



A Health Education Intervention to Improve Diabetic Foot Ulcer Prevention: Effects on Knowledge, Self-Efficacy, Social Support, and Foot Care Practices

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a major global health concern that disproportionately affects low- and middle-income countries. Health education is a fundamental component of diabetes management, as it enhances health literacy by improving patients' knowledge, self-efficacy, foot care practices, and social support. This study aimed to evaluate the effectiveness of a health education intervention in preventing diabetic foot ulcers (DFUs).

Methods: This quasi-experimental study employed a one-group pretest–post-test design. The study was conducted over a nine-month period among patients with T2DM in Pringsewu Regency. Of the 350 patients with T2DM, 107 participants were recruited using purposive sampling. Data were analyzed using the chi-square test.

Results: The health education intervention significantly improved participants' knowledge, self-efficacy, foot care practices, and perceived social support. Furthermore, the intervention demonstrated a significant effect in preventing DFUs, with all outcome measures showing statistical significance ($p < 0.05$).

Conclusion: Health education effectively enhances knowledge, self-efficacy, foot care practices, and social support, thereby contributing to the prevention of DFUs among patients with type 2 diabetes mellitus.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, peripheral insulin resistance, or both (Ahmad et al., 2022). DM encompasses several clinical categories, including type 1 diabetes mellitus, type 2 diabetes mellitus (T2DM), maturity-onset diabetes of the young (MODY), gestational diabetes mellitus, neonatal diabetes, and secondary diabetes caused by endocrinopathies, steroid therapy, or cardiovascular diseases (Dermatol, 2015). Diabetes may also develop secondary to certain medications, chemical agents, or infectious diseases (Weber, 2024). Approximately 589 million adults aged 20–79 years were living with diabetes worldwide in 2024, and this number is projected to increase to 853 million by 2050 (IDF DIABETES ATLAS, 2025). Type 2 diabetes mellitus (T2DM) has become a major global health challenge, disproportionately affecting low- and middle-income countries (Kyu, H. H., et al 2018).

One of the most common and debilitating complications of diabetes is diabetic foot ulcer (DFU), which is defined as an open wound occurring on the foot of a person with diabetes as a consequence of multiple pathological processes, particularly peripheral neuropathy and peripheral arterial disease (Schaper et al., 2020). The burden of DFU in Indonesia is considerable. Among approximately 19.47 million individuals living with diabetes, an estimated 2,336,400 to 3,699,300 are affected by DFUs (International Diabetes Federation (IDF), 2021). According to the 2023 Indonesian Health Survey (SKI), the prevalence of physician-diagnosed diabetes mellitus across all age groups in Lampung Province was approximately 1.2%, totaling an estimated weighted total of 29,331 cases (BKPK, 2023). Data from Dr. H. Abdul Moeloek Regional General Hospital, the largest government hospital in Lampung Province, indicated that approximately 15% (around 2,790 individuals) of patients with diabetes developed diabetic foot ulcer complications in 2022, while an estimated 837 patients were considered at risk of lower-limb amputation (Dinkes Provinsi Lampung, 2022). Furthermore, according to Statistics

Indonesia (BPS), Pringsewu Regency reported 5,027 individuals with diabetes mellitus in 2023, of whom approximately 78% (3,921 individuals) experienced diabetic foot ulcer complications, highlighting the substantial burden of DFU in this region (BPS, 2023).

Preventing DFUs requires active patient participation, which can be enhanced through structured health education. A variety of educational approaches, ranging from low-technology interventions such as structured verbal counseling, educational games, lectures, theoretical and practical training, instructional videos, booklets, serial flipcharts, and visual educational materials, to high-technology interventions including therapeutic footwear, customized insoles, digital infrared thermometers, foot care devices, telemedicine applications, and mobile phone-based interventions, have demonstrated effectiveness in the prevention and management of DFUs (Abraão, Lira, Sepúlveda, et al., 2023).

Although many patients demonstrate positive attitudes toward diabetes management, important gaps remain in their knowledge and foot care practices, including inadequate self-foot examination and insufficient awareness of strategies for preventing DFUs (Singh et al., 2025). These findings suggest that diabetic foot disease is largely preventable through appropriate patient education and proactive management by primary healthcare professionals (Singh et al., 2025). Patients with DFUs generally have satisfactory knowledge and positive attitudes; however, ongoing education and sustained healthcare support remain essential to maintain effective self-management and prevent disease progression (Xie et al., 2025).

Persistent deficiencies in patients' knowledge, attitudes, and self-care practices emphasize the need for structured educational programs targeting individuals with diabetes (Alaofè et al., 2021). Increasing public awareness of diabetic foot care remains an important healthcare priority (Awwad & Abukhader, 2022). Program-based health education has therefore been recognized as a key strategy for preventing DFUs (Sulistyo et al., 2024).

Health education for individuals with diabetes should comprehensively address

the risk factors for DFUs, routine self-foot examination, foot hygiene and daily foot care, safe nail trimming techniques, appropriate footwear selection, prevention of foot injuries, diabetic foot exercises, glycemic control, recognition of early warning signs of foot complications, and active family involvement in supporting daily foot care practices (Abraão, Lira, Marina, et al., 2023; Piaseu, 2020). Therefore, this study aimed to evaluate the effectiveness of a health education intervention in improving patients' knowledge, foot care practices, self-efficacy, and social support for the prevention of DFUs.

METHODS

Study Design, Population, and Sample

This study employed a pre-experimental design using a one-group pretest–posttest approach to evaluate the effect of a foot care health education intervention on knowledge, self-efficacy, foot care practices, and the occurrence of DFUs among patients with T2DM. The study population consisted of 350 individuals with diabetes mellitus residing in Pringsewu Regency, Indonesia. A total of 107 participants with T2DM were recruited for the study. The required sample size was calculated using the Lemeshow formula, $n = (Z^2 \times P \times (1 - P))/d^2$, which yielded a minimum sample size of 96 participants. To account for an anticipated 10% dropout rate, the final sample size was increased to 107 participants.

Participants were selected using purposive sampling based on the following inclusion criteria: willingness to participate in the study; a confirmed diagnosis of type 2 diabetes mellitus for at least one year; residence in Pringsewu Regency; ability to communicate

effectively; absence of speech or hearing impairments; and the ability to read and write. The exclusion criteria included patients with type 2 diabetes mellitus who had cognitive impairment or decreased consciousness, severe visual impairment, were hospitalized or experiencing acute conditions requiring intensive medical treatment, had a history of lower-limb amputation, or had an existing diabetic foot ulcer.

Study Setting, Duration, and Research Procedures

The study was conducted in nine community health centers (Puskesmas) located in Pringsewu Regency, Indonesia. A total of 107 patients with T2DM were recruited from these health centers. Data collection was conducted over approximately 36 weeks (nine months), from February to October 2024. This longitudinal study involved pre-intervention and post-intervention assessments over a 36-week follow-up period. The research procedures were conducted as follows: 1) Week 1 (Pre-intervention): Baseline data were collected using standardized questionnaires assessing participants' knowledge, self-efficacy, foot care practices, and social support; 2) Week 2 (Intervention): Participants received a structured health education program focusing on diabetic foot care for individuals with T2DM; 3) Weeks 3–35 (Follow-up): Participants' foot care practices were monitored throughout the follow-up period; 4) Week 36 (Post-intervention): The effectiveness of the health education intervention in preventing DFUs was evaluated using post-intervention questionnaires and clinical observation to identify signs and symptoms of DFUs.

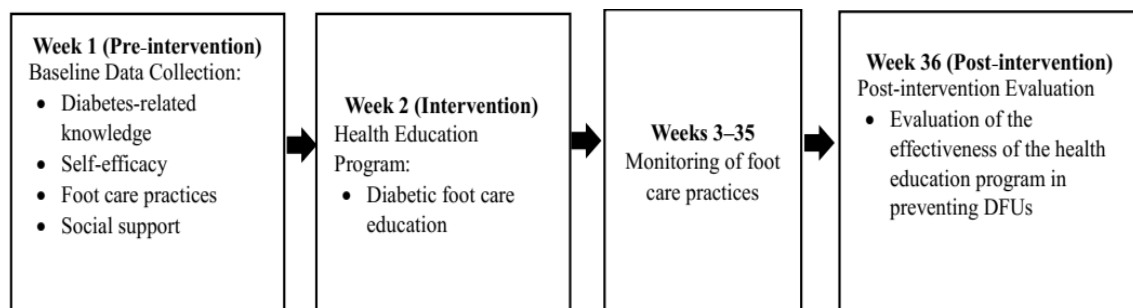


Figure 1. Study timeline of the health education intervention and outcome assessment

Intervention Procedures and Educational Content

The intervention consisted of a structured health education program on diabetic foot care for patients with T2DM. The intervention was implemented systematically through three stages: preparation, implementation, and evaluation. It was delivered during the second week of the study, following the baseline (pre-intervention) assessment, in a single educational session lasting approximately 30–60 minutes. The educational program covered key aspects of DFU prevention, including risk factors for DFU, self-foot examination, foot hygiene and daily foot care, safe nail trimming techniques, appropriate footwear selection, prevention of foot injuries, diabetic foot exercises, blood glucose control, recognition of early warning signs of foot complications, and family involvement in supporting daily foot care practices.

Health education was delivered through interactive lectures, group discussions, question-and-answer sessions, and practical demonstrations of appropriate foot care techniques. Following the intervention, participants were instructed to independently implement the recommended foot care practices in their daily lives. Their adherence to foot care practices was monitored until Week 36 to evaluate the sustainability of behavioral changes. The educational materials included the basic concepts of diabetes mellitus and DFUs, risk factors, daily foot care procedures such as routine foot inspection, maintaining foot hygiene and skin moisture, proper nail trimming, appropriate footwear selection, and the importance of regular physical activity, glycemic control, and social support in enhancing patients' confidence (self-efficacy) in performing diabetes self-care.

Study Variables

The dependent variable in this study was DFU prevention. The primary outcome was participants' behavior aimed at preventing DFUs following the health education intervention. Behavioral changes were evaluated based on the presence or absence of clinical signs indicative of DFUs.

Research Instruments

Data were collected using validated self-administered questionnaires. Diabetes-related knowledge was assessed using the Diabetes Knowledge Questionnaire (DKQ-24). Self-efficacy was measured using the Diabetes Management Self-Efficacy Scale (DMSES). Foot care practices were evaluated using the Diabetic Foot Self-Care Questionnaire (DFSQ-UMA), while perceived social support was assessed using the Social Support Scale for Self-Care in Diabetes (S4-MAD).

Data Collection and Statistical Analysis

Data were collected through questionnaire administration and clinical observation. The questionnaires were administered at baseline (Week 1) and after the intervention (Week 36) to assess participants' knowledge, self-efficacy, foot care practices, and perceived social support. Statistical analyses consisted of three stages: (1) univariate analysis to describe participants' characteristics and study variables; (2) bivariate analysis using the chi-square test to examine associations between variables; and (3) multivariable analysis using binary logistic regression to identify factors associated with diabetic foot ulcer prevention.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Committee of Universitas Muhammadiyah Pringsewu, Indonesia (Ethics Approval No. EC: 010/KEPK/FKES/2024). All research procedures complied with internationally accepted ethical principles, including obtaining written informed consent from all participants, maintaining data confidentiality and participant anonymity, and ensuring participants' right to refuse participation or withdraw from the study at any time without penalty.

RESULTS AND DISCUSSIONS

This study was conducted among patients with T2DM attending nine Puskesmas in Pringsewu Regency, Lampung Province, Indonesia, between February and October 2024.

Respondent Characteristics

As presented in Table 1, most participants were aged 18–65 years (92 participants, 86.0%), while 15 participants (14.0%) were aged 66–79 years. The majority of respondents were female (79 participants, 79.4%), whereas 28 (20.6%) were male. Regarding ethnicity, most participants were Javanese (95, 87.9%), while the remaining 12 participants (12.1%) were Lampung or Sundanese. Nearly all respondents were Muslim (96 participants, 96.3%), with only 11 participants (3.7%) reporting other religious affiliations. With respect to disease duration, most participants had been diagnosed with

diabetes mellitus for more than 10 years (81 participants, 75.7%), whereas 26 participants (24.3%) had lived with diabetes for 1–10 years. Based on educational attainment, the majority had completed senior high school (66 participants, 61.7%), while 41 participants (38.3%) had completed elementary or junior high school. Regarding occupation, most respondents were farmers or housewives (92 participants, 85.9%), whereas 15 participants (14.1%) were government employees or members of the Indonesian National Armed Forces/Police.

Table 1. Characteristics of the Study Participants

Variable	Frequency (n)	%
Age (years)		
18 – 65	92	86.0
66 – 79	15	14.0
Sex		
Female	79	79.4
Male	28	20.6
Ethnicity		
Javanese	95	87.9
Lampung and Sundanese	12	12.1
Religion		
Islam	96	96.3
Non-Islam	11	3.7
Duration of diabetes (years)		
1-10	26	24.3
> 10	81	75.7
Educational level		
Elementary and Junior High School	41	38.3
Senior High School	66	61.7
Occupation		
Farmer / Housewife	92	85.9
Government Employees and Military/Police Personnel	15	14.1

As shown in Table 2, among the 64 respondents with good knowledge following the health education intervention, 7 (7.27%) developed DFUs, whereas 56 (58.33%) did not. Among the 21 respondents with moderate

knowledge, 3 (2.21%) developed DFUs, while 18 (18.75%) did not. Among respondents with poor knowledge, none developed DFUs, whereas 18 respondents (22.21%) remained free of them. The chi-square analysis demonstrated

a statistically significant association between post-intervention knowledge and the prevention of DFUs ($p = 0.003$).

Regarding self-efficacy, Table 2 shows that among the 69 respondents with high self-efficacy, 63 (91.3%) experienced DFUs, whereas 6 (8.7%) did not. Among the 38 respondents with low self-efficacy, 20 (52.6%) experienced DFUs, and 18 (47.4%) did not. Chi-square analysis indicated a statistically significant association between post-intervention self-efficacy and diabetic foot ulcer prevention ($p < 0.001$).

Among the 54 respondents who consistently performed foot care activities, 4 (3.36%) developed DFUs, whereas 50 (52.08%) remained free of them. Among the 23 respondents who frequently performed foot care activities, 4 (3.63%) developed DFUs, and 19 (19.79%) did not. Among the

21 respondents who occasionally performed foot care activities, 3 (2.72%) developed DFUs, whereas 18 (18.75%) did not. None of the nine respondents who never performed foot care activities developed DFUs, while all nine (9.37%) remained free of them. Chi-square analysis demonstrated a statistically significant association between post-intervention foot care practices and the prevention of DFUs ($p < 0.001$).

Regarding social support, among the 82 respondents with high social support, 68 (82.9%) did not develop DFUs, whereas 14 (17.1%) did. Among the 25 respondents with low social support, 15 (60.0%) did not develop DFUs, while 10 (40.0%) did. Chi-square analysis revealed a statistically significant association between post-intervention social support and diabetic foot ulcer prevention ($p = 0.033$).

Table 2. Association of Knowledge, Self-Efficacy, Foot Care Practices, and Social Support with Diabetic Foot Ulcers

Variable	Signs of Diabetic Foot Ulcers		Total	p-Value
	Present	Absent		
Knowledge				
Good	8 (7.27%)	56 (58.33%)	64 (59.80%)	0.003
Moderate	3 (2.21%)	18 (18.75%)	21 (19.62%)	
Poor	0 (0%)	22 (22.91%)	22 (20.56%)	
Self-efficacy				
High	63 (91.3%)	6 (8.7%)	69 (100%)	<0.001
Low	20 (52.6%)	18 (47.4%)	38 (100%)	
Foot care practices				
Always	4 (3.63%)	50 (52.08%)	54 (50.46%)	<0.001
Frequently	4 (3.63%)	19 (19.79%)	23 (21.49%)	
Occasionally	3 (2.72%)	18 (18.75%)	21 (19.62%)	
Never	0 (0.0%)	9 (9.37%)	9 (8.41%)	
Social support				
High	14 (17.1%)	68 (82.9%)	82 (100%)	0.033
Low	10 (40.0%)	15 (60.0%)	25 (100%)	

Note: Values are presented as n (%). p-values were obtained using the chi-square test. Statistically significant at $p < 0.05$.

Effectiveness of Health Education in Preventing Diabetic Foot Ulcers

The majority of participants in this study were aged 18–65 years. This finding is consistent with the study by Vadila et al. (2021), which reported that increasing age is associated with a higher risk of developing T2DM. Furthermore, interactions between age and other risk factors

have been shown to contribute to variations in the prevalence of diabetes and prediabetes among middle-aged and older adults (Yan et al., 2023).

The duration of diabetes was also associated with patients' knowledge of diabetic foot care. Individuals who have lived with diabetes for more than five years are

approximately twice as likely to develop DFUs compared with those diagnosed within the previous five years (Fitria et al., 2019). Similarly, Suryati et al. (2019) reported a significant association between diabetes duration and the occurrence of DFUs.

The prevalence of T2DM has increased among both men and women; however, men are generally diagnosed at a younger age and with lower body fat mass than women. Globally, the number of men living with diabetes is estimated to exceed that of women by approximately 17.7 million individuals (Kautzky-willer & Leutner, 2023). In addition, lower educational attainment has been associated with an increased risk of diabetes-related mortality and a higher incidence of diabetes complications, highlighting the importance of targeted interventions to reduce educational disparities in diabetes management and improve health literacy among vulnerable populations (Luo et al., 2025).

Occupational factors have also been identified as important determinants of T2DM. Among both men and women, emotionally demanding work environments and confrontational job conditions are associated with an increased risk of developing T2DM. Moreover, inadequate workplace social support may further strengthen this association (Pan et al., 2025). Extended working hours have likewise been reported to increase the risk of diabetes progression among individuals with prediabetes (Seo et al., 2022).

The incidence of type 2 diabetes mellitus is influenced by age, duration of diabetes, sex, educational attainment, and occupational characteristics. The risk of diabetes and its complications increases with advancing age, disease duration exceeding five years, and lower educational levels. Furthermore, male sex, emotionally demanding occupations, limited workplace social support, and prolonged working hours may further contribute to the development and progression of T2DM. These demographic, socioeconomic, and occupational factors should therefore be considered when designing diabetes prevention and management strategies.

The present study demonstrated that most participants improved their knowledge

regarding DFU prevention following the health education intervention. Intensive educational programs have been shown to significantly improve patients' knowledge and foot care practices while reducing the incidence of foot ulcers, calluses, and fungal infections, particularly among individuals at high risk of diabetic foot complications. These findings emphasize the importance of implementing continuous educational programs for both patients with diabetes and healthcare professionals (Mohammed et al., 2021).

Health education is an effective strategy for enhancing patients' ability to prevent DFUs. It provides patients with comprehensive information that facilitates a better understanding of the disease and enables direct interaction with healthcare professionals. Previous studies have consistently demonstrated that health education significantly improves diabetes-related knowledge among individuals with diabetes mellitus (Amir & Munir, 2021). Patients who received health education showed substantial improvements in their knowledge of DFU prevention, indicating that educational interventions play a significant role in enhancing patients' understanding of preventive foot care (Pal et al., 2019).

A significant positive association has also been reported between patients' knowledge and preventive foot care practices (Awwad & Abu-khader, 2022). Approximately two-thirds of patients with diabetes possess adequate knowledge regarding diabetic foot care and its management. Higher levels of knowledge are generally observed among younger individuals, those with higher educational attainment, and patients with a family history of diabetes mellitus (Amri et al., 2021).

Health education is effective in improving patients' knowledge and preventive foot care practices for DFUs among individuals with diabetes mellitus. Improved knowledge is associated with better foot care behaviors and a reduced risk of diabetes-related foot complications. These findings underscore the importance of implementing continuous educational programs to optimize DFU prevention.

The present study found that the majority of participants demonstrated high levels of

self-efficacy in preventing DFUs following the health education intervention. High self-efficacy plays a critical role in influencing self-care behaviors among patients with diabetes mellitus by fostering confidence in maintaining their health and promoting a positive attitude toward disease self-management (Firmansyah, 2019). Among patients with T2DM, self-efficacy is strongly associated with quality of life, with health literacy acting as an important mediator of this relationship (Li et al., 2025).

These findings highlight the importance of adopting a comprehensive, patient-centered approach that emphasizes self-efficacy in the management of individuals with T2DM. Effective interventions should address not only educational needs but also psychosocial and social factors that substantially influence patients' quality of life (Eshtaya et al., 2025). Furthermore, diabetes self-efficacy has been associated with higher educational attainment and greater exposure to health education. Higher levels of self-efficacy are significantly related to better adherence to self-care practices and improved glycemic control. Therefore, greater efforts are needed to empower patients by strengthening self-efficacy and promoting adherence to self-care through structured health education interventions (Amer, F. A., et al 2018).

Self-efficacy and treatment adherence have also been identified as the primary predictors of quality of life among patients with T2DM (Bistara, D. N., et al, 2026). Most dimensions of self-efficacy among participants in the intervention group showed significant improvement after six months of educational intervention (South-east et al., 2023).

Self-efficacy is a key determinant of effective prevention and management of T2DM. Health education has been shown to strengthen patients' self-efficacy, which in turn improves adherence to self-care behaviors, glycemic control, and quality of life. Health literacy further reinforces this relationship, emphasizing the need for comprehensive interventions that integrate educational, psychological, and social components to empower patients and optimize diabetes management outcomes.

The present study also found that most participants showed improvement in their

foot care practices for the prevention of DFUs following the health education intervention. These results are consistent with those reported by Amri et al. (2021), who found that patients generally exhibited positive attitudes toward foot care and recognized the impact of diabetes on foot health, while maintaining relatively good foot care practices despite the need for improvement in several areas. Effective diabetes management requires consistent daily foot care, appropriate footwear selection, maintenance of regular physical activity involving the feet, and routine health examinations to reduce the risk of diabetic foot complications (Untari et al., 2024).

Health literacy related to diabetic foot care is closely associated with patients' knowledge of diabetic foot care and self-care behaviors, making it a key component of effective diabetes management and the prevention of foot-related complications. Educational interventions specifically designed to improve health literacy among patients at risk of diabetic foot complications have been shown to enhance self-care practices and reduce the risk of severe diabetic foot complications (Med et al., 2025). Foot care aims to prevent foot complications among individuals with diabetes mellitus. Recommended foot care behaviors include daily foot inspection, maintaining daily foot hygiene, preserving skin moisture and integrity, properly trimming toenails, selecting and wearing appropriate footwear, and providing immediate first aid for foot injuries when necessary (Sari & Herlina, 2019).

Previous studies have demonstrated a significant association between foot care behaviors and the occurrence of diabetic foot complications among patients with T2DM. Appropriate foot care practices play a crucial role in preventing DFUs, emphasizing the need for physicians and other healthcare professionals to provide continuous education that promotes positive foot care behaviors among individuals with diabetes (Amelia, 2018).

The findings of the present study further demonstrate that health education is effective in improving foot care practices and self-care behaviors among patients with diabetes mellitus to prevent DFUs. Health literacy plays an essential role in promoting appropriate

self-care practices, which are significantly associated with a reduced risk of diabetic foot complications. Therefore, continuous health education provided by healthcare professionals is essential to reinforce appropriate foot care behaviors and prevent the development of DFUs.

The present study also found that the majority of participants reported improved social support for diabetic foot ulcer prevention following the health education intervention. Social support represents an important salutogenic resource that contributes to improved physical health, mental well-being, and quality of life through various forms of assistance, including emotional support, social interaction, positive reinforcement, practical assistance, and informational support. Moreover, social support has been shown to reduce psychological stress, lower mortality risk, and mitigate the adverse effects of various stressors (Haugan, G., & Eriksson, 2021).

Peer support has been shown to improve self-efficacy among patients with T2DM, thereby facilitating positive changes in self-management (Dewi & Arisudhana, 2024). Higher levels of social support have also been associated with improved foot care behaviors among individuals with T2DM (Sari et al., 2022). Furthermore, previous studies have reported a positive relationship between social support and improved health outcomes among patients with diabetes mellitus (Almubaid et al., 2024).

Family support is positively associated with adherence to self-care among patients with DFUs. Greater family support is associated with greater adherence to recommended self-care practices (Manggasa & Rantesigi, 2024). Likewise, stronger family support has been associated with a lower risk of developing DFUs (Tiyara & Mulyono, 2025).

Overall, these findings indicate that social support is a critical determinant of physical health, psychological well-being, and quality of life among individuals with diabetes mellitus. Social support enhances patients' self-efficacy, promotes adherence to self-care behaviors, and improves foot care practices. Furthermore, strong family and social support help reduce the risk of DFUs, highlighting their importance as

integral components of comprehensive diabetes prevention and management strategies.

CONCLUSIONS

Health education was an effective strategy for preventing DFUs among patients with T2DM. Health education significantly improved patients' knowledge, self-efficacy, foot care practices, and social support, all of which contributed to the prevention of DFUs.

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