arifin H, Kusnanto K, Wahyuni ED, Pradipta RO. Diabetes Resilience Training on Self-Care, Glycemic Control, and Diabetes Burnout of Adult Type 2 Diabetes Mellitus. *Indonesian Nursing Journal of Education and Clinic (Injec)*. 2019;4(2):90. doi:10.24990/injec.v4i2.252

12. Kuang D, Gu DF, Cao H, et al. Impacts of psychological resilience on self-efficacy and quality of life in patients with diabetic foot ulcers: A prospective crosssectional study. *Ann Palliat Med*. 2021;10(5):5610-5618. doi:10.21037/apm-21-967

13. Syulce Luselya Tubalawony* AS. Jurnal Keperawatan. *Jurnal Keperawatan*. 2023;15(September 2022):331-338.

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