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The Effect of Family-Centered Empowerment Model on Social Support, Medication Adherence, and Blood Pressure Control in Patients with Hypertension

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Abstract

Background: Hypertension is highly prevalent and a major contributor to cardiovascular diseases, imposing significant economic and social burdens. Effective, theory-based interventions are required to improve clinical and behavioral outcomes.

Aim: This study aimed to investigate the effect of the Family-Centered Empowerment Model on social support, medication adherence, and blood pressure control in patients with hypertension.

Method: This randomized controlled clinical trial was conducted on 80 patients with hypertension and their family caregivers from a comprehensive health center in Mashhad, Iran. The selected center was affiliated with Mashhad Health Center No. 1 which has 20 comprehensive health services centers. Participants were randomly assigned to intervention and control groups using block randomization (blocks of four) with concealed allocation via sealed opaque envelopes. The intervention group participated in six weekly sessions grounded in the family-centered empowerment model, while the control group received standard verbal education and pamphlets. Data collection tools included a demographic questionnaire, Sherbourne–Stewart Social Support Questionnaire, Morisky Medication Adherence Scale, and a calibrated mercury sphygmomanometer. Measurements occurred before and two months post-intervention. Statistical analyses were conducted using independent t-test, Mann–Whitney, and Wilcoxon tests via SPSS version 25.

Results: At baseline, no statistically significant differences were observed between the two groups in social support, medication adherence, or systolic and diastolic blood pressure ($p>0.05$). After the intervention, the intervention group showed significantly higher levels of social support and medication adherence, as well as significantly lower systolic and diastolic blood pressure compared to the control group ($p<0.001$).

Implications for Practice: Family-centered empowerment-model education can improve social support, adherence, and blood pressure control in hypertensive patients and is recommended for patient and family education. Integration of this structured family-based approach into primary care settings is recommended.

Keywords: Family-Centered Empowerment Model, Hypertension, Medication Adherence, Social Support

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Introduction

Hypertension remains a leading risk factor for cardiovascular morbidity and mortality worldwide, particularly in low- and middle-income countries where adherence to antihypertensive treatment is often suboptimal. It is estimated that over 1.3 billion adults globally are affected by hypertension, contributing to nearly 5 million deaths annually (1). In Iran, approximately 30% of the adult population is affected by hypertension, highlighting the magnitude of this public health challenge (2). Although pharmacological treatment plays a crucial role in blood pressure control, achieving optimal therapeutic outcomes requires continuous adherence to medical recommendations and modifications in health-related behaviors. One of the major challenges is poor adherence to medication, diet, physical activity, and regular medical visits (3). A systematic review and meta-analysis reported that approximately 45% of hypertensive patients are non-adherent to antihypertensive medications, and over 83% of those with uncontrolled blood pressure are severely non-adherent (4). In recent years, there has been a growing interest in non-pharmacological interventions that leverage family dynamics to improve patient outcomes. Patients in several studies reported that the absence of family motivation and cooperation increased feelings of loneliness, hopelessness, and reduced adherence to treatment (5).

Evidence suggests that social support, especially from family, plays a pivotal role in enhancing treatment adherence in hypertensive patients (6). Family-involved interventions can significantly improve health outcomes. One study showed that family supervision and participation led to increased treatment adherence and reduced blood pressure, attributed to the quality of support provided by family members (7). Despite this, another study indicated that nearly 27% of hypertensive patients receive no social support at all (8). Social support encompasses emotional, informational, instrumental, and appraisal resources provided by an individual's social network. Such support may be expressed through empathy, guidance, financial or practical help, and social affirmation, and it plays a key role in reducing stress, improving mental and physical health, and enhancing treatment outcomes (9). Multidimensional family support through emotional reinforcement, information sharing, behavioral structuring, and self-efficacy can improve blood pressure control and treatment adherence, making it a critical component in community-level hypertension management interventions (10).

The family-centered empowerment model, a theoretical framework based on active family participation in care processes, emphasizes enhancing family members' knowledge, self-efficacy, responsibility, and supportive skills. This model promotes sustained interaction between the care team and the family, thus motivating patients and facilitating health behavior change and blood pressure control (8). However, there is insufficient interventional evidence regarding its application among hypertensive patients, particularly within the cultural context of Iran, where family structures are central. Despite evidence supporting the positive impact of family involvement in hypertension outcomes, most existing interventions lack a cohesive, model-driven framework and are often implemented in an unsystematic manner without systematic strategies. The studies show that interventions such as family member supervision or general caregiver education have yielded partial improvements, yet their lack of conceptual modeling has hindered the development of repeatable, evaluable, and generalizable approaches for enhancing adherence and social support (10-12).

A review of the literature has shown that the family-centered empowerment model has been found to be effective in improving quality of life, knowledge, self-esteem, and self-efficacy in patients with hypertension (13-15). Given the limited studies on the impact of the family-centered empowerment model on social support, medication adherence, and blood pressure control that these factors critically important in disease management, it appears that family-centered empowerment model, by promoting active family involvement, could potentially offer significant benefits. By integrating family caregivers into disease management, this study hypothesizes a bidirectional reinforcement loop wherein social support enhances adherence, improved adherence strengthens patients' understanding of control, and ultimately leads to better blood pressure regulation. This study aimed the effect of the family-centered empowerment model on social support, medication adherence, and blood pressure control in patients with hypertension.

Methods

This is a randomized controlled clinical trial with a pre-test post-test design, conducted in 2022 at Danesh-Amouz, a comprehensive health service center in Mashhad, located in northeastern Iran. The selected center was affiliated with Mashhad Health Center No. 1 which has 20 comprehensive health services centers and was situated in an urban area with a medium socioeconomic status and served a population of over 50,000 individuals. The center provided services related to the elderly, middle-aged adults, children, pregnant women, communicable and non-communicable diseases, vaccination, environmental health, and occupational health. The study population included patients diagnosed with hypertension and their family caregivers.

The sample size was calculated using the formula for comparing means and standard deviations of dependent variables (social support, treatment adherence, and systolic/diastolic blood pressure). According to the study by Mirniam et al. (2019) and Jafari et al. (2021) 2.5 and 2 participants per group were calculated for the mentioned dependent variables, respectively (16, 17). Given the low sample size calculated, the following formula was used to calculate the sample size, with 95% confidence ($Z_{1-\frac{\alpha}{2}}$) and a test power 80% ($Z_{1-\beta}$) to achieve an effect size (f^2) of 0.7, that obtained 32 participants per group. Considering a 20% attrition rate, the final sample size was determined to be 80 patients and their family caregivers. 112 participants enrolled in the study, however, 24 did not meet the inclusion criteria and 8 declined to participate in the study (Figure 1).

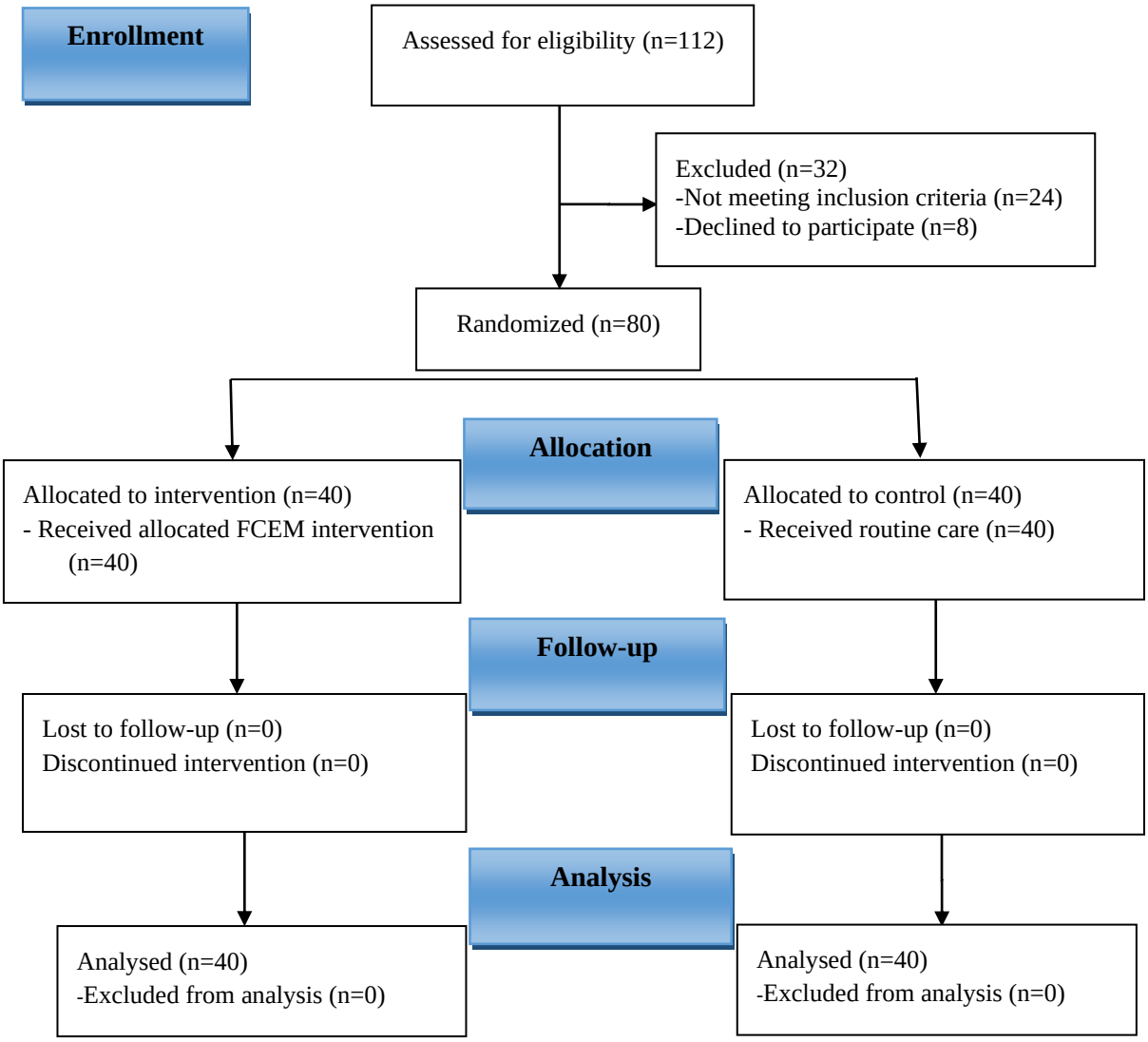

Figure 1. Flowchart of the effect of Family-Centered Empowerment Model on social support, medication adherence, and blood pressure control in patients with hypertension

Thus, 80 patients with hypertension along with their family caregivers were selected using the convenience sampling method and randomly allocated to the intervention and control groups (each group including 40 patients and their family caregivers). Randomization was done through permuted block using blocks of four sequentially numbered method and opaque sealed envelopes was used for concealment. Therefore, both of the moderator and participants were blinded to group allocation.

Inclusion criteria were: age ≥18 years, confirmed diagnosis of primary hypertension by a physician, at least six months since diagnosis, ability to attend educational sessions, having a family caregiver, and providing written informed consent. Exclusion criteria included having other uncontrolled chronic diseases, active psychiatric disorders, inability to regularly attend training sessions, or lack of caregiver cooperation.

Data collection tools included the following:

-Demographic Questionnaire for Patients and Caregivers:

This researcher-developed questionnaire was formulated based on reliable sources and previous studies. It collected information such as age, gender, education level, occupation, duration of illness, weight, body mass index (BMI), presence of comorbidities, and duration of caregiving. To assess content validity, the questionnaire was reviewed by seven faculty members from the School of Nursing, and the final version was developed after incorporating their suggested revisions. Given its design based on similar studies and repeated use in previous research, the tool's reliability is considered confirmed.

-Medical Outcomes Study Social Support Survey (MOS-SSS):

This is a standardized instrument designed to measure individuals perceived social support, originally developed by Sherbourne and Stewart in 1991. The questionnaire consists of 19 items across four subscales: emotional/informational support (8 items), tangible support (4 items), positive social interaction (4 items), and affectionate support (3 items). Responses are rated on a 5-point Likert scale ranging from 1 (never) to 5 (always). Higher total scores indicate a greater perception of received social support, with the total score ranging from 19 - 95. In the original study by Sherbourne and Stewart, internal consistency using Cronbach's alpha ranged from 0.91 to 0.97, indicating excellent reliability (18). The questionnaire has been translated into Persian and psychometrically validated in multiple Iranian studies, showing acceptable reliability. For example, in the study by Mousavi-Nasab et al. (2018), internal and external reliability were reported as 0.85 and 0.83, respectively, using Cronbach's alpha (19). In the present study, content validity was confirmed by a panel of 7 faculty members from the School of Nursing and Midwifery, Mashhad. Additionally, the internal consistency of the total social support score was assessed using Cronbach's alpha, yielding a value of 0.88.

-Morisky Medication Adherence Scale (MMAS):

The Morisky Medication Adherence Scale is a validated instrument for assessing patients' adherence to pharmacological treatment. The 8-item version (MMAS-8) consists of 8 items, with dichotomous (yes/no) responses for the first 7 questions and a 5-point Likert scale for the final item. The total score ranges from 0 to 8, where scores below 6 indicate low adherence, 6 to less than 8 indicate medium adherence, and a score of 8 reflects high adherence. The tool was psychometrically validated in numerous international and Iranian studies. In the original study by Morisky et al. (2008), internal consistency was reported with a Cronbach's alpha of 0.83 (20). In Iran, Laghousi et al. (2021) psychometrically validated the Persian version and reported a Cronbach's alpha of 0.83 (21). In the present study, to evaluate content validity, the instrument was reviewed by seven faculty members of the School of Nursing and Midwifery in Mashhad, and its alignment with the research objectives was confirmed. To assess reliability, a Cronbach's alpha coefficient of 0.79 was obtained for the total medication adherence score.

-Standard calibrated mercury sphygmomanometer:

To determine reliability, inter-rater reliability was used. Blood pressure of ten patients was independently measured by two experienced nurses, and the correlation coefficient between the two raters was calculated as 0.87, indicating good reliability of the blood pressure measurement tool.

The Family-Centered Empowerment Model (FCEM) intervention was conducted over a period of 6 weeks and consisted of six structured sessions delivered in small groups (6–8 dyads of patients and their primary family caregivers). Each session lasted approximately 45-60 minutes and was facilitated by a trained nurse educator. Multimedia methods, group discussions, educational pamphlets, practical scenarios, and individual exercises were used. Participants in the control group received standard

hypertension education from the health center, including routine pamphlets and individual brief counseling (10–15 minutes), but no structured group sessions or family involvement. The intervention model was structured according to the four core constructs of the Family-Centered Empowerment Model (22), including:

-Perceived Threat: The first and second sessions focused on raising awareness about complications of hypertension (e.g., stroke, heart failure, renal damage). Patients and caregivers were introduced to these risks through slides, pamphlets, and group discussions.

-Self-Efficacy: Sessions three and four focused on training in problem-solving and self-care skills. Practical scenarios were used to overcome treatment barriers such as medication nonadherence or dietary challenges. Blood pressure measurement training was conducted by the researcher, and participants repeated the process until they could independently perform it.

-Educational Participation: In sessions five and six, patients and caregivers were encouraged to verbally recall educational content and design individualized plans for blood pressure management. Caregivers practiced active roles in behavioral support and treatment reminders.

Evaluation: Formative evaluation was performed orally during sessions by reviewing previous content. Summative evaluation, including final outcome assessments (social support, treatment adherence, blood pressure), was conducted two months after the intervention.

Data on medication adherence and perceived social support were collected at two time points: before the intervention and two months after the final training session. Systolic and diastolic blood pressure for each participant was measured using a calibrated mercury sphygmomanometer in four sessions, and the average was recorded. Blood pressure was measured by a trained researcher at the study's start (week 0), at weeks 4 and 8, and two months post-intervention. Each participant's data were recorded on a separate form, including their code, measurement date and time, relevant pre-measurement conditions (e.g., rest, medication intake), and results. Responses were entered into the database using a unique participant code. No identifying information was recorded to ensure anonymity and data integrity, and data entry was performed independently by two individuals.

Data were analyzed using SPSS version 25. Descriptive statistics (mean, SD, frequency, and percentage) were used to summarize demographic and baseline variables. The normality of data distribution was assessed using the Kolmogorov–Smirnov test. The t-test (or Mann–Whitney U test) and the Chi-square test (or exact Chi-square test) were used to compare two groups in demographic and confounding variables. Moreover, the independent t-test (or Mann–Whitney U) was used for between-group comparisons, and the paired t-test (or Wilcoxon) was used for within-group comparisons before and after intervention. $p<0.05$ was considered statistically significant.

Ethical Consideration

This study was approved by the Research Ethics Committee of Mashhad University of Medical Sciences (ethics code: IR.MUMS.NURSE.REC.1400.018). The trial was prospectively registered at the Iranian Registry of Clinical Trials (IRCT20210622051661N1).

In order to observe the research's ethical principles, participants were provided with explanations regarding the research purpose and nature, the voluntary participation, the right to withdraw from the research at any time, and confidentiality and anonymity. Written informed consent was also obtained. Questionnaires were filled out with complete privacy for the participants. An educational booklet containing all the information from the empowerment sessions was provided to the control group after the completion of the study.

Results

The mean age of the patients was 67.63 ± 6.27 years (Table 1), and the mean age of caregivers was 55.98 ± 8.39 years (Table 2). Over 55% of the patients and more than 65% of the caregivers were female. There were no statistically significant differences between the intervention and control groups in terms of demographic variables (age, gender, education).

Before the intervention, there were no statistically significant differences between two groups regarding main variables including social support, treatment adherence, and blood pressure ($p>0.05$) (Tables 1 and 2).

Table 1. Demographic characteristics of patients with hypertension in the intervention and control groups

Variable	Intervention Group (n=40)	Control Group (n=40)	Test result
Age (years), Mean ± SD	68.35±5.27	66.92±7.13	t= -1.015, p=0.313*
Weight (Kg), Mean ± SD	72.81±6.79	73.76±6.88	Z=- 0.626, p= 0.532***
BMI (kg/m^2), Mean ± SD	26.85±2.21	27.03±3.26	t= 0.276, p= 0.783*
Duration of hypertension (years)	10.85±2.85	9.50±2.64	Z= -0.330, p= 0.741***
Gender, n (%)			
Male	22 (55)	25 (65.25)	χ^2=0.464, p=0.496**
Female	18 (45)	15 (37.5)	
Education level, n (%)			
Illiterate	1 (0.0)	2 (5)	
Primary	9 (22.5)	13 (32.5)	p=0.768****
Secondary	23 (57.55)	17 (42.55)	
Diploma	6 (15)	7 (17.5)	
University	1 (2.5)	1 (2.5)	
Employment status, n (%)			
Employed	12 (30)	13 (3.25)	p=0.719****
Retired	10 (25)	9 (22.5)	
Housewife	17 (42.5)	16 (40)	
Unemployed	1(2.5)	2 (5)	
History of comorbidities			
Yes / No (n, %)	Y: 17 (42.5) N: 23 (57)	Y: 19(47.5) N: 21 (52.5)	χ^2=0.202 p=0.653**
Type of comorbidity			
Diabetes	11 (64.7)	10 (52.7)	p=0.617****
Cardiovascular	6 (35.3)	5 (26.3)	
Renal	0 (0.0)	2 (10.5)	
Others	0 (0.0)	2 (10.5)	
Marital status, n (%)			
Single	0 (0)	1 (2.5)	p=0.314****
Married	40 (100)	39 (97.5)	

*Independent t test; **Chi-square test; ***Mann-Whitney U test; **** Exact Chi-square test

After the intervention, the mean score of social support in the intervention group significantly increased from 50.22 ± 4.35 to 54.90 ± 3.42 (p<0.001), and the mean score of medication adherence also increased from 5.22 ± 1.54 to 6.95 ± 1.13 (p<0.001) (Table 3).

Systolic blood pressure significantly decreased from 15.62 ± 0.96 to 14.73 ± 0.84 and diastolic blood pressure significantly decreased from 9.26 ± 0.54 to 8.77 ± 0.53 (p<0.001) (Table 4).

In the control group, no significant changes were observed in any of the examined variables (p>0.05). Multivariate analysis of variance showed that the effects of the intervention were independent of potential confounding variables such as age, education level, and duration of hypertension.

Table 2. Demographic characteristics of caregivers in the intervention and control groups

Variable	Intervention Group (n= 0)	Control Group (n=40)	Test result
Age (years), Mean ± SD	57.12±8.86	54.84±7.93	Z= -1.366, p=0.176*
Gender, n (%)			
Male	12 (30)	14 (65)	χ^2=0.228, p=0.633**
Female	28 (70)	26 (35)	
Duration of patient care (years)	8.00±3.49	7.65±2.68	Z=- 0.419, p= 0.675*
Relationship to patient, n (%)			
Spouse	21 (52.5)	27	
Child	7 (17.5)	7 (17.5)	
Mother	4 (10)	0 (0.00)	χ^2= 5.417, p= 0.386***
Father	4 (10)	2 (5)	
Sister	1 (2.5)	1 (2.5)	
Brother	3 (7.5)	3 (7.5)	
Education level, n (%)			
Primary	19 (47.5)	15 (37.5)	
Secondary	14 (35)	15 (37.5)	p=0.783***
Diploma	4 (10)	6 (15)	
University	3 (7.5)	4 (10)	
Employment status, n (%)			
Employed	12 (30)	13 (3.25)	
Retired	4 (10)	4 (10)	p=0.806***
Housewife	20 (50)	21 (52.5)	
Unemployed	4 (10)	2 (5)	
Marital status, n (%)			
Single	0 (0)	1 (2.5)	
Married	35 (83.45)	34 (42.5)	χ^2=0.105, p=0.745**
Widowed	5 (6.25)	5 (6.25)	

*Mann-Whitney U test; **Chi-square test; *** Exact Chi-square test

Table 3. Comparison of social support and medication adherence scores in patients with hypertension in the intervention and control groups

Variable	Time of Measurement	Intervention Group (n=40)	Control Group (n=40)	Between groups comparison
Social Support	Before the intervention	50.22±4.35	51.80±4.42	t= 1.605 p=0.112*
	After the intervention	54.90±3.42	51.07±4.83	Z= -3.52 p<0.001**
	Difference between before and after the intervention	4.67±2.56	-0.72±2.94	Z= -7.331 p<0.001**
	Within groups comparison	Z= -5.534 p<0.001***	Z= -0.991 p=0.332***	
	Effect size (Cohen's d) for intervention group difference = 0.91 (large effect)			
Medication Adherence	Before the intervention	5.22±1.54	5.56±1.95	Z= 0.942 p=0.344**
	After the intervention	6.95±1.13	5.35±1.57	Z= -4.526 p<0.001**
	Difference between before and after the intervention	1.72±1.32	-0.30±0.93	Z= -7.331 p<0.001**
	Within groups comparison	Z= 4.908 p<0.001***	t= 1.020 p=0.050****	
	Effect size (Cohen's d) for intervention group difference = 1.17 (large effect)			

*Independent t test; **Mann-Whitney U test; ***Wilcoxon test; ****Paired T test

Table 4. Comparison of systolic/diastolic blood pressure in patients with hypertension in the intervention and control groups

Variable	Time of Measurement	Intervention Group (n=40)	Control Group (n=40)	Between groups comparison
Systolic Blood Pressure (mmHg)	Before the intervention	15.62±0.96	15.06±1.41	Z= 0.010 p=0.992*
	After the intervention	14.73±0.84	15.92±1.53	***t***= 7.786 p<0.001**
	Difference between before and after the intervention	-0.89±0.12	0.86±1.16	Z= -6.283 p<0.001*
	Within groups comparison	Z= -5.293 p<0.001***	Z = -0.964 p=0.335***	
	Effect size (Cohen's d) for intervention group difference = -0.96 (large effect)			
Diastolic Blood Pressure (mmHg)	Before the intervention	9.26±0.54	9.35±0.63	Z= 0.362 p=0.717*
	After the intervention	8.57±0.50	9.28±0.55	Z = -4.526 p<0.001*
	Difference between before and after the intervention	-0.69±0.04	0.07±0.08	Z= -4.898 p<0.001*
	Within groups comparison	Z= -4.621 p<0.001***	Z = 0.507 p=0.612***	
	Effect size (Cohen's d) for intervention group difference = -1.36 (very large effect)			

*Mann-Whitney U test; **Independent t test; ***Wilcoxon test

Discussion

This study aimed to assess the impact of a Family-Centered Empowerment Model (FCEM) on medication adherence, perceived social support, and blood pressure control among patients with hypertension. The findings demonstrated that FCEM significantly improved all three outcomes over time compared to the control group.

These results are consistent with the study by Keshvari et al. (2015), which reported the effectiveness of this model in enhancing empowerment dimensions and reducing blood pressure in the elderly (8). Similarly, the findings of Mohali et al. (2016) also support the conclusion that family-centered empowerment interventions can effectively reduce blood pressure (23). The increase in social support in the intervention group is likely related to family participation in the educational sessions and the enhancement of emotional, informational, and instrumental interactions between the patient and family members. Such support, particularly from family, plays a critical role in reducing stress and increasing the patient's motivation to adhere to treatment. This systematic integration was likely the key factor contributing to the overall improvements observed in this study. Similarly, Turan et al. (2019) reported that social support directly improves treatment adherence in hypertensive patients (6). The present results extend these findings by illustrating that when social support is systematically cultivated through family engagement, it not only improves adherence but also reduces stress-related physiological activation. Such multidimensional effects are rarely captured in studies that lack a theoretical backbone.

The present study's findings regarding the role of social support in improving treatment adherence and blood pressure control are in line with reports by Pen et al. (2021) (24). However, this alignment must be analyzed in terms of scope, context, and depth of intervention. In Pen's study, social support was presented as a predictive variable, but no specific or integrated framework was used to enhance it. In contrast, the present study followed a structured conceptual model explicitly focused on empowering the family to act as a facilitator of the patient's treatability behavior. This distinction is crucial, as using models such as FCEM targets not only perceived social support but also the

cognitive, emotional, and functional components of family interaction, potentially making the intervention more sustainable and multidimensional.

The findings are also consistent with the results of the randomized clinical trial by Criswell et al. (2010), which examined the impact of self-efficacy-based interventions on medication adherence in patients with hypertension (25). In that study, enhanced social support alongside increased self-efficacy significantly improved treatment adherence and blood pressure control. However, the theoretical framework of the FCEM employed in the current study emphasizing active family participation and systematic stages of education and self-efficacy enhancement addresses broader aspects of social support and its role in sustaining therapeutic behavior. Unlike many unstructured interventions that merely offer general support, FCEM targets cognitive, emotional, and functional domains, enhancing both the effectiveness and generalizability of interventions. Thus, while both studies yielded aligned results, the main distinction lies in the application of a structured conceptual model enabling multidimensional analysis and improvement of treatment adherence.

The increased medication adherence observed in the intervention group can be attributed to training focused on enhancing self-efficacy and developing problem-solving skills. In this model, patients learn to identify and effectively overcome barriers such as forgetting medication or financial constraints. Likewise, Criswell et al. (2010) demonstrated that self-efficacy-based interventions improve adherence and blood pressure control (25). Nevertheless, the FCEM used here broadens the conceptual focus by embedding self-efficacy within family dynamics and reciprocal interactions. Instead of treating the patient as an isolated unit of behavior change, FCEM mobilizes family members as active co-regulators of the therapeutic process, thereby amplifying the intervention's effectiveness. Our study approach is consistent with the findings of Uchmanowicz et al. (2018), which showed the positive effects of self-efficacy-based education on medication adherence in hypertensive patients (26). Additionally, the positive correlation between social support and treatment adherence observed in our study aligns with the findings of Hanifah et al. (2021), who reported a link between social support and dietary compliance (27).

In our study, the significant reduction in both systolic and diastolic blood pressure in the intervention group reflects the positive impact of the applied model on patients' physiological outcomes. This effect may result from the interaction of several key mechanisms. First, structured model-based education increased patients' awareness of risk factors and blood pressure control strategies, thereby improving treatment adherence. Second, the promotion of self-care skills such as adherence to a low-sodium diet, regular physical activity, weight control, and reduced smoking directly affected vascular resistance and cardiac output, leading to lowered blood pressure. Third, active social support through family or caregiver involvement in the treatment process played a significant role in reducing psychological stress and enhancing patients' behavioral motivation, which in turn led to better blood pressure regulation through neuroendocrine pathways, such as decreased cortisol secretion and modulation of sympathetic nervous system activity. Finally, active patient participation in ongoing evaluation and receiving regular feedback increased their internal locus of control and self-efficacy, thereby sustaining effective behavioral changes at the physiological level. This finding aligns with the study by Mehta et al. (2024), which demonstrated that social support effectively reduces patients' blood pressure (28). However, Mehta's study focused solely on remote monitoring and limited interaction with a support partner, lacking direct education on lifestyle or self-efficacy. In contrast, the present study involved a multidimensional intervention with a defined theoretical framework (FCEM), including behavioral, family-centered, and interactive education.Other studies, such as Zeng et al. (2024) and Susanto et al. (2024), have also shown that family participation improves hypertension outcomes (10, 11). Nevertheless, these interventions lacked the structured cognitive–behavioral framework embedded in FCEM. The current study thus extends prior work by demonstrating that when family participation is coupled with empowerment processes, its impact becomes more sustained and multidimensional.

Alhani et al. (2022) reported that FCEM improves quality of life among patients with chronic illness (22). The present study not only confirms these psychosocial benefits but also documents concurrent improvements in physiological markers an important advancement beyond subjective measures. At the population level, Mishra et al. (2025) and Mohammadi et al. (2023) have emphasized global and regional disparities in hypertension control and called for culturally grounded family-centered interventions (1, 2). The results of this study provide empirical support for such an approach,

demonstrating that FCEM offers a replicable and context-sensitive framework adaptable to diverse healthcare settings. Furthermore, Abegaz et al. (2017) and Najimi et al. (2018) identified non-adherence as one of the main barriers to blood pressure control (4, 5). The significant adherence improvement observed here directly addresses this gap. Shen et al. (2017) and Paula et al. (2015) also highlighted the importance of lifestyle and family context in hypertension management (7, 12), yet without model-based intervention design. The current findings confirm that when family engagement is guided by a conceptual model like FCEM, outcomes are more consistent, replicable, and sustainable. Beyond immediate behavioral outcomes, FCEM offers a conceptual advancement by merging empowerment theory, family systems thinking, and self-efficacy frameworks into a unified operational model. This synthesis allows interventions to address the psychosocial determinants of hypertension more comprehensively. It shifts the paradigm from individual patient compliance to collective health empowerment, where family members act as co-participants in sustaining therapeutic routines (22). From a practical standpoint, implementing FCEM can reduce healthcare burden by enhancing self-management capacity and decreasing reliance on formal care systems. The structured nature of FCEM encompassing assessment, participatory education, evaluation, and feedback makes it adaptable to community-based health programs and telehealth interventions (29). Our study limitations include the short follow-up duration, which was only two months post-intervention and does not allow evaluation of long-term sustainability. Sampling patients from only one health center limits the generalizability of the results. Full implementation of the empowerment model required active family participation; however, in some cases, family involvement was limited. Conducting the study in a specific geographical area with unique cultural and social characteristics may also limit the applicability of the results to other populations. Therefore, to minimize the limitations, future studies should be conducted in multiple and varied settings in a larger geographical area with larger sample size to increase generalizability, longer follow-up period to assess the intervention's long-term effectiveness, and participatory rewards to increase family involvement and participation in programs.

Implications for practice

The results of this study demonstrated that the Family-Centered Empowerment Model (FCEM), by increasing social support and improving treatment adherence, led to a significant reduction in systolic and diastolic blood pressure among patients with hypertension. The model's focus on active participation of both patients and their families can strengthen the care process and facilitate the implementation of self-care behaviors. Based on these findings, training nurses and health center staff to apply this approach may enhance the effectiveness of blood pressure management. Further studies with longer follow-up periods and more diverse populations are recommended to confirm the sustained effects of this model.

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Conflicts of interest

The authors declared no conflict of interest.

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Authors' Contributions

HZ and FA designed and planned the study. FA implemented the intervention and collected the data. HR supervised the study process. ZD performed the statistical analysis and drafted the initial manuscript. All authors reviewed and approved the final version of the manuscript.

AI Statement

In the preparation of this manuscript, the AI tool was used solely for language editing.

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