The Effect of Supportive Education System (SES) on Knowledge of Diabetic Foot Ulcer Prevention Among Patients with Type 2 Diabetes Mellitus

Abstract

Background: Type 2 Diabetes Mellitus (T2DM) is a chronic disease that can lead to serious complications, one of which is diabetic foot ulcers. Health education plays a crucial role in enhancing patients' understanding of the prevention of such complications. This study aims to analyze the effect of the Supportive Education System (SES) on knowledge of diabetic foot ulcer prevention among patients with T2DM.

Methods: A quasi-experimental design with a pretest-posttest control group was employed. A total of 160 patients with T2DM were selected using purposive sampling and divided into an intervention group (n=80) and a control group (n=80). The intervention group received the SES over four sessions, while the control group received conventional education. Knowledge levels were measured before and after the intervention using a standardized questionnaire.

Results: The analysis revealed a significant increase in knowledge levels in the intervention group compared to the control group ($p < 0.001$), as assessed by the Mann–Whitney test. These findings indicate that a support-based educational approach is more effective than conventional education in improving patients' knowledge.

Conclusion: The Supportive Education System (SES) can serve as an effective educational strategy in diabetic foot ulcer prevention programs. This method is recommended for broader implementation to enhance patient understanding and adherence in diabetic foot care, thereby preventing further complications.

Keywords: Diabetic, Education, Knowledge, Supportive, Ulcer

Introduction

Diabetes Mellitus (DM) is a chronic metabolic disorder with a rising global prevalence. According to the International Diabetes Federation (IDF) 2023 report, approximately 537 million people worldwide live with diabetes, and this figure is projected to increase to 643 million by 2030. Indonesia ranks fifth globally, with an estimated 19.47 million cases, and national prevalence continues to climb, rising from 6.9% in 2018 to 8.5% in 2023. This growing burden is especially evident in urban areas such as South Kalimantan, where reported cases have steadily increased.

One of the severe complications of DM is the development of diabetic foot ulcers, open wounds caused by neuropathy, ischemia, or infection. If untreated, these ulcers can progress to gangrene and often require amputation. The World Health Organization (WHO) estimates that more than 15% of people with diabetes will experience foot ulcers during their lifetime, with 85% of diabetes-related amputations preceded by untreated ulcers. In Indonesia, over 25% of people with diabetes develop foot wounds, posing significant risks to their mobility and quality of life.

Preventive measures such as patient education on foot care, the use of appropriate footwear, and routine check-ups are critical in reducing the incidence of diabetic foot ulcers. However, despite various educational initiatives, many patients still lack sufficient knowledge and adherence to proper foot care practices due to limited understanding, low motivation, and barriers to accessing health services.

The Supportive Education System (SES) is an innovative educational approach that combines evidence-based information with social support and motivational strategies. Unlike conventional education, SES not only delivers knowledge but also provides continuous guidance and encouragement, addressing psychosocial factors that influence patients' adherence to foot care routines.

This study aims to evaluate the effectiveness of the SES in improving knowledge about diabetic foot ulcer prevention among patients with type 2 DM. The results are expected to inform the development of more effective and sustainable educational interventions to prevent foot ulcers and enhance the quality of life of diabetes patients in Indonesia, particularly in South Kalimantan.

Methods

This study used a quasi-experimental design with a pretest-posttest control group design to evaluate the effect of the Supportive Education System (SES) on improving knowledge of diabetic foot ulcer prevention among patients with Type 2 Diabetes Mellitus (T2DM). This design allows for a comparison between an intervention group receiving SES and a control group receiving conventional education, thus enabling an assessment of the effectiveness of the applied educational approach. This study was conducted from August to December 2024 at the Diabetic Foot Clinic of Banjarmasin Regional General Hospital (RSUD Banjarmasin), South Kalimantan, Indonesia. The study period included participant recruitment, implementation of the Supportive Education System (SES) intervention, and post-intervention data collection and analysis.

The study population consisted of T2DM patients receiving care at the diabetic foot clinic of Banjarmasin Regional General Hospital (RSUD Banjarmasin). A purposive sampling technique was used, with inclusion criteria including: T2DM patients who had not yet developed diabetic foot ulcers, had good communication ability, and were willing to participate in the study. Exclusion criteria included patients with cognitive impairments or severe comorbidities that hindered participation in the educational sessions. The sample size was determined using Slovin's formula, resulting in a total of 160 participants. The sample was divided into two groups: 80 participants in the intervention group and 80 participants in the control group.

Data collection was conducted using a validated knowledge questionnaire on diabetic foot ulcer prevention. This questionnaire was administered before the intervention (pretest) and after the intervention (posttest) to measure changes in participants' knowledge. In addition, observations and daily logs were used to document patient engagement during the education program.

The intervention was initiated with pretest data collection from both groups. The intervention group received the Supportive Education System (SES), which consisted of comprehensive education on diabetic foot care, supported by motivational strategies, personal assistance, and interactive Q&A sessions delivered over several sessions during a four-week period. Meanwhile, the control group received only conventional education in the form of a brief counseling session without additional support. Upon completion of the intervention, a posttest was conducted in both groups to evaluate knowledge changes.

Data normality was assessed using the Shapiro-Wilk test. The results indicated that the knowledge scores were normally distributed. Therefore, parametric tests were used for analysis. The paired *t*-test was employed to compare pretest and posttest scores within each group, while the independent *t*-test was used to compare post-intervention scores between the intervention and control groups. Statistical analysis was performed using [specify software, e.g., SPSS version XX], with a significance level set at $p < 0.05$.

Results

Characteristics of Age, Gender, Education, and Occupation

Table 1. Distribution of Age, Gender, Education, and Occupation (n=160)

Characteristics	Frequency	Percentage (%)
Age (Years)		
<45	42	26.3
45-59	72	45
≥60	46	28.7
Gender		
Male	78	48.7
Female	82	51.3
Education Level		
Elementary School	37	23.1
Junior High School	52	32.5
Senior High School	53	33.1
Higher Education	18	11.3
Occupation		
Unemployed	38	23.7
Civil Servant/Military/Police	36	16.3
Entrepreneur	37	23.1
Farmer/Laborer	31	19.4
Private Sector Employee	28	17.5

Table 1 indicates that A total of 160 patients participated in this study, with 80 assigned to the intervention group and 80 to the control group. The majority of participants were aged 45–59 years (45%), female (51.3%), had completed senior high school (33.1%), and were predominantly unemployed (23.7%)

Table 2. Distribution of Knowledge Levels on Diabetic Foot Ulcer Prevention Before Intervention (n=160)

Knowledge Level	Intervention Group		Control Group		Total Respondents	
	N	%	N	%	N	%
Low	40	50	38	47.5	78	48.8
Moderate	30	37.5	32	40	62	38.7
High	10	12.5	10	12.5	20	12.5

Table 2 Indicates a total of 160 patients participated in this study, with 80 assigned to the intervention group and 80 to the control group. The majority of participants were aged 45–59 years (45%), female (51.3%), had completed senior high school (33.1%), and were predominantly unemployed (23.7%).

Table 3. Distribution of Knowledge Levels on Diabetic Foot Ulcer Prevention After Intervention (n=160)

Knowledge Level	Intervention Group		Control Group		Total Respondents	
	N	%	N	%	N	%
Low	5	6.2	35	43.8	12	20.0
Moderate	25	31.3	30	37.5	22	36.7
High	50	62.5	15	18.7	26	43.3

Table 3 demonstrates following the implementation of the Supportive Education System (SES), the proportion of participants with high knowledge levels increased markedly to 62.5% in the intervention group, whereas only 18.7% of the control group achieved high knowledge levels.

Table 4. Comparison of Knowledge Levels on Diabetic Foot Ulcer Prevention Before and After Intervention in Intervention and Control Groups

Group	n	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean± SD)	t-value (df)	*P-value (Paired t-test)*
Intervention	80	1.63 ± 0.67	2.56 ± 0.60	0.93	<0.001
Control	80	1.65 ± 0.68	1.87 ± 0.72	0.22	0.081

Table 4 Shows the paired *t*-test results showed that the mean knowledge score in the intervention group increased significantly from 1.63 ± 0.67 before the intervention to 2.56 ± 0.60 after the intervention (0.93, $p < 0.001$). In the control group, the mean score increased slightly from 1.65 ± 0.68 to 1.87 ± 0.72, but this change was not statistically significant (*0.22,* $p = 0.081$)

Discussion

Univariate analysis revealed that the majority of respondents in this study were aged 45–59 years (45%), followed by those aged ≥60 years (28.7%) and <45 years (26.3%). Age significantly influences patients' knowledge and awareness of diabetes complications, including diabetic foot ulcers. Research by [15] found that patients aged 45–59 years are more proactive in seeking health information compared to older age groups, likely due to their active social and economic engagements. Conversely, elderly patients tend to experience cognitive decline and limited access to health information, which can affect their understanding of diabetic foot ulcer prevention [16].

The gender distribution was relatively balanced, with males comprising 48.7% and females 51.3% of respondents. Studies indicate that females are generally more health-conscious and more frequently seek information on preventing diabetes complications than males [17]. More Researcher reported that males have a higher risk of developing diabetic foot ulcers due to lower adherence to foot care practices, particularly in footwear choices and self-care habits [18].

Regarding education, most respondents had completed junior high school (32.5%) and senior high school (33.1%), while 11.3% had tertiary education. Educational attainment is closely linked to disease prevention comprehension. Patients with higher education levels possess better knowledge about diabetic foot care compared to those with lower educational backgrounds [19]. This is attributed to individuals with higher education having broader access to health information sources, including digital media and healthcare professionals. In terms of occupation, respondents exhibited varied distributions: unemployed (23.7%), entrepreneurs (23.1%), farmers/laborers (19.4%), private employees (17.5%), and civil servants/military/police (16.3%). Occupation influences access to healthcare services and the adoption of healthy lifestyles [20]. Unemployed or low-income respondents tend to face limitations in accessing healthcare facilities and encounter greater challenges in implementing optimal diabetic foot care, especially regarding appropriate footwear use and regular health check-ups [21].

The study results indicated that prior to the implementation of the Supportive Education System (SES) intervention, the majority of respondents in both groups exhibited low to moderate levels of knowledge. This finding highlights an existing information gap concerning diabetic ulcer prevention among type 2 diabetes mellitus patients. Several factors may contribute to this low level of knowledge, including limited access to accurate information, insufficient ongoing education from healthcare professionals, and a lack of patient awareness in independently seeking health information. According [22] unstructured education and ineffective learning methods often hinder the enhancement of patient knowledge regarding complication prevention, including diabetic ulcers.

Furthermore, this result aligns with the study conducted by [23] which found that most type 2 diabetes mellitus patients have limited understanding of diabetic foot care, thereby increasing the risk of ulceration and amputation. This is corroborated by research from Samuel et al. (2022), stating that

ineffective education can lead to a higher incidence of diabetic ulcers, especially among patients who do not routinely perform foot examinations [24].

The study results demonstrated a significant increase in the knowledge levels of respondents in the intervention group following the implementation of the Supportive Education System (SES) intervention, compared to the control group. This improvement indicates that a systematic, socially supported educational intervention can effectively enhance patient understanding of diabetic ulcer prevention. This study is consistent with research conducted by Anita et al. (2025), who reported that structured education using participatory methods can improve patient knowledge and adherence to diabetic foot care practices [25]. Repeated, interactive, and patient-centered education has proven more effective than conventional one-way information delivery methods.

Additionally, these findings are supported by research from [26] emphasizing that increased knowledge is a crucial initial step in reducing the incidence of diabetic ulcers and the risk of amputation in type 2 diabetes mellitus patients. This study highlights that patients with a better understanding of risk factors, early signs, and preventive measures for diabetic ulcers are more capable of performing independent foot care, ultimately reducing complications. In this study, the control group, which did not receive the SES intervention, only experienced a non-significant increase in knowledge. This suggests that unstructured conventional educational approaches are less effective in enhancing patient understanding. Education relying solely on brief counseling without active patient involvement often does not significantly impact changes in knowledge and behavior [27].

The observed improvement in the intervention group in this study also indicates that the Supportive Education System (SES)-based approach is superior to conventional educational methods. This educational model not only provides information but also facilitates interaction, social support, and a more personalized and repetitive approach, making it easier for patients to comprehend and apply the information provided.

The Mann-Whitney test analysis results indicate a significant difference between the intervention and control groups after implementing the Supportive Education System (SES) ($p < 0.001$). This suggests that educational methods based on social support are more effective in enhancing patient knowledge compared to conventional education. Research conducted by [28] found that group-based educational interventions with a participatory approach can improve the understanding of diabetes mellitus patients regarding the prevention of diabetic foot complications. This study highlights that active learning methods, such as group discussions and direct demonstrations, have a greater impact than one-way education [29]. These findings support the current study's results, indicating that the Supportive Education System (SES) can significantly enhance patient knowledge through a more interactive approach involving active patient participation.

Furthermore, research by [29] also demonstrated that health education delivered repeatedly and based on multimedia is more effective than conventional methods in increasing patient awareness about diabetic foot care [30]. This study emphasizes that using engaging educational media, such as images, videos, and interactive modules, can help patients better understand the concept of diabetic ulcer prevention [31]. This aligns with the SES intervention in the current study, where a more varied approach to material delivery can optimally enhance patient understanding.

Moreover, research by [32] found that social support provided by healthcare professionals and fellow patients in diabetes education programs contributes to increased patient understanding and adherence to diabetic ulcer prevention measures. This social support creates a more comfortable learning environment and motivates patients to apply the information they have acquired [33]. These findings reinforce the results of the current study, demonstrating that an educational approach based on social support within SES can enhance patient learning effectiveness. On the other hand, the control group, which only received conventional education, did not experience a significant increase in knowledge. This is consistent with a study conducted by [34-36] which found that health education based solely on lectures is not sufficiently effective in comprehensively improving patient understanding, especially when conducted in a short time without follow-up education.

Consequently, the findings of this study align with existing literature, confirming that an interactive, structured, and socially supported educational intervention can effectively enhance patient knowledge regarding diabetic foot ulcer prevention. The Supportive Education System (SES) thus emerges as a promising strategy that can be integrated into broader preventive programs for individuals with type 2 diabetes mellitus, with the potential to improve patient self-care practices, quality of life, and to mitigate the risk of foot ulceration.

Nonetheless, several limitations should be acknowledged. First, this study assessed only the level of knowledge without evaluating actual behavioral changes or long-term adherence to recommended foot care practices; therefore, the sustained impact of the SES intervention remains to be determined. Second, the research was conducted in a single geographic area, which may limit the generalizability of the findings to other populations with differing socio-economic and cultural contexts. Third, extraneous variables such as individual motivation, access to supplementary information, and family support were not comprehensively controlled and may have influenced the outcomes. Finally, the relatively short duration of the pre-test and post-test design did not allow for the assessment of knowledge retention or behavioral maintenance over time. Future studies employing longitudinal designs and incorporating objective behavioral and clinical outcome measures are recommended to validate these findings and to establish the long-term efficacy of the SES approach.

Conclusion

This study demonstrates that the Supportive Education System (SES) significantly enhances the level of knowledge regarding diabetic ulcer prevention in patients with Type 2 Diabetes Mellitus. Prior to the intervention, the majority of respondents had low to moderate knowledge levels in both the intervention and control groups. After implementing SES, there was a significant increase in the intervention group, while the control group did not show meaningful changes. The Mann-Whitney statistical test results indicate a significant difference between the two groups post-intervention ($p < 0.001$), suggesting that this support-based educational method is more effective than conventional education.

Conflict of Interest
In preparing this manuscript, there were no conflicts of interest. All authors approved and agreed to this manuscript.

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Ethical permissions
The procedure was reviewed and granted ethical clearance (Number: 1903-KEPK) by the Institutional Review Board (IRB) at the Banua Institute, Indonesia.

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