

The Impact of Health Education on Improving Self-Care in Type 2 Diabetes Mellitus Patients: A Scoping Review

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Abstract

Background: Type 2 Diabetes Mellitus (T2DM) is a chronic disease that requires long-term management, including behavioral changes in self-care to prevent complications. Health education is an essential strategy for improving self-care among T2DM patients. However, there remains variability in the educational approaches used and their effectiveness in enhancing patient adherence to self-care practices.

Objective: This study aims to explore and analyze various forms of health education that influence improving self-care behaviors in T2DM patients.

Methods: This study employs a scoping review approach with five main stages: (1) formulating research questions, (2) searching for relevant studies, (3) screening and selecting suitable research, (4) mapping the data, and (5) thematic analysis and summarizing the findings. The process follows the PRISMA-P protocol and evaluation using the PRISMA checklist. The literature analyzed comes from international journals in the PubMed, ProQuest, and Scopus databases. The criteria include full-text articles, English language, and publication dates between 2015 and 2024, focusing on diabetes-related subjects. Inclusion and exclusion criteria follow the PCC model. A total of 26 articles were analyzed in this study.

Results: This scoping review identifies various forms of health education that influence improving self-care behaviors in T2DM patients. From the 26 studies analyzed, it was found that digital technology-based interventions, such as mobile applications, telehealth, and video-based education, demonstrated significant improvements in self-care behaviors. Additionally, personalized, face-to-face education enhances patient understanding and adherence in the short term but requires reinforcement through follow-up interventions to sustain its benefits. Although these interventions were adequate, the main challenges identified were the heterogeneity of study designs, the relatively short duration of interventions, and sample size limitations, which may affect the generalizability of the research findings. Overall, technology-based health education shows excellent potential for supporting long-term disease management.

Conclusions: Technology-based health education approaches effectively improve self-care behaviors in T2DM patients. These findings can serve as a foundation for developing more optimal health education strategies.

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Original Manuscript

The Impact of Health Education on Improving Self-Care in Type 2 Diabetes Mellitus Patients: A Scoping Review

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a chronic disease that requires long-term management, including behavioral changes in self-care to prevent complications. Health education is an essential strategy for improving self-care among T2DM patients. However, there remains variability in the educational approaches used and their effectiveness in enhancing patient adherence to self-care practices.

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Methods: This study employs a scoping review approach with five main stages: (1) formulating research questions, (2) searching for relevant studies, (3) screening and selecting suitable research, (4) mapping the data, and (5) thematic analysis and summarizing the findings. The process follows the PRISMA-P protocol and evaluation using the PRISMA checklist. The literature analyzed comes from international journals in the PubMed, ProQuest, and Scopus databases. The criteria include full-text articles, English language, and publication dates between 2015 and 2024, focusing on diabetes-related subjects. Inclusion and exclusion criteria follow the PCC model. A total of 26 articles were analyzed in this study.

Results: This scoping review identifies various forms of health education that influence improving self-care behaviors in T2DM patients. From the 26 studies analyzed, it was found that digital technology-based interventions, such as mobile applications, telehealth, and video-based education, demonstrated significant improvements in self-care behaviors. Additionally, personalized, face-to-face education enhances patient understanding and adherence in the short term but requires reinforcement through follow-up interventions to sustain its benefits. Although these interventions were adequate, the main challenges identified were the heterogeneity of study designs, the relatively short duration of interventions, and sample size limitations, which may affect the generalizability of the research findings. Overall, technology-based health education shows excellent potential for supporting long-term disease management.

Conclusion: Technology-based health education approaches effectively improve self-care behaviors in T2DM patients. These findings can serve as a foundation for developing more optimal health education strategies.

Keywords: Type 2 Diabetes Mellitus; Self-Care; Health Education.

INTRODUCTION

Diabetes mellitus (DM) is a degenerative disease that leads to serious consequences

if not properly managed, and it represents one of the significant health challenges of the 21st century. Type 2 Diabetes Mellitus (T2DM), the most common form, accounts for more than 90% of all DM cases¹. Approximately 26.9% of adults with T2DM remain undiagnosed, potentially facing serious complications such as kidney failure, heart attacks, strokes, blindness, and lower limb amputations². Diabetes patients often die due to complications like cardiovascular disorders, neuropathy, and hypertension. About 25% of deaths from diabetes are caused by these complications. Diabetes complications also account for 91% of lower extremity amputations, 60% of hospital admissions due to cardiovascular diseases, and 50% of hospital admissions due to stroke³. T2DM is generally caused by poor lifestyle habits such as hypertension, obesity, and hypercholesterolemia. However, many patients do not engage in self-care practices such as managing their diet, exercising, monitoring blood glucose, or caring for their feet⁴. Therefore, diabetes management efforts rely not only on medical interventions but also require active patient participation in consistently practicing self-care behaviors.

Self-care in T2DM patients refers to daily actions to maintain blood glucose balance. These activities include managing diet, exercising, monitoring blood glucose levels, foot care, and adhering to prescribed medications⁵. Self-care is a crucial aspect of managing T2DM⁶. Effective health education can enhance patients' ability to self-care; however, many patients still face challenges in maintaining consistency in their self-care practices². Numerous studies have shown that active patient involvement in self-care can reduce the risk of long-term complications associated with diabetes, such as cardiovascular disease, kidney disorders, and neuropathy⁷. Thus, health education is essential in supporting self-care improvement in T2DM patients.

Health education, increased literacy, and awareness about health can assist DM patients in managing their condition, reducing perceived stress levels, and implementing more effective coping strategies. The World Health Organization (WHO) views education as fundamental in treating DM. It emphasizes the importance of attitude change, promotion of self-care, and raising awareness as key objectives in diabetes education⁸. Self-management education for diabetes provides knowledge and skills to enhance behavioral changes that improve glycemic control⁹. Diabetes management education improves patients' knowledge and enhances self-care behaviors, particularly diet and foot care¹⁰. This indicates that health education not only enhances patients' understanding of diabetes but also serves as a fundamental foundation in shaping effective self-care

behaviors.

T2DM, as a degenerative disease related to lifestyle, requires intensive self-care to control blood glucose levels and prevent long-term complications¹. Self-care in T2DM patients includes managing diet, exercise, blood glucose monitoring, foot care, and medication adherence, which heavily depend on the understanding and skills acquired through health education⁵. However, many patients still face difficulties in performing their self-care, which increases the risk of complications related to diabetes, such as cardiovascular disorders and neuropathy⁷. Considering this, it is important to explore how health education can influence changes in self-care behaviors among T2DM patients². This scoping review evaluates various health education approaches influencing self-care improvement in T2DM patients.

METHODS

To conduct a scoping review on the Impact of Health Education on Improving Self-Care in T2DM Patients, the method used will follow the framework established by Arksey and O'Malley, which includes five key stages in the execution of the scoping review. This approach is designed to map existing literature, identify research gaps, and provide an overview of the available evidence related to the topic under investigation. The methodological structure used consists of the following stages: Stage 1, defining the research questions; Stage 2, identifying studies relevant to the research questions; Stage 3, selecting studies to be included in the review; Stage 4, mapping the data from the included studies; Stage 5, synthesizing, summarizing, and reporting the findings.

Stage I: Defining the Research Question

The research question in this scoping review is: What forms of health education influence self-care improvement in T2DM patients?

Stage II: Identifying Relevant Studies and Search Strategy

This review will examine forms of health education related to improving self-care in patients with Type 2 Diabetes Mellitus. Articles will be collected through online databases, including PubMed, Scopus, and ProQuest.

Table 1: Summary of Literature Search Strategy: Databases, Keywords, and Selection Results

N o	Databas e	Keywords	Initial Results	Final Result s	Access Date
1.	PubMed	((diabetes mellitus type 2[MeSH Terms]) AND (health education[MeSH Terms])) AND (self care[Title/Abstract])	486	101	January 19, 2025
2.	Scopus	Type 2 Diabetes OR Diabetes Mellitus Type 2 OR Diabetes Type 2 OR Diabetic patients AND self-care AND health education or health promotion	456	222	January 19, 2025
3.	Proquest	abstract(Type 2 Diabetes OR Diabetes Mellitus Type 2 OR Diabetes Type 2 OR Diabetic patients) AND abstract(self care) AND abstract(health education or health promotion)	549	411	January 19, 2025

This review's inclusion and exclusion criteria are set according to the Population, Concept, Context (PCC) model (Table 2). The PubMed database search is limited to the last 10 years, full-text articles, English language, human subjects, and individuals aged 65 and above. The Scopus database is restricted to articles published between 2015-2024, English language, and journal source type. The ProQuest database is limited to full-text academic journals published in the last 10 years, focusing on diabetes, article type, and English.

Table 2: Article Eligibility Criteria

Criteria	
Population	Focus on patients with Type 2 Diabetes Mellitus
Concept	Health Education

Context	Self-Care
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Stage III: Study Selection

Study Extraction from Databases

The process, screening results, and manuscript extraction criteria after the initial search are completed are based on the inclusion and exclusion criteria of the study. Reporting is done using the Preferred Reporting Items for Systematic Review and Meta-Analyses Extension for Scoping Review Checklist (PRISMA-SCR)¹¹ guidelines. The PRISMA diagram illustrates the procedure followed, the results of the screening process, and the criteria used to extract manuscripts after the initial search based on the inclusion and exclusion criteria that have been established (Figure 1).

All articles were organized using <https://new.rayyan.ai/> for further examination. Duplicate references were identified and removed. Three individuals conducted the screening process: one author and two co-authors, who examined the titles and abstracts, followed by a full-text review of the selected articles. If an article were deemed unsuitable, it would undergo further evaluation. The creation of the PRISMA Flow Diagram was based on the site https://estech.shinyapps.io/prisma_flowdiagram/.

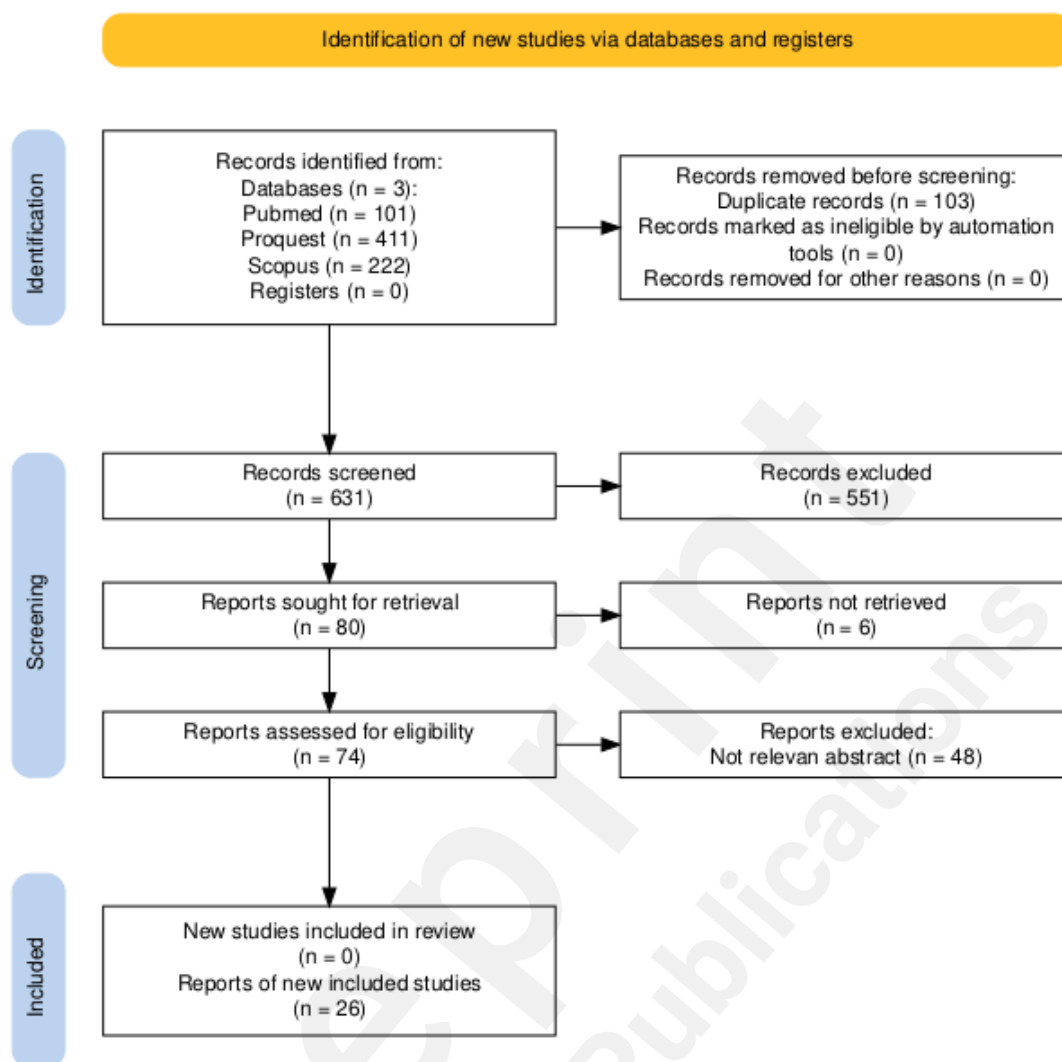


Figure 1. PRISMA-ScR Flow Diagram for Study Search and Selection: Health Education Approaches to Improve Self-Care in Type 2 Diabetes Mellitus Patients

Stage IV: Mapping the Research Data

Data was extracted from previous studies to obtain key information on relevant journal articles, which were then mapped into a synthesis table. This table includes the article title, authors, objectives, research location, study design, sample size, interventions provided, and research findings (Table 3). This step aims to facilitate data extraction for the research synthesis.

Table 3. Synthesis Analysis of 26 Articles Relevant to the Objective

N o	Title and Authors (year)	Objectives	Research Location	Study Design and Sample Size	Interventions Provided	Research Findings
1.	Effect of Diabetes Education Through Pattern Management on Self-Care and Self-Efficacy. Sung-Kyoung Lee et al. (2019)	Evaluating the effects of personalized diabetes education through a Pattern Management (PM) approach using Continuous Glucose Monitoring System (CGMS) outcomes on self-care behaviors and self-efficacy in patients with Type 2 Diabetes Mellitus (T2DM).	Bundang Jesaeng Hospital, South Korea.	Non-equivalent control group pretest-posttest, 60 patients	Education based on Pattern Management (PM) with CGMS was provided in three individual sessions. The first session (60 minutes) covered basic education about diabetes and blood glucose monitoring, followed by 3 days of CGMS monitoring and analysis of the results. The second session (90 minutes) focused on personalized counseling using CGMS data to adjust diet, physical activity, and medication. The third session was conducted via phone two weeks later to provide feedback and ensure that behavioral	Self-care was measured using a 4-point scale from Moon. After 3 months, the PM group showed an increase in self-care scores by 0.38 points compared to the control group ($p < 0.001$), but it decreased by 0.27 points after 6 months. Significant improvements were observed in diet ($p < 0.001$), exercise ($p < 0.001$), and self-management ($p = 0.009$), while medication adherence showed no significant difference ($p = 0.128$)

					changes in the patient continued.	
2.	Self-care behaviors in patients with type 2 diabetes: Education intervention based on social cognitive theory. Mastoreh-Sadat Ghoreishi et al. (2019)	Evaluating the effectiveness of theory-based cognitive social education interventions on self-care behaviors in Type 2 Diabetes Mellitus (T2DM) patients.	Community (Mashhad University of Medical Sciences), Iran	Quasi-experimental, 120 patients	The intervention was provided through 6 educational sessions of 40 minutes each, based on social cognitive theory, focusing on emotional adaptation, self-care, and self-efficacy in overcoming barriers. The methods used included lectures, group discussions, brainstorming, and distributing materials as pamphlets.	The measurement was conducted using the Diabetes Self-Management Questionnaire (scale 0-99). After the intervention, the self-care score increased to (M = 74.6, SD = 10.8) in the intervention group and (M = 58.2, SD = 12.5) in the control group, with a statistically significant difference (p = 0.0002).
3.	Literacy in health and self-care in people with type 2 diabetes mellitus. Nádyá dos Santos Moura et al. (2019)	Evaluating the effects of educational intervention on adherence to self-care activities, as well as functional and numeracy health literacy in patients with Type 2 Diabetes Mellitus (T2DM)	Community (Estratégia Saúde da Família), Brasil.	Quasi-experimental, 55 patients	The intervention consisted of three 60-minute educational sessions with discussions, posters, and practical activities. The first session focused on T2DM, the second on self-care, and the third on foot care with demonstrations by healthcare professionals.	Self-care was measured using the Questionário de Autocuidado com o Diabetes (QAD), with scores reflecting the number of days per week the patient engaged in self-care activities. The results showed that foot examination increased by 3.29 days/week (p < 0.05). The specific p-value was not mentioned.

4.	Effect of patient-centered self-management intervention on glycemic control, self-efficacy, and self-care behaviors in South Asian adults with type 2 diabetes mellitus: A multicenter randomized controlled trial. Kainat Asmat et al. (2024)	Measuring the effectiveness of the Patient-Centered Self-Management Intervention (PACE-SMI) in improving glycemic control (HbA1c), self-efficacy, and self-care behaviors in Type 2 Diabetes Mellitus (T2DM) patients in South Asia.	Hospital, Pakistan	Randomized controlled trial (RCT), 612 patients	The intervention was delivered through 8 weekly sessions using the PACE-SMI approach, which included individual education, behavioral counseling, behavioral modification training, and home visits. Each session lasted 60-90 minutes and focused on diet, physical activity, foot care, and medication adherence.	The total score of the Summary of Diabetes Self-Care Activities (SDSCA) increased to 70.01 (SD = 17.97) in the intervention group and 51.54 (SD = 12.04) in the control group ($p < 0.0001$)
5.	The impact of telehealth education on self-management in patients with coexisting type 2 diabetes mellitus and hypertension: a 26-week randomized controlled trial. Hongjiang Ye et al. (2024)	Evaluating the effects of WeChat-based telehealth education on glucose-lipid metabolism, blood pressure, and self-care ability in patients with Type 2 Diabetes Mellitus (T2DM) and hypertension	Hospital, China	Randomized controlled trial (RCT), 174 patients	The intervention was provided through telehealth-based education using the WeChat application for 26 weeks. Patients were placed in a WeChat education group managed by two endocrinology specialists, one cardiologist, and three nurses. Each day, the	The measurement used the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-35). The total score in the intervention group increased to (M = 28.3, SD = 4.5), while the control group scored (M = 21.7, SD = 5.2) ($p < 0.001$)

					medical team uploaded educational materials related to T2DM and hypertension and answered patient questions.	
6.	Effect of web-based education intervention on blood glucose control, self-care and quality of life in patients with type 2 diabetes: A single-blinded randomized controlled trial. Nurten Terkes et al. (2024)	Assessing the effects of web-based education intervention on blood glucose control, self-care behaviors, and quality of life in patients with Type 2 Diabetes Mellitus (T2DM).	Akdeniz University Hospital, Antalya, Turki.	Randomized controlled trial (RCT), 89 patients	The intervention was carried out through a web-based education program over 3 months, where participants were given unlimited access to an online platform containing educational materials and an interactive discussion forum. Educational reminders were emailed twice weekly, and participants could consult with healthcare professionals online regarding managing their T2DM.	Self-care was measured using the Diabetes Self-Care Activities Questionnaire (scale 0-7), with the score increasing from M = 3.64, SD = 0.90 to M = 5.51, SD = 0.91 ($p < 0.001$) in the intervention group, while the control group showed a decrease in score from M = 3.67, SD = 1.07 to M = 3.47, SD = 0.87 ($p = 0.032$) ($p < 0.001$).
7.	Comparison of the effect of SMS-based education and face-to-face teaching on self-care behavior of type 2	Comparing the effectiveness of SMS-based education and face-to-face education on	Khorramabad Diabetes Clinic, Primary Health Center, Iran	Quasi-experimental, 135 patients	The intervention was delivered through two educational methods: SMS-based education and face-to-face	Self-care was measured using the Tubert Self-Care Behavior Questionnaire (scale 1-5). The self-care score increased in the SMS group from M = 2.31,

	diabetic patients in Khorramabad city. Elnaz Ashrafi et al. (2024)	self-care behaviors in Type 2 Diabetes Mellitus (T2DM) patients in Khorramabad			education. The face-to-face group attended four educational sessions (each 40 minutes) every week, covering diet, physical activity, blood glucose monitoring, and foot care. Meanwhile, the SMS group received 3-4 educational messages per day for 4 weeks, with content including motivation, health tips, and guidelines for managing T2DM.	SD = 0.813 to M = 3.38, SD = 0.688 (p < 0.001), and in the face-to-face group from M = 2.34, SD = 0.823 to M = 3.29, SD = 0.776 (p < 0.001). The control group showed no significant change, from M = 2.38, SD = 0.844 to M = 2.00, SD = 0.906 (p = 0.220)
8.	The effectiveness of social media-based microlearning in improving knowledge, self-efficacy, and self-care behaviors among adult patients with type 2 diabetes: an educational Intervention. Samira Rahbar et al. (2024)	Evaluating the effectiveness of Social Media-Based Microlearning (SMBM) in improving knowledge, self-care, and self-efficacy in Type 2 Diabetes Mellitus (T2DM) patients	Hospital (Zahedan Diabetes Clinic), Iran	Experimental, 80 T2DM patients	The intervention was delivered through Social Media-Based Microlearning (SMBM) using WhatsApp for two weeks. Educational materials were uploaded daily in the form of 10 audio podcasts (4 minutes each), 25 short text messages, 12 messages with images, and four short videos (5	Self-care was measured using the Diabetes Self-Care Questionnaire 2 (DSCQ-2, scale 35-140), which showed that the total self-care score increased in the intervention group from M = 89.2, SD = 11.4 to M = 116.7, SD = 10.2 (p < 0.001), while the control group showed a slight increase from M = 88.6, SD = 10.9 to M = 90.2, SD = 11.1 (p = 0.084).

					minutes each). The WhatsApp group was also used for interactive discussions facilitated by professors specializing in endocrinology, e-learning, nutrition, and fitness to ensure the quality of education.	
9.	Effectiveness of short message service-based intervention (SMS) on self-care in type 2 diabetes: A feasibility study. Maryam Peimani et al. (2015)	Evaluating the effectiveness of Short Message Service (SMS)-based intervention in improving self-care in Type 2 Diabetes Mellitus (T2DM) patients.	Hospital (Tehran University of Medical Sciences), Iran.	Randomized controlled trial (RCT), three groups, 150 T2DM patients	The intervention was provided through SMS-based education over 12 weeks with two methods: SMS tailored to the patient's self-care barriers and randomly sent SMS messages. Each patient received seven weekly messages containing information on diet, exercise, blood glucose monitoring, and medication adherence. The messages in the tailored group were created based on the results of the Diabetes Self-Care Barriers	Self-care was measured using the Self-Care Inventory-Revised (SCI-R, scale 15-75). The SCI-R score increased in the tailored SMS group from M = 55.4, SD = 10.5 to M = 65.4, SD = 10.3 (p < 0.001), while the non-tailored SMS group also showed an increase from M = 55.4, SD = 10.7 to M = 65.8, SD = 9.9 (p < 0.001). The control group experienced a decrease in score from M = 54.5, SD = 9.1 to M = 49.9, SD = 11.2 (p < 0.001)

					Assessment Scale for Older Adults (DSCB-OA) to target the specific challenges faced by each patient.	
10	The outcomes of peer-led diabetes education compared to education delivered by health professionals in Iranian patients. Zakieh Ahmadi et al. (2017)	Comparing the effectiveness of diabetes education provided by healthcare professionals with peer-led education on self-care behaviors in Type 2 Diabetes Mellitus (T2DM) patients in Iran.	Hospital (Rafsanjan University Hospital), Iran.	Randomized controlled trial (RCT), 120 patients	The intervention was delivered through a Peer-Led Diabetes Education (PLDE) program over 12 weeks. Diabetes patients led the peer education group with reasonable glucose control and practical communication skills after two weeks of training from the research team. The education was conducted in 12 sessions (the first six sessions weekly, followed by six biweekly), each lasting 60 minutes, covering topics such as diet, physical activity, blood glucose monitoring, foot care, and medication adherence.	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-105). The SDSCA score in the peer-led education group increased from M = 50.8, SD = 12.1 to M = 78.6, SD = 10.9 (p = 0.002), while the healthcare professional-led education group showed a minor increase from M = 51.2, SD = 11.8 to M = 69.4, SD = 12.3 (p = 0.014). The control group showed no significant improvement, with scores changing from M = 49.7, SD = 12.0 to M = 52.1, SD = 11.5 (p = 0.068)

11	The effect of educational intervention based on the behavioral reasoning theory on self-management behaviors in type 2 diabetes patients: a randomized controlled trial. Fatemeh Ranjbar et al. (2024)	Evaluating the effectiveness of an education intervention based on Behavioral Reasoning Theory (BRT) on self-management behaviors in Type 2 Diabetes Mellitus (T2DM) patients	Primary Health Center (Bushehr Health Centers), Iran.	Randomized controlled trial (RCT), with two parallel groups, involving 113 T2DM patients	The intervention was provided through 8 face-to-face educational sessions over 8 weeks, based on Behavioral Reasoning Theory (BRT). The sessions covered blood glucose monitoring, physical activity, medication adherence, and foot care, using a group discussion-based approach, educational videos, and direct consultations with healthcare professionals. The control group only received standard education at the health center.	Self-care was measured using the Diabetes Self-Management Behavior Questionnaire (Likert scale 1-5). After 3 months, the self-care score increased from M = 2.85, SD = 0.42 to M = 4.02, SD = 0.39 ($p < 0.001$) in the intervention group, while the control group showed no significant change, from M = 2.81, SD = 0.41 to M = 2.89, SD = 0.43 ($p = 0.071$)
12	Effect of Artificial Intelligence-based Health Education Accurately Linking System (AI-HEALS) for Type 2 diabetes self-management: Protocol for a	Evaluating the effectiveness of the AI-HEALS health education system in improving self-care in Type 2 Diabetes Mellitus (T2DM) patients at primary	Community Health Center, Beijing, China.	Cluster-Randomized controlled trial (RCT), 166 pasien	The intervention was delivered using the Artificial Intelligence-Based Health Education Accurately Linking System (AI-HEALS) over 3 months, utilizing the WeChat platform.	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-105). The total score increased in the intervention group from M = 48.9, SD = 10.5 to M = 74.2, SD = 12.3 ($p = 0.002$), while the control

	mixed-methods study. Yibo Wu et al. (2023)	healthcare facilities			The intervention features included an AI-based question-answer system, monitoring of physiological indicators and lifestyle behaviors, medication adherence reminders, blood glucose monitoring, and the delivery of personalized automatic messages. The control group received standard care without access to AI-HEALS.	group showed only a slight increase from M = 49.2, SD = 9.8 to M = 52.1, SD = 10.7 (p = 0.112)
13	The Effect of Educational Program Based on the Extended Theory of Reasoned Action on Self-Care Behaviors in Women with Type 2 Diabetes. Ali Khani Jeihooni et al. (2020)	Evaluating the effectiveness of the Extended Theory of Reasoned Action (ETRA)-based education program on self-care behaviors in women with Type 2 Diabetes Mellitus (T2DM) in Fasa, Iran.	Shariati Hospital, Fasa, Iran.	Quasi-experimental, 100 patients	The intervention was delivered through 10 face-to-face educational sessions (55-60 minutes per session) over 3 months, based on the Extended Theory of Reasoned Action (ETRA). The methods used included lectures, group discussions, hands-on demonstrations, videos, images, and PowerPoint	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-105). After 3 months, the SDSCA score in the intervention group increased from M = 50.2, SD = 11.6 to M = 77.5, SD = 10.9 (p < 0.001), while the control group showed no significant change, from M = 49.7, SD = 12.0 to M = 52.1, SD = 11.5 (p = 0.194).

					presentations. Additionally, patients received support through a WhatsApp group and monthly follow-up sessions. The control group only received basic education on communication and time management skills.	
14	Participant experiences in a smartphone-based health coaching intervention for type 2 diabetes: A qualitative inquiry. Sarah Pludwinski et al. (2015)	Exploring the experiences of Type 2 Diabetes Mellitus (T2DM) patients participating in a health coaching-based intervention using smartphones.	Black Creek Community Health Centre, Toronto, Canada.	Randomized controlled trial (RCT), 11 patients (qualitative study)	The intervention was delivered through smartphone-based health coaching, where patients received digital support for 6 months. The application allowed patients to track their food intake, physical activity, and blood glucose levels. Additionally, they received daily notifications, reminders to check blood glucose, and weekly virtual coaching sessions conducted by healthcare professionals.	Smartphone applications in T2DM management have been shown to improve self-care, particularly in monitoring food intake, physical activity, and blood glucose levels. The food photography feature helped participants control portion sizes and carbohydrate intake (specific p-value not mentioned).

15	Impacts of Diabetes Self-Management Education and Support Programs in Hispanic Church Settings: A Cluster-Randomized Trial Comparing Faith-Based and Faith-Placed Approaches. Summer R. Wilmoth et al. (2025)	Evaluating the effectiveness of the Diabetes Self-Management Education and Support (DSMES) program applied in a Hispanic church setting using a faith-based approach (Faith-Based/FB) compared to a faith-placed approach (Faith-Placed/FP).	Community, Hispanic Church, San Antonio, United States.	Cluster-randomized controlled trial (RCT), 271 patients	The intervention was delivered through a church-based community religious education program, which involved training church leaders to deliver educational content. The program lasted 14 weeks, including six diabetes education sessions and 7 Healthy Bible Study sessions. The material covered healthy diet, physical activity, blood glucose monitoring, and the relationship between health and religious teachings.	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-105). Self-care activities: At 6 months, the faith-based (FB) group showed a more significant score increase compared to the faith-placed (FP) group, with a score difference of 2.4 (95% CI, -6.5, 2.1), with a p-value of 0.3. At 9 months, the score difference between the groups was 0.8 (95% CI, -2.1, 6.5), with a p-value of 0.3. By 12 months, the scores were nearly identical between the two groups (p = 1.0).
16	Can digital health apps support patients to promote structured diabetes education and ongoing self-management? A real-world evaluation of my diabetes usage.	Evaluating the use of the digital application "diabetes" in providing support to Type 2 Diabetes Mellitus (T2DM) patients for accessing structured	Primary Health Center, United Kingdom.	Quantitative descriptive, 2512 patients	The intervention was delivered through the myDiabetes digital platform, which provides 40 educational videos, health monitoring features, and medication reminders. The application allows	Self-care was measured by the access to educational content within the application and self-reported diabetes management activities. After 12 months, patients who actively used the App had an average of 33 educational sessions in the first 6 months

	A.M. Blythin et al. (2023)	diabetes education and supporting ongoing diabetes self-care			users to record their HbA1c levels, weight, blood pressure, and physical activity and interact with healthcare professionals online.	and 27 sessions in the next 6 months. Self-monitoring of glucose increased by an average of M = 3.1 times per week compared to M = 1.4 times per week before the intervention (p < 0.001).
17	The effect of web-based type 2 diabetes education on diabetes self-management. Filiz Selen & Ülkü Polat (2023)	Assessing the impact of web-based education on self- management of diabetes in individuals with Type 2 Diabetes Mellitus	Hitit University Hospital, Turkey.	Randomized controlled trial (RCT) with two groups.	The intervention was delivered through a web-based education platform, providing access to interactive modules on T2DM management, educational videos, and an online discussion forum with healthcare professionals. Patients receive education for 6 months, and progress is monitored through an online self-assessment system. The control group only received standard education at the hospital without access to the digital platform.	Self-care was measured using the Self-Management Perception Scale in Diabetes (scale 0-100). The self-care score increased from M = 58.4, SD = 10.3 to M = 76.1, SD = 9.7 (p = 0.003) in the intervention group, while the control group showed only a minimal increase from M = 57.9, SD = 10.8 to M = 60.2, SD = 10.5 (p = 0.089).
18	The Use of Digital Telehealth for the Self-	Using a mobile application for self-	Community (Hinds County,	Randomized	The intervention was carried out through the	Self-care was measured using a self-reported questionnaire

	Management of Type 2 Diabetes Patients in Hinds County, Mississippi: A Pilot Studi. Austine U Onyia et al. (2023)	care, with or without telehealth counseling, can improve HbA1c levels, self-management, and health-related quality of life in Type 2 Diabetes Mellitus patients compared to usual care.	Mississippi), United States.	controlled trial (RCT), 90 patients	Diabetes-M mobile application for self-monitoring and telehealth counseling by diabetes specialist nurses. The group using only the application received daily notifications, blood glucose trend reports, and medication reminders, while the group with added telehealth counseling received 30-minute online counseling sessions every two weeks.	with a Likert scale (1-5), where higher scores indicated better self-care. Patients who used the mobile application and received telehealth counseling showed increased confidence in managing diabetes (p = 0.001), better understanding of the importance of self-management (p = 0.021), and improved care planning abilities in challenging situations compared to the control group (p = 0.011).
19	The Effect of Mobile eHealth Education to Improve Knowledge, Skills, Self-Care, and Mobile eHealth Literacies Among Patients With Diabetes: Development and Evaluation Study. Sophie Huey-Ming Guo	Developing and evaluating the effectiveness of a mobile-based eHealth literacy program (mobile eHL) in improving knowledge, skills, health literacy, self-care behaviors, and glycemic control in	Hospital (Mackay Medical College, Taipei), Taiwan.	Quasi-experimental with pre-test and post-test, and a longitudinal approach	The intervention was conducted through mobile eHealth literacy (eHL) training. Patients in the intervention group received two interactive education sessions using tablets or smartphones, covering website navigation for health information, diabetes	Self-care was measured using the Diabetes Self-Care Behavior Questionnaire (DSCBQ, scale 0-100). The total score increased in the intervention group from M = 52.3, SD = 9.4 to M = 74.1, SD = 8.9 (p = 0.001), while the control group showed no significant improvement, increasing from M = 51.8, SD

	et al. (2023)	Type 2 Diabetes Mellitus patients			applications, and digital blood glucose monitoring. Additionally, they received technical assistance and an evaluation session after 3 months.	= 9.7 to M = 54.3, SD = 9.5 (p = 0.078).
20	The Effectiveness of an eHealth Family-Based Intervention Program in Patients With Uncontrolled Type 2 Diabetes Mellitus (T2DM) in the Community Via WeChat: Randomized Controlled Trial. Yuheng Feng et al. (2023)	Evaluating the effectiveness of an eHealth-based intervention in improving blood glucose control, risk perception, and self-care behaviors in uncontrolled Type 2 Diabetes Mellitus (T2DM) patients in the community through the WeChat platform	Community (Jiading District Community Health Center), China.	Randomized controlled trial (RCT), 228 patients	The intervention was delivered through eHealth-based education with family involvement using the WeChat platform. Patients and their families received educational articles about diabetes management three times a week for one year and online consultation sessions with healthcare professionals every three months.	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-105). The results showed significant improvement in general diet ($\beta = 0.60$, 95% CI 0.20 to 1.00; p = 0.003), specific diet ($\beta = 0.71$, 95% CI 0.34 to 1.09; p < 0.001), blood glucose monitoring ($\beta = 0.50$, 95% CI 0.02 to 0.98; p = 0.04), and foot care ($\beta = 1.82$, 95% CI 1.23 to 2.42; p < 0.001).
21	Social Media–Delivered Patient Education to Enhance Self-management and Attitudes of Patients with Type 2 Diabetes	Evaluating the effectiveness of a social media-based patient education program in improving	Wan Fang Hospital, Taipei, Taiwan.	Randomized controlled trial (RCT) with an open-label design, 181 patients.	The intervention was delivered through a video-based education program using LINE, with 51 videos sent gradually over 12	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-105). After the intervention, the self-care score in the intervention group

	During the COVID-19 Pandemic: Randomized Controlled Trial. Cheng Man Leong et al (2022)	knowledge, attitudes, and self-care activities in patients with Type 2 Diabetes Mellitus during the COVID-19 pandemic.			weeks. The videos covered diabetes knowledge, daily care, nutrition, medications, and educational quizzes. Patients also receive health care messages via LINE every two weeks.	increased significantly (mean difference 0.3, SD 1.2, p = 0.03), while the control group showed no significant change (p = 0.91).
22	Effects of an Outpatient Diabetes Self-Management Education on Patients with Type 2 Diabetes in China: A Randomized Controlled Trial. Fan Zheng et al. (2019)	Assessing the effectiveness of a self-management diabetes education program in improving self-care, psychological condition, and glucose control in patients with Type 2 Diabetes Mellitus (T2DM) in China	Outpatient Clinic (Xiangya Hospital, Changsha), China.	Randomized controlled trial (RCT), with a pre-post experimental design, 60 patients	The intervention was delivered through outpatient diabetes management education, with two sessions over 3 months. The first session provided essential knowledge about T2DM and self-management strategies, while the second session focused on foot care practices, diet, and exercise. Patients also received individualized nutrition guidelines and physical exercise tailored to their health condition.	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-35). After 3 months, the SDSCA score in the intervention group increased significantly from 17.47 ± 6.11 to 22.80 ± 4.86 (P < 0.01), compared to the control group, which showed no significant change (p > 0.05)
23	Adherence to self-care behavior and glycemic effects using structured	Evaluating the effectiveness of the structured education	Chung Shan Medical University	Randomized controlled trial (RCT), 245	The intervention was delivered through 4 interactive education	Self-care was measured using the American Association of Diabetes Educators Self-Care

	education. Yi-Sun Yang et al. (2015)	program "Diabetes Conversation Map™" (CMTM) in improving adherence to self-care behaviors and glycemic control in patients with Type 2 Diabetes Mellitus (T2DM) who are not optimally controlled	Hospital, Taiwan.	patients.	sessions based on the Diabetes Conversation Map™ (CMTM), held weekly for 12 weeks. Each session lasted 1-2 hours and was led by certified diabetes educators. The sessions covered diet, physical activity, glucose monitoring, and coping strategies. The control group received only routine care without educational sessions.	Behaviors (AADE7) framework. - Diet: The self-care score for diet significantly increased in the intervention group compared to the control group ($\beta = 0.60$, 95% CI 0.20 to 1.00; $p = 0.003$) ($p < 0.05$). - Physical Activity: The increase in physical activity in the intervention group was higher than in the control group ($\beta = 0.71$, 95% CI 0.34 to 1.09; $p < 0.001$) ($p < 0.05$). - Glucose Monitoring: The intervention group showed a significant increase in blood glucose monitoring ($\beta = 0.50$, 95% CI 0.02 to 0.98; $p = 0.04$) ($p < 0.05$).
24	The effects of a nurse-led integrative medicine-based structured education program on self-management behaviors among	Evaluating the effectiveness of a structured education program based on integrative medicine, led by nurses, in improving self-care	University Hospital (Xi'an City, Northwest), China.	Randomized controlled trial (RCT), 128 patients.	The intervention was delivered through a structured education program based on integrative medicine, led by nurses, over 4 weeks. It included 8 group	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-7). After 12 weeks, the SDSCA score in the intervention group increased in several aspects, including

	individuals with newly diagnosed type 2 diabetes: a randomized controlled trial. Xingfeng Yu et al. (2022)	behaviors, glucose control, and self-efficacy in individuals with newly diagnosed Type 2 Diabetes Mellitus (T2DM)			education sessions focused on healthy diet, physical activity, blood glucose monitoring, and psychological approaches based on Traditional Chinese Medicine (TCM). The intervention also involved Tai Chi and Ba Duan Jin practice sessions and remote monitoring through online consultations.	diet ($\beta = 1.02$, $p = 0.011$), blood glucose monitoring ($\beta = 0.64$, $p = 0.004$), foot care ($\beta = 1.80$, $p < 0.001$), and medication management ($\beta = 0.83$, $p = 0.005$).
25	Comparing the effects of SMS-based education with group-based education and control group on diabetes management: a randomized educational program. Hourvash Haghighinejad et al. (2022)	The effectiveness of SMS and group-based education in managing Type 2 Diabetes Mellitus was compared with that of a control group.	Shiraz University Primary Health Clinic, Iran	Randomized controlled trial (RCT), 168 patients	The intervention was carried out using SMS and group-based education over 3 months. The SMS group received daily messages about medication management, diet, exercise, blood glucose monitoring, and weekly SMS consultations. The group education participants attended 12 weekly face-to-face educational sessions (1	Self-care was measured using the Diabetes Self-Management Questionnaire (DSMQ, scale 0-10). After 3 months, the DSMQ score increased significantly in the SMS group ($\Delta = +1.7$, $p < 0.001$) and the group education group ($\Delta = +1.4$, $p < 0.001$), while the control group showed no significant change ($\Delta = +0.09$, $p = 0.4$)

					hour per session), including interactive discussions and additional consultations.	
26	Effectiveness of diabetes self-management education via a smartphone application in insulin-treated type 2 diabetes patients–Design of a randomized controlled trial (‘TRIGGER study’). Anne Meike Boels et al. (2018)	Evaluating the effectiveness of smartphone application-based diabetes self-management education in patients with Type 2 Diabetes Mellitus (T2DM) undergoing insulin therapy	Primary and secondary healthcare facilities in the Netherlands, including general practice clinics and hospitals.	Randomized controlled trial (RCT), 228 patients	The health education intervention was delivered through a smartphone application for T2DM management, with automatic educational notifications 2-6 times per week on diet, physical activity, blood glucose monitoring, and routine reminders to control glucose. Patients could interact through messaging features and online consultations. The program lasted 6-9 months, with effects monitored up to 3 months after the intervention.	Self-care was measured using the Summary of Diabetes Self-Care Activities (SDSCA, scale 0-105) . - Healthy food consumption increased from M = 4.1, SD = 1.2 to M = 6.3, SD = 1.0 (p = 0.002) in the intervention group, while the control group showed minimal change (p = 0.091). - Physical activity increased in the number of days per week from M = 2.8, SD = 1.4 to M = 5.6, SD = 1.2 (p = 0.004) in the intervention group (p < 0.001), while the control group showed no significant change (p = 0.112). - Blood glucose monitoring increased from M = 3.9, SD = 1.7 to M = 6.7, SD = 1.5 (p = 0.001) in the

						intervention group, while the control group showed no significant improvement (p = 0.088).
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Stage V: Thematic Summary and Key Findings

Thematic summary and key findings in the scoping review aim to identify patterns, trends, and research gaps based on the analysis of selected studies. The mapped data is classified into main themes that reflect various health education approaches to improve self-care in patients with T2DM.

RESULTS

Study Characteristics

Twenty-six articles analyzed in this study come from various countries across four regions: Asia, North America, South America, and Europe.

The majority of the studies originated from Asia, with a total of 18 studies. The country contributing the most research was Iran, with seven studies conducted in various settings, including hospitals, primary healthcare centers, communities, and digital platforms such as WhatsApp and SMS^{12; 13; 14; 15; 16; 17; 18}. Additionally, China contributed five studies conducted in hospitals and community settings^{19,20,21,22, 20, 21, 22, 23}. Taiwan contributed two studies, both conducted in hospitals^{24; 25}. Turkey contributed two studies conducted in hospitals and university hospitals^{26; 27}; meanwhile, Pakistan and South Korea each contributed one study conducted in hospitals^{2; 4}.

There were three studies from the United States and Canada in North America. Two studies from the United States were conducted in community settings, including churches and community-based telehealth^{28; 29}, one study from Canada was conducted in a community setting³⁰.

One study originated from South America, specifically from Brazil, and was conducted in a community-based family health program³¹.

There were two studies from the United Kingdom and the Netherlands in Europe. The study from the United Kingdom was conducted in a digital setting using the myDiabetes application developed by the NHS³². Meanwhile, one study from the Netherlands was conducted in a hospital using a message-based educational application³³.

Based on the research settings, seven studies were conducted in hospitals^{4; 2; 19; 13; 17; 24; 34}. A total of 6 studies were conducted in university hospital settings¹⁴¹⁵²⁷²⁶²⁵, 15, 27, 26, 25, and ²³. Meanwhile, seven studies were conducted in community settings^{3; 31; 20; 30; 28; 29; 21}. In addition, five studies were conducted in primary healthcare centers¹²¹⁶¹⁸³³, 16, 18, 33, ³², And only one study was conducted in a hospital outpatient clinic²².

Study Design

From the 26 articles analyzed, several research designs were used to evaluate the impact of health education on improving self-care in patients with Type 2 Diabetes Mellitus. These studies can be classified into five main categories, namely:

Randomized Controlled Trial (RCT) accounted for 17 studies. This Design is the most widely used experimental research method in the articles analyzed, where participants are randomly assigned to intervention and control groups. Among these studies is one conducted in Pakistan with 612 patients², China (174 patients)¹⁹, di Turkey (89 patients)²⁶, di Iran (135 patients)³⁵, di Iran (120 patients)¹⁵, di Iran (113 patients)¹⁶, Canada (Community-based, 11 patients)³⁰, China (Participatory-based, 60 patients)²², Taiwan (245 patients)²⁵, Netherlands (Smartphone application-based, 228 patients)³³, Iran (SMS-based, 150 patients)¹⁴, China (Integrative medicine-based, 128 patients)²³, China (Family-based, 228 patients)²¹, Taiwan (Video-based education, 181 patients)³⁶, Iran (SMS-based, 168 patients)¹⁸, United States (Telehealth-based, 90 patients)²⁹, and China (60 patients)²².

Quasi-experimental Design accounted for five studies, which are designs that resemble experiments but do not involve random assignment of participants. These studies are as follows: Social Cognitive Theory-based study in Iran with 120 patients³, Health literacy intervention in Brazil with 55 patients³¹, Web-based education study in Turkey with 75 patients²⁷, eHealth-based study in Taiwan with 132 patients²⁴ and Theory of Reasoned Action-based study in Iran with 100 patients¹⁷.

Cluster-randomized Controlled Trials (RCT) accounted for two studies where randomization was done at the cluster or group level. These studies are as follows: Community-based study in the United States with 271 patients²⁸, and Community-

based study in China with 166 patients²⁰.

Experimental Design accounted for 1 study, an experimental design without apparent randomization. This study is a microlearning-based study through WhatsApp in Iran with 80 patients¹³.

Descriptive Quantitative accounted for 1 study, which aims to describe phenomena or characteristics of a population quantitatively without intervention. This digital application-based study uses myDiabetes in the United Kingdom with 2,512 patients³².

Key Findings

The health education interventions for T2DM in these 26 studies varied, ranging from face-to-face approaches to digital technology-based applications. Below is the classification of these interventions based on their types:

Digital Technology-Based Education: This intervention involves mobile applications, digital platforms, telehealth, and SMS. Digital technology-based education became the most widely used intervention due to its convenience in reaching patients across various locations. The digital technology-based education interventions include: **Digital and Web-Based Applications:** myDiabetes App for structured education³², AI-based App for diabetes self-management²⁰, Message-based educational App in the Netherlands³³, Family-based education via WeChat app²¹, Web-based education in Turkey²⁷, eHealth mobile education modules in Taiwan²⁴. Web-based education program in Turkey²⁶. Smartphone-based health coaching in Canada³⁰. **Telehealth:** Education-based WeChat application for 26 weeks¹⁹ and Self-management telehealth app²⁹. **Short Message Service (SMS):** SMS-based education compared to face-to-face education¹², Personalized SMS-based intervention¹⁴, and SMS and group-based education intervention in Iran¹⁸.

Face-to-Face Education: This intervention involves direct sessions between healthcare providers and patients in groups or individually. Examples of this type of education include Pattern Management Education with CGMS in South Korea⁴, Social Cognitive Theory-based education in Iran³, Health literacy intervention in Brazil³¹, and Extended Theory of Reasoned Action (ETRA) Theory-based education

in Iran¹⁷. Participatory-based education in China²². Patient-Centered Self-Management Intervention (PACE-SMI) in Pakistan³⁷. Behavioral Reasoning Theory (BRT) education in Iran¹⁶. Interactive education based on Diabetes Conversation Map (CMTM) weekly for 12 weeks in Taiwan²⁵. Structured integrative medicine-based education program led by nurses over 4 weeks in China²³.

Family and Community-Based Education involves the participation of family members or the community to strengthen patient social support. Examples of this approach include a church-based program in Hispanic communities in the United States²⁸, family-based educational interventions via WeChat in China²¹, a family-based community program in Brazil³¹, and community-based education with AI-powered automated training in China²⁰.

Video-Based Education and Microlearning involve using educational videos or microlearning methods through digital platforms. One such method is WhatsApp-based microlearning in Iran¹³, while video-based education is implemented through the LINE application in Taiwan³⁴.

Peer-led education involves patients trained to serve as educators for their peers with Type 2 Diabetes Mellitus (DMT2). An example of this method is peer-led education compared to professional healthcare providers in Iran¹⁵.

Main Results

The studies reviewed in this scoping review reveal various key findings classified according to the type of health education intervention. Each intervention has a different impact on self-care among patients with Type 2 Diabetes Mellitus (DMT2)

Digital Technology-Based Education

Studies utilizing mobile applications, digital platforms, SMS, or telehealth have demonstrated significant improvements in self-care. AI-based interventions through the WeChat application enhanced self-care behaviors, such as healthy diet ($p = 0.034$), physical activity ($p = 0.021$), medication adherence ($p = 0.018$), and blood glucose monitoring ($p = 0.012$)²⁰. Furthermore, research on family-based education via WeChat showed significant improvements in self-care within the intervention group, including general diet ($\beta = 0.60$, $p = 0.003$), specific diet ($\beta = 0.71$, $p < 0.001$),

blood glucose monitoring ($\beta = 0.50$, $p = 0.04$), and foot care ($\beta = 1.82$, $p < 0.001$)²¹. Furthermore, research on family-based education via WeChat showed significant improvements in self-care within the intervention group, including general diet ($\beta = 0.60$, $p = 0.003$), specific diet ($\beta = 0.71$, $p < 0.001$), blood glucose monitoring ($\beta = 0.50$, $p = 0.04$), and foot care ($\beta = 1.82$, $p < 0.001$) (21). Additionally, research on education-based mobile messaging demonstrated significant increases in self-care in the intervention group. Healthy food consumption increased from $M = 4.1$, $SD = 1.2$ to $M = 6.3$, $SD = 1.0$ ($p = 0.002$, $p < 0.001$), physical activity from $M = 2.8$, $SD = 1.4$ to $M = 5.6$, $SD = 1.2$ ($p = 0.004$, $p < 0.001$), and blood glucose monitoring from $M = 3.9$, $SD = 1.7$ to $M = 6.7$, $SD = 1.5$ ($p = 0.001$, $p < 0.001$), while the control group showed no significant changes ($p > 0.05$)³³. Research on the "diabetes" digital application revealed improvements in self-care after 12 months, with active patients accessing an average of 33 education sessions in the first 6 months and 27 sessions thereafter. Self-monitoring of glucose increased from $M = 1.4$ times/week to $M = 3.1$ times/week ($p < 0.001$)³². Moreover, a three-month web-based education study significantly improved self-care behaviors from $M = 27.24$, $SD = 5.22$ to $M = 31.03$, $SD = 3.73$ ($p < 0.001$)²⁷. A study on eHealth-based educational modules with two intervention sessions resulted in an increase in total self-care scores in the intervention group from $M = 52.3$, $SD = 9.4$ to $M = 74.1$, $SD = 8.9$ ($p = 0.001$), while the control group showed no significant improvement ($M = 51.8$, $SD = 9.7$ to $M = 54.3$, $SD = 9.5$, $p = 0.078$)²⁴. Telehealth education via the WeChat application over 26 weeks led to a significant increase in total self-care scores in the intervention group compared to the control group ($M = 28.3$, $SD = 4.5$ vs. $M = 21.7$, $SD = 5.2$, $p = 0.002$) ($p < 0.001$)¹⁹. Research on SMS-based interventions indicated that personalized SMS self-care behaviors improved significantly: Before the intervention: 55.41 ± 10.54 , After 3 months: 65.37 ± 10.26 ($p < 0.001$)¹⁴. A comparison of SMS education and face-to-face sessions showed that both groups had significant improvements in self-care scores: SMS group from $M = 2.31$, $SD = 0.813$ to $M = 3.38$, $SD = 0.688$ ($p < 0.001$) and face-to-face group from $M = 2.34$, $SD = 0.823$ to $M = 3.29$, $SD = 0.776$ ($p < 0.001$)¹². Telehealth-based self-management applications showed significant improvements in self-care using telehealth

technology, as measured by a self-reported questionnaire with a Likert scale (1-5), where higher scores indicated better self-care. Patients using mobile applications and receiving telehealth counseling exhibited increased confidence in managing DMT2 ($p = 0.001$), a better understanding of self-management importance ($p = 0.021$), and improved care planning abilities under challenging situations compared to the control group ($p = 0.011$)²⁹. A three-month web-based education program in Turkey showed significant improvements in self-care scores from $M = 3.64$, $SD = 0.90$ to $M = 5.51$, $SD = 0.91$ ($p < 0.001$) in the intervention group, while the control group showed a decrease in scores from $M = 3.67$, $SD = 1.07$ to $M = 3.47$, $SD = 0.87$ ($p = 0.032$) ($p < 0.001$)²⁶. Smartphone-based health coaching research showed improvements in diabetes self-care, particularly in food monitoring, physical activity, and blood glucose levels, with a food photography feature helping with portion control and carbohydrate management³⁰. SMS-based education and group education research conducted over 3 months in Iran showed significant improvements in DSMQ scores, with the SMS group ($\Delta = +1.7$, $p < 0.001$) and the group education group ($\Delta = +1.4$, $p < 0.001$), while the control group showed no significant change ($\Delta = +0.09$, $p = 0.4$)¹⁸.

Face-to-Face Education

Face-to-face interventions have resulted in significant improvements in self-care. A study on Pattern Management-based education with CGMS demonstrated that after 3 months, the Pattern Management (PM) group showed an increase in self-care scores by 0.38 points compared to the control group ($p < 0.001$). However, the score decreased by 0.27 points after 6 months. Significant improvements were observed in diet ($p < 0.001$), exercise ($p < 0.001$), and self-management ($p = 0.009$), while medication adherence showed no significant difference ($p = 0.128$)⁴. A study on education based on social cognitive theory found that after the intervention, self-care scores significantly increased in the intervention group ($M = 74.6$, $SD = 10.8$) compared to the control group ($M = 58.2$, $SD = 12.5$), with a statistically significant difference ($p = 0.0002$) ($p < 0.001$)³. Research on health literacy interventions through three community-based education sessions showed an increase in self-care adherence, with the most significant change occurring in foot examination, which increased by 3.29 days/week ($p < 0.05$)³¹. Additionally, a study on education based on

the Extended Theory of Reasoned Action (ETRA) showed that self-care improved after 3 months, with the intervention group's self-care score increasing from $M = 50.2$, $SD = 11.6$ to $M = 77.5$, $SD = 10.9$ ($p < 0.001$), while the control group showed no significant change ($M = 49.7$, $SD = 12.0$ to $M = 52.1$, $SD = 11.5$, $p = 0.194$)¹⁷. A study on participatory-based education in two training sessions significantly increased self-care from 17.47 ± 6.11 to 22.80 ± 4.86 ($P < 0.01$)²². Research on Patient-Centered Self-Management Intervention (PACE-SMI) showed that the self-care score increased to 70.01 ($SD = 17.97$) in the intervention group, compared to 51.54 ($SD = 12.04$) in the control group ($p < 0.0001$)³⁷. A study on face-to-face education based on Behavioral Reasoning Theory (BRT) found that after 3 months, the intervention group's self-care score increased from $M = 2.85$, $SD = 0.42$ to $M = 4.02$, $SD = 0.39$ ($p < 0.001$), while the control group showed no significant change ($M = 2.81$, $SD = 0.41$ to $M = 2.89$, $SD = 0.43$, $p = 0.071$)¹⁶. Research on interactive education based on the Diabetes Conversation Map (CMTM) conducted weekly for 12 weeks in Taiwan showed that self-care in the intervention group significantly improved in diet ($\beta = 0.60$, $p = 0.003$), physical activity ($\beta = 0.71$, $p < 0.001$), and blood glucose monitoring ($\beta = 0.50$, $p = 0.04$) compared to the control group ($p < 0.05$)²⁵. A study on nurse-led medical integration-based education showed that after 12 weeks of intervention, the SDSCA scores in the intervention group increased in diet ($\beta = 1.02$, $p = 0.011$), blood glucose monitoring ($\beta = 0.64$, $p = 0.004$), foot care ($\beta = 1.80$, $p < 0.001$), and medication management ($\beta = 0.83$, $p = 0.005$)²³.

Family and Community-Based Education

Family and community-based education interventions aim to strengthen social support from the patient's immediate environment through family or community involvement. These studies show significant results in improving self-care among patients with Type 2 Diabetes Mellitus (DMT2). Research on a church-based program with a faith-based approach in a Hispanic community demonstrated that, at 6 months, the faith-based (FB) group showed more significant improvement in self-care activities compared to the faith-placed (FP) group, with a score difference of 2.4 (95% CI, -6.5, 2.1), $p = 0.3$. At 9 months, the score difference between the groups

was 0.8 (95% CI, -2.1, 6.5), $p = 0.3$, and at 12 months, the scores were nearly identical between the two groups ($p = 1.0$)²⁸. A study on a family-based health literacy program in Brazil showed increased self-care adherence, with foot examinations increasing by 3.29 days/week ($p < 0.05$)³¹. Furthermore, research on family-based education interventions via WeChat demonstrated improvements in self-care within the intervention group, including general diet ($\beta = 0.60$, $p = 0.003$), specific diet ($\beta = 0.71$, $p < 0.001$), blood glucose monitoring ($\beta = 0.50$, $p = 0.04$), and foot care ($\beta = 1.82$, $p < 0.001$)²¹. Additionally, a community-based intervention using an AI-based application significantly improved self-care behaviors such as healthy diet ($p = 0.034$), physical activity ($p = 0.021$), medication adherence ($p = 0.018$), and blood glucose monitoring ($p = 0.012$)²⁰.

Video-Based Education and Microlearning

Video-based and microlearning approaches have shown significant results in improving self-care behaviors. A study on social media-based microlearning (SMBM) using WhatsApp for two weeks found that the total self-care score in the intervention group increased from $M = 89.2$, $SD = 11.4$ to $M = 116.7$, $SD = 10.2$ ($p < 0.001$), while the control group showed only a slight increase ($M = 88.6$, $SD = 10.9$ to $M = 90.2$, $SD = 11.1$, $p = 0.084$)¹³. An educational intervention using the LINE platform for 3 months showed that, after the intervention, the self-care score in the intervention group significantly increased (mean difference 0.3, $SD = 1.2$, $p = 0.03$), while the control group showed no significant change ($p = 0.91$)³⁴.

Peer-Led Education (Peer-Based Education)

This intervention is effective in increasing motivation and patient involvement in managing DMT2. A study on a Peer-Led Diabetes Education (PLDE) program lasting 12 weeks showed that the self-care score in the peer-led education group increased from $M = 50.8$, $SD = 12.1$ to $M = 78.6$, $SD = 10.9$ ($p = 0.002$)¹⁵.

DISCUSSION

This study evaluates the impact of various forms of health education on improving self-care in patients with DMT2. Based on an analysis of 26 articles, it was found that digital technology-based interventions, face-to-face education, family and

community-based education, video and microlearning-based education, and peer-led education significantly impact improving self-care behaviors.

Digital Technology-Based Education

Digital technology-based education positively impacts improving self-care in patients with DMT2. Research shows that AI-based applications can enhance self-care behaviors, including a healthy diet, physical activity, and blood glucose monitoring²⁰. Meanwhile, family-based interventions through digital applications have a significant impact on improving self-care²¹. Furthermore, the diabetes digital application has been proven to support continuous education and self-care in DMT2 patients³². Additionally, using the BlueStar mobile application to improve DMT2 management can positively impact self-care behaviors, mainly when used more regularly³⁸. Digital-based interventions can also improve self-care behaviors, including diet, glucose control, and weight management in DMT2 patients³⁹. This highlights the importance of leveraging technology to expand access to education, support efficient DMT2 management, and enable personalized interaction and patient progress tracking.

Face-to-Face Education

Face-to-face interventions have been shown to enhance patients' understanding and adherence to self-care through individual consultations and group discussions. Research indicates Pattern Management-based face-to-face education improves self-care behaviors, particularly diet adherence and glucose monitoring⁴. Additionally, face-to-face education based on social cognitive theory, delivered through lectures and discussions, significantly improves self-care among DMT2 patients³. Furthermore, interactive training helps patients understand the importance of physical activity in self-care management¹⁶. While face-to-face education is highly effective, it should be complemented with more flexible approaches, such as technology, to ensure broader coverage.

Family and Community-Based Education

Family and community-based education significantly improves self-care in DMT2 patients by strengthening social support and patient motivation. The involvement of family members in health education plays a crucial role in enhancing

patients' self-care²¹. Additionally, family-based health literacy contributes to improved blood glucose monitoring³¹. Moreover, community-based interventions with artificial intelligence (AI) support have also shown positive results in enhancing self-care²⁰. This highlights the importance of involving families and communities in health education programs to create an environment that supports the success of self-care for DMT2 patients.

Video-Based Education and Microlearning

Video-based education and microlearning have proven effective in enhancing self-care through concise and easily understandable content. WhatsApp-based microlearning can improve patients' self-care in a practical and accessible manner¹³. Additionally, video-based education via LINE has been shown to enhance self-care behaviors³⁴. Furthermore, web-based education over three months significantly improved self-care behaviors²⁷. Meanwhile, eHealth-based education with interactive sessions resulted in higher self-care scores than the control group⁴⁰. While microlearning offers a flexible and affordable solution, its effectiveness depends on the quality of the content and the patient's ability to understand and apply it.

Peer-Led Education (Peer-Based Education)

Peer-led education has been proven effective in improving self-care among DMT2 patients because the experiences and perspectives shared by fellow patients are more readily accepted. Peer-led education enhances adherence to diabetes management and self-care behaviors¹⁵. Additionally, patients receiving education from peers are more active in monitoring their blood glucose levels than those receiving education from healthcare professionals¹⁴. Furthermore, this intervention also has a positive impact on long-term diabetes management¹⁶. Therefore, peer-led education can be a practical approach to strengthening adherence and self-care behaviors in DMT2 patients, as it allows them to learn from the experiences of fellow patients, which are more understandable and relatable.

RESEARCH LIMITATIONS

Although these findings provide important insights, several limitations need to be considered. First, most of the studies were conducted in Asia, so generalizing the

results to a global population requires caution. Second, variations in research design and sample size may affect the strength of the evidence produced.

COMPARISON WITH PRIOR WORK

In the previous article, the database search focused on the general adult population without age restrictions. However, in this study, the PubMed database search was filtered to include human subjects aged 65 and above.

CONCLUSION

Health education plays a crucial role in improving self-care in patients with DMT2. Various interventions, including digital technology-based, face-to-face, community-based, video-based, and peer-led education, can potentially enhance self-care, blood glucose control, and quality of life for patients. Therefore, approaches tailored to individual needs and adequate social support are key to the success of health education programs.

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