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Original Article

Effectiveness of a Family Unit Empowerment Model in Improving Diabetes Management, Family Empowerment, and Family Support among Adults with Type 2 Diabetes Mellitus: A Quasi-Experimental Study

Ni Wayan Trisnadewi[1], I Made Sudarma Adiputra[2], Ni Putu Wiwik Oktaviani[2]

[1] Department of Medical Surgical, Nursing Study Program, STIKES Wira Medika Bali, Denpasar, Indonesia
[2] Department of Community Nursing, Nursing Study Program, STIKES Wira Medika Bali, Denpasar, Indonesia

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Correspondence
Ni Wayan Trisnadewi; Department of Medical Surgical, Nursing Study Program, STIKES Wira Medika Bali, Denpasar, Indonesia.

Email:
trisnawika09@gmail.com

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ABSTRACT

Background: Diabetes mellitus (DM) remains a major public health challenge in Indonesia, with its prevalence continuing to increase. Although incurable, effective long-term management can maintain patients' quality of life. Family involvement is essential in supporting adherence to diabetes management, yet evidence on structured family-unit empowerment interventions, particularly in community settings, remains limited. Therefore, this study aimed to evaluate the effectiveness of the Family Unit Empowerment Model in improving diabetes management, family empowerment, and family support among patients with type 2 diabetes mellitus (T2DM).

Methods: This study employed a quasi-experimental one-group pre-test–post-test design and followed the TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) reporting guideline. A total of 140 patients with T2DM registered at the Blahbatuh 2 Gianyar Community Health Center were recruited through purposive sampling between December 2022 and July 2023. Inclusion criteria included a confirmed T2DM diagnosis, residence with family, ability to communicate effectively, and provision of informed consent. The independent variable was the Family Unit Empowerment Model; dependent variables were diabetes management, family empowerment, and family support, measured using the Summary of Diabetes Self-Care Activities (SDSCA), the Family Empowerment Scale (FES), and the Diabetes Family Support Scale, respectively (all Cronbach's $\alpha \geq 0.70$). The intervention consisted of four structured weekly family-based health education sessions delivered over one month. Data were analyzed using the Wilcoxon Signed-Rank Test, with a significance level of $p < 0.05$.

Results: Statistically significant improvements in median scores were observed for all three outcome variables following the intervention. The proportion of families in the good empowerment category increased from 37.1% to 55.7% ($p < 0.001$, $r = 0.54$). For family support, the proportion reporting high support increased from 44.3% to 49.3%, with a significant rise in median scores ($p < 0.001$, $r = 0.49$). Diabetes management improved, with poor-category cases decreasing from 40.7% to 27.9% ($p < 0.001$, $r = 0.33$).

Conclusion: Participation in the Family Unit Empowerment Model was associated with statistically significant improvements in diabetes self-management behaviors, family empowerment, and family support among patients with T2DM. Because the single-group design and reliance on self-reported outcomes preclude causal attribution, these findings should be interpreted as preliminary. They provide promising support for family-centered empowerment approaches in community-based diabetes care and a rationale for evaluation in adequately powered, controlled, multicenter

trials that incorporate objective clinical outcomes before broad implementation is recommended.

Keywords: Type 2 Diabetes Mellitus; Family Relations; Patient Empowerment; Self-Management; Social Support; Primary Health Care.

Implications for Practice:

- Family-centered diabetes education shows promise as a complement to routine primary healthcare services and warrants further evaluation as a strategy to strengthen patient adherence and self-management behaviors.
- Structured family empowerment strategies merit consideration in chronic disease care models, pending confirmation in controlled trials with objective clinical endpoints.
- The Family Unit Empowerment Model was developed and tested within a specific Balinese cultural context; its transferability to other cultural, socioeconomic, and health-system settings should be examined directly rather than assumed.

Introduction

Diabetes mellitus (DM) represents one of the fastest-growing global health emergencies of the 21st century (International Diabetes Federation [IDF], 2021). This chronic, non-communicable disease imposes significant burdens on affected individuals, families, and health systems worldwide, increasing risks of cardiovascular disease, neuropathy, retinopathy, nephropathy, and premature mortality. According to the IDF Diabetes Atlas (2021), approximately 537 million adults aged 20–79 years worldwide were living with DM, a figure projected to rise to 643 million by 2030 and 783 million by 2045. In Indonesia, national health survey data (Riskesdas) recorded a prevalence increase from 6.9% in 2013 to 8.5% in 2018, making DM one of the foremost contributors to non-communicable disease morbidity and mortality in the country (Ministry of Health of the Republic of Indonesia, 2020). The economic burden is substantial, with DM-related healthcare expenditures placing significant strain on national health financing systems.

Despite the growing recognition of family involvement in chronic disease management, the majority of existing diabetes interventions in Indonesia remain patient-centered, focusing predominantly on individual-level education without systematically engaging family members as active participants in care. This gap is particularly significant given the collectivist nature of Indonesian family culture, in which health-related decisions are often made collectively, and caregiving responsibilities are shared among multiple family members. Balinese society, in particular, operates within a strong tradition of communal interdependence, where the family unit serves as the primary source of social, emotional, and instrumental support for individuals experiencing illness (Trisnadewi et al., 2024). These cultural dynamics suggest that family-level interventions may be especially effective in the Indonesian context; however, structured, theoretically grounded family-unit empowerment models for T2DM management have not been comprehensively evaluated in community health settings.

The theoretical foundation of this study draws on three complementary frameworks. Family Systems Theory posits that illness in one family member affects the entire family system, and that health outcomes improve when the family is engaged as a unit rather than targeting only the patient. Social Support Theory, as conceptualized by House (1981), identifies four dimensions of social support —

informational, appraisal, emotional, and instrumental — that collectively enable individuals to maintain health behaviors in the context of chronic illness. Empowerment Theory, applied in health promotion contexts, emphasizes the importance of building individuals' and families' capacity to make informed decisions and take autonomous action in managing health. Integrating these three frameworks, the Family Unit Empowerment Model was developed to systematically strengthen family knowledge, confidence, and caregiving capacity in diabetes management, thereby enhancing both family support and patients' self-management behaviors.

Controlling DM involves therapeutic and lifestyle modification strategies across multiple domains, including dietary regulation, physical activity, pharmacological adherence, blood glucose self-monitoring, and foot care (Albikawi & Abuadas, 2015). These are challenging to sustain in the long term, and family support has been identified as a key determinant of adherence and glycemic control. Pamungkas et al. (2017) demonstrated that diabetes self-management education accompanied by family support improves both self-management and glycemic outcomes. Similarly, Pesantes et al. (2018) found that families who possess diabetes knowledge and care competence are more effective in supporting dietary management, physical activity, and treatment adherence. However, evidence regarding structured, theoretically integrated family-unit empowerment interventions in Indonesian primary care settings remains limited.

The Family Unit Empowerment Model was developed in a prior study by Trisnadewi et al. (2024) and is designed for application in community health center settings, incorporating structured education across the four dimensions of family support. The present study extends this work by empirically evaluating the model's effectiveness in a community health center sample. Therefore, this study aimed to evaluate the effectiveness of the Family Unit Empowerment Model in improving diabetes management, family empowerment, and family support among patients with T2DM registered at a community health center in Bali, Indonesia.

Methods

Study Design

This study employed a quantitative approach with a quasi-experimental one-group pre-test–post-test design. The TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) reporting guideline was followed to ensure methodological transparency. A one-group design was selected because establishing a concurrent control group was not feasible within the single community health center context, and withholding a potentially beneficial intervention from participants was considered ethically inappropriate. The study was conducted in the working area of Blahbatuh 2 Gianyar Community Health Center, Gianyar City, Bali Province, Indonesia, between December 2022 and July 2023.

Participants

The target population comprised all patients diagnosed with T2DM registered at the Blahbatuh 2 Gianyar Community Health Center, totaling approximately 350 patients. A total of 140 respondents were recruited using non-probability purposive sampling. The required sample size was calculated using G*Power (version 3.1) for a Wilcoxon signed-rank test, assuming a medium effect size ($r = 0.30$), a significance level of $\alpha = 0.05$, and a statistical power of 0.80, resulting in a minimum sample size of 111 participants. The final sample of 140 participants exceeded this requirement.

Eligible participants were patients diagnosed with T2DM who lived with their family, could communicate and participate effectively, and provided informed consent. Patients with severe cognitive impairment, those who were bedridden, and those who did not reside with any family member were excluded from the study. Participants who withdrew their consent or were absent from more than one intervention session were considered lost to follow-up; however, no participants met these criteria after enrollment.

Instruments

Three validated instruments were used to measure the outcome variables.

Diabetes Management Questionnaire.

The diabetes management instrument was adapted from the Summary of Diabetes Self-Care Activities (SDSCA) developed by Toobert, Hampson, and Glasgow (2000), a widely validated tool for measuring diabetes self-management behaviors. The SDSCA was modified to align with the Indonesian cultural context, and the management components emphasized in the Family Unit Empowerment Model (dietary adherence, physical activity, medication compliance, blood glucose self-monitoring, and foot care). The adapted instrument comprised 25 items. Content validity was established through expert review, with a Content Validity Index (CVI) ≥ 0.80. Reliability was confirmed with a Cronbach's α of 0.82. Items were measured using a Likert scale; scores were categorized into three levels: good, sufficient, and poor. Permission was obtained from the original authors prior to adaptation. The instrument was administered in paper-based, self-report format with enumerator assistance.

Family Empowerment Questionnaire.

Family empowerment was measured using an instrument adapted from the Family Empowerment Scale (FES) developed by Koren, DeChillo, and Friesen (1992), assessing the degree to which family members feel empowered in managing the health needs of a family member with a chronic condition. The instrument was modified for use with families of T2DM patients in Indonesia, focusing on three domains: family knowledge about diabetes, family confidence in providing care, and family capacity to make informed decisions regarding diabetes management—the adapted instrument comprised 20 items. Content validity was established through expert review (CVI ≥ 0.80), and reliability was confirmed with a Cronbach's α of 0.79. Responses were scored on a Likert scale and categorized as either good or poor empowerment. The instrument was self-administered in paper-based format.

Family Support Questionnaire.

Family support was assessed using an instrument adapted from the Diabetes Family Support Scale, informed by the theoretical framework of House (1981), which conceptualizes social support across four dimensions: informational support, appraisal support, emotional support, and instrumental support. The instrument was adapted to reflect support behaviors relevant to T2DM management within Indonesian family structures. The adapted instrument comprised 24 items. Validity and reliability testing yielded satisfactory psychometric properties (CVI ≥ 0.80; Cronbach's α = 0.76). Items were rated on a Likert scale; total scores were categorized as either high or low levels of family support. The instrument was paper-based and self-administered with enumerator assistance.

Instrument Adaptation and Cross-Cultural Validation

Because all three instruments were originally developed in English, they were adapted for the Indonesian context following the established cross-cultural adaptation process described by Beaton et al. (2000). The procedure comprised five stages: (1) independent forward translation from English to Indonesian by [two] bilingual translators; (2) synthesis of the forward translations into a single reconciled version; (3) back-translation into English by an independent translator blinded to the source instruments; (4) review of the back-translation against the original by an expert committee to resolve semantic, idiomatic, experiential, and conceptual discrepancies; and (5) pretesting of the prefinal version.

An expert panel consisting of [n] reviewers independently evaluated each item for relevance, clarity, and cultural appropriateness for type 2 diabetes mellitus (T2DM) care in the Indonesian context. Item-level content validity (I-CVI) was calculated for each item, and the scale-level content validity index (S-CVI/Ave) was calculated for each instrument. Items with an I-CVI of ≥0.80 were retained. Based on the expert review, culturally appropriate wording revisions were incorporated into the instruments.

The prefinal versions of the instruments were pilot-tested among [n] patients with T2DM from a population comparable to the study participants but not included in the main study. The pilot testing assessed comprehensibility and administration time, and minor wording revisions were made based on participant feedback. Internal consistency reliability was acceptable for all three instruments, with Cronbach's alpha values of 0.82 for the adapted Summary of Diabetes Self-Care Activities (SDSCA), 0.79 for the adapted Family Empowerment Scale (FES), and 0.76 for the adapted Diabetes Family Support Scale. The cut-off points used to classify total scores into ordinal categories were determined according to the scoring procedures adopted for each instrument and were applied consistently during data analysis.

Intervention

The Family Unit Empowerment Model was delivered as a structured, theory-informed health education program targeting both patients with T2DM and their family members. The intervention was grounded in Empowerment Theory, Family Systems Theory, and Social Support Theory (House, 1981). Sessions were facilitated by trained nurses holding a minimum of a bachelor's degree in nursing, with at least two years of experience in diabetes care. All facilitators participated in a two-day standardized training program before data collection to ensure fidelity of delivery.

The intervention comprised four weekly group sessions, each lasting approximately 90 minutes, delivered over one month. Session content included: (1) diabetes pathophysiology, risk factors, and the role of the family in chronic disease management; (2) dietary regulation, nutritional management, and meal planning; (3) medication adherence, blood glucose monitoring, and foot care; and (4) psychosocial support, stress management, and communication strategies for family caregivers. Educational delivery utilized a family-based diabetes management module developed by the research team (Trisnadewi et al., 2024) as the primary instructional medium. Session fidelity was monitored through attendance logs and a structured facilitator checklist completed after each session. No adverse events related to the intervention were recorded.

The Family Unit Empowerment Model differs from conventional diabetes education, which is typically delivered to the patient (sometimes with a passively

attending family member) and concentrates on transmitting disease knowledge. The model instead treats the patient–family dyad or unit as the target of change and operationalizes three theories into specific, replicable activities. From Empowerment Theory, each session moved beyond information transfer to guided collaborative goal-setting in which the patient and family jointly identified a diabetes-management priority, generated their own action plan, and reviewed progress at the next session; facilitators used open questioning and problem-solving rather than didactic instruction to build the family's decision-making capacity. From Family Systems Theory, the intervention explicitly assigned and negotiated caregiving roles among family members (for example, who supports meal preparation, medication reminders, or accompaniment to the health center), repositioning diabetes as a shared family responsibility rather than an individual patient task. From Social Support Theory (House, 1981), each of the four support dimensions was deliberately activated: informational (shared family education), instrumental (concrete role assignments), appraisal (structured feedback on the family's self-set goals), and emotional (caregiver stress-management and communication skills).

The behavior change mechanisms embedded in the intervention included goal setting and action planning, family role allocation, modeling and skills practice, and structured feedback. Group sessions enabled participants and their family members to practice essential diabetes self-management skills, including meal planning and blood glucose monitoring. Group dynamics were intentionally incorporated by delivering the intervention to small groups of patient–family units, thereby facilitating peer learning, observational modeling, and shared problem-solving among families.

All sessions were conducted according to a standardized protocol that specified the learning objectives, educational activities, and time allocation for each session. Intervention fidelity was monitored using a post-session checklist completed by the facilitators. The intervention was designed to target the family as the primary unit of care through collaborative goal setting, role negotiation, and the systematic activation of emotional, informational, instrumental, and appraisal support. These components represent the core active elements of the intervention and were expected to enhance diabetes self-management outcomes beyond those achieved through conventional patient-centered diabetes education (**Table 1**).

Table 1. Intervention Description

Component	Description
Theory	Empowerment Theory; Family Systems Theory; Social Support Theory (House, 1981)
Provider	Registered nurses with ≥ Bachelor's degree in nursing; ≥ 2 years diabetes care experience
Training	Two-day standardized facilitator training prior to data collection
Session duration	Approximately 90 minutes per session
Frequency	Weekly (4 sessions total)
Total dose	4 sessions over one month (≈ 6 hours total contact time)
Materials	Family-based diabetes management module (Trisnadewi et al., 2024)
Fidelity monitoring	Attendance logs; structured post-session facilitator checklist
Adverse events	None recorded

Data Collection

Data were collected by trained enumerators who were not involved in delivering the intervention, to minimize

assessment bias. Enumerators underwent a one-day standardized training covering instrument administration, data recording, and quality control procedures. Data collection proceeded in three stages: (1) pre-test baseline assessments were conducted prior to the first intervention session; (2) the four-session intervention was implemented over one month; and (3) post-test assessments were conducted within one week of completing the final session using the same instruments. Double data entry was performed for all questionnaires, and discrepancies were resolved by referring to the original data forms. Missing data were minimal (< 2% across all instruments) and were handled using listwise deletion.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Normality of score distributions was assessed using the Shapiro–Wilk test; non-normal distributions in all three outcome variables confirmed the appropriateness of non-parametric analysis. The Wilcoxon Signed-Rank Test was applied to assess differences between pre-test and post-test scores, with a significance level of $p < 0.05$. Statistical significance is reported as $p < 0.001$ where the computed p-value was below 0.001, in accordance with standard reporting conventions. Effect size was calculated as $r = Z / \sqrt{N}$, where Z is the Wilcoxon Z-statistic and N is the total number of observations (Rosenthal, 1991); r values of 0.10, 0.30, and 0.50 were interpreted as small, medium, and large effects, respectively. Confidence intervals (95% CI) for effect sizes were estimated using bootstrap methods.

Ethical Considerations

Ethical approval was obtained from the Wira Medika Health College Ethics Committee prior to data collection (Ref. No. 219/E1.STIKESWIKA/EC/III/2023). The study was conducted in accordance with the principles of the Declaration of Helsinki (2013). Informed consent was obtained from all participants prior to enrollment. Participants were informed of their right to withdraw at any time without consequence. All data were anonymized prior to analysis, stored securely on password-protected institutional devices, and accessible only to members of the research team. No identifying information was included in the dataset or reported outputs.

Results

A total of 140 participants completed both pre-test and post-test assessments. The majority of respondents were male (n = 78; 55.7%). The most represented age group was those older than 60 years (n = 57; 40.7%), followed by the 51–60 year group (n = 41; 29.3%). Most respondents had completed senior high school education (n = 59; 42.1%). Employment status was approximately equally distributed, with 71 respondents (50.7%) employed and 69 (49.3%) unemployed. Respondent characteristics are presented in **Table 2.**

Table 2. Respondent Characteristics (n = 140)

Characteristic	Frequency (n)	Percentage (%)
Gender		
Male	78	55.7
Female	62	44.3
Total	140	100
Age (years)		
30–40	11	7.9
41–50	31	22.1
51–60	41	29.3
> 60	57	40.7
Total	140	100

Characteristic	Frequency (n)	Percentage (%)
Education Level		
No formal schooling	34	24.3
Elementary school	26	18.6
Junior high school	16	11.4
Senior high school	59	42.1
Bachelor's degree	5	3.6
Total	140	100
Occupation Status		
Employed	71	50.7
Unemployed	69	49.3
Total	140	100

The distribution of research variables before and after intervention is presented in **Table 3.** Family empowerment was predominantly in the poor category prior to intervention (n = 88; 62.9%), shifting to predominantly good post-intervention (n = 78; 55.7%). Family support remained predominantly in the low category both before (n = 78; 55.7%) and after the intervention (n = 71; 50.7%), although the proportion classified as high increased from 44.3% (n = 62) to 49.3% (n = 69). Diabetes management showed a reduction in poor-category cases from 40.7% (n = 57) pre-intervention to 27.9% (n = 39) post-intervention, with corresponding increases in the sufficient and good categories.

Table 3. Distribution of Research Variables Before and After Intervention (n = 140)

Variable	Pre-test n	Pre-test %	Post-test n	Post-test %
Family Empowerment				
Good	52	37.1	78	55.7
Poor	88	62.9	62	44.3
Family Support				
High	62	44.3	69	49.3
Low	78	55.7	71	50.7
Diabetes Management				
Good	41	29.3	50	35.7
Sufficient	42	30.0	51	36.4
Poor	57	40.7	39	27.9

To convey the magnitude of change rather than only shifts between categories, descriptive statistics for the continuous total scores of each instrument are reported in **Table 4.** Because the Shapiro–Wilk test indicated non-normal distributions, medians with interquartile ranges are reported as the primary descriptors alongside means and standard deviations, together with the absolute pre–post change and its 95% confidence interval (**Table 5**).

Table 4. Pre–Post Continuous Scores for Outcome Variables (n = 140)

Variable (possible range)	Pre-test, Mean ± SD; Median (IQR)	Post-test, Mean ± SD; Median (IQR)	Mean (or median) difference (95% CI)
Family Empowerment (FES)	59.17 ± 8.45; 58 (54–65)	62.21 ± 7.70; 61 (57–67)	Median +2.5 (2.0 to 3.5); mean +3.04 (1.78 to 4.30)
Family Support (DFSS)	51.79 ± 13.87; 51 (42–60)	53.94 ± 11.72; 52 (46–60)	Median +2.5 (2.0 to 3.5); mean +2.15 (0.58 to 3.72)
Diabetes Management (SDSCA)	67.48 ± 9.85; 65 (61–78)	69.28 ± 11.42; 69 (63–80)	Median +2.5 (1.5 to 3.5); mean +1.80 (−0.13 to 3.73)

Note. FES = Family Empowerment Scale; DFSS = Diabetes Family Support Scale; SDSCA = Summary of Diabetes Self-Care Activities; IQR = interquartile range; CI = confidence interval. For non-normally distributed outcomes, the median difference (Hodges–Lehmann estimate) and its 95% CI are the preferred summary of effect magnitude.

Table 5. Wilcoxon Signed-Rank Test Results for Research Variables (n = 140)

Variable	Z	p-value	Effect Size (r)	Interpretation
Family Empowerment	−6.40	< 0.001	0.54	Large
Family Support	−5.85	< 0.001	0.49	Medium
Diabetes Management	−3.89	< 0.001	0.33	Medium

Note. Z = Wilcoxon test statistic; r = effect size computed as $|Z| / \sqrt{N}$; effect size benchmarks: small r = 0.10, medium r = 0.30, large r = 0.50 (Rosenthal, 1991). p < 0.001 indicates that the exact p-value was below the 0.001 threshold.

Discussion

The findings of this study show that participation in the Family Unit Empowerment Model was associated with statistically significant improvements in family empowerment, family support, and diabetes management among patients with T2DM attending a community health center in Bali, Indonesia. These results are consistent with evidence indicating that family-based interventions can meaningfully strengthen chronic disease management outcomes, although the single-group design (addressed in the Limitations) means the improvements cannot be attributed to the intervention with certainty.

The demographic profile of the sample was broadly consistent with known epidemiological patterns of T2DM in Indonesia. Male respondents constituted the majority (55.7%), and the largest age group was those older than 60 years (40.7%), reflecting the established age-related risk profile for T2DM, wherein risk escalates substantially after age 40 (American Diabetes Association [ADA], 2017). The predominance of senior high school education (42.1%) is noteworthy, as higher educational attainment has been associated with greater diabetes health literacy and treatment adherence (Pamungkas et al., 2017).

The significant improvement in family empowerment ($p < 0.001$, $r = 0.54$) following the intervention can be interpreted through the lens of Empowerment Theory. By systematically building family members' knowledge, confidence, and decision-making capacity, the Family Unit Empowerment Model appears to shift families from passive observers to active, informed participants in diabetes care. This mechanism aligns with the theoretical premise that empowerment is achieved when individuals

gain the competencies necessary to take autonomous, health-promoting action (Trisnadewi et al., 2024). In the Balinese cultural context, where health decisions are often made collectively and the family unit functions as the primary locus of care, empowering the family group as a whole may generate synergistic effects beyond what individually focused education can achieve.

Improvements in family support ($p < 0.001$, $r = 0.49$) similarly align with Social Support Theory (House, 1981), which identifies informational, appraisal, emotional, and instrumental support as interconnected mechanisms through which social networks influence health behavior. The structured education sessions in this study explicitly addressed all four support dimensions, which may explain the broad improvements observed. These findings are consistent with Pesantes et al. (2018), who reported that families with diabetes knowledge and care competence are more effective in supporting patients' dietary management, physical activity, and adherence to treatment. McEwen et al. (2019) similarly demonstrated that family-based diabetes interventions can improve social capital outcomes relevant to long-term disease management.

The improvement in diabetes management ($p < 0.001$, $r = 0.33$) is consistent with evidence that family involvement is a key mediator of self-management adherence in T2DM. As Pamungkas et al. (2017) demonstrated in a systematic review, diabetes self-management education accompanied by family support improves glycemic outcomes and self-management behaviors. The active participation of family members in diet management, medication monitoring, and psychosocial support — as encouraged by the Family Unit Empowerment Model — appears to reinforce patients' self-efficacy, facilitate shared decision-making, and improve treatment monitoring.

From the perspective of Family Systems Theory, the improvements across all three variables reflect the interconnected nature of family dynamics: enhancing family members' knowledge and empowerment appears to catalyze improvements in support provision, which in turn reinforces patients' diabetes self-management. This cascade effect suggests that intervening at the family-system level, rather than at the level of the individual patient, may generate broader and more sustainable behavior change, particularly in collectivist cultural contexts such as Bali, where communal caregiving norms and shared responsibility for health are culturally normative.

The magnitude of the observed effects warrants careful interpretation. Applying Rosenthal's (1991) benchmarks ($r = 0.10$ small, 0.30 medium, 0.50 large), the effect was large for family empowerment ($r = 0.54$), approached the large-effect threshold for family support ($r = 0.49$), and was medium for diabetes management ($r = 0.33$). Although these magnitudes are encouraging, effect sizes derived from a single-group pre–post design are susceptible to upward bias from the design-related threats discussed below—most notably regression to the mean and the absence of a control condition—so they may overstate the change attributable to the intervention itself. They should therefore be read as preliminary indications of potential benefit rather than as established treatment effects, and whether these gains translate into clinically meaningful or durable improvement cannot be determined from the present design. This caution is reinforced by the continuous descriptive statistics in Table 5: the absolute pre–post changes were modest in raw-score terms (median changes of approximately 2.5 points on each instrument), underscoring that statistically robust effects need not

correspond to large shifts on the underlying scales.

A further consideration concerns the theoretical model underpinning the intervention, which posits that strengthening family empowerment enhances family support, which in turn improves diabetes self-management. The present analysis examined only the independent pre–post change in each outcome; it did not test whether change in empowerment statistically mediated change in support, or whether change in support mediated change in self-management. The proposed pathway therefore remains untested, and the parallel improvement of the three outcomes is consistent with, but does not constitute evidence for, the hypothesized mechanism. Future studies with adequate samples and repeated or staggered measurements should apply mediation or path-analytic approaches (e.g., structural equation modeling) to test these relationships directly and to clarify the mechanisms through which the Family Unit Empowerment Model exerts its effects.

Implications and limitations

This study has several limitations. The one-group pre-test–post-test design without a control group limits causal inference and increases the risk of bias, while the use of self-reported outcomes without objective clinical measures (e.g., HbA1c or fasting blood glucose) prevents confirmation that improved self-management resulted in better clinical outcomes. In addition, purposive sampling from a single community health center in Bali limits the generalizability of the findings, and the short intervention period with immediate post-test precludes assessment of long-term effects. Despite these limitations, the study provides preliminary evidence that the Family Unit Empowerment Model may improve family empowerment, family support, and diabetes self-management in primary care. Future multicenter studies using randomized or controlled designs, longer follow-up, and objective clinical outcomes are needed to establish causality and evaluate the model's effectiveness before wider implementation.

Relevance to Practice

The findings of this study offer tentative, practice-relevant insights for nurses, community health workers, and primary care providers managing patients with T2DM, while recognizing that they derive from a single-site study without a control group or objective clinical outcomes. They suggest that more deliberately engaging the family unit—rather than the patient alone—through structured, theory-informed education may be a promising direction for community diabetes care and merits piloting and formal evaluation within existing services. Where such programs are trialed, frontline health workers would benefit from standardized training in facilitating family-based education, with particular attention to the four dimensions of social support identified by House (1981). The development of culturally adapted, Indonesian-language family-based diabetes education modules could support such efforts; however, embedding the model as a core component of frameworks such as Prolanis (Program Pengelolaan Penyakit Kronis) or incorporating family empowerment indicators into routine monitoring should follow rather than precede confirmation of effectiveness in adequately controlled multicenter studies. Until such evidence is available, the model is best positioned as a candidate intervention for further evaluation rather than as an established standard of care.

Conclusion

Participation in the Family Unit Empowerment Model was associated with statistically significant improvements in diabetes self-management, family empowerment, and family support among patients with T2DM in a community health center setting in Bali, Indonesia. These findings are consistent with the theoretical premise that chronic disease outcomes are shaped by the broader social and familial environment and suggest that structured family-level empowerment interventions are a promising avenue for primary care diabetes management. Because the single-group design, reliance on self-reported outcomes, and absence of objective clinical measures preclude causal conclusions, the results should be regarded as preliminary. Family-centered empowerment strategies now warrant evaluation in adequately powered, randomized or controlled multicenter studies with longer follow-up, objective clinical endpoints, and formal mediation analysis to establish their effectiveness, the mechanisms involved, and the durability and broader applicability of any effects.

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CrediT Authorship Contributions Statement

Ni Wayan Trisnadewi: Conceptualization, Methodology, Supervision, Writing - Original Draft

I Made Sudarma Adiputra: Software, Validation, Formal Analysis, Writing - Review & Editing

Ni Putu Wiwik Oktaviani: Investigation, Resources, Data Curation, Project Administration

Conflicts of Interest

There is no conflict of interest.

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