

# Effects of Integrated Health Coaching, Mindfulness, and Family Participation on Self-Efficacy and HbA1c among People with Type 2 Diabetes with Neuropathy: A Quasi-Experimental Study

La Ode Saltar,\* Junaiti Sahar, Etty Rekawati, Dian Ayubi, M. Agung Akbar

**Abstract:** Type 2 diabetes mellitus with diabetic peripheral neuropathy often leads to impaired self-management and poor glycemic control. Psychological stress, limited family support, and insufficient behavioral guidance may weaken motivation to maintain effective diabetes care. An integrated intervention was developed by combining Bandura's self-efficacy construct and Orem's self-care theory to strengthen diabetes self-management. The quasi-experimental study took place at community health centers in Kendari City, Indonesia. People with type 2 diabetes and diabetic peripheral neuropathy were recruited using consecutive sampling and randomly allocated to an intervention group (n = 45) or a control group (n = 47). The 12-week intervention consisted of six structured sessions that integrated diabetes coaching, mindfulness practices, family participation, and scheduled home visits. Primary outcomes were diabetes self-efficacy, measured at baseline, 3 months, and 6 months, and HbA1c, measured at baseline and 6 months after the intervention. Data were collected using a demographic questionnaire, the Holistic Diabetes Self-Efficacy Scale, and HbA1c testing. Analyses included descriptive statistics, paired t-tests, independent t-tests, and generalized estimating equations. Post-intervention analysis demonstrated that the intervention group had significantly higher total and domain-specific self-efficacy scores than the control group at both 3 and 6 months, and also showed greater improvement in HbA1c over time. Self-efficacy and glycemic control were improved through this integrated intervention among people with type 2 diabetes mellitus and diabetic peripheral neuropathy. Nurses can apply this intervention to practice. However, further multi-site randomized controlled trials are needed before wider implementation.

**Keywords:** Diabetic peripheral neuropathy, Family participation, Glycemic control, Health coaching, Mindfulness practices, Self-efficacy, Type 2 diabetes

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## Introduction

Type 2 diabetes mellitus (T2DM) is a major chronic health condition affecting millions of people worldwide and significantly increasing the burden of long-term disease management.<sup>1</sup> Diabetic peripheral neuropathy (DPN) is one of the most common complications<sup>2</sup> with prevalence ranging from 6% to 51%.<sup>7</sup> This condition often develops in those who

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experience prolonged metabolic imbalance and inadequate glycemic control.<sup>3</sup> It is characterized by symptoms such as pain, numbness, sensory impairment, and reduced physical functioning.<sup>2,4</sup> This condition is characterized by pain, numbness, sensory impairment, and reduced physical functioning.<sup>8</sup> Furthermore, poor glycemic control contributes to the onset and progression of neuropathy, thereby worsening long-term health outcomes and increasing the complexity of diabetes management.<sup>9</sup>

There are several approaches to improving diabetes management and preventing adverse outcomes among people with T2DM.<sup>1,2</sup> Systematic reviews indicate that interventions incorporating personalized feedback and regular follow-up yield greater improvements in both clinical outcomes (e.g., HbA1c, fasting blood glucose) and psychosocial outcomes, including self-efficacy and quality of life.<sup>3</sup> Overall, current evidence suggests that DSM interventions are most effective when they are patient-centered, theory-based, and supported by continuous monitoring and behavioral reinforcement strategies. The resilience-based Islamic program is built on integrating stress management, mindfulness, prayer, and *dhikr*, a devotional Sufi ritual recited in praise of Allah to facilitate an ecstatic spiritual experience.<sup>4,5</sup> Family-based support has also been encouraged because family members can reinforce adherence to diet, medication, glucose monitoring, and other self-care activities.<sup>6,7</sup> These approaches show that current diabetes care has moved beyond routine education toward more behavioral, psychological, and social support strategies.<sup>8</sup>

Existing evidence regarding T2DM and DPN interventions remains fragmented, focusing primarily on isolated strategies rather than integrated care. Consequently, the interplay among health coaching, mindfulness, and family support, and its subsequent impact on clinical outcomes, is poorly understood. Furthermore, the lack of site-specific data from Indonesian primary care settings limits the generalizability of current global

models. Therefore, developing a comprehensive intervention that concurrently targets these multiple dimensions is essential to address the unmet needs of people with T2DM.

## **Review of Literature and Conceptual Framework**

Optimal management of DPN necessitates a holistic, integrated approach anchored in robust theoretical frameworks.<sup>16</sup> The chronic complications of T2DM impose multifaceted demands requiring behavioral, psychological, and social adaptations for effective long-term care.<sup>2</sup> In this context, theoretical models serve as structural blueprints for developing interventions that foster sustainable self-care behaviors.<sup>3</sup>

Central to this study was Bandura's Social Cognitive Theory, which elucidates the pivotal role of self-efficacy in driving health behavior change.<sup>4,5</sup> Self-efficacy functions as a primary determinant of an individual's confidence to execute self-care activities amidst the complexities of chronic illness.<sup>5</sup> Consequently, theory-driven interventions are essential to bolster behavioral regulation and improve clinical outcomes among people with diabetic neuropathy.<sup>6</sup>

Bandura's framework emphasizes a triadic reciprocal interaction between personal factors, behavior, and environmental influences.<sup>4</sup> Within this triad, self-efficacy enhances the motivation of people with T2DM to adhere to rigorous self-management regimens, including dietary control, medication adherence, glucose monitoring, and preventive foot care.<sup>5,6</sup> By leveraging mastery experiences, verbal persuasion, emotional regulation, and social modeling, confidence in disease management among people with T2DM can be significantly strengthened.<sup>4,5</sup> However, the integration of psychological, spiritual, and social dimensions within standalone social cognitive models remains underdeveloped.<sup>3</sup> This limitation suggests that incorporating complementary nursing theories is

imperative to enhance the comprehensiveness and cultural resonance of behavioral intervention.<sup>3,7</sup>

Orem's Self-Care Deficit Nursing Theory provides a conceptual basis for encouraging independence among individuals with chronic conditions in managing their health.<sup>9</sup> Orem described self-care as purposeful activities carried out by individuals to preserve health and support well-being in everyday life.<sup>10</sup> The theory emphasizes the nurse's role in supporting people when self-care deficits occur in complex health conditions. T2DM with DPN creates physical and psychological limitations that may reduce the self-care capacity of people living with these conditions.<sup>11</sup> Nursing interventions aim to enhance self-care agency through supportive-educative systems in clinical practice.<sup>12</sup>

The conceptual framework of this study integrates Bandura's self-efficacy construct with Orem's self-care theory to develop an integrated model intervention. Health coaching functions as a supportive-educative strategy that enhances self-care agency through structured goal setting and behavioral guidance.<sup>13,14</sup> Mindfulness intervention strengthens psychological regulation and emotional adaptation through self-awareness practices.<sup>4</sup> Family participation reinforces environmental support and promotes sustained behavioral engagement in home settings.<sup>15</sup> These components interact to improve physiological outcomes through enhanced adherence and stress reduction. Consequently, the integrated model links psychological empowerment, behavioral adaptation, and glycemic control within a comprehensive care framework.<sup>16</sup>

The proposed integrated intervention model combines diabetes coaching, mindfulness practice, and family involvement to optimize self-efficacy and glycemic control among people with neuropathy. Therefore, this conceptual framework supports an integrated nursing intervention to strengthen diabetes self-care and metabolic outcomes.

## Study Aim and Hypothesis

This study examined the effect of integrated health coaching, mindfulness, and family participation on self-efficacy and HbA1c among people with T2DM with neuropathy. It was hypothesized that participants receiving the integrated intervention would show significantly improved self-efficacy and reduced HbA1c levels compared with those receiving standard diabetes care alone.

## Method

**Study Design:** A quasi-experimental pretest-posttest control group design was used. The reporting of this study followed the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) guidelines.

**Sample and Setting:** The study was conducted across nine community health centers in Kendari City, Southeast Sulawesi, Indonesia. Participants were recruited using a non-probability consecutive sampling technique, in which those with T2DM who met the inclusion criteria during the recruitment period were enrolled sequentially until the required sample size was achieved. Eligibility criteria included a confirmed T2DM diagnosis, symptoms of DPN as assessed by the researchers in collaboration with healthcare providers at the community health centers, the ability to participate in intervention activities, and at least one family member willing to engage in family-focused components. Exclusion criteria comprised severe acute complications requiring hospitalization, major cognitive impairment or psychiatric disorders limiting participation, and concurrent enrollment in other structured diabetes interventions.

Health centers were selected using proportional sampling based on the number of registered T2DM cases to ensure representation across service areas. The sample size was calculated using G\*Power, with  $\alpha = 0.05$ , power = 0.80, and effect size = 0.6;

a minimum of 45 participants was required in each group. To compensate for potential data loss, the sample size was increased by 10%, resulting in a final enrollment of 50 participants per group. Eligible participants were assigned to the experimental and control groups using a simple random allocation method through a lottery process. Initially, 100 participants

were approached and screened for eligibility; however, eight were excluded, including two who died, three who did not complete the intervention procedures, and three who were unavailable at the study site during the evaluation period. Consequently, 92 participants completed the study and were included in the final analysis (Figure 1).

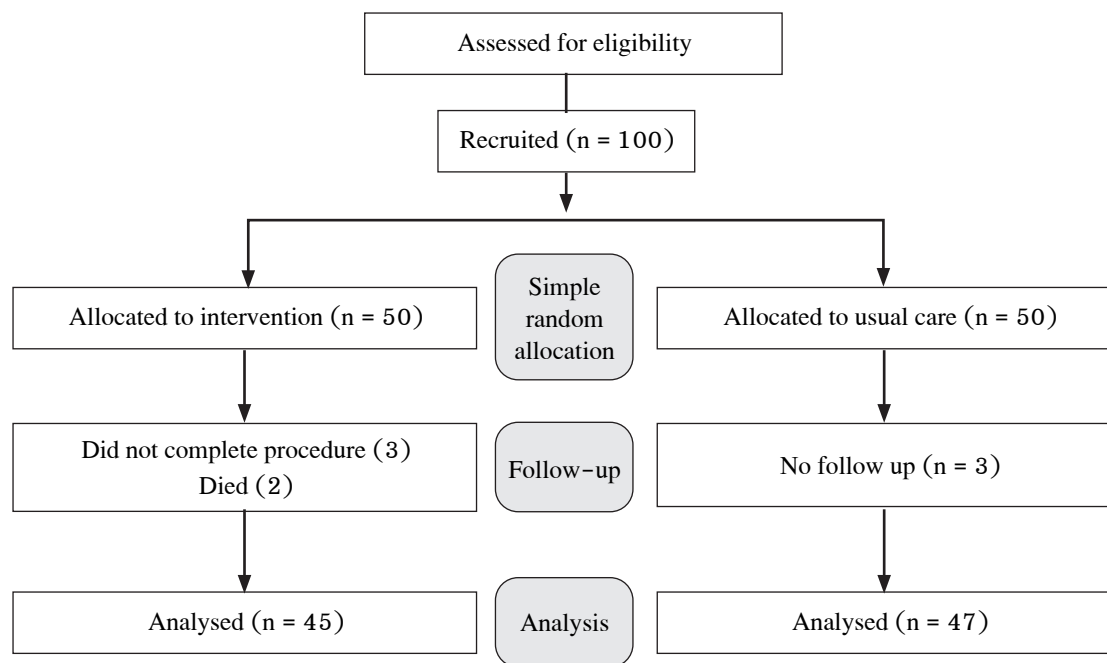


Figure 1. The flowchart of the study

**Ethical Considerations:** Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Nursing, University of Indonesia (Approval No: 232/UN2.F12.D1.2.1/PPM.00.02/2021). All participants provided written informed consent, confidentiality was ensured, and participants were informed of their right to withdraw without any impact on access to health services.

**Instruments:** The study employed two structured questionnaires and laboratory HbA1c testing to collect data.

A *Demographic Data Questionnaire* was used, consisting of age, duration of disease, gender, education level, employment status, history of foot ulcer, marital

status, and type of medication.

*The Holistic Diabetes Self-Efficacy Scale (HDSSES)* was originally developed in Bahasa Indonesia by Saltar.<sup>17</sup> HDSSES is a 28-item instrument for measuring holistic diabetes self-efficacy among people with T2DM in Indonesia. The scale was designed to capture diabetes self-management from a holistic perspective and consists of six dimensions: nutrition (5 items, e.g., “I am able to follow a healthy eating plan most of the time”), physical exercise (4 items, e.g., “I am able to perform sufficient physical activity [e.g., walking, yoga, gardening, or stretching exercises]”), treatment adherence (5 items, e.g., “I am able to take my medication as prescribed”),

blood glucose monitoring (4 items, e.g., “I am able to check my blood glucose level when needed”), psychosocial adaptation (5 items, e.g., “I am able to manage stress related to diabetes effectively”), and spiritual coping (5 items, e.g., “I am able to allocate time for prayer and dhikr”).

Each item assesses the individual’s confidence in performing the behavior on a 5–point Likert scale, ranging from 1 (very uncertain) to 5 (very confident). The total HDESES score is calculated by summing the scores across all 28 items, with a range of 28 to 140. Higher total scores indicate greater holistic diabetes self-efficacy. Previous studies demonstrated construct validity, with item–total Pearson correlation coefficients ranging from 0.587 to 0.814 and Cronbach’s alpha values ranging from 0.801 to 0.861, indicating acceptable to strong internal consistency.<sup>17</sup> In the current study, Cronbach’s alpha ranged from 0.850 to 0.910, demonstrating strong internal consistency.

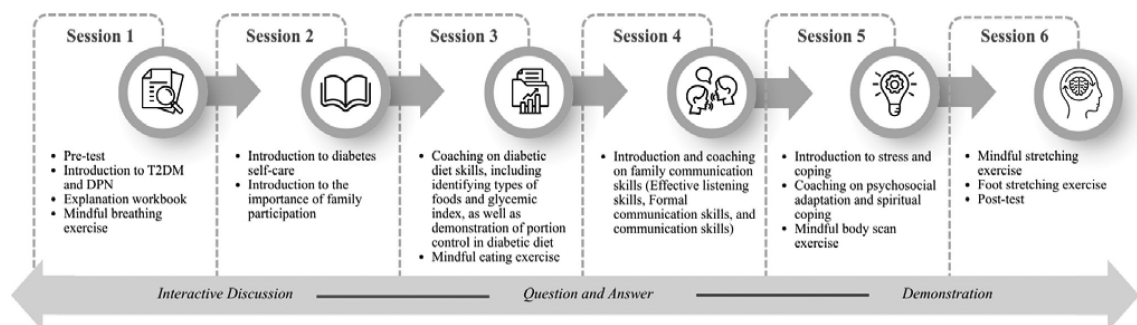
**HbA1c:** We assessed glycemic control through laboratory examination conducted by certified local health laboratory personnel to ensure measurement consistency and accuracy. The laboratory reported HbA1c results in percentage (%).

#### Intervention: Integrated Health Coaching, Mindfulness, and Family Participation

The intervention was developed based on evidence from previous studies, relevant diabetes self-management guidelines, Bandura’s self-efficacy construct, and Orem’s self-care theory. The intervention components were designed to address behavioral,

psychological, and family support needs among people with T2DM and DPN. Three experts with doctoral qualifications were involved in the intervention development process, including a specialist in coaching therapy, a specialist in mindfulness therapy, and an expert in community nursing. These experts reviewed the content, structure, and relevance of the intervention to ensure its appropriateness, clarity, and applicability for the target population.

The intervention was delivered over 12 weeks through six structured sessions supported by modules and guided video exercises. Content addressed diabetes and DPN education, medication adherence, physical activity, self-monitoring of blood glucose, foot care demonstration, diabetes diet coaching (glycemic index, food selection, portion control), family communication skills (active listening and collaborative problem solving), stress management and coping strategies, and guided mindfulness practices (mindful breathing, mindful eating, body scan, and stretching). Home visits were conducted twice weekly during the first two weeks and weekly for the subsequent two months, lasting 60–90 minutes per visit, to reinforce adherence, monitor self-care activities, and address barriers. Intervention fidelity was strengthened through standardized facilitator training, use of manuals/workbooks, structured session checklists, and supervisory monitoring during implementation. **Figure 2** presents the structure and content of the six-session integrated intervention program delivered to study participants.



**Figure 2.** Schematic representation of the 6-Session Integrated Intervention Program

**Standard diabetes care:** Both groups received standard diabetes care at the community health centers (CHCs); the experimental group also received the intervention. Nurses at the CHCs provided standard care, including routine health assessments, blood glucose monitoring, and regular follow-up in line with usual practice. No further structured intervention beyond standard care was provided to the control group.

**Data Collection:** After obtaining IRB approval, the principal investigator (PI) obtained research permission from the local health authority and the participating CHCs. The PI and eight research assistants were trained to administer the study questionnaires using standardized procedures to ensure uniform data collection and consistent study implementation. The PI and facilitators then visited participants at their homes to explain the study objectives and benefits and to obtain informed consent. A simple random lottery method was used to assign eligible participants to the experimental and control groups. Participants and their family members then agreed with the researcher on the schedule for delivering the intervention. The intervention was delivered over 12 weeks from August 2022 to January 2023. Participants allocated to the experimental group were invited to join a WhatsApp group, received a module, and participated in the integrated intervention. Participants in the control group received only standard care. Self-efficacy was measured 3 months and 6 months after completion of the intervention, whereas HbA1c was measured at 6 months. Blinding

was not feasible because the intervention involved face-to-face activities, making it impractical to mask participants, intervention providers, and outcome assessors. After the final outcome measurement, the control group also received the integrated intervention.

**Data Analysis:** Descriptive statistics summarized participant characteristics. Data normality was assessed using, and the results indicated a normal distribution; therefore, parametric statistical tests were applied. Independent-samples t-tests compared outcomes between groups at each time point, while paired-samples t-tests evaluated within-group changes. Generalized estimating equations (GEE) were subsequently applied to evaluate longitudinal intervention effects while accounting for within-subject correlations across repeated measurements. Statistical analyses were conducted using SPSS version 23, and a p-value < 0.05 was considered statistically significant.

## Results

### Demographic characteristics of the participants

A total of 92 participants with T2DM and DPN were included (intervention n = 45; control n = 47). Baseline sociodemographic and clinical profiles were comparable between groups, including age and diabetes duration, and no significant differences were observed across gender, education, employment status, ulcer history, marital status, or medication type (all p > 0.05), supporting the appropriateness of comparative effectiveness analyses (**Table 1**).

**Table 1.** Comparison of respondents' characteristics between intervention and control groups

| Variables        | Intervention group (n = 45) | Control group (n = 47) | p-value            |
|------------------|-----------------------------|------------------------|--------------------|
| Gender           |                             |                        |                    |
| Male             | 5 (12.2%)                   | 12 (25.5%)             | 0.130 <sup>a</sup> |
| Female           | 40 (88.8%)                  | 35 (74.5%)             |                    |
| Education level  |                             |                        |                    |
| Higher education | 9 (20.0%)                   | 9 (19.1%)              | 0.738 <sup>b</sup> |
| High school      | 30 (66.7%)                  | 34 (72.3%)             |                    |
| Primary school   | 6 (13.3%)                   | 4 (8.6%)               |                    |

**Table 1.** Comparison of respondents' characteristics between intervention and control groups (Cont.)

| Variables              | Intervention group (n = 45) | Control group (n = 47) | p-value            |
|------------------------|-----------------------------|------------------------|--------------------|
| Employment status      |                             |                        |                    |
| Employed               | 14 (31.1%)                  | 23 (62.2%)             | 0.093 <sup>a</sup> |
| Unemployed             | 31 (68.9%)                  | 24 (43.6%)             |                    |
| Foot ulcer history     |                             |                        |                    |
| No                     | 33 (73.3%)                  | 38 (80.9%)             | 0.542 <sup>a</sup> |
| Yes                    | 12 (26.7%)                  | 9 (19.1%)              |                    |
| Marital status         |                             |                        |                    |
| Married                | 33 (73.3%)                  | 40 (85.1%)             | 0.346 <sup>b</sup> |
| Single                 | 1 (2.2%)                    | 1 (2.1%)               |                    |
| Widowed                | 11 (24.5%)                  | 6 (12.8%)              |                    |
| Medication type        |                             |                        |                    |
| Oral antidiabetic      | 41 (91%)                    | 44 (93.6%)             | 0.711 <sup>a</sup> |
| Insulin                | 4 (9%)                      | 3 (6.4%)               |                    |
|                        | Mean ± SD                   |                        |                    |
| Age (years)            | 54 ± 5                      | 53.3 ± 6.5             | 0.364 <sup>c</sup> |
| Duration of DM (years) | 6.8 ± 4                     | 6 ± 1.9                | 0.398 <sup>c</sup> |

Note. <sup>a</sup> Chi-square test; <sup>b</sup> Fisher's exact test; <sup>c</sup> Independent t-test

#### Between-group comparison

As presented in **Table 2**, the intervention group demonstrated significantly higher mean self-efficacy scores than the control group at post-test across all domains. Significant between-group differences were observed in overall self-efficacy, nutrition management, physical exercise, treatment adherence, blood glucose monitoring, psychosocial adaptation, and spiritual coping ( $p < 0.001$  for most comparisons). The highest effect sizes were observed for blood glucose monitoring at T2 ( $d = 1.77$ ) and nutrition management at T2 ( $d = 1.69$ ), indicating a strong intervention effect in these domains. In contrast, the lowest effect

sizes were found for spiritual coping at T1 ( $d = 0.82$ ) and psychosocial adaptation at T1 ( $d = 0.91$ ), although both remained within the moderate-to-large range.

At baseline, most domains showed no significant differences between groups ( $p > 0.05$ ), indicating comparable initial conditions. Regarding HbA1c levels, **Table 2** shows no significant between-group difference at baseline or at T2; however, the intervention group exhibited a lower mean HbA1c at follow-up with a small-to-moderate effect size ( $d = 0.40$ ). Overall, the findings presented in **Table 2** indicate that the intervention produced substantial improvements in self-efficacy outcomes and glycemic control.

**Table 2.** Mean scores of self-efficacy and HbA1c between groups

| Variables     | Intervention group (n = 45) |       | Control group (n = 47) |       | t    | p-value | Cohen's d |
|---------------|-----------------------------|-------|------------------------|-------|------|---------|-----------|
|               | Mean                        | SD    | Mean                   | SD    |      |         |           |
| Self Efficacy |                             |       |                        |       |      |         |           |
| Overall       |                             |       |                        |       |      |         |           |
| T0            | 99.73                       | 15.18 | 92.40                  | 15.03 | 2.37 | 0.020   | 0.49      |
| T1            | 111.40                      | 14.42 | 93.09                  | 13.77 | 8.02 | <0.001  | 1.31      |
| T2            | 113.31                      | 15.01 | 93.00                  | 13.71 | 8.83 | <0.001  | 1.40      |

**Table 2.** Mean scores of self-efficacy and HbA1c between groups (Cont.)

| Variables               | Intervention group<br>(n = 45) |      | Control group<br>(n = 47) |      | t    | p-value | Cohen's d |
|-------------------------|--------------------------------|------|---------------------------|------|------|---------|-----------|
|                         | Mean                           | SD   | Mean                      | SD   |      |         |           |
| Nutrition               |                                |      |                           |      |      |         |           |
| T0                      | 30.93                          | 4.88 | 28.32                     | 5.16 | 2.49 | 0.015   | 0.52      |
| T1                      | 34.69                          | 2.84 | 28.55                     | 4.66 | 7.65 | <0.001  | 1.57      |
| T2                      | 35.13                          | 2.77 | 28.51                     | 4.71 | 8.25 | <0.001  | 1.69      |
| Physical exercise       |                                |      |                           |      |      |         |           |
| T0                      | 14.44                          | 2.22 | 12.66                     | 2.68 | 3.46 | <0.001  | 0.72      |
| T1                      | 15.67                          | 1.43 | 12.74                     | 2.46 | 6.99 | <0.001  | 1.47      |
| T2                      | 15.98                          | 1.34 | 12.81                     | 2.41 | 7.83 | <0.001  | 1.57      |
| Treatment adherence     |                                |      |                           |      |      |         |           |
| T0                      | 10.64                          | 2.78 | 10.00                     | 2.69 | 1.12 | 0.263   | 0.23      |
| T1                      | 12.47                          | 1.76 | 9.94                      | 2.48 | 5.65 | <0.001  | 1.19      |
| T2                      | 12.58                          | 1.68 | 9.89                      | 2.53 | 6.01 | <0.001  | 1.31      |
| Blood glucose checks    |                                |      |                           |      |      |         |           |
| T0                      | 14.13                          | 3.16 | 13.26                     | 2.94 | 1.37 | 0.172   | 0.29      |
| T1                      | 16.64                          | 1.68 | 13.36                     | 2.53 | 7.29 | <0.001  | 1.55      |
| T2                      | 16.91                          | 1.57 | 13.43                     | 2.55 | 7.83 | <0.001  | 1.77      |
| Psychosocial adaptation |                                |      |                           |      |      |         |           |
| T0                      | 21.60                          | 3.34 | 20.49                     | 3.80 | 1.48 | 0.141   | 0.31      |
| T1                      | 23.24                          | 1.68 | 20.55                     | 3.51 | 4.71 | <0.001  | 0.91      |
| T2                      | 23.60                          | 1.65 | 20.55                     | 3.41 | 5.47 | <0.001  | 1.10      |
| Spiritual coping        |                                |      |                           |      |      |         |           |
| T0                      | 7.98                           | 1.42 | 7.68                      | 1.46 | 0.98 | 0.326   | 0.21      |
| T1                      | 8.69                           | 0.94 | 7.85                      | 1.12 | 3.85 | <0.001  | 0.82      |
| T2                      | 9.11                           | 0.95 | 7.89                      | 1.12 | 5.63 | <0.001  | 1.14      |
| HbA1c levels (%)        |                                |      |                           |      |      |         |           |
| T0                      | 10.03                          | 1.90 | 9.89                      | 2.03 | 0.34 | 0.731   | 0.07      |
| T2                      | 9.42                           | 1.75 | 10.17                     | 2.04 | 1.90 | 0.060   | 0.40      |

**Within-group comparison**

As shown in **Table 3**, the paired t-test indicated that the intervention group showed significant improvements in self-efficacy across all follow-up assessments. Significant increases were observed between T0 and T1, T0 and T2, and T1 and T2, with large effect sizes (Cohen's d ranging from 0.96 to 1.03).

These findings suggest substantial enhancement of self-efficacy following the intervention. In contrast, the control group showed no significant changes in self-efficacy across time points (all  $p > 0.05$ ), with negligible to small effect sizes (d ranging from 0.01 to 0.14), indicating minimal natural change without intervention.

Regarding glycemic control, Table 3 shows a significant reduction in HbA1c levels in the intervention group from baseline to follow-up ( $p < 0.001$ ), with a moderate effect size ( $d = 0.62$ ), indicating a meaningful improvement in glycemic control. Although a statistically significant change in HbA1c was also observed in

the control group ( $p < 0.001$ ), the effect size remained moderate ( $d = 0.74$ ), indicating that the improvement was less attributable to the intervention. Overall, the within-group findings in **Table 3** highlight the intervention's greater impact on self-efficacy and glycemic outcomes than usual care.

**Table 3.** Comparison of the mean scores of self-efficacy and HbA1C between the intervention and control groups in each phase

| Comparison         | Mean difference | SD    | SE   | 95% CI |       | t    | p-value | Cohens'd |
|--------------------|-----------------|-------|------|--------|-------|------|---------|----------|
|                    |                 |       |      | Lower  | Upper |      |         |          |
| Self-efficacy      |                 |       |      |        |       |      |         |          |
| Experimental group |                 |       |      |        |       |      |         |          |
| T0 vs T1           | 11.66           | 12.09 | 1.80 | 15.30  | 8.03  | 6.47 | < 0.001 | 0.96     |
| T0 vs T2           | 13.57           | 13.14 | 1.95 | 17.52  | 9.63  | 6.93 | < 0.001 | 1.03     |
| T1 vs T2           | 1.91            | 1.91  | 0.28 | 2.48   | 1.33  | 6.68 | < 0.001 | 1.00     |
| Control group      |                 |       |      |        |       |      |         |          |
| T0 vs T1           | 0.50            | 3.58  | 0.52 | 1.56   | 0.56  | 0.94 | 0.349   | 0.14     |
| T0 vs T2           | 0.47            | 4.20  | 0.62 | 1.72   | 0.77  | 0.77 | 0.444   | 0.11     |
| T1 vs T2           | 0.02            | 1.42  | 0.21 | 0.40   | 0.44  | 0.10 | 0.918   | 0.01     |
| HbA1c levels (%)   |                 |       |      |        |       |      |         |          |
| Experimental group |                 |       |      |        |       |      |         |          |
| T0 vs T1           | 0.616           | 1.00  | 0.14 | 0.31   | 0.91  | 4.11 | < 0.001 | 0.62     |
| Control group      |                 |       |      |        |       |      |         |          |
| T0 vs T1           | 0.29            | 0.39  | 0.05 | 0.40   | 0.17  | 5.06 | < 0.001 | 0.74     |

Note. SD = Standard deviation, SE = Standard error, CI = Confidence interval

#### Longitudinal effects of the intervention

As presented in **Table 4**, the GEE analysis demonstrated significant group-by-time interaction effects for self-efficacy outcomes. The intervention group showed a greater improvement in self-efficacy than the control group at both 3 and 6 months. These findings indicate that the intervention produced sustained improvements in self-efficacy over time, beyond those observed in the control group.

For glycemic control, **Table 4** shows a significant group-by-time interaction at 6 months, indicating a differential longitudinal effect between the groups. The magnitude and direction of the coefficient suggest that the intervention contributed to a clinically meaningful improvement in HbA1c levels over time compared with usual care. Overall, the GEE results confirm that the intervention had a significant and sustained longitudinal impact on both self-efficacy and glycemic outcomes.

**Table 4.** Generalized estimating equation (GEE) analysis of adjusted group  $\times$  time effects on self-efficacy and HbA1c outcomes

| Parameter                                            | adjusted $\beta$ | 95% CI        | p-value |
|------------------------------------------------------|------------------|---------------|---------|
| <b>Self-Efficacy</b>                                 |                  |               |         |
| Group $\times$ Time (Intervention $\times$ 3 months) | 9.89             | 6.64 to 13.14 | < 0.001 |
| Group $\times$ Time (Intervention $\times$ 6 months) | 11.52            | 7.95 to 15.09 | < 0.001 |
| <b>HbA1c</b>                                         |                  |               |         |
| Group $\times$ Time (Intervention $\times$ 6 months) | 0.90             | 0.47 to 1.33  | < 0.001 |

## Discussion

The findings of this study support the stated hypothesis, demonstrating that integrated health coaching, mindfulness, and family participation significantly improved self-efficacy and reduced HbA1c levels among people with T2DM with neuropathy compared with those receiving standard diabetes care. The integrated intervention addressed behavioral, psychological, and social dimensions of diabetes self-management. This combined approach strengthened participants' self-efficacy by helping them build confidence, regulate emotional responses, and receive consistent support from family members during daily care. The simultaneous delivery of these components produced a complementary effect because health coaching improved goal-directed behavior, mindfulness enhanced self-awareness and stress control, and family participation reinforced adherence and motivation. This synergistic mechanism contributed to better psychological adaptation and improved glycemic control, as reflected in reduced HbA1c levels among people with T2DM and neuropathy. These findings indicate that an integrated intervention may yield stronger outcomes than single-component strategies because it targets multiple determinants of self-management simultaneously.

Improved self-efficacy likely contributed to better diabetes self-management behaviors.<sup>18</sup> This aligns with evidence that health coaching improves diabetes self-management efficacy, particularly through goal setting, self-monitoring, and guided problem-solving.<sup>15</sup> Self-efficacy enhanced perceived control over disease management among people with T2DM during the intervention phase. Increased confidence supported behavioral consistency in long-term diabetes care activities.<sup>19</sup> Consistent self-care behaviors subsequently led to better glycemic control during clinical monitoring periods.<sup>20</sup> Therefore, interventions targeting psychological empowerment may improve clinical outcomes in people with chronic diabetes complications.<sup>21</sup>

Health coaching provided structured education and motivational guidance for people with T2DM.<sup>22</sup> Healthcare providers delivered coaching sessions through goal setting, problem solving, and behavioral reinforcement during program implementation. Structured coaching improved the understanding of diabetes management strategies among people with T2DM in clinical practice.<sup>23</sup> Improved knowledge strengthened their engagement in disease control activities during follow-up.<sup>13</sup> Enhanced engagement facilitated better adherence to recommended lifestyle and medication regimens.<sup>24</sup> Consequently, health coaching served as a key component in improving diabetes self-efficacy outcomes in this study.<sup>14,25</sup>

Mindfulness practices complemented coaching interventions by addressing psychological stress.<sup>4</sup> People with T2DM practiced focused attention techniques during intervention sessions under guided supervision.<sup>26</sup> Mindfulness reduced emotional distress and anxiety related to chronic illness in the intervention phase. Reduced stress improved physiological regulation and behavioral stability in diabetes management contexts.<sup>27,28</sup> Improved emotional regulation supported consistent adherence to lifestyle modification recommendations. Thus, mindfulness integration contributed to both psychological adaptation and metabolic improvement in diabetes care.<sup>29</sup>

Family participation further strengthened the intervention's effectiveness through social support mechanisms.<sup>30</sup> Family members provided emotional encouragement and practical assistance in daily diabetes management routines.<sup>31</sup> Supportive family involvement increased the motivation of people with T2DM to sustain self-care behaviors during the study period.<sup>6</sup> Active family participation improved medication adherence and dietary compliance in home environments. Improved adherence led to better glycemic outcomes during clinical evaluation periods.<sup>21,32</sup> Therefore, family engagement played an important role in reinforcing behavioral changes promoted by the intervention.<sup>15</sup>

Despite significant improvements in self-efficacy, HbA1c reduction appeared to be of a more moderate magnitude than psychological outcomes. Glycemic control reflected complex physiological and behavioral interactions in chronic diabetes conditions.<sup>33</sup> Neuropathy complications may have limited rapid metabolic improvement despite behavioral changes.<sup>34</sup> This aligns with prior evidence indicating that coaching-based and family-supported interventions often yield moderate improvements in glycemic outcomes, particularly when implemented in real-world settings.<sup>13,22,31</sup> Importantly, HbA1c values remained above target thresholds, suggesting that while behavioral and psychosocial interventions contribute meaningfully, they may be insufficient on their own for people with long-standing diabetes, high baseline HbA1c, and complications such as DPN.<sup>35,36</sup> Further multi-site randomized controlled trials are needed before wider implementation. In addition, specialized training for nurses and other healthcare providers is necessary to ensure consistent and effective implementation of the intervention in clinical practice.

### **Limitations**

This study has several limitations that warrant careful consideration when interpreting the findings. Potential performance and detection biases may have arisen from the absence of double blinding among participants and research assistants. In addition, difficulty in achieving a balanced sex distribution occurred because male patients were less available during recruitment due to work commitments outside the home; however, statistical analyses controlled for the potential confounding effect of sex on glycemic control and diabetic peripheral neuropathy outcomes.

### **Conclusion and Implications for Nursing Practice**

The findings of this study showed that self-efficacy and glycemic control among people

with T2DM and neuropathy improved through integrated health coaching, mindfulness, and family participation. The intervention increased their confidence in managing nutrition, physical activity, treatment adherence, glucose monitoring, psychosocial adaptation, and spiritual coping during follow-up assessments. Improved self-efficacy supports better diabetes self-management behaviors in daily clinical and home settings. Enhanced behavioral adherence is associated with improved HbA1c outcomes over time in the intervention group. These findings indicate that integrated psychosocial and educational interventions provide comprehensive benefits for both psychological resilience and metabolic control. In nursing practice, nurses and other healthcare providers can integrate health coaching, mindfulness, and family participation into community and clinical diabetes programs to improve outcomes among people with chronic complications. In nursing education, these findings support the inclusion of coaching, mindfulness-based care, and family-centered approaches in training curricula and competency development programs. In nursing administration, the findings may guide the development of service protocols, workforce training, and program planning to support the implementation of integrated diabetes care in diverse settings. However, special training in implementing the intervention is needed.

### **Author Contributions**

Conceptualization, Method and design: L.O.R., J.S., E.R., D.A.

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## Conflict of Interests

The authors declare that they have no competing interests.

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## ผลของการให้คำปรึกษาด้านสุขภาพโดยบุคลากรกับการฝึกสติและการมีส่วนร่วมของครอบครัวต่อสมรรถนะแห่งตนและระดับน้ำตาลสะสมในผู้ที่เป็นโรคเบาหวานชนิดที่ 2 ที่มีภาวะเส้นประสาทเสื่อม : การศึกษาแบบกึ่งทดลอง

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**บทคัดย่อ :** โรคเบาหวานชนิดที่ 2 ที่มีโรคเส้นประสาทส่วนปลายเสื่อมจากเบาหวาน มักนำไปสู่ความบกพร่องในการจัดการตนเองและการควบคุมระดับน้ำตาลในเลือดที่ไม่มีประสิทธิภาพ ความเครียดทางจิตใจ แรงสนับสนุนจากครอบครัวที่มีจำกัด และการขาดคำแนะนำด้านพฤติกรรมที่เพียงพออาจส่งผลให้แรงจูงใจในการดูแลรักษาโรคเบาหวานลดน้อยลง ผู้วิจัยจึงได้มีการพัฒนาโปรแกรมการดูแลแบบบูรณาการโดยการผสานแนวคิดสมรรถนะแห่งตนของแบนดูราและทฤษฎีการดูแลตนเองของโอเร็มเพื่อส่งเสริมการจัดการโรคเบาหวานด้วยตนเอง การวิจัยแบบกึ่งทดลองนี้ ดำเนินการที่ศูนย์บริการสาธารณสุขในเมืองเคนดารี (Kendari City) ประเทศอินโดนีเซีย โดยคัดเลือกกลุ่มตัวอย่างที่เป็นผู้ป่วยโรคเบาหวานชนิดที่ 2 ที่มีภาวะเส้นประสาทส่วนปลายเสื่อม ใช้วิธีการสุ่มตัวอย่างแบบต่อเนื่อง (consecutive sampling) และแบ่งกลุ่มโดยการสุ่มเข้ากลุ่มทดลอง 45 รายและกลุ่มควบคุม 47 ราย ในการทดลอง ใช้เวลา 12 สัปดาห์ ประกอบด้วย 6 กิจกรรมหลักที่จัดไว้อย่างเป็นระบบซึ่งบูรณาการการให้คำปรึกษาในการควบคุมโรคเบาหวาน การฝึกสติ การมีส่วนร่วมของครอบครัว และการเยี่ยมบ้านตามกำหนด ตัวแปรตาม คือ สมรรถนะแห่งตนในการจัดการโรคเบาหวาน วัดที่จุดเริ่มต้น 3 เดือน และ 6 เดือน และระดับน้ำตาลสะสม (HbA1c) วัดที่จุดเริ่มต้น และ 6 เดือนหลังเสร็จสิ้นการทดลอง เครื่องมือที่ใช้ในการเก็บข้อมูล ได้แก่ แบบสอบถามข้อมูลส่วนบุคคล แบบวัดสมรรถนะแห่งตนในการจัดการโรคเบาหวานแบบองค์รวม และการตรวจทางห้องปฏิบัติการเพื่อวัดระดับน้ำตาลสะสม

ผลการวิจัย พบว่ากลุ่มทดลองมีคะแนนสมรรถนะแห่งตนทั้งในภาพรวมและรายด้านสูงกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ทั้งในระยะ 3 เดือน และ 6 เดือน และกลุ่มทดลองมีระดับน้ำตาลสะสมลดลง สรุปว่าการดูแลแบบบูรณาการนี้ช่วยพัฒนาทั้งสมรรถนะแห่งตนและควบคุมระดับน้ำตาลในเลือดในกลุ่มผู้ป่วยโรคเบาหวานชนิดที่ 2 ที่มีภาวะเส้นประสาทส่วนปลายเสื่อม พยาบาลสามารถนำไปปรับนำไปประยุกต์ใช้ในเวชปฏิบัติได้ อย่างไรก็ตาม ควรมีการวิจัยเชิงทดลองแบบสุ่มและมีกลุ่มควบคุมในหลายพื้นที่เพิ่มเติม ก่อนที่จะนำไปใช้ในวงกว้างต่อไป

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**คำสำคัญ :** โรคเส้นประสาทส่วนปลายเสื่อมจากเบาหวาน การมีส่วนร่วมของครอบครัว การควบคุมระดับน้ำตาลในเลือด การให้คำปรึกษาด้านสุขภาพ การฝึกสติ สมรรถนะแห่งตน โรคเบาหวานชนิดที่ 2

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