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The Effect of Interactive Nursing Diabetes Self-Management Education on Self-Care Knowledge and Self-Care Behavior in Type 2 Diabetes Patients: A Randomized Controlled Trial

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ABSTRACT: Introduction: The continued rise in the prevalence of type 2 diabetes mellitus globally poses significant challenges for healthcare systems in various countries. Interactive, nurse-led diabetes self-management education programs play a crucial role in diabetes treatment, improving patients' knowledge and skills in self-care. Aim: The purpose of this study was to analyse the impact of interactive nursing diabetes self-management education on self-care knowledge and self-care behaviour. Method: The research design employed was a randomised controlled trial (RCT) study, utilising a simple random sampling technique with sample determination based on inclusion and exclusion criteria, resulting in a sample size of 116 respondents, divided equally between the intervention and control groups, with 58 respondents in each group. The instruments used in this study were the Diabetes Knowledge Test (DKT) and the Summary of Diabetes Self-Care Activities (SDSCA). Statistical analysis used the t-test with $p < 0.05$. Results: The results showed that in the intervention and control groups, the average self-care knowledge before and after the intervention was 7.06, while the average after the self-care behaviour intervention was: diet was 3.14, exercise was 3.2, blood sugar was 226.20, foot care was 3.08, and general self-care behaviour was 3.08. Data analysis revealed that interactive diabetes self-management education, focusing on self-care knowledge and behaviour, was significantly valued, with a p-value of 0.000. Conclusion: There was a significant increase in the average scores for self-care knowledge and self-care behaviour after interactive nursing diabetes self-management education. These results confirm that interactive nursing diabetes self-management education in healthcare facilities plays a crucial role in optimising self-care management for diabetes patients.

1. INTRODUCTION

Diabetes mellitus is a chronic metabolic disease caused by defects in insulin function, insulin release, or both (Mlynarska et al., 2025). In the management of type 2 diabetes mellitus (T2DM), a crucial issue lies in the gap between self-care knowledge and the implementation of self-care behaviours. Although information about diet, exercise, and medication is widely available, low self-care knowledge, often exacerbated by misinformation or a lack of in-depth understanding, leads to suboptimal self-care behaviours. This includes non-adherence to recommended diets, lack of regular physical activity, and inconsistent medication management. As a result, patients experience difficulty achieving stable glycemic control, increasing the risk of long-term complications (Alfulayw et al., 2022; Andersen et al., 2024; Chawla et al., 2019).

Based on the latest data from the NCD Risk Factor Collaboration (2022), the number of patients is 828 million, of which more than 95% suffer from type 2 diabetes. Statistical data shows that the prevalence of diabetes will continue to increase until 2050 to around 10.8% in the United States alone, but this is likely to be even higher due to various estimates of the current prevalence of diabetes (Borse et al., 2021; Ong et al., 2023; Zhou et al., 2024). Observation and interview results of 45 DM patients in the Wonokromo Community Health Centre area, Surabaya, showed that 85% were lacking in diet, blood sugar control, compliance in taking medication and self-care.

Diabetes mellitus (DM) management encompasses ongoing medical and non-pharmacological care that patients must undertake. Nurse-led diabetes self-management education (DSME) is a key and essential component of diabetes care (Borse et al., 2021; Galindo et al., 2023). Education contributes to good glycemic and metabolic control, thereby preventing long-term complications. Improving diabetes self-care competency and maintaining behaviours in adults is a major challenge, especially in the community (Galindo et al., 2023; Ibrahim et al., 2024). In particular, self-care in adults with diabetes is complicated because they live with a chronic disease accompanied by long-term medication and require specialised practices and attention based on their disease condition and the environment in which they live (Ibrahim et al., 2024). Low levels of self-care knowledge in patients with Type 2 Diabetes Mellitus (T2DM) trigger a vicious cycle that significantly impacts self-care behaviour. A lack of fundamental understanding of disease management, including the importance of a balanced diet, regular physical activity, and appropriate medication use, directly hinders patients' ability to perform effective self-care measures. Patients tend to have difficulty controlling blood glucose levels, increasing the risk of microvascular and macrovascular complications and reducing overall quality of life (Aloke et al., 2022; Alsaïdan et al., 2023; Ferreira et al., 2024; Paudel et al., 2022).

The problems that occur indicate that assistance is needed in patient self-care, such as self-care knowledge and skills through eating habits, physical activity, and medical compliance to maintain their health and well-being (Freeman-Hildreth et al., 2024; Funnell & Anderson, 2004). Nurses are healthcare workers who play a crucial role in helping patients improve glycemic values through developing diabetes self-care practices in maintaining health status (Changsieng et al., 2023; Diriba et al., 2024; Yari et al., 2023). A comprehensive solution is needed to break the chain of this problem, which focuses not only on increasing self-care knowledge, but also on sustainable behavioural changes. Diabetes Self-Management Education (DSME) interventions that are designed interactively and personally, involving healthcare workers, especially nurses, can be key. DSME should include in-depth education about the pathophysiology of the disease, self-management strategies, and practical skills to overcome daily challenges. Furthermore, strong social support from family, friends, or peer groups, as well as easy access to relevant health resources, can strengthen patients' commitment to self-care and help them achieve optimal glycemic control, prevent complications, and improve quality of life sustainably (Changsieng et al., 2023; Diriba et al., 2024; Leong et al., 2022; Yari et al., 2023). This study presents an innovation in the field of diabetes self-management education through the Interactive Nursing Diabetes Self-Management Education (DSME) approach. Unlike conventional DSME models that are often passive and impersonal, this intervention focuses on high interactivity through the use of a combination of telenursing, digital-based applications, and participatory learning strategies tailored to the individual needs of type 2 diabetes patients. This novelty lies in the effort to optimise active patient engagement, which is expected to not only improve self-care knowledge but also transform that knowledge into sustainable self-care behaviour. Therefore, this study aims to investigate the effects of Interactive Nursing Diabetes Self-Management Education on Self-Care knowledge and Self-Care behaviour in Type 2 Diabetes Patients.

2. MATERIALS AND METHODS

2.1 Materials

This study used a Randomised Controlled Trial (RCT) design with a pre-test post-test design with a control group. This study involved two groups of subjects, namely the intervention group and the control group, with the target population of all type 2 Diabetes Mellitus patients at the Wonokromo Community Health Centre in Surabaya. The planned sample size was 116 participants. Furthermore, the collected samples were divided into two groups, with 58 respondents in the treatment group given Interactive Nursing Diabetes Self-Management Education and 58 respondents in the control group who received routine care. The sampling method that will be carried out in this study uses Probability Sampling with a simple random sampling technique with sample determination according to inclusion and exclusion criteria. Inclusion criteria: DM patients undergoing a treatment program with fasting blood sugar (FBS) levels >126 mg/dl and random blood sugar/post prandial blood sugar (FBS) >200 mg/dl, DM patients aged ≥ 18 years, able to communicate verbally well, able to read and write, suffering from DM for ≥ 6 months, patients receiving rapid action insulin therapy (regular insulin) or oral hyperglycemic drugs. As for the exclusion

criteria: DM patients with physical, mental or cognitive limitations (blindness, deafness, mental disabilities), pregnancy, uncontrolled high blood pressure ($\geq 180/110$ mmHg). Drop-out criteria: patients undergoing hospitalisation or patients who died.

2.2 Data Collection Procedures

The independent variable in this study was Interactive Nursing Diabetes Self-Management Education. The dependent variables were self-care knowledge and self-care behaviour. Data collection was conducted using structured interviews, measuring self-care knowledge using the Diabetes Knowledge Test (DKT). This instrument was designed to assess knowledge of diet, exercise, blood glucose levels, and self-care activities. Self-care behaviour was measured using the Summary of Diabetes Self-Care Activities (SDSCA) to assess self-care activities in the past 7 days, covering aspects of the diabetes regimen: general diet, foot care, exercise, and medication use.

Interactive Nursing Diabetes Self-Management Education was delivered in a small group format of 8 to 10 patients, with sessions lasting one and a half hours over a month. The educational topics covered seven self-care behaviours as outlined by the American Association for Diabetes Education (AADE), including healthy eating, physical activity, monitoring, medication administration, problem-solving, healthy coping, and risk reduction. Participants in the intervention group received (1) a diabetes management booklet, (2) watched four 10-minute video clips, (3) attended four weekly group-based education sessions, and (4) received weekly follow-up telephone calls. Interactive Nursing Diabetes Self-Management Education was delivered using various methods, including lectures, demonstrations, observations, role-plays and scenarios, and problem-solving.

Data analysis was conducted using paired sample t-tests and independent sample t-tests. Data collection procedures for this study were conducted after passing and qualifying for ethical review by the Health Research Ethics Committee, which will be conducted at the hospital where the study took place. The hypothesis was accepted if the p-value was < 0.05 .

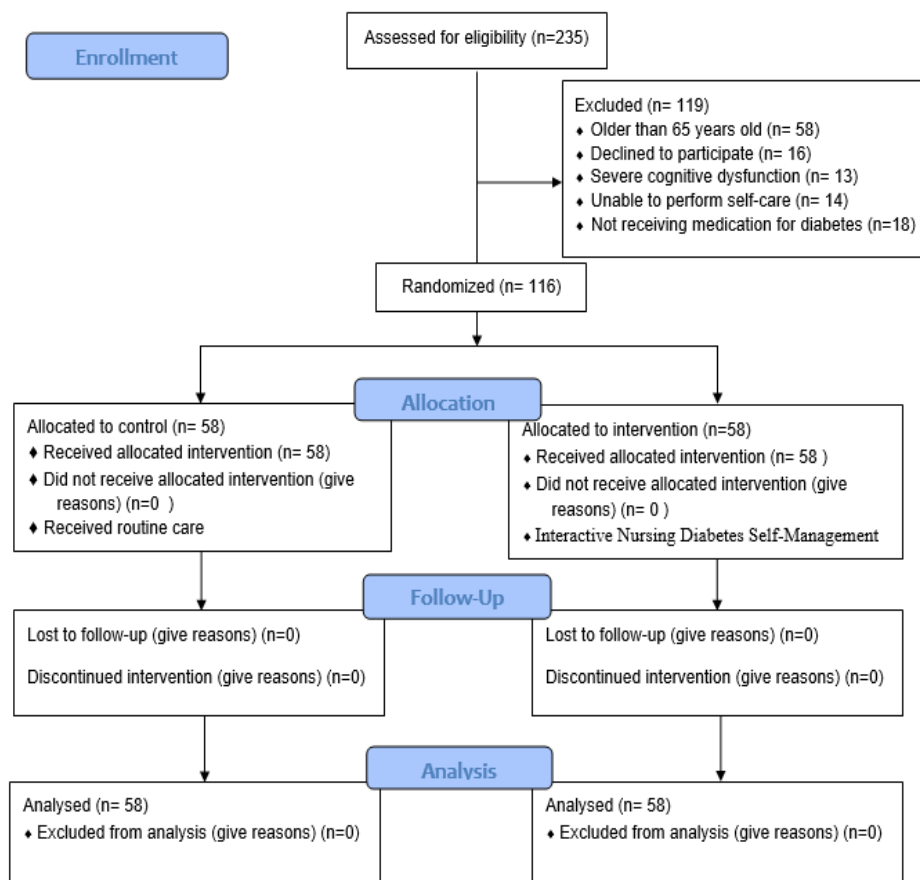


Figure 1: Consort Flow Diagram of Study Participation

2.3 Data Analysis

Data analysis was tested using Paired sample t-Test and Independent sample t-Test with $p < 0.005$.

3. RESULTS AND DISCUSSION

3.1 Results

Table 1: Subjects' Characteristics

Characteristic	Intervention Group (n=58)		Control Group (n=58)		P-Value
	f	%	f	%	
Age (Years)					
Early Adulthood (26-35)	4	6.9	5	8.6	0.828
Late Adulthood (36-45)	14	24.1	23	39.7	
Early Old Age (46-55)	29	50.0	23	39.7	
Late Old Age (56-65)	11	19.0	7	12.1	
Sex					
Male	15	20	17	29.3	0.210
Female	43	80	41	70.7	
Education					
Basic	23	39.7	22	37.9	0.582
Intermediate	30	51.7	33	56.9	
High	5	8.6	3	5.2	
Profession					
Civil Servants	6	10.3	6	10.3	0.610
Entrepreneur	18	31.0	24	41.4	
House Wife	23	39.7	23	39.7	
Does not Work	11	19.0	5	8.6	
Long DM					
1-3 Years	19	18.3	7	12.7	0.715
4-5 Years	27	51.7	34	58.6	
>5 Years	20	30	17	29.3	
Comorbidities					
No	11	18.9	20	33.3	0.120
Yes	47	81.1	38	66.7	

The homogeneity test of the characteristics of respondents in the intervention group and the control group was used Lavene's test. It showed a p-value of age (0.828), sex (0.210), education (0.582), profession (0.610), long DM (0.715) and comorbidities (0.120).

Table 2: Effect of Interactive Nursing Diabetes Self-Management Education on Self-Care knowledge in Type 2 Diabetes Patients

Variable	Group	Pre	Post	N	P-Value	
		Mean $\pm$ SD	Mean $\pm$ SD			
Self-Care knowledge	Intervention	10.83 $\pm$ 3.48	17.84 $\pm$ 3.48	58	0.000	Paired Sample t-Test
	Control	10.83 $\pm$ 3.48	10.78 $\pm$ 3.51	58	0.182	
Self-Care knowledge	Intervention	0.00 $\pm$ 0.64	7.06 $\pm$ 0.65	58	0.000	Independent Sample t-Test
	Control					

Table 2. The average Self-Care knowledge in the intervention group before the action was 10.83 (less) and after the action, the average Self-Care knowledge was 17.84 (good), with a p-value of 0.000. While in the control group, the average Self-Care knowledge was 10.83 and after the intervention, the average value was 10.78 with a p-value of 0.182. which can be interpreted that there was a significant increase in Self-Care knowledge after being given a Interactive Nursing Diabetes Self-Management Education.

Table 3: (a) Effect of Interactive Nursing Diabetes Self-Management Education on Self-Care Behavior in Type 2 Diabetes Patients

Variable	Group	Pre	Post	N	P-Value	
		Mean $\pm$ SD	Mean $\pm$ SD			
Diet	Intervention	2.72 $\pm$ 0.08	3.94 $\pm$ 0.09	58	0.000	Paired Sample t-Test
	Control	2.50 $\pm$ 0.11	2.61 $\pm$ 0.09	58	0.162	
	Intervention	2.64 $\pm$ 0.10	3.14 $\pm$ 0.10	58	0.000	Independent Sample t-Test
	Control					
Exercise	Intervention	2.59 $\pm$ 0.11	3.9 $\pm$ 0.14	58	0.000	Paired Sample t-Test
	Control	2.22 $\pm$ 0.09	2.41 $\pm$ 0.10	58	0.182	
	Intervention	2.48 $\pm$ 0.12	3.2 $\pm$ 0.14	58	0.000	Independent Sample t-Test
	Control					

Table 3: (b) Effect of Interactive Nursing Diabetes Self-Management Education on Self-Care Behavior in Type 2 Diabetes Patients

Variable	Group	Pre	Post	N	P-Value	Variable
Blood Sugar	Intervention	312.72 $\pm$ 49.84	220.10 $\pm$ 31.91	58	0.000	Paired Sample t-Test
	Control	320.32 $\pm$ 56.01	310.15 $\pm$ 49.78	58	0.256	
	Intervention	318.10 $\pm$ 51.89	226.20 $\pm$ 30.08	58	0.000	Independent Sample t-Test
	Control					
Foot Care	Intervention	2.10 $\pm$ 0.07	3.26 $\pm$ 0.09	58	0.000	Paired Sample t-Test
	Control	2.28 $\pm$ 0.11	2.28 $\pm$ 0.12	58	0.242	
	Intervention	2.19 $\pm$ 0.09	3.08 $\pm$ 0.11	58	0.000	Independent Sample t-

	Control					Test
General Self-Care Behavior	Intervention	2.34± 0.05	3.47± 0.08	58	0.000	Paired Sample t-Test
	Control	2.35± 0.06	2.45± 0.06	58	0.142	
	Intervention	2.32± 0.05	3.08± 0.08	58	0.000	Independent Sample t-Test
	Control					

Table 3. Shows that from the results of data analysis obtained p-value = 0.000 on Self-Care Behavior (diet, exercise, blood sugar, foot care, general self-care behavior) after intervention. in the intervention group before and after the action it was found that diet obtained an average value of 3.94, exercise an average value of 3.9, blood sugar an average value of 220.10, foot care an average value of 3.26, and general self-care behavior with an average value of 3.47. in the control group before and after the action it was found that diet obtained an average value of 2.61, exercise an average value of 2.14, blood sugar an average value of 310.15, foot care an average value of 2.28, and general self-care behavior with an average value of 2.45. which can be interpreted that there was a significant increase in Self-Care Behavior after being given a Interactive Nursing Diabetes Self-Management Education.

3.2 Discussion

Our research results show that the Interactive Nursing Diabetes Self-Management Education program on Self-Care Knowledge and Self-Care Behaviour in Type 2 Diabetes Patients in the intervention group showed significant improvements in self-care knowledge and self-care behaviour (diet, exercise, blood sugar, foot care, general self-care behaviour) compared to the control group. No side effects from the implementation during our intervention were reported by our research subjects. In addition, no patients were hospitalised or died due to hypoglycemia. The results of this study indicate patient acceptance of the intervention given and its success. However, financial problems are known to significantly affect diabetes self-management, which can be seen from the results of the study, where almost half of housewives without income in the intervention group and entrepreneurs in the control group, where finances for daily needs are very fluctuating, to the point of being insufficient to meet daily needs. Low-income individuals face environmental risks associated with poor diabetes control, such as lack of access to healthy food, difficulty accessing and paying for healthcare, high medical equipment costs, lack of access to tailored activity programs, and stress (Hill-Briggs et al., 2020; Medina et al., 2024). This is in line with research by Been et al., which shows that addressing broader poverty issues is key to better diabetes management (Been et al., 2024).

The implementation of Interactive Nursing Diabetes Self-Management Education (IN-DSME) has been proven effective in improving self-care knowledge in type 2 diabetes patients. Through an interactive approach, patients not only receive relevant educational materials but are also actively involved in the learning process, thus being able to better understand and implement self-management concepts (Ayuso-Diaz et al., 2025; Tamiru et al., 2023). This is by the statements of the majority of respondents in the intervention group who stated that their knowledge increased not only about the understanding of the disease and its causes, which they often receive, but also about how to manage diabetes mellitus independently, correctly and appropriately. In contrast, almost all of the control group stated that there was confusion and misunderstanding regarding diabetes management, making it difficult to determine the right management for themselves. This increase in knowledge is very important because it is closely related to efforts to prevent complications and self-manage the disease. Patients who have an adequate understanding of their disease tend to be better able to monitor blood sugar, recognise symptoms of hypoglycemia, and understand the importance of diet, exercise, and medication adherence. Several recent studies confirm that education provided by nurses, both in person and digitally, has a direct impact on patients' knowledge and confidence in managing diabetes (Shaban et al., 2024; Tamiru et al., 2023). This finding is further supported by the fact that the majority of patients are female and have a secondary education. Recent studies have shown that women with a secondary education are more receptive to interactive health education; they are more likely to understand educational materials and apply that knowledge to their daily lives (Montazeri et al., 2023; Romero-Castillo et al., 2022).

The increased self-knowledge experienced by respondents in the intervention group significantly impacted the self-behaviour of patients with diabetes mellitus. A systematic and ongoing nursing education program was able to assess respondents' knowledge, enabling them to better understand the principles of a balanced diet, the importance of exercise, and preventative measures. Interactive education played a significant role in changing dietary behaviour, physical exercise, foot care, and general

self-care behaviour in type 2 diabetes patients, particularly in dietary behaviour, which is often the biggest problem that results in uncontrolled blood sugar levels, thus worsening health. Interactive education played a significant role in changing the dietary behaviour of type 2 diabetes patients. Through counselling, group discussions, and regular monitoring, patients were encouraged to choose foods with a low glycemic index, increase fibre intake, and control portion sizes (Ernawati et al., 2021; Samudera et al., 2021; Türe et al., 2023). These changes were also accompanied by changes in physical activity behaviour, self-control of blood sugar levels, foot care, and general self-care behaviour. Interactive Nursing Diabetes Self-Management Education (IN-DSME) not only improves knowledge in specific aspects, but also in general, better and consistent healthy behaviours so that patients are able to manage their disease independently and optimally. This is also supported by the fact that most respondents have had diabetes for 4-5 years, providing sufficient time for patients to experience various aspects of disease management and feel the benefits of the education provided. This is in line with research by Montazeri et al., and Muniyapillai et al., which states that time experience influences the assimilation of self-care behaviours, where patients who have suffered for longer are usually more open to innovation and ongoing education programs (Montazeri et al., 2023; Muniyapillai et al., 2024).

The nurses' interactive educational method, a combination of face-to-face and digital technology, provides a space for discussion, practical exercises, and emotional support. This approach creates a conducive learning environment, making it easier for patients to ask questions, clarify information, and receive real-time feedback. Intervention results show positive changes in patients' understanding of dietary management, wound care, insulin use, and other preventive measures for type 2 diabetes (Ayuso-Diaz et al., 2025; Shaban et al., 2024; Tamiru et al., 2023). Furthermore, the key to the intervention's success lies in personal interaction, psychosocial support, and adapting education to each individual's needs, thereby strengthening motivation and empowering patients to live healthier lives (Ibrahim et al., 2025). Recent studies also indicate that nurse-led DSME interventions can significantly improve self-care behaviours, contributing to haemoglobin A1c control and reducing the risk of diabetes complications (Paudel et al., 2022). The success of these educational programs is also supported by an approach that emphasises personal understanding and strengthening motivation, which collectively improves the quality of life of patients with type 2 diabetes sustainably.

4. CONCLUSION

Interactive Nursing Diabetes Self-Management Education has been proven effective in improving knowledge and self-care behaviour in patients with type 2 diabetes. This intervention significantly improved patient understanding of diabetes management and encouraged the better implementation of self-care behaviours, such as dietary adherence, physical activity, medication management, blood glucose monitoring, and foot care. These findings emphasize the important role of interactive nursing-based educational interventions in empowering patients to be more active in their disease management. Thus, the implementation of a structured and interactive nursing-based self-management education program can be recommended as an integral part of the type 2 diabetes management strategy to improve clinical outcomes and quality of life for patients.

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6. ETHICAL CONSIDERATION

This research has been approved by the Chakra Brahmanda Lentera Institute Research Ethics Committee in May with the number 019/08/V/EC/KEP/LCBL/2025

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