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Efficacy of an Integrated Intervention Model in Improving Peripheral Neuropathy Among Patients with Type 2 Diabetes: A Quasy-Experimental Study

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ABSTRACT
Type 2 diabetes mellitus (T2D) with Peripheral Neuropathy (PN) is a common and debilitating complication that does not directly affect quality of life (QoL) at first; rather, it primarily impacts causing weakness, numbness, and pain. This study analyzes the effectiveness of an integrated intervention model in improving PN outcomes among T2D patients in Kendari, Indonesia. A quasi-experimental design. A modified instrument was developed by integrating the Chinese Diabetes Management Self-Efficacy Scale (C-DMSES), the Diabetes Empowerment Scale (DES), and the Michigan Neuropathy Screening Instrument (MNSI) to assess diabetic peripheral neuropathy (DPN). The supporting theories are Bandura's efficacy and Dossey's integrated intervention theories. Participants were divided into treatment and control groups. Statistical analyses included bivariate analysis, Kolmogorov-Smirnov tests to determine data distribution, and Generalized Estimating Equations (GEE) linear regression for multivariate analysis. Results showed self-efficacy scores, with increases of 16.59 by the 3rd month and 16.30 by the 6th month. HbA1c levels in the control group were significantly higher than those in the intervention group (62.48 vs. 29.81), and DPN scores were considerably higher than those in the intervention group at both the 3rd month (68.83 vs. 23.18) and the 6th month (68.83 vs. 23.18). The findings suggested the integrated intervention model demonstrated practical potential for broader implementation in nursing. Future research should address limitations such as the lack of family participation, uncontrolled risk factors, and imbalanced gender representation. Extending facilitator training and enhancing collaboration are also recommended to optimize the impact on self-efficacy, glycemic control, and neuropathy outcomes.
Keywords: *Integrated intervention model, DPN, Self-efficacy, T2D*

INTRODUCTION

In The number of diabetes cases in Indonesia continues to increase and is expected to continue to increase until 2045 (Aktifah et al., 2023). Various types of DM case management have been carried out depending on lifestyle, type and complications. They reveal critical gaps in diabetes self-care, with 75% of T2D patients in Indonesia, failing to exercise regularly, 58% neglecting dietary guidelines, and 83% overlooking foot care (Sartika et al., 2023). In Kendari, Indonesia, it was found that these deficiencies significantly increase risks of pain neuropathy and diabetic foot ulcers (DFUs), where community wound care nurses could play a vital prevention role (Saltar, Sahar and Rekawati, 2023). Similarly concerning is medication non-adherence (67%), highlighting the need for stronger support from community diabetes nurses in patient education and monitoring in other provinces such as Yogyakarta and East Java (Asih, Agung Widiastuti and Mursudarinah, 2023; Puryanti, Subiyanto and Amigo, 2023). Comparable challenges regionally exist in Northern India, 52% of patients skip exercise, 46.5% neglect medications, and 29% disregard dietary advice (Gupta, Kapoor and Sood, 2021). Globally, inactive T2D patients face a 4.8-fold higher PN and DFU risks, underscoring the urgent need for nurse-led interventions (Soelistijo et al., 2018). While community diabetes nurses are well-positioned to improve self-care, systemic barriers and resource limitations - particularly in low-income settings - hinder their effectiveness. Community diabetes nurses play a pivotal role in education and monitoring, yet systemic barriers limit their impact (Astuti et al., 2022). Despite global efforts, diabetes management remains fragmented, with inadequate coordination between glycemic control, pain management, and lifestyle support (Girach et al., 2019).

Community diabetes nurses could bridge this gap through personalized care, but resource constraints—especially in low-income settings—hinder scalability (Astuti et al., 2022).
Recent studies call for culturally adapted, nurse-led interventions, yet evidence from regions like Southeast Asia is lacking.[12] This study addresses these gaps by analyzing a nurse-driven, community-based intervention for T2D patients with PN in Kendari, Indonesia. By testing its feasibility in real-world settings, this research aims to provide a scalable blueprint for nurse-led diabetes care in underserved areas. The implications for nursing practice include effective in improving self-efficacy, glycemic control, and DPN conditions. This model allows nurses to conduct regular DPN checks using a holistic approach (cognitive, affective, psychomotor) in diabetes care.

MATERIALS AND METHODS

a) Study design, setting, and samples

This study utilized a quantitative approach with an experimental design. This study tried to answer the research question if a culturally adapted, integrated intervention model improves self-efficacy, glycemic control (HbA1c), and peripheral neuropathy (PN) outcomes among T2D patients in Kendari, Indonesia. Two theories used to support this research are Bandura's Efficacy theory and the Integrated Intervention theory by Barbara Dossey. Bandura's theory has proven to be effective and is widely used in various fields of health services (Kardong-Edgren, 2013). Dossey's framework is commonly applied in integrated nursing care as it offers methods to manage varying patient experiences, feelings, and requirements (Moore, Avino and McElligott, 2022). The study was divided into two main stages: the creation of an integrated holistic model and the analysis of its effectiveness. The study was carried out between August 1, 2022, and January 31, 2023. It was conducted at nine public health centers or called Puskesmas (in Indonesian language) in Kendari City, including Puuwatu, Perumnas, Kemaraya, Kandai, Abeli, Lepo-Lepo, Mekar, and Mata. These nine Puskesmas were chosen because they had the largest number of T2D patients compared to the other 15 Puskesmas in Kendari City. The target population were individuals diagnosed with T2D living in Kendari City. The T2D patients who visited community health centers (puskesmas) in Kendari City during 2019, amounting to 1,581 cases, collected directly from puskesmas throughout Kendari City. The study employed proportional sampling. The sample size was calculated using the formula for hypothesis testing of the difference between two independent group means. This study employed a significance level (type 1 error) of α = 0.05% (with a standard deviation of α = 1.96) and a test power of 80% (β = 1-0.8 = 0.2). The sample size was determined using data from prior studies. Inclusion Criteria: Participants must be enrolled in the chronic disease management program (Prolanis) at a puskesmas, aged 18–59 years, officially diagnosed with T2D by a physician, free from diabetic foot ulcers, capable of clear communication, possess good hearing, be literate, exhibit loss of protective sensation in at least one of three points on each foot during a 10g monofilament test, and have an HbA1c level ≥ 6.5% in the past three months or a random blood glucose level (GDS) ≥ 200 mg/dl. This sampling strategy was recommended by WHO and used by previous studies.(Zhang et al., 2018; World Health Organization, 2022; Senarath et al., 2025) Exclusion Criteria: Individuals with health conditions that could interfere with their participation in the intervention program.

b) Instruments

Demographic questionnaire. This questionnaire collected information such as respondent codes, initials, age, gender, highest educational attainment, occupation, marital status, ethnicity, duration of T2D diagnosis, and HbA1c levels from the past three months.
Diabetes Management Self-Efficacy Scale (C-DMSES). C-DMSES and the Diabetes Empowerment Scale (DES) were used to measure self-efficacy, the study utilized a modified instrument combining the Chinese version (Mahjouri et al., 2012; Silolonga, Kadar and Sjattar, 2019). The self-awareness and psychosocial management items were taken from the DES, while the spiritual items were developed by the researcher. The combined instrument covered five key areas: nutrition, physical activity and weight, medical care, blood sugar and foot monitoring, and psychosocial and spiritual management. Reliability was tested by piloting the modified self-efficacy questionnaire on T2D patients at Puskesmas in Kendari City. A split-half method was used for reliability testing, and the results were analyzed using Cronbach's alpha. The Michigan Neuropathy Screening Instrument (MNSI) was used with interval scale ranging from 0 to 20, with higher scores indicating more severe neuropathy. Glycemic control was assessed through HbA1c levels, measured at a government-recognized health laboratory in Kendari City. The target HbA1c level for effective glycemic control is <7% .(Semere et al., 2024) The results are on an interval scale of 0–10, where higher scores reflect a greater loss of protective sensation.

c) Data Collection

Respondents were assigned to the treatment or control group consecutively. They were guided on completing the self-efficacy questionnaire and underwent a PN examination. HbA1c results from the past three months were recorded. A Kappa test was conducted to ensure consistency between the researcher and facilitators, resulting in a Kappa value of 0.76 (Lins et al., 2017). A briefing was held to explain the intervention procedures. In the intervention month 3 was chosen as the initial evaluation point because during this period the intervention was given intensively through coaching sessions, mindfulness, and direct assistance by nurses. The evaluation at month 3 aimed to assess the participants' initial response to the intervention, including changes in self-efficacy, glycemic control, and peripheral neuropathy conditions. The measurement at month 6 was conducted after the participants were independent, without active intervention, and only through monitoring. The evaluation at month 6 provides an overview of the consistency and sustainability of the intervention results in the context of self-care. This two-stage approach is important to see not only short-term success, but also the client's ability to maintain self-care after the assistance phase is complete.

Respondents received diabetes coaching with family involvement and mindfulness training for three months, following a set schedule. Support was provided through phone calls and home visits over three months. Self-efficacy and PN were measured at the 3rd and 6th months, while HbA1c was tested at the 6th month. The control group participated in regular Prolanis activities at the public health centers and received the integrated holistic nursing intervention after the final measurement. This study employed a significance level (type 1 error) of $\alpha = 0.05\%$ (with a standard deviation of $\alpha = 1.96$) and a test power of 80% ($\beta = 1\text{-}0.8 = 0.2$). The sample size was determined using data from prior studies. The study required 18 participants per group. Using the formula, the sample size was calculated as 7.3 participants per group. The formula yielded a sample size of 22 participants per group. Consequently, the researcher opted for the largest calculated sample size to ensure robust results. Five participants from the intervention group were removed from the study—two due to death and three for not completing the full intervention. This left the intervention group with 45 participants. In the control group, three individuals were excluded because they were unavailable at the research site during the evaluation phase. The final sample size across both groups was 92 respondents.

d) Statistical Analysis

The study analyzed several variables, including respondent demographics (age, gender, educational background, occupation, duration of diabetes, and history of diabetic foot ulcers). Additional variables were self-efficacy, glycemic control (HbA1c levels), and diabetic PN. Bivariate analysis was employed to assess the relationship between dependent and independent variables. Prior to this analysis, the normality of each variable's data distribution was evaluated using the Kolmogorov-Smirnov test, along with skewness/SE skewness values. For multivariate analysis, Generalized Estimating Equations (GEE) linear regression was applied using the enter method. Independent variables included the intervention group, gender, age, education level, duration of diabetes, and history of diabetic foot ulcers. Dependent variables consisted of self-efficacy (measured at three time points: before, after the 3-month intervention, and after the 6-month intervention), HbA1c (measured before and after the 6-month intervention), and diabetic PN scores (measured at three time points: before, after the 3-month intervention, and after the 6-month intervention). The systematic component of the analysis combined independent variables into a linear function, assuming a working correlation structure (WCS) with an unstructured correlation (where all correlations were treated as distinct).

e) Ethical Considerations

The study was approved by the Research Ethics Committee of the Faculty of Nursing, University of Indonesia, under approval number Ket-231/UN2.F12.D1.2.1/PPM.00.02/2021, and was registered on clinicaltrials.gov. No ethical concerns emerged during data collection, and the rights of research participants were prioritized throughout the process. The ethical framework for this study aligned with the fundamental principles outlined by the Indonesian Health Research Ethics Committee (KNEPK, 2017). Three core principles guided the research: Self-determination, Beneficence, and Non-maleficence. Informed consent was obtained from potential participants, including T2D patients and their families. The researcher detailed the study's objectives, the rationale for participant selection, research procedures, potential risks and discomforts, direct benefits, data confidentiality, voluntary participation, and the right to withdraw. After the explanation, participants who agreed to participate signed the informed consent form. During this process, two individuals declined to join the study—one due to reluctance to undergo blood sugar tests at a health laboratory and the other due to high mobility, making them difficult to

contact. The researcher then identified alternative candidates who met the inclusion criteria. Over the course of the study, five participants from the intervention group dropped out: three did not complete all intervention stages, and two passed away.

RESULTS

a) Univariate analysis

Table 1: Respondents' characteristics in the intervention and control groups

Variables	Intervention group		Control group		P-Value*
	n	%	n	%	
Gender					
Males	5	12.2	12	25.5	
Females	40	88.8	35	74.5	0.130
Level of education					
College	9	20.0	9	19.1	
Junior High School/Senior High School	30	66.7	34	72.3	
SD	6	13.3	4	8.6	0.738
Work					
Work	14	31.1	23	62.16	
Unemployed	31	68.9	24	43.64	0, 093
History of leg wounds					
No	33	73.3	38	80.9	
Yes	12	26.7	9	19.1	0.542
Marital status					
Married	33	73.3	40	85.1	
Single	1	2.2	1	2.1	
Widower/widow	11	24.5	6	12.8	0.346
Types of Treatment					
Oral OAD	41	91	44	93.6	0.711
Insulin	4	9	3	6.4	
Σ	45	100	47	100	

*Chi-square test

Table 1 reveals that in the intervention group, females outnumbered males, but the difference was not statistically significant (p-value > 0.05). The majority of participants had a secondary education, while the smallest group had only elementary education, though the distribution was not significantly different (p-value > 0.05). Most participants were unemployed, and while those without a history of foot wounds were more common than those with a history, these differences were not statistically significant (p-value > 0.05). Married participants made up the largest proportion, with unmarried individuals being the smallest group, but again, the distribution was not significantly different (p-value > 0.05). The use of oral anti-diabetic drugs (OAD) was more common than insulin use. Table 1 demonstrates that there were no significant differences in the proportional characteristics of respondents between the intervention and control groups.

Table 2: The Comparison between Experimental dan Control Groups in the Intervention Methods

Intervention Methods	Experimental Group	Control Group
Preparation stage:	Nurses prepare participants who are included in the control group, researchers prepare training materials and media.	Nurses prepare participants to be assigned to the control group.
Training stages:	**Nurses training** lasted for 4 sessions. Each session lasted 135 minutes with materials on the concept of T2D, and DPN, Mindfulness techniques, Coaching techniques. **Training of participants (respondents)**	Participants only follow routine activities from

	Training of client and family participants by trained nurses for six sessions: **Session 1**: Pre-test;Introduction to T2D and NPD: understanding T2D and NPD, causes of T2D, signs and symptoms of T2D and NPD, risk factors, complications of T2D, prevention and management of NPD; Explanation of client and family workbook; Mindful breathing exercises. The first training session lasts for ±90 minutes. **Session 2**: Introduction to diabetes self-care: physical exercise, medication, self-blood sugar checks, and foot care; Introduction to the importance of family participation.The second training session lasts for ±90 minutes. **Session 3**: T2D diet skills coaching includes recognizing the types and glycemic index of diets, as well as demonstrations of managing T2D diet portions; Mindful eating exercises. This session lasts 60-90 minutes **Session 4:** Introduction and coaching of family communication skills: a. Effective listening skills b. Formal communication skills c.Problem solving skills. Training session four takes ±90 minutes. **Session 5**: Introduction to stress and coping; Coaching psychosocial adaptation and spiritual coping; Mindful body scan exercises.The fifth session of training takes ±90 minutes. **Session 6**: Mindful stretching exercises; Leg stretching exercises. The time required is approximately ±90 minutes.	the PTM posbindu
Mentoring stage	Mentoring once a week for 2 weeks, then once every two weeks for 2 months, for 3 months (12 weeks). **The first visit**, the companion identifies and reflects on the client's behavior related to diabetes self-care for ±20 minutes. Next, the companion reviews again about T2D and NPD by asking participants' knowledge about the definition of T2D and NPD, causes of T2D, signs and symptoms of T2D and NPD, risk factors, complications of T2D, prevention and management of NPD. The method in this session is interactive discussion and Q&A. The facilitator reminds participants about filling out the client workbook and family workbook so that the activities carried out are always recorded. Furthermore, the facilitator asks participants to do mindful breathing exercises. This first session lasts for 60-90 minutes. **The second visit,** discuss goal setting and targets for changes in diabetes self-care behavior to be achieved. Diabetes self-care change targets include: physical exercise, medication, self-blood sugar checks, and foot care. The companion reviews the importance of family involvement. The method is interactive discussion, Q&A demonstration and practice.This session lasts 60 – 90 minutes. **Third visit**, demonstrating T2D 's diet skillsincludes recognizing the types and glycemic index of diets, as well as a demonstration of managing T2D diet portions.Participants to carry out mindful eating exercises.The method is interactive discussion, Q&A,	Participants only follow routine activities from the PTM posbindu

	demonstration and practice.This session lasts 60-90 minutes. **Fourth visit**, revieweffective listening skills, formal communication skills, and problem solving skills. The methods are interactive discussion, question and answer and demonstration.This session lasts 60-90 minutes. **The fifth visit**, identifying and interactive discussion about psychosocial adaptation and spiritual coping of participants. Conducting body scan exercises. The method is interactive discussion, questions and answers and practice.This session lasts 60-90 minutes. **The sixth visit**, discussion, feedback to the client and family regarding the goals that have not been achieved and have been achieved and the follow-up plan. Next, the client is asked to do mindful stretching exercises and leg stretching exercises. This session lasts 60-90 minutes.	
Monitoring stage	Participants underwent independent interventions accompanied by monitoring for three months. Monitoring by facilitators was carried out once a week, using the home visit method in the first week and by telephone in the following weeks, which was carried out alternately for 3 months.	Participants only follow routine activities from the PTM posbindu.
Evaluation stage	Three months before the intervention started, three months after the intervention and six months after the intervention.→measurement of self-efficacy, HbA1c levels, and DPN conditions	Three months before the intervention started, three months after the intervention and six months after the intervention -→measurement of self-efficacy, HbA1c levels, and DPN conditions.

The table compares two groups: the Experimental Group, which received a structured program (training on diabetes management, mindfulness, family support, and regular mentoring), and the Control Group, which only followed routine health checks. The experimental group had detailed sessions (6 training + 6 mentoring visits) over 3 months, while the control group had no extra support. Both groups were tested before, after, and 6 months later to see changes in diabetes control (HbA1c), confidence (self-efficacy), and nerve damage (DPN). This design helps check if the special program works better than usual care.

b) Bivariate analysis

Table 3: Difference in Self-Efficacy, HbA1c, and DPN Scores between the Intervention and Control groups of the Intervention and Control Groups according to observation time

Group	Observation Time	Difference				P-Value*
		n	Mean	SD	Mean Rank	
Self-Efficacy: Intervention	3rd Month vs Before	45	10.42	10.80	62.36	
Control		47	0.53	3.22	31.32	0.001
Intervention	6th Month vs Before	45	12.12	11.73	62.90	
Control		47	0.61	3.91	30.80	0.001
HbA1c:	6th Month vs Before	45	-0.62	1.00	29.81	

Intervention						
Control		47	0.28	0.39	62.48	0.001
DPN Scores	3rd Month vs Before					
Intervention		45	-16.00	12.79	23.18	
Control		47	8.25	6.93	68.83	0.001
Intervention	6th Month vs Before	45	-15.94	12.74	23.18	
Control		47	8.03	6.84	68.83	0.001

*mann-whitney test

The mean difference test revealed that the self-efficacy scores in the intervention group were significantly higher than those in the control group at both the 3rd month (62.36 vs. 31.32) and the 6th month (62.90 vs. 30.80), with a statistically significant intervention effect observed (p-value < 0.05). The mean difference test revealed that the HbA1c levels in the control group were significantly higher than those in the intervention group (62.48 vs. 29.81), with a statistically significant intervention effect observed at the 6th month compared to pre-intervention levels (p-value < 0.05). While the mean difference in DPN scores revealed that in the control group were significantly higher than those in the intervention group at both the 3rd month (68.83 vs. 23.18) and the 6th month (68.83 vs. 23.18). These findings demonstrate that the intervention model effectively enhanced self-efficacy in the intervention group compared to the control group during the 3rd and 6th months of the study, and. the Integrated Intervention Model successfully improved glycemic control in the intervention group by the 6th month, whereas the control group experienced a significant decline in glycemic control. The intervention group had better DPN conditions at both time points compared to the control group, with a statistically significant intervention effect observed (p-value < 0.05). The analysis highlights that the Integrated Intervention Model significantly improved DPN conditions in the intervention group during the 3rd and 6th months of the study compared to the control group.

c) Multivariate analysis

Table 4: Effect of intervention on changes in Self-Efficacy, HbA1c, and DPN Scores

Predictor	**Self-efficacy**	**HbA1c**	**DPN**	**Self-efficacy**	**HbA1c**	**DPN**	**Self-efficacy**	**HbA1c**	**DPN**
	Coefficient			**SE**			**P-Value**		
Constants	43.48	12.34	65.36	13.05	1.64	15.29	0.001	0.001	0.001
Group									
Control	0.0	0.0	0.0						
Intervention	6.17	0.10	-4.93	2.56	0.41	3.29	0.016	0.814	0.134
Gender									
Males	0.0	0.0	0.0						
Females	6.90	-0.13	-3.07	4.11	0.54	4.33	0.093	0.818	0.478
Level of education									
Elementary	0.0	0.0	0						
Junior High School	-4.33	0.75	9.75	2.80	0.64	4.21	0.121	0.241	0.021
Senior High School	-0.77	0.48	7.00	4.06	0.76	5.44	0.851	0.526	0.199
T2D Wound History									
No	0.0	0.0	0.0						
Yes	-3.89	-0.08	11.8	2.72	0.45	3.16	0.152	0.865	0.001
Age	0.31	-0.07	-0.63	0.21	0.03	0.29	0.140	0.023	0.031
T2D Time	-0.59	0.11	0.49	0.23	0.04	0.42	0.010	0.016	0.238
Observation Time									
Before	0.0	0.0	0.0						
3 months	0.53		8.25	0.46		1.00	0.252		0.001
6 months	0.61	0.28	8.03	0.57	0.06	0.99	0.282	0.001	0.001
Group Interaction and Observation									

Intervention*prior observation	0.0	0.0	0.0						
Intervention*after 3-month observation	9.89		-23.98	1.66		2.13	0.001		0.001
Intervention*after 6-month observation	11.52	-0.90	-24.25	1.82	0.16	2.12	0.001	0.001	0.001

The analysis revealed a significant interaction between the intervention group and the observation period for self-efficacy, HbA1c, and DPN scores, after adjusting for factors such as gender, education level, diabetes history, age, and diabetes duration. At the 3rd month, the intervention group's mean self-efficacy score increased by 9.89 ($p < 0.05$), rising further to 11.52 by the 6th month ($p < 0.05$). Overall, compared to pre-intervention levels, the intervention group's self-efficacy scores improved by 16.59 at the 3rd month and 18.30 at the 6th month, highlighting the effectiveness of the Integrated Intervention Model in enhancing self-efficacy, with more pronounced effects at the 6th month. Using Generalized Estimating Equations (GEE), the intervention's impact on HbA1c was assessed before and at the 6th month. The intervention group's mean HbA1c level decreased by 0.9 at the 6th month ($p < 0.05$), with an overall reduction of 0.52 compared to pre-intervention levels. These results suggest that the Integrated Intervention Model was effective in lowering HbA1c, though the reduction was modest. The intervention group also showed significant improvements in DPN scores, with a decrease of 24.25 at the 3rd month ($p < 0.05$) and 23.98 at the 6th month ($p < 0.05$). Compared to pre-intervention, the mean DPN scores decreased by 20.93 at the 3rd month and 20.87 at the 6th month, demonstrating the model's effectiveness in reducing DPN symptoms over 3 to 6 months.

DISCUSSION

The study found that 60% of respondents were over 53 years old, with no significant age difference between the intervention and control groups. Ages 50–64 are particularly predictive of DPN-related pain, with consistent evidence linking age to PN (Li et al., 2023). While men are at higher risk for DPN complications, women are more prone to developing neuropathy (Aktifah et al., 2023). Although this study did not explore the link between education level and DPN severity, lower education levels are associated with poor glycemic control, which in turn increases the risk of DPN (Li et al., 2023). Sedentary behavior also elevates DPN risk due to high blood glucose levels (Li et al., 2023). However, these findings warrant further research to confirm the assumptions due to several gaps. Age over 50 increases DPN risk, but mechanisms are unclear. Men face higher DPN complications, while women are more prone to neuropathy, suggesting gender-specific factors. Lower education links to poor glycemic control, but its direct impact on DPN severity is unexplored. Sedentary behavior raises DPN risk, but optimal activity levels are unknown. Longer diabetes duration increases DPN risk, yet the role of cumulative damage needs clarification. Ages 50–64 predict DPN-related pain, but pain management strategies require improvement. Interactions between risk factors are not fully understood. Further research is needed to confirm these relationships, refine risk models, and develop targeted interventions.

Mindfulness training in this model boosts self-efficacy by reducing stress and anxiety, fostering positive emotions that enhance self-efficacy. Weekly home-visit mentoring also proved effective in improving self-efficacy and addressing barriers in diabetes self-care. Analysis showed increased median scores across all self-efficacy components—nutrition, exercise, medication, blood sugar and foot checks, psychosocial adaptation, and spiritual coping—after 3 and 6 months of intervention. Mindful eating, which applies mindfulness to eating-related thoughts, emotions, and behaviors, further supports dietary self-efficacy (Hamasaki, 2023). Physical exercise and weight training self-efficacy also improved after 3 and 6 months, with self-efficacy training shown to reduce stress in type 2 diabetes patients (Cerf, 2021). Family participation, a key part of the intervention, provides emotional support, comfort, and motivation, aiding psychosocial adaptation during long-term diabetes care. However, mindfulness among diabetes patients faces challenges like time constraints, lack of awareness, and physical discomfort from complications such as neuropathy. Mental health issues like depression or stress can hinder engagement, while skepticism or cultural beliefs may reduce acceptance. Accessibility to programs, cost barriers, and difficulty maintaining consistency further complicate adoption. Additionally, patients may lack guidance on how mindfulness specifically benefits diabetes management. Addressing these challenges through education, tailored programs, and support can improve mindfulness integration.

This study demonstrated improved glycemic control, with the intervention group showing a 0.9% reduction in average HbA1c levels by the 6th month. The difference between the intervention and control

groups was statistically significant ($p < 0.05$). These findings align with Wolever et al. (2010), where coaching over 14 sessions led to a 0.64% decrease in HbA1c (Wolever et al., 2010). Similarly, Pamungkas et al. found that a self-management coaching program reduced HbA1c by an average of 1.6% in uncontrolled type 2 diabetes patients over three months (Pamungkas, Usman and Chamroonsawasdi, 2023). Nonetheless, the majority of studies support the effectiveness of health coaching in enhancing glycemic control. However, intervention models aimed at reducing HbA1c require further development to maximize effectiveness, particularly in enhancing self-efficacy related to dietary behavior, insulin treatment, and stress adaptation. Diet-related content should be expanded, including education on the glycemic index and improving respondents' ability to identify the glycemic index of various foods.

Lifestyle interventions, including physical exercise, foot care, and blood sugar monitoring with supportive educational interventions can alleviate PN in female patients with T2D, have been shown to reduce the severity of DPN. This study demonstrated improved foot sensitivity, with increased sensitivity points on both feet, linked to better glycemic control. Intensive glycemic control has also been shown to support nerve repair in PN, and even short-term foot exercises can aid DPN recovery and prevent diabetic foot ulcers (Wang et al., 2022). The model has proven effective in improving DPN conditions, as evidenced by enhanced foot sensation. However, DPN progression continues to worsen with prolonged diabetes duration, sustained high glycemic levels, and cardiovascular risk factors (Derison M. Bakara et al., 2023). To address this, the model should be expanded to include: collaboration with medical teams for early management of cardiovascular risk factors (e.g., hypertension, dyslipidemia, smoking, and obesity); regular monitoring of these risk factors; and advanced diagnostic tools for more accurate DPN assessment. Further research is needed to evaluate the model's effectiveness in addressing DPN risk factors such as hypertension, dyslipidemia, smoking, and obesity.

This integrated intervention model has demonstrated the effectiveness of nurses in improving self-efficacy, glycemic control, and DPN outcomes during 0-3 months of intervention through holistic approaches and intensive support. Community health center nurses should incorporate this model into existing programs like Posbindu and Prolanis by providing self-care coaching, engaging family members, and utilizing prepared educational modules and videos. The study highlights that self-efficacy - comprehensively measured in this research - should become a nursing priority as it significantly impacts diabetes self-management success. However, implementing this integrated intervention requires advanced competencies like coaching and mindfulness techniques, which general practice nurses may not fully possess. Additional training or certification programs are therefore necessary to enhance nurses' capacity for effective intervention delivery. Furthermore, DPN screening tools (such as MNSI and 10g monofilament testing) - currently underutilized in community health centers - need to be routinely administered every six months as part of standard care. The available educational modules and videos can help nurses more effectively teach diabetes foot care and prevention techniques to patients. However, the application of both Bandura and Dossey theories in this research has limitations. Bandura's self-efficacy theory has overreliance on individual agency while neglecting systemic barriers, potential cultural bias favoring individualistic societies, and challenges in objectively measuring efficacy beliefs (Virginia Koutroubas and Michael Galanakis, 2022). On the other hand, Dossey's integral nursing theory, although holistic, faces criticism for being abstract and difficult to implement in conventional medical settings, lacking strong empirical support, and requiring time-intensive practices that may not align with evidence-based healthcare (Alharbi and Alshammari, 2021). Both theories remain influential but must be adapted to address their respective gaps—Bandura's by incorporating external influences and Dossey's by balancing spirituality with scientific rigor.

Therefore, this study emphasized the importance of multidisciplinary approach that refer to coordinated collaboration involving physicians (for pharmacological treatment), diabetes nurses (for foot care education and glucose monitoring), dietitians (for meal planning), physiotherapists (for exercise guidance), and counselors (for mental health support) to comprehensively manage diabetic peripheral neuropathy. This team-based model addresses medical, lifestyle, and psychosocial aspects simultaneously for better outcome.

This study found both groups continued diabetes medication, so collaboration with the medical team and the effects of drugs on glycemic control and DPN were not assessed. Risk factors such as hypertension, dyslipidemia, smoking, and obesity were not controlled. A balanced gender sample was challenging to achieve due to fewer male participants, potentially affecting glycemic control and DPN outcomes, though gender's influence was controlled statistically. Facilitator training was too short, limiting nurses' effectiveness, indicating the need for longer mentoring to optimize the integrated intervention model.

CONCLUSIONS

This study highlights emphasize the key risk factors for DPN, though barriers such as time constraints and mental health challenges hindered mindfulness adoption. The integrated intervention model significantly improved glycemic control, with a 0.9% reduction in HbA1c levels after six months, supported by evidence from similar studies. Additionally, lifestyle interventions such as physical exercise, foot care, and mindful eating contributed to better dietary self-efficacy and DPN outcomes, with improved foot sensitivity observed during monofilament examinations. However, the progression of DPN remains influenced by prolonged diabetes duration, poor glycemic control, and cardiovascular risk factors like hypertension, dyslipidemia, smoking, and obesity. To maximize the model's impact, further development is needed, including deeper dietary education (e.g., glycemic index awareness), collaboration with medical teams for early management of cardiovascular risks, and advanced diagnostic tools for DPN monitoring. Family participation also played a crucial role, providing emotional support and motivation for long-term diabetes care. While the findings are promising, further research is required to validate the model's effectiveness in addressing DPN risk factors and optimizing intervention strategies. The research findings have significant implications for the nursing practice, demonstrating effectiveness in improving self-efficacy, glycemic control, and DPN conditions. This model enables nurses to conduct regular DPN checks. As a practical intervention, it integrates cognitive, affective, and psychomotor aspects of diabetes self-care, making it highly suitable for nurses to enhance self-efficacy, glycemic control, and DPN outcomes. To maximize its impact, this model should be introduced to nursing professional associations for broader dissemination across educational institutions and nursing services in Indonesia.

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Availability Of Data And Materials

This research data and materials can be accessed through a properly submitted request.

Authors' Contributions

LS, JS, ER, and DA were involved in conceptualizing and designing the study. They were also responsible for data collection, screening, and initial analysis. JS, ER and DA continued with more in-depth statistical analysis and interpreted the results. LS provided critical input and supervised the entire research process. All authors participated in writing the manuscript, reviewed, and approved the final version before submission.

Conflict Of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, or publication of this article.

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