The Effectiveness of Family-Based Health Education Programs on Managing Type 2 Diabetes

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a global public health challenge that requires comprehensive management strategies. Family-based health education programs have emerged as a promising approach to enhance glycemic control, self-care behaviors, and patient outcomes by leveraging the supportive role of family members.

Objective: To evaluate the effectiveness of a family-based health education program on the management of T2DM in Al-Hofuf City, Saudi Arabia.

Methods: A quasi-experimental study was conducted involving 140 participants (70 patients with T2DM and 70 family members) recruited from three primary healthcare centers. Participants underwent a 12-week culturally tailored educational program focused on diabetes management, self-care practices, and family support. Pre- and post-intervention assessments included glycated hemoglobin (HbA1c), fasting blood glucose, body mass index (BMI), diabetes knowledge, self-care behaviors, and family support using validated tools.

Results: Significant improvements were observed post-intervention in HbA1c levels (mean reduction: 0.7%; $p < 0.001$), fasting blood glucose (mean reduction: 18.4 mg/dL; $p < 0.001$), and BMI (mean reduction: 0.9 kg/m²; $p = 0.02$). Diabetes knowledge, self-care behaviors, and family support scores increased significantly ($p < 0.001$). Correlation analysis revealed strong associations between family support and improved glycemic control and self-care practices.

Conclusion: Family-based health education programs significantly improve glycemic control, self-care behaviors, and family support among patients with T2DM. These findings highlight the importance of incorporating family-centered approaches into diabetes management to address cultural and social dynamics effectively.

1. Introduction

Type 2 diabetes mellitus (T2DM) has emerged as a global health crisis, with its prevalence and associated morbidity rising exponentially in both developed and developing countries. Characterized by insulin resistance and impaired pancreatic β-cell function, T2DM contributes significantly to chronic complications, including cardiovascular diseases, kidney failure, and neuropathy, posing a substantial burden on healthcare systems worldwide [1]. Despite the availability of effective pharmacological treatments, the management of T2DM heavily relies on patient adherence to lifestyle modifications, such as dietary adjustments, regular physical activity, and consistent self-monitoring of blood glucose levels [2, 3]. However, individual efforts often fall short due to the complexity of behavioral changes required for optimal disease control. This underscores the need for innovative, sustainable, and holistic interventions, such as family-based health education programs, to enhance self-management and improve health outcomes [4].

Family dynamics play a pivotal role in influencing an individual's health behaviors and disease management strategies. The family serves as the primary source of emotional support, health-related decision-making, and reinforcement of lifestyle behaviors [5]. Recognizing this, family-centered health education has gained prominence as a critical component of T2DM management. Unlike traditional individual-focused education, family-based interventions incorporate family members into the educational process, fostering a collaborative environment that emphasizes shared responsibilities for disease management [6]. This approach aligns with evidence indicating that family involvement enhances treatment adherence, mitigates psychological stress, and promotes sustainable health behaviors among patients with chronic illnesses [7, 8, 17, 9–16]

The rationale for integrating family members into health education stems from the socioecological model, which posits that individual health behaviors are deeply embedded within interpersonal, organizational, and

community contexts [18]. By addressing these multiple levels of influence, family-based programs can create an enabling environment that empowers patients to adopt and maintain recommended lifestyle changes. Family members often assist in meal preparation, facilitate physical activity, and provide reminders for medication adherence, making their involvement essential for successful diabetes management [19]. Moreover, such programs offer a unique opportunity to address the shared risk factors for diabetes, such as obesity and physical inactivity, which are prevalent among family members of diabetic patients [20].

Numerous studies have demonstrated the efficacy of family-based health education programs in improving glycemic control and other clinical outcomes in patients with T2DM. A systematic review by Baig et al. [21] revealed that family-oriented interventions resulted in significant reductions in glycated hemoglobin (HbA1c) levels compared to standard care. This effect was attributed to the combined benefits of improved medication adherence, enhanced dietary practices, and consistent physical activity, facilitated by family involvement. Similarly, a randomized controlled trial conducted in Malaysia reported that patients who participated in a family-based intervention exhibited better diabetes knowledge, improved self-care behaviors, and reduced HbA1c levels over a six-month period compared to those receiving conventional care [22]. These findings highlight the potential of family-focused programs to address the multifaceted challenges of T2DM management.

In addition to physiological outcomes, family-based interventions have shown promise in addressing the psychosocial dimensions of diabetes care. Living with T2DM often imposes a significant psychological burden on patients, manifesting as stress, anxiety, and depression, which can adversely affect self-care practices and glycemic control [23]. Family support has been identified as a critical buffer against these stressors, providing emotional reassurance and fostering resilience [24]. Studies have reported that patients with supportive families demonstrate better coping mechanisms, lower levels of diabetes-related distress, and greater satisfaction with their treatment plans [25]. Furthermore, involving family members in diabetes education fosters mutual understanding and empathy, reducing potential conflicts and enhancing family cohesion (15).

Despite these benefits, implementing family-based health education programs is not without challenges. Cultural, socioeconomic, and logistical barriers often limit the participation of family members in such interventions (16). For instance, in low- and middle-income countries, financial constraints and competing responsibilities may hinder family involvement in structured education sessions (17). Additionally, cultural norms and traditional family roles may affect the extent to which family members can actively participate in diabetes management. Addressing these barriers requires culturally tailored approaches that consider the unique needs and preferences of patients and their families (18). Community engagement, flexible scheduling, and the use of digital platforms for remote education are among the strategies that have been proposed to enhance the accessibility and feasibility of family-based programs (19).

The role of healthcare professionals is crucial in designing and delivering effective family-based health education interventions. Multidisciplinary teams comprising physicians, nurses, dietitians, and psychologists are well-positioned to provide comprehensive support to patients and their families (20). Nurses, in particular, play a central role as educators and advocates, bridging the gap between patients and their families to foster a supportive and collaborative care environment (21). By leveraging their expertise in patient education and counseling, nurses can facilitate behavior change and empower families to take an active role in diabetes management. Furthermore, integrating technology, such as mobile health (mHealth) applications and telehealth platforms, can enhance the scalability and sustainability of family-based programs, especially in resource-limited settings (22).

The significance of family-based health education extends beyond individual health outcomes to broader public health implications. As the global burden of T2DM continues to rise, scaling up such interventions could have a substantial impact on reducing diabetes-related morbidity and healthcare costs. The shared benefits of family involvement, including improved dietary practices and increased physical activity, contribute to the prevention of diabetes and other non-communicable diseases within the household (23). This highlights the potential of family-centered approaches as a cost-effective and sustainable solution for addressing the dual challenges of diabetes management and prevention.

2. Methods

Study Design and Setting

This study employed a quasi-experimental design to assess the impact of family-based health education programs on managing Type 2 Diabetes Mellitus (T2DM). The research was conducted in Al-Hofuf City, a prominent urban center in the Eastern Province of Saudi Arabia. Al-Hofuf offers a unique blend of cultural and socioeconomic diversity, making it an ideal setting to evaluate interventions involving both patients and their families. Three primary healthcare centers (PHCs) within the city were selected as study sites. These centers were chosen based on their accessibility to a diverse population and their capacity to provide diabetes care, ensuring a representative sample of participants with varying demographic and clinical characteristics.

Ethical Approval

The study was conducted in full compliance with ethical research standards. Ethical approval was obtained from the Institutional Review Board (IRB) of King Faisal University in Dammam (IRB approval number: [insert number]). The ethical review process ensured that the study met the highest standards of safety, privacy, and participant rights as outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion in the study. Patients and family members were provided with detailed information about the study's objectives, procedures, potential risks, and benefits to ensure informed participation.

Participants

The study targeted adults diagnosed with T2DM and their immediate family members, recognizing the integral role families play in supporting chronic disease management. Patients were eligible for inclusion if they were 18 years or older, had a confirmed diagnosis of T2DM for at least six months as per their medical records, and were proficient in Arabic to facilitate comprehension and engagement. Additionally, participants had to be regular attendees at the selected PHCs to ensure continuity and consistency in follow-up care. Family members were eligible if they were co-residing with the patient, aged 18 years or older, and willing to actively participate in the health education sessions.

Exclusion criteria were defined to avoid confounding factors that could interfere with the study outcomes. Patients with severe diabetes-related complications, such as advanced kidney disease or retinopathy requiring immediate intervention, were excluded. Additionally, individuals with cognitive impairments, mental health issues, or language barriers that might hinder active participation were not included. This approach ensured a homogenous sample capable of fully engaging with the intervention.

Sample Size

The sample size was determined through a rigorous power analysis using G*Power software. Based on the assumption of a medium effect size (Cohen's $f = 0.25$), a statistical power of 80%, and a significance level of 0.05, the minimum required sample size was calculated to be 60 participants per group. To account for potential dropout or attrition, the initial recruitment aimed for 140 participants, comprising 70 patients and 70 family members. This ensured the study had sufficient statistical power to detect meaningful differences in outcomes.

Intervention

The family-based health education program was meticulously designed to address the multifaceted needs of T2DM management. It consisted of six interactive sessions delivered over a 12-week period. The sessions, conducted in Arabic, were facilitated by a multidisciplinary team that included a nurse educator, a dietitian, and a psychologist. Each session lasted approximately 90 minutes and was hosted at the participating PHCs in designated community rooms to foster a welcoming and supportive environment.

The curriculum covered a comprehensive range of topics critical to diabetes management. The first session introduced the pathophysiology of diabetes and potential complications, helping patients and families understand the significance of effective disease management. Subsequent sessions focused on practical aspects, such as blood glucose monitoring techniques, dietary planning, and meal preparation tailored to cultural dietary preferences. Participants also engaged in activities promoting physical activity, including simple exercise demonstrations that could be incorporated into daily routines.

In addition to physical health, the program addressed psychological and emotional challenges associated with

T2DM. Dedicated sessions emphasized stress management techniques, the importance of emotional resilience, and the role of family support in mitigating diabetes-related distress. Participants practiced communication skills to enhance mutual understanding and problem-solving within the family. The final session reviewed key takeaways and reinforced strategies to sustain long-term behavior changes.

Data Collection

Baseline and Post-Intervention Assessments
Data were collected at two time points: baseline (before the intervention) and at the end of the 12-week program (post-intervention). Trained data collectors conducted structured interviews and administered validated tools to gather comprehensive information. Clinical measurements, including glycated hemoglobin (HbA1c) levels, fasting blood glucose, and body mass index (BMI), were obtained from medical records and verified using standardized equipment.

Sociodemographic and Clinical Data
A structured questionnaire collected sociodemographic details, such as age, gender, education level, and household income. Clinical information, including duration of diabetes and medication regimens, was documented to contextualize the study outcomes.

Knowledge and Self-Care Behaviors
Diabetes knowledge was assessed using the Arabic-translated version of the Diabetes Knowledge Test (DKT), a validated tool that evaluates understanding of diabetes management principles. Self-care behaviors were measured using the Summary of Diabetes Self-Care Activities (SDSCA) scale, which assesses adherence to dietary recommendations, physical activity, blood glucose monitoring, and medication regimens.

Family Support
Family involvement and support were evaluated using the Diabetes Family Behavior Checklist (DFBC). This tool measures the frequency and quality of family behaviors that support or hinder diabetes management, providing insights into the dynamics of family-patient interactions.

Data Analysis

Data analysis was performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including means, standard deviations, and frequencies, summarized baseline characteristics. Paired t-tests were used to compare pre- and post-intervention outcomes within groups, while independent t-tests assessed differences between the intervention and control groups. Analysis of covariance (ANCOVA) was employed to adjust for confounders, such as baseline HbA1c levels or sociodemographic variables. A p-value of <0.05 was considered statistically significant.

3. Results

Demographic Characteristics

A total of 140 participants (70 patients with T2DM and 70 family members) were included in the study. The mean age of the patients was 56.4 years, reflecting the predominance of middle-aged and older adults among individuals managing chronic diabetes. Female participants constituted the majority of the sample (63%), consistent with gender disparities in healthcare utilization, where women are more likely to engage in educational programs. Most participants had secondary education (41%) or higher education (29%), while 30% reported no formal education. Employment data indicated a high rate of unemployment (65%) among patients, with 25% engaged in part-time work. Family members' employment status was more balanced, with 40% employed full-time. Monthly household income revealed a substantial financial burden, with 60% of participants reporting income below 7,000 SAR, highlighting the socioeconomic challenges faced by the population (Table 1).

Table 1: Demographic Characteristics of Participants (n = 140)

Variable	Mean (SD) or %	n
Age of Patients (years)	56.4 (9.8)	70
Gender		
Male	37%	52
Female	63%	88
Education Level		
No formal education	30%	42

Secondary education	41%	58
Higher education	29%	40
Employment Status		
Unemployed	65%	91
Part-time work	25%	35
Full-time work	10%	14
Income Level (SAR)		
Low (< 7,000)	60%	84
Medium (7,000–12,000)	30%	42
High (> 12,000)	10%	14

Clinical Outcomes

Significant improvements in clinical outcomes were observed following the family-based health education program. Patients demonstrated a mean reduction in HbA1c levels from 8.2% at baseline to 7.5% post-intervention, indicating enhanced glycemic control. Fasting blood glucose levels also decreased, with a mean reduction of 18.4 mg/dL. Additionally, body mass index (BMI) showed a modest but statistically significant decrease of 0.9 kg/m² over the intervention period (Table 2).

Table 2: Clinical Outcomes of Patients with T2DM (n = 70)

Clinical Variable	Baseline Mean (SD)	Post-Intervention Mean (SD)	p-value
HbA1c (%)	8.2 (1.3)	7.5 (1.1)	<0.001
Fasting Blood Glucose (mg/dL)	145.3 (24.7)	126.9 (22.5)	<0.001
Body Mass Index (kg/m²)	28.6 (3.5)	27.7 (3.3)	0.02

Knowledge, Self-Care, and Family Support

Participants demonstrated marked improvements in diabetes knowledge, self-care behaviors, and family support scores post-intervention. Mean diabetes knowledge scores increased from 18.5 at baseline to 25.7, reflecting a significant enhancement in participants' understanding of diabetes management. Self-care activities, as measured by the SDSCA scale, showed notable increases across all domains, particularly in dietary adherence and physical activity. Family support scores, as assessed by the DFBC, also improved significantly, emphasizing the positive impact of family engagement on diabetes management (Table 3).

Table 3: Knowledge, Self-Care, and Family Support Scores (n = 140)

Variable	Baseline Mean (SD)	Post-Intervention Mean (SD)	p-value
Diabetes Knowledge Score	18.5 (4.2)	25.7 (5.1)	<0.001
Self-Care Activities			
- Dietary Adherence	3.2 (1.1)	4.5 (1.2)	<0.001
- Physical Activity	2.7 (1.0)	4.0 (1.1)	<0.001
- Glucose Monitoring	3.5 (1.3)	4.6 (1.0)	<0.001
Family Support Score	21.3 (5.4)	28.2 (6.1)	<0.001

Correlation Analysis

Correlation analysis revealed significant associations between family support and key clinical outcomes. Higher family support scores were positively correlated with improvements in HbA1c and self-care behaviors. These findings highlight the critical role of family involvement in achieving better diabetes management outcomes (Table 4).

Table 4: Correlation Analysis Between Family Support and Outcomes (n = 140)

Outcome	r	p-value
HbA1c Reduction	-0.42	<0.001
Self-Care Activities	0.58	<0.001
Knowledge Score	0.36	0.02

4. Discussion

The findings of this study highlight the significant impact of family-based health education programs on the management of Type 2 Diabetes Mellitus (T2DM), particularly in improving clinical outcomes, self-care behaviors, and family support. These results align with the growing body of evidence that underscores the importance of involving family members in diabetes care to foster a supportive environment conducive to long-term behavioral and lifestyle changes [26].

Clinical Outcomes

The significant reduction in glycated hemoglobin (HbA1c) levels observed in this study is a noteworthy indicator of improved glycemic control. Participants achieved a mean reduction of 0.7%, which, although modest, is clinically relevant. Previous studies have established that even a 0.5% reduction in HbA1c is associated with decreased risks of diabetes-related complications, including retinopathy and cardiovascular diseases [27]. The improvement in fasting blood glucose levels further corroborates the effectiveness of the intervention. These findings are consistent with studies that demonstrate the positive effects of structured education programs on glycemic outcomes. For example, a meta-analysis by Chrvala et al. [28] found that diabetes self-management education, when extended to family members, resulted in significant improvements in HbA1c levels. The family's involvement likely facilitated adherence to dietary plans, physical activity, and medication regimens, which are critical components of diabetes management.

In addition to glycemic outcomes, the modest reduction in body mass index (BMI) observed among participants underscores the potential of family-based interventions in promoting weight management. While the mean reduction of 0.9 kg/m² may appear small, it is well-documented that even minor weight loss contributes to improved insulin sensitivity and glycemic control [29]. The interactive sessions on dietary planning and physical activity, which encouraged family participation, likely played a role in achieving these outcomes. These findings are consistent with evidence from interventions in similar populations, which emphasize the role of family support in facilitating sustainable lifestyle changes [30].

Knowledge and Self-Care Behaviors

Participants' significant improvement in diabetes knowledge scores post-intervention reflects the success of the educational component of the program. Knowledge enhancement is a cornerstone of effective diabetes self-management, as it equips patients with the information needed to make informed decisions about their care. Studies have shown that higher diabetes knowledge correlates with better glycemic control and reduced risk of complications [31]. The structured and culturally tailored sessions in this study provided participants and their families with practical insights into the pathophysiology of diabetes, dietary management, and glucose monitoring, empowering them to take proactive steps in managing the condition.

Self-care behaviors, including dietary adherence, physical activity, and glucose monitoring, showed significant improvements across all measured domains. These findings mirror those of Shah et al. who reported enhanced self-care practices following family-based educational interventions in a Middle Eastern population. The involvement of family members in this study likely provided the emotional and logistical support needed for patients to sustain these behaviors. For instance, family members may have played a role in meal preparation, encouraging physical activity, or providing reminders for glucose monitoring, thereby reinforcing positive behaviors. The role of family as a reinforcing agent has been extensively documented in the literature, particularly in the context of chronic disease management [32].

Family Support

The improvement in family support scores post-intervention underscores the centrality of family dynamics in diabetes management. Family support, as measured by the Diabetes Family Behavior Checklist (DFBC), showed significant enhancements in both supportive behaviors, such as encouragement and assistance with self-care tasks, and a reduction in unsupportive behaviors, such as criticism or neglect. These findings are consistent with evidence suggesting that family support is a critical determinant of diabetes outcomes. Rosland et al. [33] emphasized that supportive family behaviors are associated with better glycemic control, whereas negative interactions can lead to increased diabetes-related distress and poorer outcomes.

The intervention in this study included role-playing exercises and discussions aimed at fostering mutual understanding between patients and their families. This likely contributed to the observed improvements in family support. By addressing common barriers to effective communication and emphasizing the shared responsibilities of diabetes management, the program succeeded in creating a collaborative care environment. This approach aligns with socioecological models of health, which emphasize the importance of interpersonal dynamics in shaping individual health behaviors [34].

Correlation Between Family Support and Outcomes

The significant correlations observed between family support and key clinical and behavioral outcomes underscore the importance of engaging family members in diabetes care. Higher family support scores were

positively associated with improvements in HbA1c, self-care activities, and diabetes knowledge. These findings corroborate those of previous studies, such as Baig et al. , who demonstrated that family-oriented interventions enhance patients' adherence to treatment regimens and improve glycemic control. The mechanisms underlying these associations likely include increased accountability, emotional encouragement, and practical assistance provided by family members [35].

Notably, the strongest correlation was observed between family support and self-care activities, suggesting that the presence of supportive family members significantly enhances patients' ability to adhere to prescribed behaviors. This is particularly important in the context of Middle Eastern cultures, where family plays a central role in daily life and decision-making processes [36]. The findings highlight the potential of leveraging familial relationships to improve health outcomes in culturally relevant ways.

Relevance to Saudi Arabia's Healthcare Context

The findings of this study hold particular significance within the Saudi Arabian healthcare context, where the prevalence of T2DM is among the highest globally (14). Cultural factors, including the collectivist nature of Saudi society, make family-centered approaches particularly suitable. However, the study also highlights systemic challenges, such as financial constraints and educational disparities, which may hinder the broader implementation of such programs. Addressing these barriers requires a multi-faceted approach that incorporates culturally tailored interventions, community engagement, and policy-level support.

The observed improvements in clinical outcomes, self-care behaviors, and family support provide compelling evidence for the integration of family-based health education programs into the standard care for T2DM patients in Saudi Arabia. These programs align with the goals of the Saudi Vision 2030, which emphasizes preventive healthcare and the promotion of healthy lifestyles (15). Moreover, the emphasis on family involvement resonates with Islamic values, which prioritize caregiving and mutual responsibility within families.

5. Conclusion

This study underscores the significant impact of family-based health education programs in improving the management of Type 2 Diabetes Mellitus (T2DM) through enhanced glycemic control, self-care behaviors, and family support. The integration of family members into the educational process fostered a supportive environment that empowered patients to adopt and sustain lifestyle changes critical for effective diabetes management. These findings highlight the potential of culturally tailored, family-centered interventions to address the complex challenges associated with T2DM, particularly in settings where family dynamics play a pivotal role in health decision-making, such as in Saudi Arabia.

The positive correlations between family support and clinical outcomes, such as HbA1c reduction and improved self-care, emphasize the importance of engaging family members as active participants in diabetes care. This approach not only benefits patients but also enhances the overall family's health literacy, potentially reducing the collective risk of chronic diseases within households. The study's results provide compelling evidence for policymakers and healthcare providers to incorporate family-centered strategies into standard diabetes care, aligning with broader goals of preventive healthcare and lifestyle improvement.

While the findings are promising, further research is warranted to explore the long-term sustainability of such interventions and their scalability across different cultural and socioeconomic contexts. By addressing these areas, family-based programs can become an integral part of global efforts to combat the growing burden of diabetes and improve quality of life for individuals and their families.

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