Journal of Caring Sciences

eISSN: 2251-9920 https://jcs.tbzmed.ac.ir

Mobile Health Interventions with Family Support for Diabetes Self-Management in Type 2 Diabetes Mellitus: A Systematic Review

Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana

DOI: 10.34172/jcs.34967

Please cite this article as: Alfianur A, Rahmat I, Noviana U. Effect of Posture. Mobile Health Interventions with Family Support for Diabetes Self-Management in Type 2 Diabetes Mellitus: A Systematic Review. J Caring Sci 2026; 15(3): x-x. doi: 10.34172/jcs.34967

Phone: +984114799785
Fax: +984114796969

Mobile Health Interventions with Family Support for Diabetes Self-Management in Type 2 Diabetes Mellitus: A Systematic Review

Alfianur Alfianur[1], Ibrahim Rahmat[2*], Uki Noviana[3]

[1]Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia; (b) Nursing Department, Institut Kesehatan Payung Negeri, Pekanbaru, Indonesia
alfianurchaniago@gmail.com. 0009-0009-8046-9696
[2]Department of Mental Health and Community Nursing, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, 55281 Sleman, Daerah Istimewa Yogyakarta, Indonesia
ibrahim.rahmat@ugm.ac.id. 0000-0002-5337-3252
[3]Department of Mental Health and Community Nursing, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
uki.noviana@ugm.ac.id. 0000-0003-2856-7677
***Corresponding author**: Ibrahim Rahmat, **Email**: ibrahim.rahmat@ugm.ac.id. http://orcid.org/0000-0002-5337-3252

Review Article
Received: February 01, 2025
Revised: October 17, 2025
Accepted: December 01, 2025
ePublished: September 13,2026

Alfianur Alfianur[1], Ibrahim Rahmat[2*], Uki Noviana[3]. Mobile Health Interventions with Family Support for Diabetes Self-Management in Type 2 Diabetes Mellitus: A Systematic Review. JCS

Abstract

Introduction: Type 2 diabetes mellitus (T2DM) affects approximately 537 million adults worldwide, yet fewer than 20% achieve optimal glycemic control. Mobile health (mHealth) interventions and family support each improve diabetes management, but their combined effect is understudied. This review evaluated the effectiveness of mHealth interventions that engage family members as active support partners in improving self-management and glycemic control in T2DM.
Methods: We searched four databases (MEDLINE, CINAHL, CENTRAL, and Web of Science) for studies published from 2007 onwards, following PRISMA and Joanna Briggs Institute (JBI) methodology. Eligible studies examined mHealth diabetes interventions that actively involved family members or caregivers. Two reviewers independently screened records and appraised quality using the Mixed Methods Appraisal Tool (MMAT), with findings combined through narrative synthesis.

Results: Ten studies met the inclusion criteria, including four randomized controlled trials. Samples ranged from 7 to 512 participants and interventions from 2 weeks to 15 months. All reported improved glycemic control, with HbA1c reductions of 0.97% to 1.40%. Text messaging was the most effective platform, with 48% of participant's actively engaging family support. Family involvement was linked to greater self-efficacy, better dietary behaviors, and improved adherence, and cultural adaptation with autonomy-supportive family behaviors emerged as critical success factors. MMAT scores ranged from 60% to 100%.

Conclusion: mHealth interventions incorporating family support improve glycemic control and self-management behaviors in T2DM. Text messaging platforms were promising for family engagement, though success depends on culturally appropriate design and autonomy-supportive involvement. These findings support integrating family-supported digital interventions into routine diabetes care.

Keywords: Family support, Glycemic control, Mobile applications, Self-management, Type 2 diabetes mellitus

Introduction

Type 2 diabetes mellitus (T2DM) imposes a substantial global health burden, with approximately 537 million adults (10.5% of the adult population aged 20-79 years) currently affected. The disease prevalence has nearly doubled since 1980, rising from 4.7% to 8.5% in the adult population by 2014, with T2DM accounting for more than 90% of all diabetes cases worldwide. This burden is projected to rise further, reaching 783-784 million affected individuals (12.2% of the adult population) by 2045, driven by population aging, rising obesity rates, and suboptimal health behaviors.[1–4] Notably, three-quarters of adults with diabetes reside in low- and middle-income countries, with the highest prevalence rates observed in the Eastern Mediterranean, parts of Asia, and Africa.[3,5,6] The complications of T2DM are severe and multisystemic, including cardiovascular and cerebrovascular damage, sexual dysfunction, skin alterations, neuropathy, and nephropathy.[7–9] Without proper disease control, vascular complications can develop within three years of diagnosis; however, effective management can delay these complications by up to 20 years or longer.[10] Glycated hemoglobin (HbA1c) is a key indicator of diabetes control, reflecting the patient's overall management of the disease.[11] Achievement of glycemic targets remains poor in several settings, with more than 90% of patients in India[12] and over 80% in both Indonesia[13] and Saudi Arabia[14] failing to reach recommended targets.

The three primary approaches to T2DM management are nutritional management, physical activity, and medication adherence.[1] However, achieving optimal adherence to these management strategies remains challenging for many patients, particularly in the absence of continuous monitoring and support. Mobile health (mHealth) offers one way to address these challenges by providing mobile-based tools that support diabetes self-management. mHealth applications facilitate remote monitoring, chronic disease management, and telemedicine services, improving patient outcomes through enhanced treatment adherence and patient-provider communication.[15–18] Specifically, these applications support real-time tracking of patient data, enable communication with healthcare professionals, allow for treatment adjustments with professional guidance, and provide platforms for interaction and counseling.[19] The American Diabetes Association (ADA) endorses the use of mobile apps for implementing effective lifestyle changes, with studies reporting significant reductions in HbA1c among patients using these tools.[20]

Beyond technological interventions, family support is central to diabetes management. Strong family support correlates with improved HbA1c levels, while insufficient support is often linked to poor glycemic control.[21] Family members contribute through various mechanisms, including transportation to medical appointments, meal preparation, insulin injection assistance, and emotional support.[22,23] Family-centered care, actively engaging family members in the healthcare process, has shown promising results in diabetes management.[24] One strategy, accordingly, is to guide family members in setting goals for the patient's self-care behaviors, influencing mental well-being, treatment adherence, and lifestyle modifications.[25] Studies of family-centered interventions (FCIs) in diabetes management have produced mixed results: some report significant reductions in HbA1c,[26,27] whereas others find no improvement in glycemic control.[28] Previous systematic reviews have confirmed the benefits of mHealth interventions in diabetes management;[25,29–31] however, none has examined the FCI approach delivered through mHealth platforms.

While several systematic reviews have examined related topics, no current or in-progress systematic reviews specifically examining mHealth interventions that integrate family support for type 2 diabetes self-management were identified. The closest related reviews include that by Matrook et al[32] which synthesized family-based interventions for adults with T2DM but focused on traditional face-to-face family interventions (counseling, behavioral therapy, home visits) where technology use was optional or incidental rather than examining mHealth platforms as the primary delivery mechanism. Pamungkas et al[33] reviewed family support integrated with diabetes self-management education (DSME) among uncontrolled T2DM patients; however, their review

focused on traditional in-person DSME programs where family members attended educational sessions, with mHealth tools (such as phone calls or SMS) used only incidentally for follow-up rather than as the core intervention platform. Recently, Sabahi et al[34] conducted a systematic review of mHealth applications for the self-management of T2DM in Iran. However, their review focused on individual patient-centered mHealth interventions across various self-care domains without including family involvement as a criterion.

These existing reviews have either examined family interventions without technology requirements, traditional DSME with optional family involvement, or mHealth interventions without family integration requirements. None has specifically synthesized evidence on the intersection of mobile health technology as the primary delivery platform combined with active family member engagement as support partners. Therefore, this systematic review aimed to evaluate the effectiveness of mHealth interventions that engage family members as active support partners in improving diabetes self-management and glycemic control among adults with type 2 diabetes mellitus. Specifically, it addressed the following research question: Among adults with T2DM, how effective are mHealth self-management interventions that actively involve family members as support partners in improving glycemic control and self-management behaviors?

Materials and Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[35] and followed the Joanna Briggs Institute (JBI) methodology for systematic reviews.[36] The review protocol was not prospectively registered in a systematic review database.

Search Strategy

A systematic search was conducted in December 2024 across four major electronic databases: MEDLINE (via PubMed), CINAHL (via EBSCOhost), CENTRAL (via the Cochrane Library), and Web of Science. The search timeline was established from 2007 onwards, aligning with major advancements in mHealth technology.[18] Database-specific search strategies were developed using appropriate indexing terms, including Medical Subject Headings (MeSH), combined with Boolean operators. The search framework covered seven core concepts: patients with T2DM, family-centered mHealth interventions, self-management, glycemic control, adherence to treatment regimens, mental well-being, and quality of life. Supplementary manual searches included forward and backward citation tracking. The search terms comprised variations of “Patient,” “Diabetes

mellitus type 2," "mHealth," "Family-centered," "Self-management," "Glycemic control," "Adherence to treatment regimens," "Mental well-being," and "Quality of life." The complete search strategy, with detailed search terms and Boolean combinations, is provided in Supplementary File 1. Grey literature was addressed by screening the reference lists of all included studies and relevant reviews and by forward citation tracking. A separate search of trial registries and dissertation databases was not performed.

Inclusion and Exclusion Criteria

Studies were included if they involved adults aged 18 years and older diagnosed with type 2 diabetes mellitus (T2DM) according to standard diagnostic criteria, and if they evaluated patient-centered diabetes self-management interventions in which family members, caregivers, or support persons played an active supportive role through mHealth platforms, including mobile applications, text messaging systems, or telehealth services accessed via mobile devices.

With respect to study design, studies were included if they were randomized controlled trials (RCTs), quasi-experimental studies, cohort studies, or mixed-methods studies reporting quantitative outcomes for glycemic control or other diabetes management indicators, and if they were published in full text in peer-reviewed journals in English from 2007 onward. Studies were excluded if participants had other types of diabetes (for example, type 1 diabetes mellitus or gestational diabetes), unless separate data were reported for participants with T2DM. Studies were excluded if they were descriptive studies, case reports, or purely qualitative studies, unless they formed part of a mixed-methods study that also reported quantitative outcomes.

This systematic review was structured according to the PICO framework (Population, Intervention, Comparison, Outcomes). The target population comprised adults diagnosed with T2DM. The intervention of interest was diabetes self-management interventions that incorporated active family member involvement or support. Instead of traditional family-centered care, which prioritizes the family unit, these interventions view family members as active support partners in mHealth diabetes self-management programs. The PICO framework is detailed in Table 1.

Table 1. PICO Framework

Component	Description	Key Search Term
Population (P)	Adults aged ≥18 years diagnosed with Type 2 Diabetes Mellitus according to standard diagnostic criteria	Patients, diabetes mellitus type 2, diabetic patients, T2DM, NIDDM, non-insulin dependent diabetes, diabet*
Intervention (I)	Mobile health (mHealth) diabetes self-management programs that incorporated active family member involvement as support partners. These interventions focus primarily on patient self-management while utilizing family members, caregivers, or support persons as active partners to enhance the patient's diabetes self-care behaviors through mobile platforms including smartphone applications, text messaging, and telehealth services.	Mobile health applications, telemedicine, digital health technologies, family support, family-centered care, caregiver involvement, mHealth, eHealth, smartphone applications
Comparison (C)	No comparator restriction was applied. Studies with or without a comparison or control group were eligible, including comparisons with usual or standard diabetes care.	Usual care, standard care, control group, comparison group, no comparator
Outcomes (O)	Primary**:** Glycemic control (HbA1c levels) Secondary**:** Diabetes self-management behaviors, treatment adherence, mental well-being, health-related quality of life, family involvement measures	Glycemic control, HbA1c, A1C, self-management, treatment adherence, patient compliance, mental health, quality of life, HRQOL

Note: Search terms included both Medical Subject Headings (MeSH) terms and free-text keywords with appropriate truncation symbols (*) to capture variations in terminology across databases.

Study Selection

The screening process was conducted using Rayyan (https://www.rayyan.ai), a web-based and mobile application designed for systematic reviews. All members of the project team participated in the screening and selection process. Two reviewers (AA and UN) screened the titles and abstracts of the identified records independently after removing duplicates. Subsequently, full texts of potentially relevant reports were retrieved and independently reviewed by all reviewers (AA, UN, and EM) based on the predetermined eligibility criteria. The entire search and selection process is outlined in a PRISMA flowchart (see Figure 1).

Assessment of Risk of Bias

The methodological quality of included studies was independently assessed by two reviewers (AA and UN) using the Mixed Methods Appraisal Tool (MMAT).[37] The MMAT was designed for appraising studies in mixed-methods reviews and is widely used for that purpose; its 2018 version evaluates methodological quality across qualitative, quantitative, and mixed-methods designs.[37] All quality assessments underwent independent moderation by a third reviewer to ensure accuracy. No studies were excluded based on quality assessment outcomes, as all met the MMAT criteria. The detailed results of the quality appraisal are presented in Table 2.

Data Synthesis

Data extraction used a customized form developed and piloted by the research team. The extraction tool, unanimously approved by all team members, captured study characteristics including author(s), year of publication, study design, country, sample size, type of intervention, family involvement, intervention duration, measurement tools, effect size, and key findings, as detailed in Table 2. The primary investigator conducted the initial data extraction, followed by review and discussion among all team members to ensure alignment with the research question.

Data were synthesized using a narrative approach rather than quantitative meta-analysis, a choice guided by several considerations. The included studies were expected to differ in mHealth platforms and in the mechanisms of family involvement, and they varied in outcome measurement tools and reporting methods. Mixed-methods and feasibility studies were included alongside randomized controlled trials, intervention duration and follow-up periods differed, and the research question itself was exploratory, directed at mapping the evidence rather than at quantitative precision.

The narrative synthesis followed a structured four-stage process adapted from Popay et al's[38] framework, beginning with developing a preliminary synthesis where studies were organized by intervention type and outcome categories, with data tabulated to identify patterns across study characteristics and findings. The second stage involved exploring relationships within and between studies through thematic analysis to identify common mechanisms of action, barriers and facilitators to implementation, and factors influencing intervention effectiveness. The third stage assessed the robustness of the synthesis by examining consistency of results across different study designs, populations, and settings, while considering methodological quality scores. The final stage involved drawing conclusions by synthesizing evidence to develop overarching conclusions

about intervention effectiveness, with explicit acknowledgment of limitations and areas of uncertainty.

Clinical and methodological heterogeneity was assessed across participant characteristics (age, diabetes duration, baseline HbA1c), intervention characteristics (technology type, family involvement intensity, duration), and outcome measures (primary endpoints, measurement timing). Pre-planned subgroup considerations included intervention duration (< 6 months vs ≥ 6 months), technology type (mobile applications vs telehealth vs mixed platforms), family involvement intensity (passive vs active engagement), and study design (RCTs vs non-randomized studies), although formal subgroup analysis was contingent upon adequate study numbers within each category. The overall quality of evidence for each outcome was evaluated considering study limitations, consistency of results, directness of evidence, precision of estimates, and presence of publication bias, following established systematic review methodology principles.

Results

Study Selection and Characteristics

The systematic literature search identified 4,876 potentially relevant studies in total (4,873 from database searching and three from citation searching). After 1,568 duplicate records were removed, 3,308 records were screened by title and abstract, of which 3,290 were excluded. The remaining 18 full-text reports were assessed for eligibility, and eight were excluded (three with no family involvement in the intervention and five with an incorrect outcome), leaving 10 studies in the review (Figure 1). The 10 included studies were methodologically and geographically diverse, comprising four randomized controlled trials (RCTs),[39–42] two mixed-methods studies,[43,44] two feasibility studies,[45,46] one mixed-methods evaluation,[47] and one action research-based pilot study.[48] Geographically, studies were predominantly conducted in the United States (n= 7), with additional representation from Singapore (n= 1), Thailand (n= 1), and Hawaii (n= 1, classified separately due to its distinct cultural context). Sample sizes ranged from seven participants in a pilot study conducted in Hawaii[48] to 512 participants in the largest RCT examining the FAMS intervention.[43] Intervention durations varied from two weeks in the initial FAMS feasibility study[45] to 15 months in the ongoing FAMS 2.0 trial.[42]

The methodological quality of included studies, assessed using the Mixed Methods Appraisal Tool (MMAT), was generally good, with scores ranging from 60% to 100% and a mean of 80%. Two studies achieved the maximum score of 100%,[45,47] indicating sound methodology in both their quantitative and qualitative components. Six studies scored 80%,[39,41,42,44,46,48] with minor

limitations such as incomplete outcome reporting or single-site recruitment. Two studies scored 60%,[40,43] reflecting concerns mainly about incomplete outcome data, potential selection bias, and short follow-up. No studies were excluded on quality grounds, as all met the minimum MMAT criteria.

Primary Outcome: Glycemic Control

Studies consistently reported improvements in glycemic control among intervention participants, with HbA1c reduction the most clinically meaningful outcome across the included studies. The most substantial reduction was observed in the Latino population study by Burner et al[46] which reported a greater mean HbA1c decrease in the intervention group than in the control group over three months. Similarly, Poonprapai et al[41] reported a clinically significant HbA1c reduction in the intervention group versus the control group over nine months among older Thai adults.

The REACH+FAMS intervention[39] provided evidence for sustained glycemic improvement, showing indirect effects on HbA1c through improved family involvement at both six- and 12-month follow-ups, with mediation analysis revealing that enhanced helpful family involvement accounted for significant variance in glycemic control improvements. This longitudinal evidence suggests that family-supported mHealth interventions can maintain glycemic benefits over extended periods when family engagement is effectively sustained, with the intervention showing continued effectiveness even as the initial novelty of the technology diminished. Conversely, Zupa et al[40] found that participants with higher baseline HbA1c levels showed reduced engagement with telehealth interventions, suggesting that patients with poorer initial glycemic control may require more intensive support or alternative intervention approaches to achieve meaningful improvements.

Secondary Outcomes and Intervention Effectiveness

Text messaging was the predominant delivery platform across studies and showed particular promise for family engagement and sustained behavior change. The FAMS program, implemented across multiple studies,[39,43,45,47] used bidirectional text messaging to deliver synchronized support to both patients and family members, with participants receiving personalized messages based on their self-identified self-care goals while support persons received complementary messages designed to reinforce and encourage the patient's diabetes management efforts. Burner et al[46] found that synchronized text messaging between patients and supporters led to improved glucose self-monitoring frequency and increased physical activity engagement, with intervention participants showing significantly higher adherence to self-care recommendations compared to control

participants. The Thai study[41] showed that pharmacist-delivered education via mobile applications to family members significantly improved multiple diabetes management parameters beyond glycemic control, including blood pressure management, medication adherence scores, and diabetes knowledge scores.

Family involvement mechanisms varied across studies but were consistently associated with better patient outcomes when appropriately structured and supported. Mayberry et al[47] found that participants invited support persons to take part in the intervention, and that younger participants, those in committed relationships, and those with higher depressive symptom scores were more likely to engage family support. Support persons who participated reported increased awareness of diabetes management challenges, improved diabetes-related communication with patients, and adoption of supportive behaviors such as healthy meal preparation and medication reminders. However, Zupa et al[40] noted that family supporter involvement in medication management was paradoxically associated with lower intervention completion rates, suggesting that overly intensive or controlling family involvement may undermine patient autonomy and engagement. The REACH+FAMS study[39] provided mechanistic evidence for family involvement effectiveness, with mediation analysis demonstrating that improved helpful family involvement (measured using validated family support scales) accounted for the sustained improvements in glycemic control, supporting family systems theory and suggesting that interventions succeed through enhanced family dynamics rather than through mHealth delivery alone.

Self-management behaviors improved across multiple domains in the studies that measured them. The large-scale FAMS trial[43] reported significant improvements in family/friend involvement scores, diabetes self-efficacy measures, and dietary behaviors, including increased fruit and vegetable consumption and reduced consumption of high-fat foods, though physical activity improvements were not consistently observed across studies. Poonprapai et al[41] reported improvements in diabetes knowledge, in self-management behaviors across all domains of the Summary of Diabetes Self-Care Activities scale, and in medication adherence. The Hawaii study[48] found improvements in diabetes self-management knowledge and specific self-care behaviors including regular glucose monitoring, appropriate dietary choices, and timely healthcare provider communication, with qualitative data indicating increased confidence in diabetes management abilities among both patients and family members.

Several studies also documented psychosocial benefits beyond clinical measures, including improvements in diabetes-related distress, family communication, and quality of life indicators. Support persons in the Mayberry et al[47] study also adopted better health behaviors themselves,

including dietary changes and increased physical activity, suggesting that these interventions benefit family members as well as patients. The intervention appeared particularly beneficial for patients with higher psychosocial needs, including those with depressive symptoms, who showed greater engagement with family support features and more substantial improvements in self-efficacy measures. Brew-Sam et al[44] identified a paradox in which higher levels of informal family support were associated with reduced diabetes app usage, suggesting that strong existing family support systems may reduce perceived need for mHealth interventions, while patients with less robust family support networks showed greater technology adoption and engagement.

Cultural and Contextual Considerations

The interventions were adapted and implemented across diverse cultural contexts and healthcare settings, though with variations in approach and effectiveness. The Latino-focused study[46] incorporated culturally appropriate messaging in both English and Spanish, integrated cultural dietary preferences into nutritional recommendations, and used culturally relevant family engagement strategies that acknowledged extended family networks and community support systems common in Latino communities. The Thai study[41] adapted content specifically for older adults and integrated pharmacist expertise into family education, recognizing the important role of pharmacists in Thai healthcare systems and the cultural emphasis on intergenerational family support in diabetes management. The Hawaii study[48] leveraged community social capital and culturally relevant support networks within Native Hawaiian and Pacific Islander communities, showing that interventions can be adapted to indigenous populations when community values and traditional support systems are incorporated into the design.

Healthcare setting integration varied across studies, with successful implementations in community health centers serving predominantly low-income populations, academic medical centers, rural healthcare facilities, and specialized diabetes clinics. The diversity of successful implementations suggests broad applicability across healthcare settings, though the predominance of US-based studies (7 of 10) limits international generalizability, and research in other healthcare systems is still needed. Studies conducted in lower-resource settings, such as the community-based Hawaii intervention[48] and the Thai study,[41] which used existing pharmacy infrastructure, showed that effective family-supported mHealth interventions can be implemented without extensive technological infrastructure or specialized clinical staff, which suggests potential for wider use in resource-constrained settings.

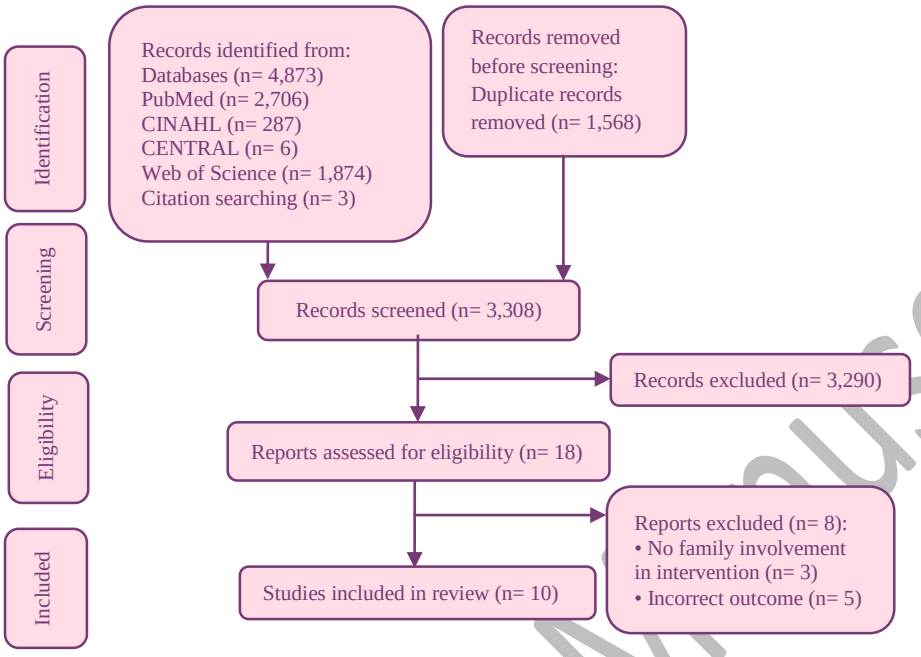

Figure 1. PRISMA flowchart

Table 2. Included study characteristics

No	Author(s) Year	Study Design	Country	Sample Size	Intervention Type (Mobile App Type)	Family Involvement	Duration of Intervention	Measurement Tools	Impact	Key Findings	MMAT Score
1	Brew-Sam et al[44] (2020)	Mixed methods (qualitative and quantitative)	Singapore	86 participants	Mobile health (mHealth) apps for diabetes self-management	Examined the influence of both professional (healthcare) and non-professional (family/friends) support	Cross-sectional	Thematic analysis, binary logistic regression	Support by healthcare professionals, especially diabetes specialists, significantly predicted diabetes app use. Family and friend support was negatively associated with diabetes app use.	Healthcare professional support positively influences the use of diabetes self-management apps, whereas higher family/friend support may reduce the need for app use.	80%
2	Burner et al[46] (2018)	Randomized controlled feasibility trial, mixed methods	United States (Los Angeles, California)	44 patients (22 in intervention arm, 22 in control arm)	Mobile health (mHealth) via text messaging	Supporters (family or friends) received synchronized text messages (FANS curriculum) to encourage support for patients	3 months	HbA1c, diabetes empowerment scale, problem areas in diabetes scale, social support questionnaire	HbA1c decreased more in the intervention group (mean decrease 1.4%) compared to control (mean decrease 0.6%), Improved self-monitoring of glucose and physical activity in the intervention group	mHealth interventions combined with family support are feasible and acceptable, with promising outcomes for diabetes management among low-income Latino patients. Further research with larger, longer-term studies is needed.	80%
3	Mayberry et al[45] (2016)	Feasibility study, qualitative approach	United States (Nashville, TN)	19 adults with T2D	mHealth intervention (FAMS - Family-Focused Add-On for Motivating Self-Care) via phone calls and text messages	Participants could invite a support person (SP) to receive supportive text messages tailored to their self-care goals	2 weeks	Interviews, feedback surveys, coaching assessments, technical data from MEMOTEXT	Participants reported increased self-care and improved support and communication about diabetes. Family involvement through supportive text messages was found to be feasible and acceptable.	FAMS is a usable and feasible mHealth intervention that helps patients manage self-care support from family members, though some patients may not have a support person.	100%
4	Mayberry et al[43] (2021)	Mixed-methods randomized controlled trial	United States (Nashville, TN)	512 participants (adults with T2D)	Mobile phone-delivered diabetes self-care support (FAMS intervention)	Participants could invite a support person to receive supportive text messages tailored to their self-care goals	6 months	Surveys, interviews, physical activity questionnaires, diet questionnaires, diabetes self-efficacy scales	Improvements in family/friend involvement, diabetes self-efficacy, and diet but not physical activity. Family involvement mediated effects on self-efficacy and diet for FAMS participants.	FAMS intervention was well received and demonstrated significant improvements in family/friend involvement, self-efficacy, and dietary behavior. The intervention is a promising approach to improve diabetes management by engaging patients' social context.	60%
5	Mayberry et al[47] (2019)	Mixed-methods evaluation	United States (Nashville, TN)	123 participants (adults with T2D)	Mobile phone-delivered diabetes self-care support (text messaging)	Participants had the option to invite a support person to receive supportive text messages tailored to their self-care goals	6 months	Surveys, interviews, hemoglobin A1c test	Nearly half (48%) invited a support person. Participants who invited a support person were younger, more likely to be partnered, and reported more depressive symptoms. Support persons reported increased awareness, improved dialogue, and better health behaviors.	Text messaging is an acceptable method to engage friends/family in diabetes self-management support across diverse populations. The intervention is particularly beneficial for patients with higher levels of need, such as those with depressive symptoms.	100%
6	Roddy et al[39] (2022)	Randomized controlled trial (RCT)	United States (Nashville, TN)	506 participants (adults with T2D)	Mobile health intervention with text messaging (REACH and REACH+FAMS)	Participants could invite a support person to receive supportive text messages tailored to their self-care goals	12 months	HbA1c, family involvement scales	REACH+FAMS had an indirect effect on HbA1c through improved helpful family involvement at both 6 and 12 months. No significant effect was found for REACH alone.	Family systems theory is supported as improved family involvement mediated sustained improvements in glycemic control, highlighting the importance of family-focused interventions in diabetes management.	80%

7	Zupa et al[40] (2021)	Randomized controlled trial (RCT)	United States (Pittsburgh, PA)	123 participants (adults with T2D)	Telehealth intervention using IVR calls and coach-delivered visit preparation calls	Participants enrolled with a family supporter who received summaries and were involved in care	12 months	Call completion rates, HbA1c, patient activation scores	Higher patient activation predicted higher call completion, while higher HbA1c and depressive symptoms predicted lower call completion. Family supporter involvement in medication was associated with lower call completion.	Engagement with telehealth calls was high overall, but patients with higher HbA1c, depression, or who received medication support from family were less likely to complete calls. Family support tailored to patient needs may improve engagement.	60%
8	Mayberry et al[42] (2022)	Randomized controlled trial (RCT)	United States (Nashville, TN)	338 adults with T2D, 300 with a support person	Mobile phone-delivered intervention (FAMS 2.0) with phone coaching and text message support	Participants invited to enroll with a support person who also received tailored text messages	15 months	HbA1c, diabetes distress, psychosocial well-being, support burden	Data collection ongoing. Initial recruitment indicates high feasibility and acceptability. Findings will inform the utility of engaging family/friends in diabetes self-care.	The study is ongoing, but recruitment and early feedback suggest the intervention is feasible and could be scalable. Future findings will contribute to understanding the impact of family/friend support on diabetes management and well-being.	80%
9	Higa et al[48] (2021)	Action research-based pilot study	United States (Hawai'i)	7 dyads (7 patients with T2D and 7 family/friend supporters)	Telehealth-enabled DSM education, Bluetooth-enabled glucose monitors, and text messaging support	Involvement of a family member or friend as a support partner for DSM activities, including participation in telehealth classes and ongoing communication	9 months	HbA1c, surveys, interviews, participant observations	Six out of seven participants with diabetes reduced HbA1c levels, three by more than 1%. The seventh participant maintained HbA1c levels within recommended ranges. DSM knowledge and self-care behaviors improved across all participants.	The study demonstrated that integrating family/friend support with HIT and DSM education in a community-centric approach can improve DSM behaviors and health outcomes in under-resourced rural communities. The use of social capital was key to program success.	80%
10	Poonpraphai et al[41] (2022)	Randomized controlled trial (RCT)	Thailand	157 participants (78 intervention, 79 control)	Mobile application-based intervention with educational support provided by pharmacists to family members	Family members received education via mobile app and assisted patients in self-management tasks	9 months	HbA1c, blood pressure, family behavior, diabetes knowledge, self-management, medication adherence	The intervention group showed a significant decline in HbA1c levels compared to the control group (−0.97% vs. −0.12%). Significant improvements were also observed in family behavior, diabetes knowledge, self-management, and medication adherence.	The study demonstrated that a family support-based intervention delivered via a mobile application can significantly improve glycemic control and related outcomes in older adults with type 2 diabetes.	80%

Discussion

This review shows that mHealth interventions incorporating family support consistently improve glycemic control across methodologically diverse studies, although one boundary should be stated at the outset. Every included study enrolled adults with type 2 diabetes mellitus; therefore, the findings discussed here apply to T2DM and should not be extended to type 1 or gestational diabetes, in which the self-management tasks, the age profile of patients, and the role families play all differ. Within that boundary, the results align with theoretical work positioning family-centered approaches as a shift in how diabetes care is organized.[49] The Family Approach to Diabetes Management treats the family system, rather than the individual patient, as the unit of care and reports measurable clinical gains,[49] and the 2025 American Diabetes Association Standards of Care now integrate family involvement across the lifespan through interprofessional teams.[50]

Several mechanisms plausibly underlie this benefit, most of them consistent with social cognitive theory, the behavioral framework applied most often in this literature.[51] Self-efficacy appears to be the pivotal variable, since family support seems to work partly by strengthening it, particularly where that support has been culturally adapted.[51] Patient activation has been proposed as a second pathway linking family involvement to self-management behavior,[52] and mediation analysis in one included trial supports this reading: improvements in helpful family involvement accounted for the sustained glycemic gains.[39] The relationship between family involvement and self-management is not uniformly positive, however. Practical help, emotional involvement, and open communication assist management, whereas control, criticism, and poor communication undermine it.[53] A related paradox appears both in the wider literature and in one included study, in that patients who already had strong family support used diabetes applications less.[44,53] Read together, these findings suggest that what a family-supported mHealth program adds depends on the baseline family dynamic, and that autonomy-supportive involvement outperforms controlling involvement.[25]

Across the wider evidence base, mHealth tools support self-management through patient-generated data and tailored messaging,[54,55] and both smartphone applications and SMS outperform website-based delivery.[56,57] Smartphone applications have produced the largest HbA1c reductions, with SMS close behind,[56] while network comparisons favor teleconsultation and combined telemonitoring.[58] Sustaining engagement over time remains the central difficulty for these platforms. Dropout is substantial by six months, and SMS retains users better than applications or web programs,[59] which is consistent with the prominence of text messaging among the effective interventions identified here. A separate question concerns which patients stand to benefit most. Self-efficacy is the strongest psychological predictor of self-management,[51] and depression and diabetes distress are both common in T2DM and impair it.[60] That patients with depressive symptoms were more likely to engage family support therefore suggests these programs may be most useful for those with complex psychosocial needs,[20] where shared routines around eating and activity can build positive interdependence.[61]

Implementation succeeded across quite different cultural settings, which speaks to adaptability rather than to any single design. Culturally tailored, evidence-based adaptation is effective at scale,[62] and community-based approaches shaped to local context support self-management.[63] The Latino- and Thai-focused studies in this review illustrate the point, since effectiveness rested on cultural relevance rather than on the technology itself. Digital access, however, remains unequal by race and ethnicity,[64] which makes community-based delivery in rural and underserved settings

particularly valuable. Economic evidence is broadly favorable, with digital prevention programs reporting cost savings and incremental cost-effectiveness ratios within accepted thresholds.[65,66] Implementation research points to organizational readiness, leadership, resources, and climate as the main facilitators, and describes family-centered barriers at individual, interpersonal, and system levels. Structured family education, peer support, and multi-user interface design have been proposed to address them.[67]

Digital platforms can support patient agency through personalized behavior-change interventions,[68] much as home telemonitoring does,[57] and that involving families in the process improves outcomes.[69] Patient-reported outcomes point the same way, with gains in self-efficacy and perceived support and reductions in depressive symptoms where family members are involved,[70] and patients themselves prefer autonomy-supportive to controlling behaviors.[25] Designs of this kind are feasible even among low-income adults.[45] However, long-term sustainability remains unresolved, because technology can strain family relationships as readily as it can strengthen them, and caregiver burden is common.[71,72] Sustained engagement is therefore likely to require adaptive, multi-modal strategies that combine behavioral design, personalization, and human support alongside the digital component,[73] with attention to participant burden, timely feedback, and theory-based design.[74] With those caveats, the consistency of effects across settings supports integrating family-supported mHealth into routine T2DM care without sophisticated infrastructure,[57] since simple text-messaging approaches scale broadly and family involvement adds measurable benefit.[45,46] Engagement, digital equity, and system integration will still require coordinated action at several levels.[56]

These findings carry practical implications for services and policy. Health systems can build family assessment and support into routine diabetes care, and clinical guidelines can treat the evaluation of family dynamics as a standard part of care planning, supported by staff training in family-centered approaches. Because the interventions that worked were technologically simple, they can be delivered without heavy infrastructure. That matters for reimbursement decisions and for reaching the underserved groups in whom diabetes disparities are greatest.

Several limitations temper these conclusions, beginning with the search, which covered four databases; Embase and Scopus were not searched, and although citation tracking was performed, eligible studies may still have been missed. Seven of the 10 included studies were conducted in the United States, which limits generalizability. Heterogeneity in design, sample size, intervention duration, and outcome measurement prevented meta-analysis and reduced the precision of any effect estimate. Methodological quality varied, follow-up rarely exceeded 12 months, and mobile

technology moves quickly enough that the earlier studies may not reflect currently available tools. Restricting inclusion to English-language publications may have introduced language bias, economic evaluations seldom reported lifetime costs, and family involvement was not always beneficial. Finally, as noted, conclusions are confined to T2DM.

Building on these findings, future research should pursue several directions. Trials should adopt standardized outcome measures and follow participants beyond 24 months, so that the durability of glycemic and behavioral gains can be established. Hybrid effectiveness-implementation designs would allow clinical outcomes and real-world scalability, including cost-effectiveness, to be tested together. Studies should also specify how particular family-support components are built into mHealth platforms, and which mechanisms sustain engagement across different populations and settings. As the evidence base grows, future reviews should draw on broader database coverage and, once outcome reporting becomes more consistent, attempt meta-analysis.

Conclusion

This review shows that mHealth interventions incorporating family support improve glycemic control, self-management behaviors, and psychosocial outcomes in adults with T2DM. The effect held across varied populations and settings, and the most effective platforms, text messaging in particular, were technologically simple, which points to genuine potential for scale-up in routine care. What mattered was less the sophistication of the technology than the manner of family involvement, in that autonomy-supportive engagement helped where controlling involvement did not. With attention to family dynamics and cultural context, family-centered mHealth interventions offer a practical and scalable route to better outcomes for adults with T2DM and their families.

Acknowledgement

The authors thank Universitas Gadjah Mada and Institut Kesehatan Payung Negeri for providing database access in literature searching. Thanks to the Human Resources Learning Task Manager of the Ministry of Health of the Republic of Indonesia for providing educational and research funding assistance.

Authors' Contributions

Conceptualization: Alfianur Alfianur
Data curation: Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana
Formal Analysis: Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana
Funding acquisition: Alfianur Alfianur

Investigation: Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana
Methodology: Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana
Project administration: Alfianur Alfianur
Resources: Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana
Software: Alfianur Alfianur
Supervision: Ibrahim Rahmat, Uki Noviana
Validation: Alfianur Alfianur, Uki Noviana
Visualization: Alfianur Alfianur
Writing – original draft: Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana
Writing – review & editing: Alfianur Alfianur, Ibrahim Rahmat, Uki Noviana

Conflict of Interest

There is nothing to declare.

Data availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Issues

Not applicable.

Funding

BPI (Indonesian Education Scholarship), *Pusat Pelayanan Pembiayaan dan Asesmen Pendidikan Tinggi* (Center for Higher Education Funding and Assessment, Ministry of Higher Education, Science, and Technology of the Republic of Indonesia), and LPDP (Indonesia Endowment Fund for Education) provided the funding through grant number 202329112943.

Study Highlights

What is the current knowledge?

- M Health improves diabetes self-management, and prior reviews confirm its benefits for adherence and glycemic outcomes.
- Family support correlates with better HbA1c through practical assistance, emotional support, and coordination of care.

What is new here?

- Text messaging was the predominant platform, yielding HbA1c reductions of 0.97%–1.40%.
- Autonomy-supportive family involvement outperformed controlling involvement.
- Simple text-messaging approaches scaled broadly, with family involvement adding measurable benefit.

References

1. Mirahmadizadeh A, Khorshidsavar H, Seif M, Sharifi MH. Adherence to medication, diet and physical activity and the associated factors amongst patients with type 2 diabetes. Diabetes Therapy. 2020; 11: 479–4. doi: 10.1007/s13300-019-00750-8
2. Shawon MS, Hossain FB, Adhikary G, Das Gupta R, Hashan MR, Rabbi MF, et al. Attitude towards diabetes and social and family support among type 2 diabetes patients attending a tertiary-care hospital in Bangladesh: a cross-sectional study. BMC Res Notes. 2016; 9: 286. doi: 10.1186/s13104-016-2081-8
3. Arokiasamy P, Salvi S, Selvamani Y. Global burden of diabetes mellitus. Handbook of Global Health. Cham: Springer International Publishing; 2021. 495–538.
4. Forouhi NG, Wareham NJ. Epidemiology of diabetes. Medicine. 2022; 50: 638–43. doi: 10.1016/j.mpmed.2022.07.005
5. Pizzol D. Diabetes Mellitus in Elderly. Reference Module in Biomedical Sciences. Elsevier; 2019.
6. Mazhari A, Emanuele MA, Charnogursky G. Diabetes Mellitus. Atlas of Clinical Endocrinology and Metabolism. Boca Raton: CRC Press; 2024. 40–73.
7. Aravinda J. Risk factors in patients with type 2 diabetes in Bengaluru: A retrospective study. World J Diabetes. 2019; 10: 241–8. doi: 10.4239/wjd.v10.i4.241
8. Nizar AMN, Kusnanto, Lilik Herawati. Effectiveness of family empowerment towards diet compliance and family independence in caring for family members with diabetes mellitus: a systematic review. Poltekita : Jurnal Ilmu Kesehatan. 2021; 15: 9–19. doi: 10.33860/jik.v15i1.435
9. Siopis G, Colagiuri S, Allman-Farinelli M. People with type 2 diabetes report dietitians, social support, and health literacy facilitate their dietary change. J Nutr Educ Behav. 2021; 53: 43–53. doi: 10.1016/j.jneb.2020.09.003
10. Cheraghi F, Shamsaei F, Mortazavi SZ, Moghimbeigi A. The effect of family-centered care on management of blood glucose levels in adolescents with diabetes. Int J Community Based Nurs Midwifery. 2015; 3:177–86.
11. Gujral UP, Prabhakaran D, Pradeepa R, Kandula NR, Kondal D, Deepa M, et al. Isolated HbA1c identifies a different subgroup of individuals with type 2 diabetes compared to fasting or post-challenge glucose in Asian Indians: The CARRS and MASALA studies. Diabetes Res Clin Pract. 2019; 153: 93-102. doi: 10.1016/j.diabres.2019.05.026

12. A Kakade A, R Mohanty I, Rai S. Assessment of factors associated with poor glycemic control among patients with Type II diabetes mellitus. Integr Obes Diabetes. 2018; 4. doi: 10.15761/IOD.1000209
13. Pamungkas RA, Hadijah St, Mayasari A, Nusdin N. Factors associated with poor glycemic control among type 2 diabetes mellitus in Indonesia. Belitung Nurs J. 2017; 3: 272–80. doi: 10.33546/bnj.61
14. Ghabban SJ, Althobaiti B, Farouk IM, Al Hablany M, Ghabban A, Alghbban R, et al. Diabetic Complications and Factors Affecting Glycemic Control Among Patients With Type II Diabetes Mellitus Attending the Chronic Illness Clinics at Tabuk, Saudi Arabia. Cureus. 2020;12(11):e11683. doi: 10.7759/cureus.11683
15. Porter-Williamson KB, Sinclair CT. What is the evidence supporting the use of mobile health technologies in palliative care? Evidence-based practice of palliative medicine. Elsevier; 2023. 684–9.
16. Gawali DH, Wadhai VM. Long term health monitoring using mHealth platform. 2015 International Conference on Information Processing (ICIP). IEEE; 2015. 472–6.
17. Buttigieg S. mHealth - a pocket-sized revolution. Digit Health. Elsevier; 2025. 75–88.
18. Steinhubl SR. Where mobile health technologies are needed in healthcare. Mhealth Innovation. HIMSS Publishing; 2021. 287–95.
19. Brzan PP, Rotman E, Pajnkihar M, Klanjsek P. Mobile applications for control and self-management of diabetes: a systematic review. J Med Syst. 2016; 40: 210. doi: 10.1007/s10916-016-0564-8
20. American Diabetes Association. Standards of medical care in diabetes-2018 abridged for primary care providers. Clin Diabetes. 2018; 36(1):14-37. doi: 10.2337/cd17-0119
21. Solo Traoré, Oumar Guira, Lassané Zoungrana, Yempabou Sagna, Réné Bognounou, Constant B Paré, et al. Factors associated with prolonged poor glycemic control in type 2 diabetes mellitus (T2DM) patients followed in the department of internal medicine at the yalgado ouedraogo teaching hospital, Ouagadougou (Burkina Faso). Open Journal of Internal Medicine. 2021;11:1–26. doi: 10.4236/ojim.2021.111001
22. Gomes LC, Coelho ACM, Gomides D dos S, Foss-Freitas MC, Foss MC, Pace AE. Contribution of family social support to the metabolic control of people with diabetes mellitus: A randomized controlled clinical trial. Applied Nursing Research. 2017; 36: 68–76. doi: 10.1016/j.apnr.2017.05.009

23. Wichit N, Mnatzaganian G, Courtney M, Schulz P, Johnson M. Randomized controlled trial of a family-oriented self-management program to improve self-efficacy, glycemic control and quality of life among Thai individuals with Type 2 diabetes. Diabetes Res Clin Pract. 2017; 123: 37–48. doi: 10.1016/j.diabres.2016.11.013
24. Shahabi N, Kolivand M, Salari N, Abbasi P. The effect of telenursing training based on family-centered empowerment pattern on compliance with diet regimen in patients with diabetes mellitus type 2: a randomized clinical trial. BMC Endocr Disord. 2022; 22: 36. doi: 10.1186/s12902-022-00953-4
25. Baig AA, Benitez A, Quinn MT, Burnet DL. Family interventions to improve diabetes outcomes for adults. Ann N Y Acad Sci. 2015; 1353: 89–112. doi: 10.1111/nyas.12844
26. Keogh KM, et al. Psychological family intervention for poorly controlled type 2 diabetes. Am J Manag Care. 2011; 17: 105–13.
27. Withidpanyawong U, Lerkiatbundit S, Saengcharoen W. Family-based intervention by pharmacists for type 2 diabetes: A randomised controlled trial. Patient Educ Couns. 2019; 102: 85–92. doi: 10.1016/j.pec.2018.08.015
28. Garcia-Huidobro D, Bittner M, Brahm P, Puschel K. Family intervention to control type 2 diabetes: a controlled clinical trial. Fam Pract. 2011; 28: 4–11. doi: 10.1093/fampra/cmq069
29. Costa BM, Fitzgerald KJ, Jones KM, Dunning AM T. Effectiveness of IT-based diabetes management interventions: a review of the literature. BMC Fam Pract. 2009; 10: 72. doi: 10.1186/1471-2296-10-72
30. El-Gayar O, Timsina P, Nawar N, Eid W. A systematic review of IT for diabetes self-management: Are we there yet? Int J Med Inform. 2013; 82: 637–52. doi: 10.1016/j.ijmedinf.2013.05.006
31. Mushcab H, Kernohan WG, Wallace J, Martin S. Web-Based remote monitoring systems for self-managing type 2 diabetes: a systematic review. Diabetes Technol Ther. 2015; 17: 498–509. doi: 10.1089/dia.2014.0296
32. Matrook KA, Whitford DL, Smith SM, McGilloway S, Piyasena MP, Cowman S. Family-based interventions for adults with type 2 diabetes mellitus: A systematic review and meta-analysis. Prim Care Diabetes. 2025; 19: 111–9. doi: 10.1016/j.pcd.2025.01.006
33. Pamungkas R, Chamroonsawasdi K, Vatanasomboon P. A systematic review: family support integrated with diabetes self-management among uncontrolled type II diabetes mellitus patients. Behavioral Sciences. 2017; 7: 62. doi: 10.3390/bs7030062

34. Sabahi A, Jalali S, Ameri F, Garavand A, Negahban A. The effect of using mobile health on self-management of type 2 diabetic patients: A systematic review in Iran. J Educ Health Promot. 2023; 12:358. doi: 10.4103/jehp.jehp_910_22
35. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. Updating guidance for reporting systematic reviews: development of the PRISMA 2020 statement. J Clin Epidemiol. 2021; 134: 103-12. doi: 10.1016/j.jclinepi.2021.02.003
36. Lizarondo L, Stern C, Carrier J, Godfrey C, Rieger K, Salmond S. JBI Manual for Evidence Synthesis [Internet]. Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. JBI; 2024 [cited 2025 Mar 13]. Available from: https://synthesismanual.jbi.global
37. Hong QN, et al. The mixed methods appraisal tool (MMAT) version 2018 for information professionals and researchers. Education for Information. 2018; 34: 285–91. doi: 10.3233/EFI-180221
38. Popay J, et al. Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC Methods Programme. Lancaster: Lancaster University; 2006.
39. Roddy MK, Nelson LA, Greevy RA, Mayberry LS. Changes in family involvement occasioned by FAMS mobile health intervention mediate changes in glycemic control over 12 months. J Behav Med. 2022; 45: 28–37. doi: 10.1007/s10865-021-00250-w
40. Zupa MF, Piette JD, Stoll SC, Obrosky DS, Boudreaux-Kelly M, Youk AO, et al. Patient and supporter factors affecting engagement with diabetes telehealth. Am J Manag Care. 2021;27(10):409-14. doi: 10.37765/ajmc.2021.88758
41. Poonprapai P, Lerkiatbundit S, Saengcharoen W. Family support-based intervention using a mobile application provided by pharmacists for older adults with diabetes to improve glycaemic control: a randomised controlled trial. Int J Clin Pharm. 2022; 44: 680–8. doi: 10.1007/s11096-022-01389-5
42. Mayberry LS, et al. Rationale, design, and recruitment outcomes for the Family/Friend Activation to Motivate Self-care (FAMS) 2.0 randomized controlled trial among adults with type 2 diabetes and their support persons. Contemp Clin Trials. 2022; 122: 106956. doi: 10.1016/j.cct.2022.106956
43. Mayberry LS, et al. Mixed-Methods Randomized Evaluation of FAMS: A Mobile Phone-Delivered Intervention to Improve Family/Friend Involvement in Adults' Type 2 Diabetes Self-Care. Annals of Behavioral Medicine. 2021; 55: 165–78. doi: 10.1093/abm/kaaa041

44. Brew-Sam N, Chib A, Rossmann C. Differential influences of social support on app use for diabetes self-management – a mixed methods approach. BMC Med Inform Decis Mak. 2020; 20: 151. doi: 10.1186/s12911-020-01173-3
45. Mayberry LS, Berg CA, Harper KJ, Osborn CY. The design, usability, and feasibility of a family-focused diabetes self-care support mhealth intervention for diverse, low-income adults with type 2 Diabetes. J Diabetes Res. 2016; 2016:1–13. doi: 10.1155/2016/7586385
46. Burner E, Lam CN, DeRoss R, Kagawa-Singer M, Menchine M, Arora S. Using mobile health to improve social support for low-income latino patients with diabetes: a mixed-methods analysis of the feasibility trial of TExT-MED + FANS. Diabetes Technol Ther. 2018; 20: 39–48. doi: 10.1089/dia.2017.0198
47. Mayberry LS, Bergner EM, Harper KJ, Laing S, Berg CA. Text messaging to engage friends/family in diabetes self-management support: acceptability and potential to address disparities. Journal of the American Medical Informatics Association. 2019; 26: 1099–108. doi: 10.1093/jamia/ocz091
48. Higa C, Davidson EJ, Loos JR. Integrating family and friend support, information technology, and diabetes education in community-centric diabetes self-management. Journal of the American Medical Informatics Association. 2021; 28: 261–75. doi: 10.1093/jamia/ocaa223
49. Solowiejczyk J. The Family Approach to Diabetes Management: Theory into Practice toward the Development of a New Paradigm. Diabetes Spectrum. 2004; 17: 31–6. doi: 10.2337/diaspect.17.1.31
50. American Diabetes Association Professional Practice Committee. Sec. 7. Diabetes technology: standards of care in Diabetes 2025. Diabetes Care [Internet]. 2024; 48: S146–S66. doi: 10.2337/dc25-S007.
51. Xue H, Zhang L, Shi Y, Zhang H, Zhang C, Liu Y, et al. The effectiveness of digital health intervention on glycemic control and physical activity in patients with type 2 diabetes: a systematic review and meta-analysis. Front Digit Health. 2025; 7: 1630588. doi: 10.3389/fdgth.2025.1630588
52. Chen T-T, Su W-C, Liu M-I. Patient-centered care in diabetes care-concepts, relationships and practice. World J Diabetes. 2024; 15: 1417–29. doi: 10.4239/wjd.v15.i7.1417
53. Bennich BB, Røder ME, Overgaard D, Egerod I, Munch L, Knop FK, et al. Supportive and non-supportive interactions in families with a type 2 diabetes patient: an integrative review. Diabetol Metab Syndr. 2017;9: 57. doi: 10.1186/s13098-017-0256-7

54. Nundy S, Dick JJ, Solomon MC, Peek ME. Developing a behavioral model for mobile phone-based diabetes interventions. Patient Educ Couns. 2013; 90: 125–32. doi: 10.1016/j.pec.2012.09.008
55. Fatehi F, Gray LC, Russell AW. Mobile Health (mHealth) for Diabetes Care: Opportunities and Challenges. Diabetes Technol Ther. 2017; 19: 1–3. doi: 10.1089/dia.2016.0430
56. Moschonis G, Siopis G, Jung J, Eweka E, Willems R, Kwasnicka D, et al. Effectiveness, reach, uptake, and feasibility of digital health interventions for adults with type 2 diabetes: a systematic review and meta-analysis of randomised controlled trials. Lancet Digit Health. 2023; 5(3):e125-e43. doi: 10.1016/S2589-7500(22)00233-3
57. Kitsiou S, Paré G, Jaana M, Gerber B. Effectiveness of mHealth interventions for patients with diabetes: An overview of systematic reviews. PLoS One. 2017; 12: e0173160. doi: 10.1371/journal.pone.0173160
58. Lee SWH, Chan CKY, Chua SS, Chaiyakunapruk N. Comparative effectiveness of telemedicine strategies on type 2 diabetes management: A systematic review and network meta-analysis. Sci Rep. 2017; 7: 12680. doi: 10.1038/s41598-017-12987-z
59. Böhm A-K, Jensen ML, Sørensen MR, Stargardt T. Real-World evidence of user engagement with mobile health for diabetes management: longitudinal observational study. JMIR Mhealth Uhealth. 2020; 8: e22212. doi: 10.2196/22212
60. Akshatha S, Nayak UB. The psychological distress associated with type 2 diabetes mellitus represents an unmet need for drug discovery. Med Drug Discov. 2024; 23: 100196. doi: 10.1016/j.medidd.2024.100196
61. Hu J, Wallace DC, McCoy TP, Amirehsani KA. A Family-Based diabetes intervention for hispanic adults and their family members. Diabetes Educ. 2014; 40: 48–59. doi: 10.1177/0145721713512682
62. Mathews E, et al. Cultural adaptation of a peer-led lifestyle intervention program for diabetes prevention in India: the Kerala diabetes prevention program (K-DPP). BMC Public Health. 2017; 17: 974. doi: 10.1186/s12889-017-4986-0
63. Eshete A, Lambebo A, Mohammed S, Shewasinad S, Assefa Y. Effect of nutritional promotion intervention on dietary adherence among type II diabetes patients in North Shoa Zone Amhara Region: quasi-experimental study. J Health Popul Nutr. 2023; 42: 49. doi: 10.1186/s41043-023-00393-3

64. Rodriguez JA, Seiglie JA, Caballero AE. What does a new health technology landscape mean for Hispanic/Latino people with diabetes? Clinical Diabetes. 2023; 41: 289–91. doi: 10.2337/cd22-0087
65. Zhou X, Siegel KR, Ng BP, Jawanda S, Proia KK, Zhang X, Albright AL, Zhang P. Cost-effectiveness of diabetes prevention interventions targeting high-risk individuals and whole populations: A systematic review. Diabetes Care. 2020; 43(7):1593-616. doi: 10.2337/dci20-0018
66. Blankart KE, Felder S. Do Medicine Shortages Reduce Access and Increase Pharmaceutical Expenditure? A retrospective analysis of Switzerland 2015-2020. Value in Health. 2022; 25: 1124–32. doi: 10.1016/j.jval.2021.12.017
67. Rangachari P, Mushiana SS, Herbert K. A scoping review of applications of the Consolidated Framework for Implementation Research (CFIR) to telehealth service implementation initiatives. BMC Health Serv Res. 2022; 22: 1450. doi: 10.1186/s12913-022-08871-w
68. Abidi S, Vallis M, Piccinini-Vallis H, Imran SA, Abidi SSR. Diabetes-Related Behavior Change Knowledge Transfer to Primary Care Practitioners and Patients: Implementation and Evaluation of a Digital Health Platform. JMIR Med Inform. 2018; 6: e25. doi: 10.2196/medinform.9629
69. Su D, Zhou J, Kelley MS, Michaud TL, Siahpush M, Kim J, et al. Does telemedicine improve treatment outcomes for diabetes? A meta-analysis of results from 55 randomized controlled trials. Diabetes Res Clin Pract. 2016; 116: 136-48. doi: 10.1016/j.diabres.2016.04.019
70. Scholle SH, Morton S, Anderson D, Kendrick D, Homco J, Rodriguez K, et al. Using Patient-Reported Outcome Measures during Routine Care of Patients with Type 2 Diabetes [Internet]. Washington (DC): Patient-Centered Outcomes Research Institute (PCORI); 2019.
71. Balcázar-Hernández L, Huerta-Martínez H, Garrido Magaña E, Nishimura-Meguro E, Jiménez Márquez A, Rivera-Hernández A. Burden in primary informal caregivers of children and adolescents with type 1 diabetes: Is it associated with depression, family dysfunction, and glycemic control? Front Endocrinol (Lausanne). 2023; 13: 1089160. doi: 10.3389/fendo.2022.1089160
72. Kobos E, Rojkowska S, Szewczyk A, Dziedzic B. Burden of care and a sense of loneliness in caregivers of children with type 1 diabetes. A cross-sectional study. Biopsychosoc Med. 2023; 17: 34. doi: 10.1186/s13030-023-00291-4
73. Barker MM, Chauhan R, Davies MJ, Brough C, Northern A, Stribling B, et al. User Retention and Engagement in the Digital-Based Diabetes Education and Self-Management for Ongoing

and Newly Diagnosed (myDESMOND) Program: Descriptive Longitudinal Study. JMIR Diabetes. 2023; 8: e44943. doi: 10.2196/44943

74. Adu MD, Malabu UH, Malau-Aduli AEO, Malau-Aduli BS. Users' preferences and design recommendations to promote engagements with mobile apps for diabetes self-management: Multi-national perspectives. PLoS One. 2018; 13: e0208942. doi: 10.1371/journal.pone.0208942