Nurse Media Journal of Nursing
e-ISSN: 2406-8799, p-ISSN: 2087-7811
https://medianers.undip.ac.id
14(2):267-278, August 2024
https://doi.org/10.14710/nmjn.v14i2.56893

ORIGINAL RESEARCH

The Effect of Family Caregiver Empowerment Model Intervention on Fear of Hypoglycemia in People with Type 2 Diabetes Mellitus

Rondhianto Rondhianto [1], Kushariyadi Kushariyadi [1], M. Nauval Rahmatullah[1]

[1]*Faculty of Nursing, Universitas Jember, Jember, Indonesia*

Article Info

Article History:
Received: 30 July 2023
Revised: 27 August 2024
Accepted: 30 August 2024
Online: 31 August 2024

Keywords:
Empowerment; family caregiver; fear of hypoglycemia; type 2 diabetes mellitus

Corresponding Author:
Rondhianto Rondhianto
Faculty of Nursing, Universitas Jember, Jember, Indonesia
Email: rondhianto@unej.ac.id

Abstract

Background: The family plays a vital role in T2DM self-management, but many families need to understand their role and function as caregivers. This lack of understanding can increase the burden of disease management, contributing to the emergence of psychological problems in people with T2DM, such as fear of hypoglycemia, which in turn worsens blood glucose control. The Family Caregiver Empowerment Model (FCEM) intervention is one model that can be used to empower families as caregivers in T2DM self-management.
Purpose: This study aimed to analyze the effect of the FCEM intervention on the fear of hypoglycemia in people with T2DM.
Methods: The study design was quasi-experimental with a randomized control pretest-posttest design. The sample size consisted of 85 respondents (a pair of family caregivers and people with T2DM), who were randomly divided into two groups: the treatment group (41 respondents) and the control group (44 respondents). The FCEM intervention was conducted once per week for ten weeks for family caregivers, and fear of hypoglycemia was measured using the Indonesian version of the Fear of Hypoglycemia Scale questionnaire. The data were analyzed using the Wilcoxon signed rank test and independent t-test.
Results: The results showed significant differences in fear of hypoglycemia between the pre-test and post-test in the treatment group (p=0.001) and the control group (p=0.001). However, there was a significant difference in the decrease of fear of hypoglycemia between the treatment and control groups (t=-7.087; p=0.001). This finding suggests that FCEM intervention can significantly reduce the fear of hypoglycemia in people with T2DM.
Conclusions: The FCEM intervention can reduce the fear of hypoglycemia in people with T2DM by increasing the family caregiver's ability and support in managing T2DM. Nurses can use the FCEM intervention in T2DM management to improve diabetes management outcomes.

How to cite: Rondhianto, R., Kushariyadi, K., Rahmatullah, M. N. (2024). The effect of family caregiver empowerment model intervention on fear of hypoglycemia in people with type 2 diabetes mellitus. *Nurse Media Journal of Nursing, 14*(2), 267-278. https://doi.org/10.14710/nmjn.v14i2.56893

1. Introduction

Type 2 diabetes mellitus (T2DM) is a disease that requires ongoing medical care because it is a complex chronic disease. As much as 10.5% of the world population in the age range of 20-79 years have diabetes. Indonesia is one of the ten countries with the highest number of T2DM cases globally, with 19.5 million (International Diabetes Federation, 2021). T2DM not only interferes with a person's metabolic system but, in some cases, also causes several mental disorders, such as distress, anxiety, depression, and fear of hypoglycemia. Fear of hypoglycemia is a specific and extreme fear of the risk or occurrence of hypoglycemia. A previous study showed that fear of hypoglycemia affects one in seven people with T2DM worldwide (Hendrieckx et al., 2021). Research in Central and Eastern European countries showed that 5.9% of people with T2DM experienced severe fear of hypoglycemia (Haluzik et al., 2018). A study in China also showed that 17.4% of people with T2DM experienced a fear of hypoglycemia (Huang et al., 2022). Another study at Dr. Soebandi Hospital Jember, Indonesia, showed that 21.4% of people with T2DM experienced fear of hypoglycemia (Roessanti et al., 2022). The fear of hypoglycemia in people with T2DM is related to their inability to manage their diabetes independently. The failure to manage

the disease properly, including diet, physical activity, and taking medication, can cause worry and fear about whether the actions taken are correct (American Diabetes Association, 2023). In addition, the inability to self-monitor blood glucose also adds to the problem of further fear because they do not know what their blood glucose level is when needed (Wang et al., 2019). The fear of hypoglycemia can change patient habits, such as increasing inappropriate compensatory behavior, such as improving food portions, reducing insulin use, and others. This fear is often associated with impaired quality of life and emotional well-being, reduced involvement with diabetes management, and poor diabetes outcomes (Hendrieckx et al., 2021).

Effective management of diabetes mellitus for individuals with T2DM requires consideration of their characteristics and the support of their families. Therefore, healthcare providers should give the family and patient education and training in specific skills required for self-management at home (American Diabetes Association, 2023; International Diabetes Federation, 2021). Previous studies showed that families play a vital role in the self-management of diabetes (Pesantes et al., 2018; Rondhianto et al., 2023). However, a previous study showed that 48.18% of family caregivers only had self-management skills (diet, physical activity, self-monitoring of blood glucose with medication, and foot care management) in the moderate category, which was still not optimal, thus having an impact on diabetes self-management (Rondhianto et al., 2019). Therefore, it is necessary to make a series of efforts to improve their abilities.

The inability of families to self-manage T2DM can result in failure of self-management, leading to low family support for managing T2DM, which increases the fear of complications such as hypoglycemia or other issues (American Diabetes Association, 2023). Nurses can use behavioral strategies to support diabetes self-management and engagement in health behaviors, such as medication management, physical activity management, and diabetes diet, to promote optimal diabetes health outcomes (American Diabetes Association, 2023). Studies show that family empowerment can improve the self-management of people with T2DM and their health status (International Diabetes Federation, 2021; Luthfa & Ardian, 2019). The application of the empowerment model commonly intervened at this time is focused on empowering people with T2DM. The family's vital role in managing diabetes often receives less attention from healthcare workers, making families unable to carry out diabetes self-management (Rondhianto et al., 2020). Effective management of DM needs to be supported by family and consistent education for families and patients (Luthfa & Ardian, 2019). Education and self-management support for diabetes patients is also carried out to support ongoing medical care (Andriyanto et al., 2019), with the goal of preventing both short and long-term complications (American Diabetes Association, 2022).

The Family Caregiver Empowerment Model (FCEM) is an intervention developed by nurses for family caregivers to increase positive control of the mind and body, create positive and proactive behavior in exploring the role of a family caregiver, support the independence of those receiving care, foster a positive reciprocal relationship, and promote a positive relationship between family caregivers and others around them. FCEM interventions can also improve the ability of family caregivers to carry out diabetes self-management, which includes diet, physical activity, medication, and monitoring blood glucose levels independently, as well as foot care (Rondhianto et al., 2022). Several previous studies have been conducted in Indonesia on family empowerment in diabetes management. However, the most widely practiced empowerment is the empowerment of T2DM patients, not family caregivers of people with T2DM (Andriyanto et al., 2019; Damhudi et al., 2021; Deswita et al., 2020; Pamungkas & Chamroonsawasdi, 2020; Rusdiana et al., 2020; Sari et al., 2022). The absence of optimal support from families who understand the disease and its management can lead to increased non-compliance and decreased self-care, thereby increasing the risk of complications (International Diabetes Federation, 2021). In addition, some interventions in other models are carried out unstructured and prioritize the educational context that only focuses on improving cognitive aspects and skills of family, without supporting and mentoring process (Al Mahdi et al., 2020; Appil et al., 2022; Subrata, 2021). FCEM interventions are structured education, focusing on enhancing cognitive aspects through education, skills aspects through training, and affective aspects through mentoring, monitoring, and evaluation (Rondhianto et al., 2020). In addition, previous studies did not examine the effect of family caregiver empowerment on psychological disorders. Therefore, this study aimed to analyze the effect of the FCEM intervention on the fear of hypoglycemia in people with T2DM.

2. Methods

2.1. Research design

This study used a quasi-experimental design with a randomized controlled group and a pre-test and post-test design. Randomization was performed to assign respondents to either the treatment or control groups using single-blind randomization.

2.2. Setting and samples

This study was conducted from 26 March to 2 July 2023 at a public health center in Jember, Indonesia. The study population consisted of 300 people across five villages: Village 1 (39 people), Village 2 (83 people), Village 3 (75 people), Village 4 (18 people), and Village 5 (85 people). The samples consisted of pairs, namely family caregivers and people with T2DM. The inclusion criteria for family caregivers were: 1) age > 20 years; 2) acting as family caregivers for people with T2DM; 3) having only one person with T2DM in the family; and 4) willingness to participate as a respondent. The inclusion criteria for people with T2DM were: 1) diagnosed with T2DM; 2) not currently hospitalized or receiving treatment in other healthcare facilities; and 3) not having severe complications that require hospitalization. The exclusion criteria were: 1) family caregivers with physical disabilities such as blindness and deafness; and 2) illiteracy.

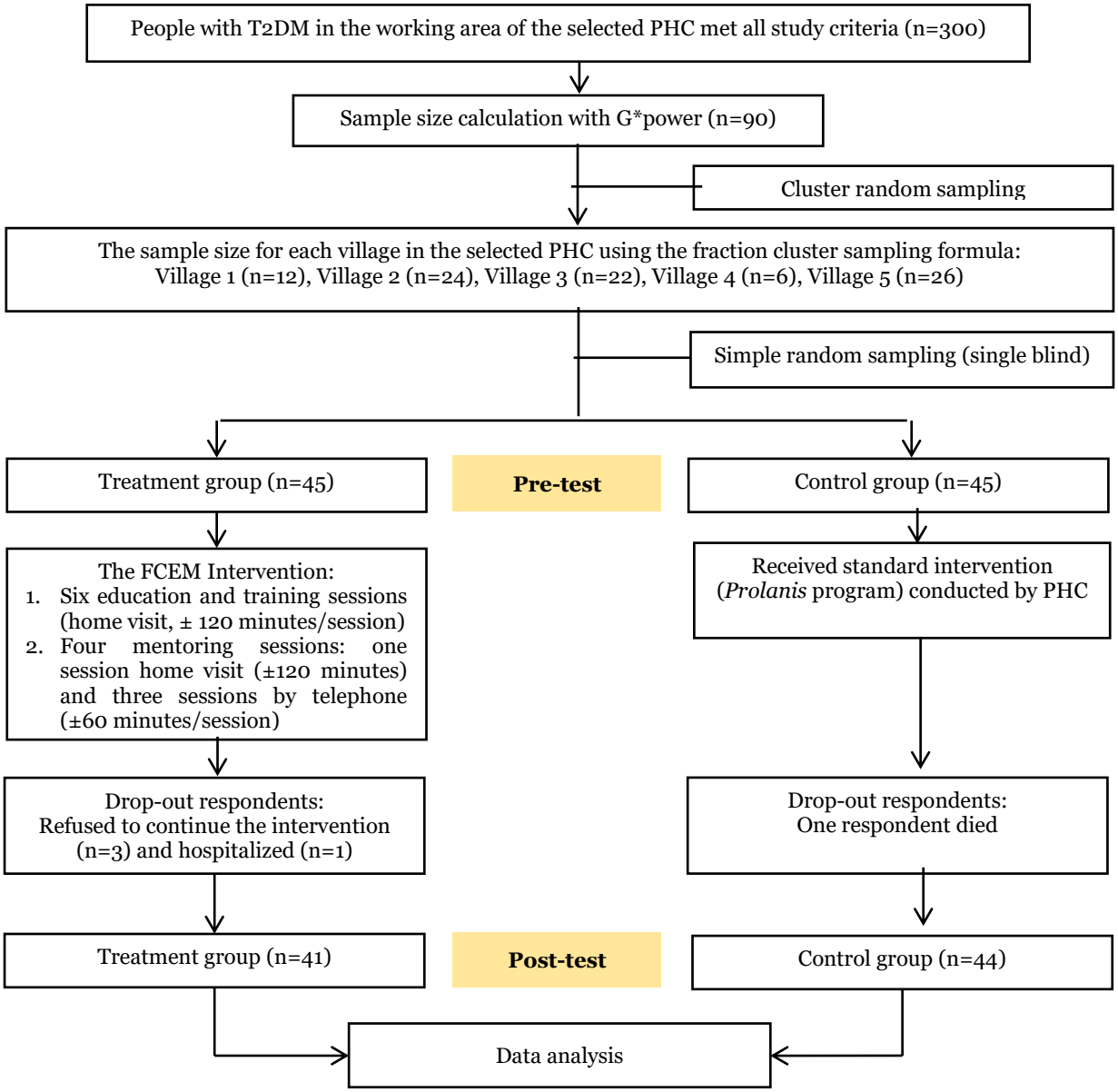

Figure 1. Flowchart of study stages

The sample size was calculated using G*Power software (α=0.05; β=0.8; f^2=0.64), resulting in a minimum requirement of 80 respondents. To account for potential drop-outs or loss to follow-up, the researcher added approximately 10%, yielding a total sample size of 90. The sample consisted of 45 respondents in the treatment group and 45 respondents in the control group, selected through cluster random sampling. The researcher determined the sample size for each village with the fraction cluster sampling formula. With a population (N) of 300, the sample size for each village was as follows: (1) Village 1 = 39/300 x 90 = 12 respondents, (2) Village 2 = 83/300 x 90 = 24 respondents, (3) Village 3 = 75/300 x 90 = 22 respondents, (4) Village = 18/300 x 90 = 6 respondents, and (5) Village 5 = 85/300 x 90 = 26 respondents. Furthermore, the researcher randomly divided (single-blind) respondents in each village into two groups, namely the treatment group and the control group proportionally. During the study, five respondents dropped out for various reasons: four from the treatment group (one was hospitalized, and three chose to withdraw) and one from the control group (due to death). The final sample size at the post-test was 85 respondents, which exceeds the minimum required sample size of 80. Therefore, the sample size remained appropriate for this study. The study stages are detailed in Figure 1.

2.3. Intervention

The researcher conducted the FCEM intervention for the treatment group. In contrast, the control group only received standard intervention, namely health education, through the *Prolanis (Program Pengelolaan Penyakit Kronis)*, or Chronic Disease Management Program, provided by the PHC. The FCEM intervention was based on the results of previous research. In general, the FCEM intervention consists of two main stages, namely education and training (sessions 1-6) and mentoring (sessions 7-10), which are aimed at increasing the capacity of family caregivers in self-managing T2DM so that they can provide the assistance needed by people with T2DM (Rondhianto et al., 2020, 2022). The treatment group was given intervention during 10 sessions within 10 weeks, namely six education and training sessions followed by four mentoring sessions (Table 1).

To ensure that the families implemented T2DM self-management correctly, the researchers provided action record sheets for monitoring, which each family caregiver had to fill in when carrying out self-management actions according to their components (diet management, physical exercise management, medication management, self-monitoring of blood glucose, and foot care). Additionally, the researchers clarified directly with the family caregivers during home visits in week 7 to check whether they had carried out the actions as planned. The researchers also clarified directly with people with T2DM regarding the actions taken by their family caregivers. Family caregivers began carrying out T2DM self-management actions for people with T2DM starting in week 7 (with home visits by the researchers to ensure correct implementation), and continued from week 8 to week 10, with monitoring and evaluation conducted via telephone. Monitoring, evaluation, and corrective actions for the implementation of T2DM self-management by family caregivers were carried out in stages, beginning with home visits in week 7 and continuing with telephone follow-ups from week 8 to week 10.

2.4. Measurement and data collection

Fear of hypoglycemia, as the dependent variable in this study, was measured using the Indonesian version of the Fear of Hypoglycemia Scale (FH-15), which assesses fear of hypoglycemia in people with T2DM in Indonesia (Roessanti et al., 2022). This questionnaire was initially developed by Ortiz et al. (2011) and consisted of 15 unfavorable question items categorized under three indicators: fear, avoidance, and interference. The FH-15 uses a Likert scale ranging from 1 to 5 (1=never, 2=rarely, 3=sometimes, 4=almost always, 5=every day). The minimum score for the questionnaire is 15, and the maximum score is 75, with a cut-off point of 28. If the score is ≥28, it means people with T2DM experience a fear of hypoglycemia. A score <28 indicates that people with T2DM do not experience a fear of hypoglycemia (Ortiz et al., 2011). The questionnaire was translated into Indonesian by Roessanti et al. (2022) and had its sentence structure reviewed by a professional language institute. The researcher re-tested the validity and reliability of the questionnaire using 30 respondents with T2DM from a public health center in another region that shares similar characteristics with the study site. The validity and reliability test results showed that this questionnaire is valid and reliable with a value of r = 0.479 - 0.898 > r table = 0.374 and Cronbach alpha = 0.883. Data collection was conducted through direct

interviews, where respondents answered questions based on the questionnaire. The researchers recorded each response in the questionnaire. Before collecting data, the researchers provided an overview of the study, including its objectives, benefits, procedures, and potential risks. Respondents who agreed to participate signed a consent form. Data were collected to measure fear of hypoglycemia both before the intervention (pre-test) and two weeks after the intervention (post-test).

Table 1. Summary of family caregiver empowerment model intervention

Session/ Time	Learning Outcomes	Material	Method	Strategy
Session 1 (±120 minutes)	Explain basic concepts of T2DM, self-management, illness management in the family, and situational factors in T2DM self-management	The basic concepts and self-management of T2DM, management of illness in the family, and situational factors within self-management of diabetes	Lectures, discussions, and counseling	Build relationship Provide complete and accurate information Guide the assessment of support and resources Help determine needs Provide support in setting goals in the T2DM self-management
Session 2 (±120 minutes)	Explain the role of nurses, filial values, and empowerment in T2DM self-management	Filial values, the role of nurses, and empowering family caregivers in self-management of T2DM		
Session 3 (±120 minutes)	Demonstrate diet management	DM diet management concept and strategy	Lectures, discussions, demonstrations, and counseling	Assess ability Provide information Strengthen the capability Encourage active participation Designing a strategy for implementing self-management
Session 4 (±120 minutes)	Demonstrate physical activity management	Physical activity management concept and strategy		
Session 5 (±120 minutes)	Demonstrate medication, SMBG, and foot care management	T2DM Medication and Self-monitoring blood glucose concept and strategy		
Session 6 (±120 minutes)	Design T2DM self-management plan	Concepts and strategies for foot care, prevention of complications, and preparation of T2DM self-management plans		
Session 7 (±120 minutes)	Face challenges in T2DM	Follow-up and support for resource access (This activity is carried out so that family caregivers can carry out diabetes self-management according to the target)	Mentoring, discussion, and counseling	Encourage action Help solve problems Strengthen the ability Provide information and choice of sources
Session 8-10 (±60 minutes)	Demonstrate T2DM self-management independently	Monitoring and evaluation that includes support and assistance for the continuity of quality care		Evaluate capability Monitoring and support Recognition of the role and competence

Source: Rondhianto et al. (2022)

2.5. Data analysis

The researchers conducted a descriptive analysis to describe the respondents' characteristics and the variable of fear of hypoglycemia. Inferential analysis was performed to determine the effect of the FCEM intervention. The Wilcoxon signed-rank test was used to analyze the pre-test and post-test results for each group, as the data for each group were not normally distributed (p-value $< \alpha = 0.05$). However, the score change (Δ) in each group was normally distributed ($p > \alpha = 0.05$). Therefore, the difference between the treatment and control groups was analyzed using the independent t-test to compare the pre-test and post-test results for each group.

2.6. Ethical considerations

An ethical review was conducted for this study and approved by the ethics committee of the Faculty of Nursing, Universitas Jember, with reference number 124/UN25.1.14/KEPK/2023. Before conducting the research, the researcher provided prospective respondent with information about the general description of the study. Additionally, the researchers explained the objectives, benefits, procedures, potential risks, and rewards for participation. There was no coercion for participation, and respondents were free to withdraw at any time during the study. Prospective respondents who agreed to participate were asked to sign the consent form prepared by the researchers.

3. Results

3.1 Characteristics of respondents

The results showed that the number of respondents in this study was 85 (Table 2). Most of the respondents were early elderly (43.53%), female (80%), elementary school graduates (55.29%), unemployed or housewives (56.47%), and married (83.53%). They had T2DM for less than five years (90.59%), never had hypoglycemia (77.65%), and were hospitalized less than equal to one time (89.41%).

Table 2. Characteristics of respondents (n=85)

Characteristics	Treatment Group (n=41)		Control Group (n =44)		Total (n=85)	
	f	%	f	%	f	%
Age (years)						
< 25 (late adolescent)	0	0	0	0	0	0
26 – 35 (early adulthood)	1	2.44	1	2.27	2	2.35
36 – 45 (late adulthood)	4	9.76	6	13.64	10	11.76
46 – 55 (early elderly)	16	39.02	21	47.73	37	43.53
56 – 65 (late elderly)	13	31.71	9	20.45	22	25.88
> 65 (old)	7	17.07	7	15.91	14	16.48
Gender						
Male	6	14.63	11	25	17	20
Female	35	85.37	33	75	68	80
Education level						
No education	6	14.63	10	22.73	16	18.82
Elementary school	20	48.78	27	61.36	47	55.29
Junior high school	7	17.07	3	6.82	10	11.76
Senior high school	7	17.07	4	9.09	11	12.94
College	1	2.44	0	0	1	1.18
Employment status						
Unemployed/housewives	24	58.54	24	54.55	48	56.47
Civil servant	1	2.44	1	2.27	2	2.35
Indonesian National Army/ Police	0	0	0	0	0	0
Fisherman	0	0	0	0	0	0
Laborer	0	0	1	2.27	1	1.18
Teacher	0	0	0	0	0	0
Farmer	4	9.76	4	9.09	8	9.41
Self-employed	12	29.26	14	31.82	26	30.58
Marital status						
Unmarried	0	0	0	0	0	0
Married	31	75.61	40	90.91	71	83.53
Widow/widower	10	24.39	4	9.09	14	16.47
Duration since diagnosis						
< 5 years	37	90.24	40	90.91	77	90.59
> 5 years	4	9.76	4	9.09	8	9.42
Hypoglycemia history						
No	30	73.17	36	81.82	66	77.65
Yes	11	26.83	8	18.18	19	22.35
Hospitalization history						
≤ 1 time	38	92.68	38	86.36	76	89.41
> 1 time	3	7.32	6	13.64	9	10.59

3.2 The effect of the FCEM intervention on fear of hypoglycemia

The effect of the FCEM intervention on fear of hypoglycemia is illustrated by the results of the difference tests shown in Table 3, which include tests for within-group differences (Wilcoxon signed rank test) for both the treatment and control groups, as well as between-group differences (independent t-test) comparing the treatment and control groups.

Table 3. Differences in fear of hypoglycemia between the treatment and control groups before and after the FCEM intervention

Group	Test	Normality test (*p*)	Mean(SD)	Wilcoxon signed rank-test		Independent t-test	
				Z	*p*	t	*p*
Treatment	Pre-test	0.149	35.59(6.892)	-5.581	0.001		
	Post-test	0.027	20.85(3.712)				
Control	Pre-test	0.914	51.36(10.041)	-3.297	0.001		
	Post-test	0.025	66.27(7.711)				
Difference (Δ)	Δ treatment group	0.143	-14.73(6.454)			-7.087	0.001
of each group	Δ control group	0.172	-3.95(7.483)				

Table 3 shows a significant difference in fear of hypoglycemia among people with T2DM in the treatment group before and after family empowerment with the FCEM. A significant difference in fear of hypoglycemia was also found in the control group, which did not receive the FCEM intervention. Negative Z scores in both the treatment and control groups indicate that the pre-test scores were higher than the post-test scores. The researchers applied the non-parametric Wilcoxon signed-rank test because one of the data sets was not normally distributed. However, the normality test results for the difference data, which showed the change in scores from the pre-test to the post-test, indicated normal distribution ($p>\alpha=0.05$). Therefore, a parametric statistical test, the independent t-test, was conducted. The independent t-test results showed a significant difference in fear of hypoglycemia between the treatment and control groups (t=-7.087, $p=0.001 <\alpha=0.05$). The negative t-value indicates that the decrease in fear of hypoglycemia scores was greater in the treatment group than in the control group. Based on the results and interpretation above, it can be concluded that the FCEM intervention has an effect on reducing fear of hypoglycemia in people with T2DM.

4. Discussion

This study examined the effect of the FCEM intervention on the fear of hypoglycemia in people with T2DM. The results showed that the FCEM intervention significantly reduced the fear of hypoglycemia in people with T2DM. The results of this study align with a previous study showing that family-based interventions significantly affected knowledge about the risk of T2DM, self-control, blood sugar measurements, and concerns about T2DM (Feng et al., 2023). In this study, there were differences in intervention between the treatment and the control groups. The treatment group received the FCEM intervention, while the control group did not receive any intervention and was only involved in the pre-test and post-test process. The FCEM intervention consisted of education and training in six sessions, followed by four mentoring sessions (Rondhianto et al., 2022, 2020). Family caregiver empowerment is an intervention that involves family empowerment in its implementation (Abedini et al., 2020; Jafari et al., 2020), which can increase self-efficacy and self-control in people with T2DM (Al Mahdi et al., 2020). The study results for the control group showed a significant decrease in fear of hypoglycemia, but not as much as in the intervention group. Respondents in the control group did not receive the FCEM intervention. They carried out their usual activities according to directions from health workers, such as visiting hospitals, attending the *Prolanis* program, and following their daily routines.

This study also showed that some respondents in the control group had a history of hypoglycemia. Patients who experience hypoglycemia often have good knowledge about it due to interactions with healthcare providers and information obtained from other sources (Fisher et al., 2018). Family caregiver empowerment interventions can increase an individual's self-efficacy, self-esteem, and self-control, allowing them to manage diabetes more effectively (Jafari et al., 2020). Self-efficacy is also essential for managing hypoglycemia events (Grammes et al., 2018).

Understanding the mechanisms underlying the fear of hypoglycemia is crucial. Tailoring diabetes education to address themes relevant to people with T2DM can help foster self-efficacy and prevent negative impacts on self-management and quality of life (Grammes et al., 2017). A previous study showed a positive correlation between self-efficacy and self-care behavior in T2DM patients, leading to improved self-care behavior and glycemic control (Tharek et al., 2018). If family self-efficacy increases, families can regain self-confidence and become more independent, relying less on health workers and engaging more in disease management discussions (Abedini et al., 2020; Jafari et al., 2020).

According to previous research, family empowerment interventions can improve family caregivers' capabilities in managing T2DM, including components like diet management, physical activity, drug management, independent blood glucose monitoring, and foot care (Rondhianto et al., 2022). Other studies also state that family-based interventions can increase families' ability to detect hypoglycemia. After the intervention, there was an increase in the motivation and awareness of respondents and their families regarding the importance of managing DM, especially the ability to detect hypoglycemia events (Damayantie et al., 2021). Additionally, family empowerment, conducted for four weeks with 120-minute home visits, positively impacted family support for people with T2DM (Luthfa & Ardian, 2019). Increasing caregiver support and supervision can assist patients, particularly those who need help preparing food, taking medication, and managing hypoglycemia before it becomes severe (Silbert et al., 2018). There is a positive relationship between family coherence and diabetes self-management ability. The greater the family support received, the better the independence of diabetes management by family caregivers will be (Rondhianto et al., 2019). Educating about hypoglycemia and fear of hypoglycemia can help reduce fear, increase medication adherence, and provide optimal glycemic control (Yuksel & Bektas, 2021). Furthermore, appropriate health education can improve patients' understanding of hypoglycemia (Huang et al., 2022).

The fear of hypoglycemia score in the intervention group was lower than in the control group, likely due to the provision of the FCEM intervention. The FCEM intervention is structured education that empowers family members as caregivers by increasing knowledge and skills in managing T2DM through three stages: education, training, and mentoring. Each family caregiver receives education and training on T2DM self-management skills gradually over six weeks, followed by mentoring (discussion and consultation) through home visits and telephone calls during weeks 7 to 10 (Rondhianto et al., 2022). In addition to receiving materials related to self-management, family caregivers also receive materials about filial values (care, respect, and responsibility), the role of nurses, and empowering family caregivers in self-managing T2DM. This helps improve their understanding of the family's roles in managing the disease and strengthens collaboration with health workers, particularly nurses (Rondhianto et al., 2020). This finding is in line with previous studies that suggest family empowerment can increase family support for diabetes management (Luthfa & Ardian, 2019), self-efficacy (Abedini et al., 2020; Jafari et al., 2020), and self-care capabilities of family caregivers (Pesantes et al., 2018; Rondhianto et al., 2022). The FCEM involves families in the intervention process to enhance caregivers' ability to manage diabetes and improve both family and patient knowledge of hypoglycemia, with one session dedicated to explaining hypoglycemia and how to manage it. Family involvement in diabetes management can facilitate health behavior improvements in people with T2DM (American Diabetes Association, 2022; Onyango et al., 2022). Providing continuous education and support from nurses to patients and families regarding hypoglycemia and fear of hypoglycemia can improve self-efficacy, self-care behavior, and glycemic control in people with T2DM (Hendrieckx et al., 2021; Tharek et al., 2018; Yuksel & Bektas, 2021). Lack of family support can lead to increased distress (Li et al., 2021), which in turn increases the risk of fear of hypoglycemia (Huang et al., 2022; Y. Wang et al., 2021). Improving family understanding and skills in T2DM management can enhance family involvement and support to help people with T2DM control blood glucose levels within the normal range and reduce fear of hypoglycemia.

5. Implication and limitations

The Family Caregiver Empowerment Model (FCEM) intervention can be used as a guideline in nursing management to address the incidence of hypoglycemia and fear of hypoglycemia in T2DM patients. Healthcare providers, especially nurses, can improve self-care management skills for people with T2DM by increasing family caregivers' health literacy and capability in T2DM self-

management to reduce patients' fear of hypoglycemia. Nurses do not only provide education and help patients make decisions but they also educate and empower family caregivers. Family caregivers are essential in assisting patients with independent care related to T2DM. One effort that can be made is to provide family empowerment interventions. Family empowerment is expected to increase family knowledge about diabetes care, which can help patients manage self-care, remind patients to control their fears, and assist in recognizing the signs and symptoms of hypoglycemia, thus reducing the fear of hypoglycemia in patients. The limitations of this study include the intervention being postponed for one week due to a significant event that required the researcher to delay the scheduled interventions. Furthermore, while the study included 85 respondents, this may not be large enough to generalize the findings to a broader population of people with T2DM and their caregivers.

6. Conclusion

This study concludes that the FCEM intervention effectively reduces the fear of hypoglycemia in people with T2DM. It enhances family caregivers' ability to manage T2DM, including regulating eating patterns, physical activity, medication, blood glucose monitoring, and foot care. Family caregivers with adequate skills in T2DM self-management can be directly involved in the care of people with T2DM. Family involvement can provide maximum support in diabetes care, increasing awareness, self-confidence, and self-control among people with T2DM. This, in turn, can improve the self-management abilities of people with T2DM, which is necessary for controlling blood sugar and reducing fear of hypoglycemia. Further research can re-examine the effectiveness of the FCEM intervention in different locations/settings with a diverse and larger sample size.

Acknowledgment

The researchers are deeply grateful to all respondents who have participated in this study. They also express their deepest gratitude to the Jember District Health Office, especially the Public Health Center where the study took place. We express our appreciation to the Institute of Research and Community Service, Universitas Jember, which has facilitated this study.

Author contribution

RR, the primary author, selected the theme, developed the concept and intervention protocol, collected and analyzed data, and compiled the manuscript. KK, as a member author, played a role in preparing references, analyzing data, and refining the discussion. MNR, as a member author, compiled the manuscript, collected research data, and compiled the results and discussion.

Conflict of interest

The authors declare no conflict of interest.

References

Abedini, F., Zareiyan, A., & Alhani, F. (2020). The effects of the family-centered empowerment model on self-efficacy and self-esteem among the family caregivers of patients with prosthetic heart valve: A controlled clinical trial. *Nursing and Midwifery Studies, 9*(2), 61–67. https://doi.org/10.4103/nms.nms_45_18

Al Mahdi, F., Negara, C. K., & Basid, A. (2020). The effect of family empowerment in nursing implementation toward self-efficacy among patients with diabetes mellitus. *Indonesian Nursing Journal of Education and Clinic (INJEC), 5*(2), 141–146. https://doi.org/10.24990/injec.v5i2.303

American Diabetes Association. (2022). 5. Facilitating behavior change and well-being to improve health outcomes: Standards of medical care in diabetes—2022. *Diabetes Care, 45*(Suppl. 1), S60–S82. https://doi.org/10.2337/dc22-S005

American Diabetes Association. (2023). 5. Facilitating positive health behaviors and well-being to improve health outcomes: Standards of care in diabetes—2023. *Diabetes Care, 46*(Suppl. 1), S68–S96. https://doi.org/10.2337/dc23-S005

Andriyanto, A., Rekawati, E., & Rahmadiyah, D. C. (2019). Increasing knowledge, attitudes, skills, and glucose control in type-2 diabetic patients through EMAS interventions. *Nurse Media Journal of Nursing, 9*(2), 141–150. https://doi.org/10.14710/nmjn.v9i2.22989

Appil, R., Sjattar, E. L., Yusuf, S., & Kadir, K. (2022). Effect of family empowerment on HbA1c levels and healing of diabetic foot ulcers. *International Journal of Lower Extremity Wounds, 21*(2), 154–160. https://doi.org/10.1177/1534734620930120

Damayantie, N., Dewi, M., Rusmimpong, R., & Masnah, C. (2021). Diabetes self-management education effect on family knowledge of hypoglycemia episodes detection on type 2 diabetes mellitus. *Open Access Macedonian Journal of Medical Sciences, 9*(E), 1398–1402. https://doi.org/10.3889/oamjms.2021.7275

Damhudi, D., Kertia, N., & Effendy, C. (2021). The effect of modified diabetes self-management education and support on self-care and quality of life among patients with diabetic foot ulcers in rural area of Indonesia. *Open Access Macedonian Journal of Medical Sciences, 9*(G), 81–87. https://doi.org/10.3889/oamjms.2021.6614

Deswita, D., Sefrizon, S., Mirawati, A., Zulharmaswita, Z., Afconneri, Y., Deharnita, D., & Hardoni, Y. (2020). Empowerment strategies through coaching interventions on controlling blood sugar levels in the elderly. *Indonesian Journal of Global Health Research, 2*(1), 65–72. https://doi.org/10.37287/ijghr.v2i1.68

Feng, Y., Zhao, Y., Mao, L., Gu, M., Yuan, H., Lu, J., Zhang, Q., Zhao, Q., & Li, X. (2023). The effectiveness of an eHealth family-based intervention program in patients with uncontrolled type 2 diabetes mellitus (T2DM) in the community via WeChat: Randomized controlled trial. *JMIR MHealth and UHealth, 11,* e40420. https://doi.org/10.2196/40420

Fisher, S. J., Huang, X., Pawaskar, M., Witt, E. A., Rajpathak, S., Shankar, R. R., & Inzucchi, S. E. (2018). Hypoglycemia in type 2 diabetes: Understanding patients' and physicians' knowledge and experience. *Endocrine, 60*(3), 435–444. https://doi.org/10.1007/s12020-018-1545-0

Grammes, J., Schäfer, M., Benecke, A., Löw, U., Klostermann, A. L., Kubiak, T., & Witthöft, M. (2018). Fear of hypoglycemia in patients with type 2 diabetes: The role of interoceptive accuracy and prior episodes of hypoglycemia. *Journal of Psychosomatic Research, 105,* 58–63. https://doi.org/10.1016/j.jpsychores.2017.12.010

Grammes, J., Stock, W., Mann, C. G., Flynn, E. M., & Kubiak, T. (2017). Focus group study to identify the central facets of fear of hypoglycaemia in people with type 2 diabetes mellitus. *Diabetic Medicine, 34*(12), 1765–1772. https://doi.org/10.1111/dme.13506

Haluzik, M., Kretowski, A., Strojek, K., Czupryniak, L., Janez, A., Kempler, P., Andel, M., Tankova, T., Boyanov, M., Smircic Duvnjak, L., Madacsy, L., Tarnowska, I., Zychma, M., & Lalic, N. (2018). Perspectives of patients with insulin-treated type 1 and type 2 diabetes on hypoglycemia: Results of the HAT observational study in central and eastern European countries. *Diabetes Therapy, 9*(2), 727–741. https://doi.org/10.1007/s13300-018-0388-2

Hendrieckx, C., Halliday, J., Beeney, L., & Speight, J. (2021). *Diabetes and emotional health: A practical guide for health professionals supporting adults with type 1 and type 2 diabetes* (3rd ed.). American Diabetes Association.

Huang, J., Peng, W., Ding, S., Xiong, S., & Liu, Z. (2022). Fear of hypoglycemia and associated factors in hospitalized patients with type 2 diabetes: A cross-sectional study. *Scientific Reports, 12*, 20338. https://doi.org/10.1038/s41598-022-24822-1

International Diabetes Federation. (2021). *IDF diabetes atlas* (10th ed.). International Diabetes Federation. https://doi.org/10.1016/j.diabres.2013.10.013

Jafari, Y., Tehrani, H., Esmaily, H., Shariati, M., & Vahedian-shahroodi, M. (2020). Family-centered empowerment program for health literacy and self-efficacy in family caregivers of patients with multiple sclerosis. *Scandinavian Journal of Caring Sciences, 34*(4), 956–963. https://doi.org/10.1111/scs.12803

Li, S., Fang, L., Lee, A., Hayter, M., Zhang, L., Bi, Y., Wu, X., Liu, L., Zhang, H., Yuan, Y., Gong, W., & Zhang, Y. (2021). The association between diabetes-related distress and fear of hypoglycaemia in patients with type 2 diabetes mellitus: A cross-sectional descriptive study. *Nursing Open, 8*(4), 1668–1677. https://doi.org/10.1002/nop2.800

Luthfa, I., & Ardian, I. (2019). Effects of family empowerment on increasing family support in patients with type 2 diabetes mellitus. *Nurse Media Journal of Nursing, 9*(1), 58–68. https://doi.org/10.14710/nmjn.v9i1.22501

Onyango, J. T., Namatovu, J. F., Besigye, I. K., Kaddumukasa, M., & Mbalinda, S. N. (2022). The relationship between perceived social support from family and diabetes self-management among patients in Uganda. *Pan African Medical Journal, 41*(279). https://doi.org/10.11604/pamj.2022.41.279.33723

Ortiz, M. T. A., Caballero, F. F., de Adana, M. S. R., & Haya, C. (2011). Development of a new fear of hypoglycemia scale: FH-15. *Psychological Assessment, 23*(2), 398–405. https://doi.org/10.1037/a0021927

Pamungkas, R. A., & Chamroonsawasdi, K. (2020). Self-management based coaching program to improve diabetes mellitus self-management practice and metabolic markers among uncontrolled type 2 diabetes mellitus in Indonesia: A quasi-experimental study. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14*(1), 53–61. https://doi.org/10.1016/j.dsx.2019.12.002

Pesantes, M. A., Del Valle, A., Diez-Canseco, F., Bernabé-Ortiz, A., Portocarrero, J., Trujillo, A., Cornejo, P., Manrique, K., & Miranda, J. J. (2018). Family support and diabetes: Patient's experiences from a public hospital in Peru. *Qualitative Health Research, 28*(12), 1871–1882. https://doi.org/10.1177/1049732318784906

Roessanti, N. D., Sutawardana, J. H., & Kushariyadi. (2022). Relationship between fear of hypoglycemia and self-management of type 2 diabetes mellitus patients at dr. Soebandi hospital, Jember. *Pustaka Kesehatan, 10*(1), 59–66. https://doi.org/10.19184/pk.v10i1.11326

Rondhianto, R., Nursalam, N., Kusnanto, K., & Melaniani, S. (2022). The effect of family caregiver empowerment interventions on family caregiver capabilities in self-management of type 2 diabetes mellitus in Indonesia. *Enfermeria Clinica, 32*(6), 385–395. https://doi.org/10.1016/j.enfcle.2022.01.005

Rondhianto, R., Nursalam, N., Kusnanto, K., & Melaniani, S. (2020). Development of family caregiver empowerment model (FCEM) to improve family caregiver capability on type 2 diabetes self-management. *Systematic Reviews in Pharmacy, 11*(6), 1042–1051. https://doi.org/10.31838/srp.2020.6.149

Rondhianto, R., Nursalam, N., Kusnanto, K., Melaniani, S., & Ahsan, A. (2019). Analysis of the sociodemographic and psychological factors of the family caregivers' self-management capabilities for type 2 diabetes mellitus. *Jurnal Ners, 14*(2), 215–223. https://doi.org/10.20473/jn.v14i2.16592

Rondhianto, R., Ridla, A. Z., & Budi, F. A. K. S. (2023). Analysis of psychosocial factors affecting dietary behavior among people with type 2 diabetes mellitus in Indonesia. *Jurnal Keperawatan Soedirman, 18*(3), 122–128. https://doi.org/10.20884/1.jks.2023.18.3.6488

Rusdiana, R., Savira, M., Widjaja, S. S., & Ardinata, D. (2020). The effect of health education on control glycemic at type 2 diabetes mellitus patients. *Open Access Macedonian Journal of Medical Sciences, 8*(E), 133–137. https://doi.org/10.3889/oamjms.2020.3371

Sari, C. W. M., Witdiawati, W., Purnama, D., Kurniawan, T., & Santoso, M. B. (2022). Effect of integrated care programs on self-efficacy and self-management behaviors among diabetic in a primary health care in Indonesia. *Malaysian Journal of Medicine and Health Sciences, 18*(Supp. 3), 157–161.

Silbert, R., Salcido-Montenegro, A., Rodriguez-Gutierrez, R., Katabi, A., & McCoy, R. G. (2018). Hypoglycemia among patients with type 2 diabetes: Epidemiology, risk factors, and prevention strategies. *Current Diabetes Report, 18*(53), 1–27. https://doi.org/10.1007/s11892-018-1018-0

Subrata, S. A. (2021). The nursing outlook of the self-and family management support programs among Indonesians with diabetes: An umbrella review. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 15*(1), 109–119. https://doi.org/10.1016/j.dsx.2020.12.018

Tharek, Z., Ramli, A. S., Whitford, D. L., Ismail, Z., Mohd Zulkifli, M., Ahmad Sharoni, S. K., Shafie, A. A., & Jayaraman, T. (2018). Relationship between self-efficacy, self-care behaviour and glycaemic control among patients with type 2 diabetes mellitus in the Malaysian primary care setting. *BMC Family Practice, 19*, 39. https://doi.org/10.1186/s12875-018-0725-6

Wang, X., Luo, J. F., Qi, L., Long, Q., Guo, J., & Wang, H. H. (2019). Adherence to self-monitoring of blood glucose in Chinese patients with type 2 diabetes: Current status and influential factors based on electronic questionnaires. *Patient Preference and Adherence, 13,* 1269–1282. https://doi.org/10.2147/PPA.S211668

Wang, Y., Zeng, Z., Ding, J., Yuan, R., Wang, R., Zhang, Y., Bai, L., Yu, H., & Tang, J. (2021). Fear of hypoglycaemia among patients with type 2 diabetes mellitus: A cross-sectional study. *Scientific Reports, 11*(1), 1–8. https://doi.org/10.1038/s41598-021-86954-0

Yuksel, M., & Bektas, H. (2021). Compliance with treatment and fear of hypoglycaemia in patients with type 2 diabetes. *Journal of Clinical Nursing, 30*(11–12), 1773–1786. https://doi.org/10.1111/jocn.15736