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RESEARCH

DIGITAL TECHNOLOGIES FOR SELF-CARE IN INDIVIDUALS WITH TYPE 2 DIABETES MELLITUS: AN INTEGRATIVE REVIEW

TECNOLOGIAS DIGITAIS PARA AUTOCUIDADO DE PESSOAS COM DIABETES MELLITUS TIPO 2: REVISÃO INTEGRATIVA

TECNOLOGÍAS DIGITALES PARA EL AUTOCUIDADO DE PERSONAS CON DIABETES MELLITUS TIPO 2: REVISIÓN INTEGRADORA

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ABSTRACT

Objective: this study aimed to examine the impact of digital technologies on promoting self-care among individuals with type 2 diabetes mellitus (DM2). **Method**: An integrative literature review was conducted in November 2021, utilizing the following databases: Medline via PubMed, Lilacs, BDENF, IBECS via the Virtual Health Library, Embase, and Web of Science. Primary studies, specifically randomized clinical trials that investigated the effect of digital technology in promoting self-care among individuals with DM2, were included. The studies could be published in Portuguese, English, or Spanish, and there were no restrictions on the year of publication. **Results**: Eight articles met the inclusion criteria. Various digital technologies were examined, each with a different theoretical background. The majority of the studies were conducted in primary care settings. The technologies tested included platforms, apps, programs, and software, with content focused on lifestyle factors such as dietary habits, physical activity, weight control, medication management, emotional well-being, and social support. The results indicated that individuals with DM2 experienced improvements in self-management of healthy food intake, glucose monitoring, medication adherence, body mass index monitoring, and positive changes in diet and weight control. The studies also demonstrated comprehensive outcomes, including a reduction in HbA1c levels and an enhancement in quality of life. **Conclusion**: The studies reviewed provided a strong theoretical foundation for achieving behavioral and clinical changes, considering the social context of individuals with DM2. Furthermore, these studies highlighted the potential benefits of digital technologies in promoting self-care and improving the quality of life among this population.
Keywords: Diabetes Mellitus, Type 2; Digital Technology; Self Care.

RESUMO

Objetivo*: verificar o efeito das tecnologias digitais (TD) na promoção do autocuidado em pessoas com diabetes mellitus tipo 2 (DM2).* ***Método****: revisão integrativa da literatura realizada em novembro de 2021, utilizando as bases de dados: Medline via PubMed, Lilacs, BDENF, IBECS, via Biblioteca Virtual em Saúde, Embase e Web of Science. Foram incluídos estudos primários realizados por meio de Ensaio Clínico Randomizado (ECR) que testaram o efeito da tecnologia digital na promoção do autocuidado em pessoas com diabetes mellitus tipo 2, publicados em português, inglês e espanhol, sem restrição quanto ao ano de publicação.* ***Resultados****: Foram incluídos 08 artigos. Diferentes tecnologias digitais foram testadas, com embasamento teórico variado. O local predominante de realização do estudo foi a Atenção Primária. Em relação aos tipos de tecnologia, foram utilizadas plataformas, aplicativos, programas e software, com conteúdo relacionado ao estilo de vida (hábitos alimentares e atividade física), controle do peso, medicação, bem-estar emocional e apoio social. Quanto ao efeito das TD, detectou-se o autogerenciamento da ingestão de alimentos saudáveis, monitoramento da glicose, melhor adesão à medicação, acompanhamento do Índice de Massa Corporal (IMC) e mudanças positivas no controle da dieta e do peso. O estudo também demonstrou resultados abrangentes em relação ao objetivo, como a redução da HbA1c e melhoria na qualidade de vida.* ***Conclusão****: Os estudos apresentaram embasamento teórico sólido para alcançar mudanças comportamentais e clínicas, levando em consideração o contexto social das pessoas com DM2, além de proporcionar melhorias no autocuidado e na qualidade de vida.*
Palavras-chave: Diabetes Mellitus tipo 2; Tecnologia Digital; Autocuidado.

RESUMEN

Objetivo*: verificar el efecto de las tecnologías digitales (TD) en la promoción del autocuidado en personas con diabetes mellitus tipo 2 (DM2).* ***Método****: revisión integrativa de la literatura realizada en noviembre de 2021, utilizando las bases de datos: Medline vía PubMed, Lilacs, BDENF, IBECS, vía Biblioteca Virtual en Salud, Embase y Web of Science. Se incluyeron estudios primarios realizados a través de Ensayo Clínico Aleatorizado (ECR) que probaron el efecto de la tecnología digital en la promoción del autocuidado en personas con diabetes mellitus tipo 2, publicados en portugués, inglés y español, sin restricción en cuanto al año de publicación.* ***Resultados****: Se incluyeron 08 artículos. Se probaron diferentes tecnologías digitales, con fundamentos teóricos variados. El lugar predominante de realización del estudio fue la Atención Primaria. En cuanto a los tipos de tecnología, se utilizaron plataformas, aplicaciones, programas y software, con contenido relacionado con el estilo de vida (hábitos alimentarios y actividad física), control del peso, medicación, bienestar emocional y apoyo social. En cuanto al efecto de las TD, se detectó la autogestión de la ingesta de alimentos saludables, el monitoreo de la glucosa, una mejor adhesión a la medicación, el seguimiento del Índice de Masa Corporal (IMC) y cambios positivos en el control de la dieta y el peso. El estudio también demostró resultados amplios en cuanto al objetivo, como la reducción de la HbA1c y la mejora en la calidad de vida.* ***Conclusión****: Los estudios presentaron fundamentos teóricos sólidos para lograr cambios conductuales y clínicos, teniendo en cuenta el contexto social de las personas con DM2, además de proporcionar mejoras en el autocuidado y la calidad de vida.*
Palabras clave: *Diabetes Mellitus Tipo 2; Tecnología Digital; Autocuidado.*

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INTRODUÇÃO

Type 2 diabetes mellitus (DM2) comprises approximately 90-95% of all cases of diabetes mellitus (DM)[1]. It is a polygenic disease with strong familial inheritance that has yet to be fully elucidated. Unhealthy dietary habits and physical inactivity contribute to the development of DM2, often leading to obesity, a prominent risk factor[1]. DM self-management education aims to provide individuals with the knowledge, skills, and abilities necessary for proper disease management[2]. The overall objectives of such education, in relation to the individual, are to facilitate decision-making, guide self-management and problem-solving, and promote active collaboration between the patient and the healthcare team. These goals strive to enhance clinical outcomes, improve health status, and enhance quality of life cost-effectively[3,4].

Self-care is vital to managing DM, requiring individuals to adopt a proactive attitude towards their health and well-being. While not an easy task, self-care necessitates the adoption of healthy lifestyle habits to prevent complications associated with uncontrolled disease[5]. Key aspects of self-care involve engaging in regular physical activity, adopting a nutritious diet, and adhering to medication protocols to achieve metabolic control and minimize potential disease-related complications[2].

In light of this, using technology to facilitate self-care has shown promise in improving DM management. For instance, digital technologies (DT) and mobile applications can potentially support DM control programs[6]. A web-based survey conducted among 1,682 individuals with types 1 and 2 diabetes from various regions worldwide demonstrated enhanced self-care practices among those utilizing mobile apps for access to diabetes-related content[7]. Furthermore, a systematic review encompassing thirteen randomized clinical trials indicated that smartphone apps yielded moderate benefits in glycemic control among individuals with DM2[8]. Nevertheless, while the use of social media for self-care in diabetes shows promise, the current evidence base remains limited, necessitating further research to establish its effectiveness and safety[9].

Innovative technologies hold the potential to aid in DM management and are centered around applying scientific and technological advancements to develop new tools that assist individuals with DM[10]. Incorporating information and communication technologies can transform the current healthcare system, prioritizing overall well-being rather than solely focusing on disease. Furthermore, these novel approaches offer advantages such as reducing iatrogenesis, generating valuable data for disease research, and enhancing opportunities for continuous improvement[11]. In this sense, technology is widely utilized globally, playing a significant role in fostering innovation in healthcare, assisting healthcare professionals in various domains, and providing support for individuals with chronic health conditions, particularly those living with DM2. This raises the question: "What impact do digital technologies have on promoting self-care in individuals with DM2?"

Within this context, this study examines the influence of digital technologies and the theories underpinning their applicability in promoting self-care among individuals with DM2. This is accomplished through educational approaches and tools that identify the support and enhancement of health practices while considering each person's individuality. Furthermore, this study is aligned with the Sustainable Development Goals of the United Nations' 2030 Agenda, specifically those targeting health and well-being, as well as reducing inequalities and other pertinent objectives. Regarding health promotion, it is in accordance with ensuring a healthy lifestyle and fostering well-being across all age groups[12]. Additionally, it adheres to public policies, programs, and strategies at various healthcare levels while aligning with the National Agenda of Health Research Priorities. The fundamental premise of this agenda is to address national and regional health needs and increase the production of knowledge and tangible goods concerning priority areas for developing social policies. This research falls under the sub-agendas of "non-communicable diseases" and "technology assessment and health economics"[5,12].

Considering the beneficial aspects of digital technologies in diabetes education, a comprehensive review becomes imperative to comprehend the constituent elements and their potential effects on the population. Distinguishing between these technologies empowers healthcare professionals to make informed decisions regarding their usage and enables them to adapt their approaches to digital self-care interventions[13]. Many of the commercially available applications exhibit limited behavior change techniques and inadequate resources, except for self-monitoring[14]. Further evidence is required before their widespread adoption. Additionally, individuals with diabetes have expectations for applications to be engaging, offer multiple functionalities, and cover a diverse array of content, including psychological and emotional support[15]. Though some recent systematic reviews and meta-analyses have indicated a modest effect of app-based interventions in supporting diabetes self-management,

uncertainties and gaps still exist regarding their feasibility, acceptability, and real-world effectiveness[16-18].

Given the significance of this theme, it is imperative to examine the impact of digital technologies and validate the theoretical and/or methodological foundation employed in developing DT. This validation will ascertain its relevance in the field of healthcare. The results obtained from this investigation offer insights into the correlation between health and empowerment concerning fostering healthy behaviors. Moreover, it is crucial to employ robust health theories that encompass care autonomy within its intricate and unique nature. This approach will effectively raise awareness among professionals and encourage the utilization of technologies designed for the health education of individuals with DM, ultimately reducing public healthcare expenditures associated with the complications arising from inadequate disease management. Thus, to address the identified knowledge gap, this study aims to examine the impact of DT on the promotion of self-care among individuals with DM2.

MÉTODO

This integrative literature review is organized into five stages: problem identification, literature search, data evaluation (levels of evidence), data analysis, and presentation[19]. To report the review, we adhered to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[20]. The research question was structured using the acronym PICO (population, intervention, comparison, and outcome)[21], with the following components: P - "people with DM2," I - "digital technology," C - none, and O - "promotion of self-care." Based on these components, the following research question was formulated: "What is the effect of digital technologies in promoting self-care among individuals with DM2?"

The bibliographic survey was conducted in November 2021 using a paired approach in the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE) via PubMed, Latin American and Caribbean Literature in Health Sciences (LILACS), Nursing Database (BDENF), and Spanish Bibliographic Index in Health Sciences (Ibecs) via Virtual Health Library (VHL), Web of Science (Clarivate Analytics), and Embase (Elsevier). The articles were accessed through the CAPES journal database. The search utilized Descriptors in Health Sciences (DeCS), MeSH, and Emtree from Embase, along with natural language, to form search expressions using the Boolean operators "OR" and "AND" (Table 1). The search strategies were modified to suit the specific characteristics of each database.

Primary studies consisting of randomized clinical trials (RCTs) that examined the impact of digital technology on promoting self-care in individuals with DM2 were included. The studies were published in Portuguese, English, and Spanish without restricting the publication year. The decision not to restrict the publication year was made in order to analyze as many relevant publications as possible on the topic, allowing for new insights into the use of technologies that promote self-care. Robust theories were applied to ensure practical implementation and

Table 1 - Descriptors and natural language used in the search strategy according to the PICO strategy. Teresina/PI, Brazil, 2021

Acronym	Descriptors	Natural language
P = People with type 2 diabetes mellitus	**MeSH/DeCS:** ""diabetes mellitus, type 2" [Mesh].. **Emtree:** 'non insulin dependent diabetes mellitus'/exp.	**Synonyms MeSH/DeCS:** diabetes mellitus, type 2; diabetes mellitus, type ii; type 2 diabetes mellitus; type 2 diabetes; diabetes, type 2. **Synonyms Emtree:** diabetes mellitus type 2; diabetes mellitus type ii; diabetes mellitus, type II; non insulin dependent diabetes; type 2 diabetes mellitus.

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Acronym	Descriptors	Natural language
I = Digital technologies	**MeSH/DeCS:** "digital technology"[Mesh] **Emtree:** 'digital technology'/exp 64 (37,2)	Synonyms MeSH/DeCS: digital technology; digital technologies; technologies, digital; technology, digital; digital electronics; electronics, digital.
C = None		
O = Promoting self-care	**MeSH/DeCS:** "self care"[Mesh] **Emtree:** 'self care'/exp.	**Synonyms MeSH/DeCS**: self care; care, self; self-care. **Synonyms Emtree:** self management; self treatment; self-management; self-nurturance; selfcare selfmanagement; selftreatment

applicability in healthcare. RCTs were chosen due to their high level of evidence and availability in the literature. Studies that did not separate the outcome of interest in the results for DM1 and DM2 were excluded.

The studies were evaluated and categorized based on the hierarchy of levels of evidence: level 1 for evidence derived from systematic reviews or meta-analyses of RCTs (the strongest evidence); level 2 for evidence from well-designed RCTs; level 3 for evidence from well-designed non-randomized controlled trials; level 4 for evidence from well-designed cohort and case-control studies; level 5 for evidence from systematic reviews of descriptive and qualitative studies; level 6 for evidence from a single descriptive or qualitative study; and level 7 for evidence derived from expert opinion (the weakest evidence)[22].

The search was conducted independently and simultaneously by two researchers. They standardized the sequence of descriptor use and cross-references in each database and compared the results obtained. The references obtained from the search were properly stored and organized using the reference manager, Endnote Web, available on the Web of Science database. Endnote Web also facilitated the identification of duplicate articles based on the order in which the databases were exported, selecting the most recently included study as a duplicate. The selected articles were then transferred to the Rayyan QCRI software[23] for blind analysis of the texts. In case of any discrepancies in the inclusion or exclusion of a study, a third reviewer would make the final decision.

An instrument adapted from the Red de Enfermería en Salud Ocupacional (RedENSO Internacional) form[24] was used to extract and summarize the information. The extracted information included authors, year and country of publication, study site, sample size and age of participants, digital technology used, rationale for DM, content of DM, person-machine interaction, and effects of DM. The results were presented in tables and discussed descriptively.

As this study involved secondary data analysis and did not involve human subjects, obtaining ethical approval from a research ethics committee was unnecessary. It is important to note that the authenticity of the concepts, definitions, and findings presented in the articles was maintained.

RESULTS

A total of 158 publications were initially identified. After applying the eligibility criteria, eight articles were chosen for inclusion in this review. The PRISMA flowchart in Figure 1 illustrates the selection process.

Sobre a caracterização dos estudos incluídos (Tabela 2) três foram publicados em 2020, dois em cada ano 2019 e 2018, e um nos respectivos anos 2017, 2016 e 2008. Os estudos foram desenvolvidos em sua maioria na Nova Zelândia.

Regarding the characterization of the included studies (Table 2), three studies were published in 2020, two studies each were published in 2019 and 2018, and one study each was published in 2017, 2016, and 2008. Most of the studies were conducted in New Zealand. All the studies were published in English. In terms of the study location, there was a predominant focus on Primary Care, particularly studies involving individuals diagnosed with DM2. The sample sizes varied according to the study design, ranging from 91 to 500 participants. The mean age of the target population ranged from 16 to 75 years. All the publications were classified as level I evidence, as they were RCTs.

Table 3 presents the range of digital technologies developed to facilitate self-care for individuals with DM2. These digital technologies encompass platforms,

applications, programs, and software. Regarding the theoretical foundations employed in the creation of DT, the following theories were emphasized: the theory of behavioral change[25,27], the transtheoretical model[26], gamification[26], cognitive behavioral theory[26,27], the Theory of Person-Centered Care[28], Bandura's Social Cognitive theory[29], the principles of participatory design[31], the theory of planned behavior[27], the health belief model[30,32], and Bandura's theory of self-efficacy[32]. It is important to note that the two articles incorporated multiple theories in the development of DT[26,32].

Regarding DT content, the focus areas included lifestyle factors such as eating habits and physical activity, weight control, medication management, emotional well-being, and social support. Various forms of person--machine interaction were identified, including automated text messages, embedded conversational agents (robots), online support and goal tracking, online forums, photo logging, and daily step tracking. The impact of DT on self-care promotion for individuals with DM2 was evident in several aspects, including self-management of food intake through meal diaries, glucose monitoring, improved medication adherence, monitoring of body mass index, and positive changes in diet and weight control. In addition, DT also enhanced participant engagement and disease awareness. Furthermore, numerous studies reported significant reductions in glycated hemoglobin (HbA1c) as an additional outcome of DT implementation.

DISCUSSION

Digital platforms, interactive applications for self--management in the home environment, a support and goal-tracking program, and care adherence software were utilized to monitor and manage DM2, aiming to enhance quality of life and continuity of care. These tools focused on various aspects, including lifestyle factors (such as eating habits and physical activity), weight control, medication management, emotional well-being, and social support.

The study revealed the wide range of approaches used in DT management, highlighting the maturity of actions presented in randomized clinical trials from 2008 onwards. The results showed that the technology-based interventions utilized in the study fostered self-learning through various interactions, ensuring the successful treatment of individuals with diabetes. The use of DT in educating, supporting, and managing diabetic patients differed greatly in terms of interventions and methods. Advancements in information and communication technologies have made these interventions viable in health

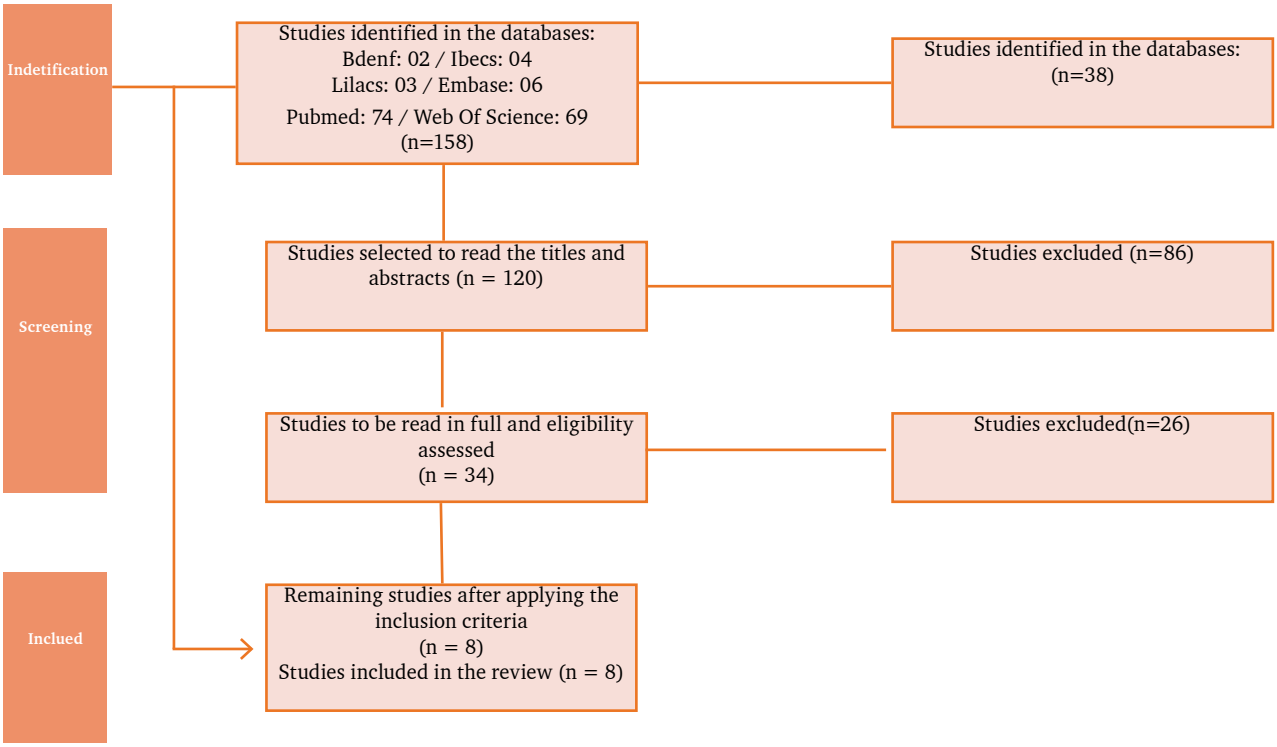

Figure 2 - Flowchart depicting the article selection process, adapted from PRISMA. *Teresina*/PI, 2021

education, demonstrating promising results in knowledge dissemination. Specifically in the case of diabetes, these technologies have proven beneficial in preventing complications, reducing risks, and cutting costs associated with diabetic care. Given this context, it is important to investigate the theoretical foundation behind the use of digital technologies in promoting self-care and educating individuals with DM2. This includes examining the design of these technologies, as well as the utilization of approaches based on the transtheoretical model of

Table 2 - Characterization of the selected studies. *Teresina*/PI, Brazil, 2021

Authors	Year/country	Place of study	Level of evidence	Sample/age
Dobson et al.	2016/New Zealand	Primary and secondary care	I	500 adults with poorly controlled types 1 or 2 diabetes; ≥16 years.
Gong et al.	2020/Australia	Online chat	I	187 adults with DM2; mean age 57 years.
Mcleod et al.	2020/New Zealand	Primary care	I	429 adults and elderly people with DM2; 18-75 years old.
Oberg et al.	2019/Sweden	Primary care	I	92 adults with DM2; ≥18 years.
Sevick et al.	2008/United States	Research center and outpatient clinic	I	232 adults with DM2; ≥18 years.
Koot et al.	2019/Singapore	Primary care	I	100 adults and elderly people with DM2 and HbA1c ≥7.5%; mean age 54 years.
Li et al.	2018/England	Primary care	I	374 adults and elderly people with DM2; mean 64.9 years for controlled and 64.7 years for non-controlled.
Kleinman et al.	2017/India	DHL research center in Ahmedabad, diabetes action center clinics focused on diabetes	I	91 adults and elderly people with DM2 and an A1c between 7.5% and 12.5%; 18 to 65 years old..

behavior change[25,26,32], cognitive-behavioral therapy[27,31], and Bandura's social cognitive theory[26,30].

The transtheoretical model comprises the dynamics that drive behavioral change, providing insights to facilitate individuals' progression and offering guidance to healthcare professionals on how to best support this change. This model has been employed in various therapeutic contexts and has also been combined with other techniques[25,26,32]. Theoretical basis of patient-centered intervention helps to adapt tools and/or instruments according to the population's needs, considering the cultural context in which individuals exist. For instance, it demonstrates ways to adopt healthy eating habits based on the available food options. Cognitive-behavioral therapy asserts that behavioral changes can be achieved through changes in cognition. From this perspective, the theoretical basis enhances interdisciplinary healthcare and improves the application and utilization of digital technology while acknowledging individual uniqueness. It is crucial to highlight that incorporating and valuing theories in developing educational technologies for individuals with DM2 aids in disease management, fostering autonomy in care, health decision-making, and mitigating complications.

Furthermore, the social cognitive theory explores the link between personal beliefs and their influence on adopting and maintaining new behaviors. Personal beliefs underpin human motivation, and the educational process can positively impact the adoption and sustenance of new behaviors and promote perseverance in overcoming challenges.

Effective health behavior changes are often associated with strong self-efficacy, particularly in advanced stages of change. Consequently, it becomes a crucial element

Table 3 - Summary of the articles in the review, according to d, theoretical basis, DT content, person-machine interaction, and effects of DT. Teresina/PI, Brazil, 2021

Authors	DT	Rationale for DT	DT content	Person-machine interaction	Effects of DT on promoting care and additional results
Dobson et al.	mHealth diabetes self-management support program (SMS4BG)	Theory of behavioral change	Diet, being active, monitoring, medication, risk reduction, and healthy coping.	Automated text messaging	Considered effective in DM self-management, it has the potential to be implemented in health services. HbA1c reduction of -8.85 mmol/mol (SD = 14.84) in the intervention group than in the control group (-3.96 mmol/mol (SD = 17.02)
Gong et al.	My Diabetes Coach (MDC) app	My Diabetes Coach (MDC) app	Transtheoretical model, social cognitive theory, and gamification	The embedded conversational agent (Laura – a robot)	Health-related quality of life utility scores improved in the intervention group. HbA1c no difference between groups. Better quality of life with DT (p = 0.04)
Mcleod et al.	BetaMe/Melon Program	Cognitive behavioral theory	Individual health training; provision of evidence-based resources	Online support and goal tracking via a forum.	It has not demonstrated clinical efficacy for this specific program. HbA1c levels at 12 months did not differ between the study arms. Weight decreased slightly at 12 months for participants in both study arms
Oberg et al.	Interactive self-management support project (iSMS)	Theoretical perspectives on Person-Centered Care (PCC)	Support for self-management; food and medication intake; glucose levels; physical activity and weight	Messages and forums.	Greater engagement through increased awareness of the disease and improved self-management needs
Sevick et al.	Personal digital assistant (PDA) food	Bandura's Social Cognitive Theory (SCT),	Glucose monitoring, physical activity; diet; medication management; social support; stress	Information management, with immediate feedback for meeting targets.	The participants consider food monitoring based on the PDA useful and acceptable. 88% find the PDA useful; 85% find it easy to insert food; 70% find it easy to interpret feedback graphs
Koot et al.	GlycoLeap (Holmusk) lifestyle management program.	Comprehensive DM2 educational curriculum. Health belief model	Blood glucose monitoring, weight and meal log, physical activity.	Online classes. Photos of meals uploaded to the app. Daily step tracking.	Dietary changes due to app engagement (p<0.001); HbA1c (-1.3%, p<0.001) for those who recorded their weight more frequently; 2.3% reduction in initial weight (p<0.001)

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Authors	DT	Rationale for DT	DT content	Person-machine interaction	Effects of DT on promoting care and additional results
Li et al.	HeLP-Diabetes, programa de autogestão baseado na Web	Principles of participatory design. Cognitive-behavioral theory and mindfulness	Behavioral changes to support the adoption of healthier lifestyles; emotional well-being	An online forum to share questions, concerns, and experiences	Facilitated access to HeLP-Diabetes is cost-effective, compared to usual care, below the recommended threshold of £20,000 to £30,000 per QALY. Incremental cost-effectiveness ratios of £58 (95% CI -411 to 587) per unit improvement on the PAID scale and £5,550 (95% CI -21,077 to 52,356) per QALY gained by HeLP-Diabetes
Kleinman et al.	m-Health software	Behavioral changes theories, the belief model, and Bandura's self-efficacy theory	Message reminders; data visualization and ongoing support (chat);	Lembretes por mensagens; visualização de dados e suporte contínuo (bate-papo);	They rated the software as very acceptable. Medication adherence (39.0% vs. 12.8%; $p = 0.03$); increased frequency of blood glucose (39.0% vs. 10.3%; $p = 0.01$) at 6 months from baseline.

to cultivate in improving adherence. Therefore, in order to make health education effective, it is essential to address barriers and consider users holistically, recognizing the uniqueness of individuals and the various factors influencing their lifestyle habits. These challenges include socioeconomic, ethnic-racial, and cultural disparities. In this context, information technology is suggested to create new opportunities to meet individual needs and offer personalized guidance and instructions.

Regarding the content of DM, most articles focused on self-care for glucose monitoring and self-management of food intake[25,28-30,32]. Monitoring blood glucose levels and maintaining a proper diet are crucial aspects of diabetes treatment. New technologies, which are continually evolving, aim to electronically manage diabetes and improve glycemic control, decrease episodes of hypoglycemia and hyperglycemia, and facilitate disease management for healthcare professionals and patients and their families. It is worth noting that effective educational interventions can increase knowledge levels and empower patients to better control their disease. Numerous publications in different countries have emphasized the significance of educational programs in promoting treatment adherence and improving diabetes control. As for human-machine interactions, the technologies demonstrated a dialogic approach, utilizing text messages (automatic and chat rooms), online forums, image recording of meals, and goal tracking. Evaluating the use of these technologies requires more than just assessing usage rates. To analyze the retention of transmitted information, it is essential to consider user engagement and their intention to consistently apply the acquired knowledge, as this implies behavioral changes.

This study provides comprehensive findings on the use of DT for glycemic control, specifically highlighting the reduction of HbA1c[25,27,32]. A study that investigated the association between glycemia and macro and microvascular complications found that any decrease in HbA1c is likely related to a reduced risk of diabetic complications. In this context, educational interventions to improve specific skills for managing diabetes can enhance the quality of life for patients with diabetes[42-45]. However, there is a lack of digital educational technologies focused on health literacy, particularly regarding the appropriate use of hypoglycemic agents, insulin, and guidance on disease complications.

Considering the above, healthcare professionals, especially nurses, should support these educational strategies to promote self-care in individuals with DM2. Nevertheless, nursing professionals must receive training and be proficient in using technological resources for the teaching and learning process of patients with DM, including information technology, the Internet, hypermedia, multimedia, and various interaction and communication tools. Despite the contributions of this research, it is important to acknowledge the potential limitation of the absence of long-term studies that have reported secondary outcomes from other studies, as well as publications with a robust method, which increases the risk of biased information.

CONCLUSION

This review examined the use of digital technologies in promoting self-care among individuals with type 2 diabetes mellitus), as well as their impact and applicability in the population. The findings indicate a positive influence of these technologies on self-care, as most studies focused on improving healthy food intake, glucose monitoring, medication adherence, body mass index monitoring, and positive changes in diet and weight control. Additionally, significant improvements in glycemic control, as evidenced by a reduction in Hb1Ac levels, were observed after implementing these technologies, demonstrating their potential to promote individual care. Nevertheless, certain weaknesses were identified in some technologies targeting this population. These weaknesses are associated with issues such as usability, accessibility, cost-effectiveness, and alignment with the social reality of the target audience. The studies presented a range of theoretical frameworks aimed at achieving behavioral and clinical changes and enhancing self-care and quality of life over an extended follow-up period.

In conclusion, it is essential to raise awareness among managers and healthcare professionals about the various types of digital technologies and their effectiveness in the population. By integrating these tools into healthcare services, self-care among individuals with DM2 can be promoted, thereby reducing complications and problems caused by the disease. However, the scientific community must continue developing and testing new studies with rigorous methodological designs, as this will enable the efficient addressing of health needs at both the individual and collective levels while also evaluating and expanding the effects of these technologies' applicability.

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