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Digital Health Interventions for Self-Management Among Adults with Type 2 Diabetes in South America: A Systematic Review

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A B S T R A C T

Type 2 diabetes mellitus (T2DM) has become one of the most severe chronic public health burdens across South America. The prevalence of adult type 2 diabetes continues to rise steadily in Brazil, Argentina, Colombia, Peru, Ecuador, and Chile, driven by rapid urbanization, dietary transition toward high-calorie processed food, sedentary lifestyles, and persistent socioeconomic inequality within regional health systems (Alvarez et al., 2022). Many primary healthcare services across South America face shortages of endocrinologists, limited capacity for long-term routine follow-up, long waiting times for outpatient consultations, and uneven distribution of medical resources between large metropolitan centers and remote rural zones (Barros et al., 2021). These structural barriers hinder continuous self-management support for patients living with type 2 diabetes, resulting in suboptimal glycemic control, higher incidence of microvascular and macrovascular complications, repeated emergency hospital admissions, and increasing economic burden for public health systems throughout the continent (Gómez et al., 2023). Digital health interventions have emerged as a feasible supplementary strategy for chronic disease care in middle-income South American nations, leveraging widely available mobile communication tools to deliver ongoing health education, medication reminders, glucose tracking, and remote clinical follow-up outside of hospital and primary care clinics (Luna et al., 2020). Compared with expensive dedicated medical hardware, low-cost communication platforms including WhatsApp, short message services, simple mobile applications, and web-based telemonitoring systems have become the dominant forms of digital diabetes intervention adopted in South American primary care settings (Rojas et al., 2022). This systematic review synthesizes peer-reviewed original quantitative, qualitative, and mixed-method research studies conducted exclusively within South America to evaluate the effectiveness, implementation experience, acceptability, and barriers of digital health interventions for adult T2DM self-management. The review follows PRISMA 2020 reporting guidelines for systematic reviews, with literature retrieved from PubMed, Scopus, LILACS, Embase, and Web of Science databases. Eligible research studies were limited to original investigations recruiting adult participants diagnosed with type 2 diabetes, implemented within South American countries, and reporting measurable outcomes associated with diabetes self-management, glycemic control, treatment adherence, health-related quality of life, or adverse clinical events. Studies focusing only on type 1 diabetes, pediatric populations, or digital tools without self-management behavioral support were excluded from analysis. After screening titles, abstracts, and full-text manuscripts, 37 published studies met all inclusion criteria and were integrated into this synthesis. Findings demonstrated that most WhatsApp and mobile application-based interventions produced statistically meaningful reductions in glycated hemoglobin levels and improved patient adherence to medication, blood glucose self-monitoring, healthy diet, and regular physical activity (Paz et al., 2024). Nevertheless, substantial implementation barriers persist across South American settings, including uneven digital literacy among older adult patients, unstable internet connectivity in peripheral rural regions, frequent changes of mobile phone numbers among low-income populations, concerns about personal health data privacy, limited financial sustainability of intervention programs once research funding terminates, and insufficient formal training of primary care nurses and physicians to manage digital follow-up workflows (Sánchez et al., 2023). Variation in intervention effectiveness was observed between urban and rural cohorts, between patients with differing socioeconomic status, and between countries with different primary care infrastructure. Beyond glycemic indicators, many included studies also captured secondary patient-reported outcomes

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such as diabetes-related distress, perceived self-efficacy, and quality of life, revealing that digital support can deliver psychosocial benefits alongside metabolic improvements. This review identifies existing gaps in current South American evidence, including limited long-term follow-up data beyond 12 months, few head-to-head comparisons of different digital intervention formats, and insufficient exploration of equity impacts among marginalized subgroups including Indigenous populations, low-literacy adults, and residents of remote frontier regions. The results of this systematic review provide evidence-based insights for policymakers and primary care teams in South America to design, adapt, scale up, and sustain digital diabetes self-management interventions suitable for local socioeconomic and cultural contexts, while explicitly addressing health inequity to avoid widening disparities between privileged and underserved patient groups.

Keywords: *type 2 diabetes mellitus; digital health; mHealth; self-management; South America; chronic disease care; primary health care; health equity*

1. Introduction

Chronic noncommunicable diseases dominate the morbidity and mortality landscape across South America, and type 2 diabetes mellitus ranks among the leading contributors to premature death, disability, and rising healthcare expenditure within the region (Organización Panamericana de la Salud [OPS], 2021). Population-level epidemiological surveys conducted over the past decade show that national prevalence estimates of T2DM among adults range between 9% and 14% in most South American nations, with faster growth observed in low-income urban neighborhoods and semi-rural communities where access to routine preventive health services remains limited (Alvarez et al., 2022). As urban populations adopt obesogenic dietary patterns and reduce daily physical activity, the incidence of T2DM continues to increase, and many patients receive diagnosis only after the emergence of early diabetes-related complications (Barros et al., 2021). Late diagnosis is especially prevalent among socially marginalized groups, including Indigenous communities and informal workers who rarely engage in regular preventive health screening, leading to earlier onset of retinopathy, neuropathy, nephropathy and cardiovascular complications that substantially raise long-term healthcare costs (Gómez et al., 2023). The management of type 2 diabetes relies heavily on sustained patient self-management behaviors, including regular blood glucose monitoring, consistent medication taking, dietary adjustment, physical activity maintenance, foot self-examination, and timely recognition of hypoglycemic or hyperglycemic warning signs (Ferreira et al., 2020). Clinical guidelines developed by regional diabetes societies emphasize that patient self-management education constitutes the cornerstone of long-term diabetes care, rather than pharmacotherapy alone (Sociedade Brasileira de Diabetes, 2022). Self-management is not merely a set of repetitive health behaviors; it requires patients to build health knowledge, develop problem-solving skills, and maintain motivation over many years, which is difficult to achieve through one-off clinic counseling sessions.

Nevertheless, traditional face-to-face primary care follow-up encounters in South America are constrained by multiple structural limitations. Many public primary care centers operate with insufficient staffing, short consultation windows, and long intervals between scheduled appointments, often three months or longer for stable diabetes patients (Gómez et al., 2023). This long gap between clinic visits creates a discontinuity of support: once patients leave the consultation room, they lack regular prompts, health information, or professional feedback to sustain self-care routines between medical appointments. This gap is especially pronounced in rural and peripheral regions where travel distances to health facilities are large and transportation costs create additional barriers for low-income households (Luna et al., 2020). During the COVID-19 pandemic, routine in-person diabetes care was disrupted across South America, accelerating local adoption of telehealth and mobile health tools to maintain chronic disease follow-up when face-to-face consultations were suspended (Pérez et al., 2022). This crisis-driven adoption demonstrated the practical possibility of digital interventions within resource-limited public health services and stimulated a rapid expansion of local research evaluating digital diabetes programs throughout Brazil, Argentina, Colombia, Peru, Ecuador and Chile (Rojas et al., 2022). Many health systems that first deployed digital

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tools as emergency alternatives during lockdowns continued these services after the pandemic subsided, sparking research interest in evaluating whether these digital tools could become permanent components of routine primary care.

Digital health interventions for diabetes self-management encompass a spectrum of technology-enabled support activities. Within the South American context, high-end commercial continuous glucose monitoring platforms and specialized medical applications remain costly and are rarely fully covered by public health insurance systems, limiting broad population-level uptake (Silva et al., 2021). Instead, most local research and routine public health pilots depend on widely accessible consumer communication tools. Instant messaging platforms, especially WhatsApp, are the most commonly deployed intervention medium because of high smartphone penetration even among low-income urban residents, low data consumption requirements, and familiarity among patients and community health workers (Martínez et al., 2023). These messaging programs deliver scheduled educational content, medication reminders, blood glucose logging prompts, and asynchronous answers to patient questions managed by nurses or community health agents. Other intervention modalities include simple SMS text message reminders, mobile applications customized with local language nutrition and physical activity guidance, web-based telemonitoring dashboards for clinical teams, and remote video consultation sessions for patients with poorly controlled glycemia (Paz et al., 2024).

Prior systematic reviews covering Latin America often combine studies from Central America, the Caribbean, and South America together, mixing heterogeneous health system environments and population characteristics (Vásquez et al., 2021). Few existing reviews focus exclusively on South American nations and conduct a granular synthesis of implementation barriers and facilitators specific to this subregion. Many previous reviews also prioritize quantitative clinical outcomes such as HbA1c reduction, while giving limited attention to qualitative evidence describing patient, nurse and system-level challenges of sustained program operation. This review fills that gap by restricting inclusion to original research performed within South America, examining both clinical and behavioral outcomes of digital self-management interventions, synthesizing contextual factors that influence scalability in public primary care services, and integrating qualitative implementation science evidence to understand real-world adoption and sustainability. The primary research questions of this systematic review are as follows: What is the effectiveness of digital health interventions for improving glycemic control and diabetes self-management behaviors among adults living with T2DM in South America? What types of digital health tools have been evaluated in South American T2DM populations? What barriers and enabling factors influence implementation, acceptability, and sustainability of these interventions in local primary care settings? How do socioeconomic and geographic inequities shape the benefits and risks of digital diabetes interventions for vulnerable patient subgroups?

2. Methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021). A pre-defined review protocol established eligibility criteria, search strategy, screening procedure, data extraction framework, and risk of bias assessment method before literature retrieval commenced. The protocol was developed with consideration of regional literature characteristics, including the large volume of relevant publications written in Spanish and Portuguese, which are frequently omitted from reviews limited to English-only databases.

2.1 Eligibility Criteria

Inclusion criteria: Original quantitative, qualitative, or mixed-method peer-reviewed research studies published in English, Spanish, or Portuguese; study conducted in any country of South America; participants aged 18 years or older with confirmed diagnosis of type 2 diabetes mellitus; intervention defined as digital health or mobile health support targeting diabetes self-management; at least one reported outcome related to glycemic control, medication adherence, self-monitoring behavior, diet, physical activity, diabetes knowledge, quality of life, diabetes-related distress, or diabetes-related emergency visits and hospitalizations.

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Exclusion criteria: Review articles, commentaries, editorials, conference abstracts without full manuscript; research performed outside South America; participants exclusively with type 1 diabetes, gestational diabetes, or pediatric diabetes; digital tools used only for retrospective data collection without ongoing self-management behavioral support; studies lacking extractable outcome data for adult T2DM participants.

2.2 Information Sources and Search Strategy

Electronic databases included PubMed/MEDLINE, Scopus, LILACS, Embase, and Web of Science. LILACS was prioritized for retrieving Spanish and Portuguese language regional studies that are not indexed in English-focused databases, which is critical to reduce publication bias against non-English local research. The search terms combined synonyms for type 2 diabetes, digital health, mHealth, telehealth, self-management, and South American country names. Search terms were adapted to Spanish and Portuguese for LILACS to capture regional literature published in local languages. The search window covered articles published from January 2015 through March 2025. Reference lists of included full-text papers and previously published related systematic reviews were manually screened to identify additional potentially eligible studies missed by database searches (Horsley et al., 2011). Grey literature such as government technical reports was not included, to maintain consistency with peer-reviewed evidence standards.

2.3 Study Selection

All retrieved records were imported into reference management software, and duplicate entries were removed automatically and manually. Two-stage screening was performed. First, titles and abstracts were screened against eligibility criteria. Records judged potentially eligible moved forward to full-text screening, where the complete manuscript was examined to confirm all inclusion requirements. Disagreements between screeners were resolved through consensus discussion. Where uncertainty remained about eligibility, the full article was retained for discussion rather than automatically excluded.

2.4 Data Extraction

Standardized data extraction form captured the following information from each included study: country of implementation, study design, sample size, participant demographic characteristics including age, education level, residential area and socioeconomic status, type of digital intervention, duration of follow-up, comparison group (if present), primary and secondary outcome measures, main quantitative or qualitative findings, reported barriers and facilitators, and study limitations. Data extraction was completed independently and cross-checked to reduce transcription error. For qualitative studies, we also extracted themes related to user acceptability, privacy concerns, and interaction with existing primary care workflows.

2.5 Risk of Bias Assessment

For randomized controlled trials, Cochrane Risk of Bias 2 tool was applied to evaluate bias arising from randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results (Higgins et al., 2019). For non-randomized quantitative studies, the ROBINS-I tool was used. Qualitative studies were assessed using the CASP qualitative critical appraisal checklist (Critical Appraisal Skills Programme, 2018). Risk of bias assessment was used to judge the overall strength of evidence rather than excluding studies on the basis of high bias, given the objective to synthesize real-world implementation evidence across South American primary care. Studies with high risk of bias were marked and their limitations highlighted in discussion, rather than discarded from synthesis.

3. Results

3.1 Characteristics of Included Studies

A total of 1,278 unique citations were retrieved from database searches. After title and abstract screening, 146 manuscripts proceeded to full-text evaluation, and 37 studies satisfied all eligibility criteria for inclusion in this systematic review. Included studies

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were distributed across South American nations: Brazil contributed 16 studies, Argentina 7, Colombia 6, Peru 4, Ecuador 2, Chile 2. Study designs included 18 randomized controlled trials, 10 pre-post single-group studies, 5 observational cohort studies, and 4 qualitative or mixed-method studies exploring user and healthcare provider experiences. Sample sizes ranged from 36 participants in small qualitative pilot investigations up to 946 participants in large public-sector messaging intervention programs. The duration of intervention follow-up varied widely: 21 studies followed participants for 3 to 6 months, 10 studies had follow-up periods of 6 to 12 months, and only six studies-maintained observation longer than 12 months. Participant age ranged from 34 to 87 years old, with most participants falling between 50 and 70 years old. Educational attainment varied substantially across samples; many urban cohorts had secondary or higher education, while rural samples contained large proportions of participants with only primary schooling or incomplete primary education.

Table 1 summarizes key characteristics of representative digital health intervention research conducted in South America for adults with type 2 diabetes.

Table 1. Representative South American digital health intervention studies for adults with type 2 diabetes

Country	Intervention type	Sample size	Follow-up	Main reported outcome
Argentina	WhatsApp educational messaging and nurse asynchronous follow-up	412	6 months	Improved medication adherence; HbA1c reduced significantly in intervention arm
Brazil	Telephone monitoring plus SMS glucose reminders	237	12 months	Small but statistically significant reduction in HbA1c; improved self-monitoring frequency
Ecuador	Connected glucometer plus weekly telemonitoring review by diabetes care team	100	6 months	Substantial HbA1c reduction; complete elimination of diabetes-related emergency visits
Peru	Mobile application for nutrition and diabetes self-care guidance	123	4 months	Fasting glucose, total cholesterol and body mass index decreased significantly
Colombia	Video consultation combined with flash glucose monitoring data sharing	91	5 months	Increased time-in-range glucose values; improved patient knowledge of hypoglycemia management
Chile	Web-based self-management platform with monthly automated reminders	186	8 months	Increased physical activity; modest improvement in glycemic control

3.2 Categories of Digital Health Interventions Identified

Three major categories of digital health interventions were identified within the included South American literature. The largest group consisted of instant messaging interventions delivered primarily via WhatsApp. These programs were typically embedded within public primary care services, developed with locally adapted educational messages about nutrition, medication safety, foot care, recognition of acute glucose complications, and routine glucose self-checking (Paz et al., 2024). Many WhatsApp interventions relied on nurses or community health workers to monitor participant responses and trigger remote clinical review when patients reported dangerously high or low glucose readings. This form of intervention was favored because it required no purchase of specialized devices and operated on ordinary smartphones already owned by most urban participants (Martínez et al., 2023). Many projects built closed patient groups moderated by clinical staff, avoiding open public chat spaces to reduce misinformation and protect participant privacy as much as possible within the limitations of commercial messaging software.

The second category involved standalone mobile applications built for diabetes self-management. Some applications allowed manual entry of blood glucose values, stored medication schedules, generated reminders, and delivered culturally tailored dietary advice suitable for local food environments in Brazil, Peru and Chile (Silva et al., 2021). A smaller subset integrated connected glucose meters that automatically uploaded measurement data to a cloud platform accessible to clinical teams, enabling structured telemonitoring. These connected monitoring interventions showed particularly strong clinical benefits, but hardware costs limited widespread rollout in low-

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resource public services (Cordero et al., 2023). Most apps evaluated in South America were developed locally or adapted from international prototypes, with translation and adjustment to match regional food customs and health vocabulary, rather than directly importing unmodified commercial apps designed for North American or European populations.

The third category included low-technology digital interventions such as SMS text message reminders and scheduled telephone follow-up calls. This type was used for participants with basic mobile phones without smartphone capability, mostly in rural areas or among older adults with limited smartphone skills. While these simple reminder interventions improved medication attendance, they offered less opportunity for interactive health education compared with WhatsApp groups or mobile applications (Rojas et al., 2022). These low-tech options remain highly relevant for regions with limited smartphone penetration and poor mobile data connectivity, representing an important strategy to avoid excluding older and rural patients entirely from digital chronic disease support.

3.3 Clinical and Behavioral Outcomes

Glycated hemoglobin (HbA1c) was the most commonly reported primary clinical outcome across quantitative studies. In 29 of the 31 quantitative studies measuring HbA1c, the digital health intervention group demonstrated reduction in glycated hemoglobin compared with usual care or baseline values, although the magnitude of improvement varied substantially. Interventions combining remote glucose data sharing plus regular clinical team review produced the largest HbA1c reductions, while basic reminder-only SMS interventions yielded smaller average effects (Cordero et al., 2023). Improvements in secondary behavioral outcomes were widely reported, including increased frequency of home blood glucose testing, higher medication adherence rates, increased engagement in weekly physical activity, improved diabetes-related knowledge, and better adherence to dietary recommendations (Ferreira et al., 2020). Several studies measured healthcare service utilization outcomes. The controlled cohort study performed in Ecuador reported zero diabetes-related emergency visits within the intervention group over six months, while the usual care control group experienced eight emergency attendances for diabetic complications (Herrera et al., 2024). This finding indicates that well-structured remote monitoring may reduce acute care demand and relieve pressure on emergency departments in public hospitals.

Not all studies reported uniformly positive results. A small number of investigations found no statistically significant difference in long-term glycemic control, especially when the digital intervention was implemented without dedicated staff training or regular clinical oversight (Pérez et al., 2022). When messages were sent automatically without any human review of patient responses, participant engagement tended to decline rapidly after the first three months of intervention, leading to diminished sustained behavioral benefits. Patient-reported psychosocial outcomes also varied: some participants reported reduced diabetes-related stress because they could receive answers to questions quickly, while others reported increased anxiety from repeated glucose alerts and constant reminders about their chronic disease status.

3.4 Barriers and Facilitators from Qualitative Evidence

Qualitative and mixed-method studies captured patient, nurse, and primary care physician perspectives regarding digital diabetes interventions. Key facilitating factors for successful implementation included culturally adapted health content written in simple plain language, personalized reminders, integration of the digital workflow into existing routine primary care responsibilities, ongoing professional support from nurses, and low or zero cost for participants (Luna et al., 2020). Patients valued the convenience of receiving support without traveling to clinics, and appreciated rapid asynchronous answers to simple diabetes questions that would otherwise wait for the next scheduled consultation. Community health workers played a critical bridging role in many successful projects; these local workers understand regional culture and dialect, and can help patients troubleshoot basic mobile device problems.

Major barriers fell into several interconnected domains. Digital literacy was a prominent limitation, particularly among older adults, patients with low formal education, and residents of remote rural zones. Some participants could receive messages but struggled to enter glucose readings or navigate mobile application functions independently (Sánchez et al., 2023). Intermittent mobile network coverage and unstable internet connectivity in rural and peripheral communities disrupted message delivery and data upload. High mobile data

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costs represented another burden for low-income households. Frequent changes of mobile phone numbers among economically vulnerable populations created participant loss to follow-up, as individuals changed SIM cards to reduce mobile service expenses (Paz et al., 2024). Privacy concerns also emerged as a barrier; many participants worried that personal glucose data and health information shared on messaging platforms might be accessed by unauthorized third parties. Health workforce barriers included heavy existing workloads for primary care nurses, lack of protected working time to manage remote digital patient follow-up, and insufficient formal training for clinicians to operate digital monitoring dashboards. Sustainability represented a critical long-term challenge: nearly all successful South American digital diabetes programs were initiated under time-limited research grants. Once external project funding ended, many public health services lacked budget allocations to continue paying staff time and platform operational costs, leading to program discontinuation after study completion (Vásquez et al., 2021).

4. Discussion

This systematic review synthesizes 37 research studies exclusively conducted in South America and confirms that digital health interventions can deliver measurable improvements in glycemic control and diabetes self-management behaviors among adults living with type 2 diabetes, though effectiveness depends heavily on intervention design, local infrastructure, health workforce capacity, and patient socioeconomic characteristics. The dominant successful model within South American public primary care systems centers on low-cost messaging tools rather than expensive specialized medical devices. WhatsApp-based interventions are especially well-suited to regional context because they leverage existing consumer mobile technology and require minimal capital investment, making them easier to pilot within resource constrained public health services compared with proprietary medical software and connected monitoring hardware (Martínez et al., 2023). When digital interventions include human oversight from nurses or community health workers to review patient-reported glucose data and respond to patient questions, the clinical benefits are consistently larger than fully automated message-only interventions without clinical review (Cordero et al., 2023). This finding is consistent across Brazilian, Argentine, Ecuadorian and Colombian studies, demonstrating that digital tools act as a supplement rather than replacement for human primary care support. Automated reminders alone cannot address individual patient barriers such as financial hardship, food insecurity, depression or family conflict that undermine diabetes self-management.

The results also highlight substantial equity gaps. Intervention benefits are not distributed evenly across South American populations. Urban participants with stable smartphone access and basic digital literacy gain the greatest benefit. Rural residents, older adults, people with low educational attainment, and households experiencing economic insecurity encounter more barriers and lower sustained engagement (Sánchez et al., 2023). Indigenous communities face additional layers of inequity, including language barriers, limited mobile network infrastructure in ancestral territories, and historical distrust of formal health services, which reduce uptake of digital health programs (Molina et al., 2023). These equity considerations must be central when health authorities consider national scale-up of digital diabetes programs; simply introducing mobile messaging tools may widen health disparities if no additional support is provided for digitally excluded groups. The evidence further shows that short-term pilot results are often promising, yet long-term sustainability remains the most serious challenge in South America. Most published trials run for only 3 to 12 months under research funding. Few studies evaluate program performance after integration into routine public health budgets, and there is limited evidence about long-term retention of self-management behavior change once formal research support ends (Vásquez et al., 2021).

Several limitations of the available South American evidence base deserve consideration. First, many trials have relatively short follow-up periods, so conclusions about lasting metabolic benefits and long-term reduction of diabetes complications remain limited. Second, there is heterogeneity in intervention design and outcome measurement, which prevents pooling all data into a formal meta-analysis. Third, several studies were single-group pre-post evaluations without a separate control group, which increases the risk that

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observed improvements could partly reflect Hawthorne effects or seasonal variation rather than the digital intervention itself. Fourth, the geographic distribution of research is uneven: the bulk of evidence comes from Brazil and Argentina, while Bolivia, Paraguay, Uruguay, Venezuela, Guyana, Suriname have very few published studies on digital T2DM self-management interventions, limiting generalizability to those countries. Fifth, only a small subset of studies collect disaggregated data according to race, ethnicity, income level, and rural or urban residence, which restricts deeper analysis of health equity impacts.

For clinical practice and health policy in South America, the findings suggest actionable recommendations. Digital diabetes self-management programs should be designed as low-cost, low-bandwidth interventions, prioritizing messaging platforms familiar to local populations rather than complex proprietary mobile applications. Program design should incorporate plain-language, culturally adapted educational content aligned with regional dietary patterns and local diabetes care guidelines. Health systems must allocate dedicated protected working time and training for primary care nurses and community health workers responsible for remote digital follow-up, without simply adding digital monitoring duties onto already overloaded staff workloads. Implementation plans should include targeted accommodations for low-digital-literacy patients, including family caregiver involvement, simple paper backup logs, and hybrid models combining digital messaging with periodic telephone calls or in-person check-ins. Before large national rollout, local feasibility pilots should be performed in rural and low-income urban neighborhoods to assess network access, data cost barriers, and participant retention. Regulatory and institutional frameworks should be developed to define how personal diabetes health data collected via messaging platforms is stored and protected, addressing patient privacy concerns.

Future South American research should prioritize longer-duration trials extending beyond one year, comparative studies testing different digital intervention formats against each other, and stratified analysis by socioeconomic and geographic subgroups to examine equity outcomes. Implementation science studies are also needed to identify sustainable financing models that can maintain digital chronic disease support after research funding ends. Qualitative research exploring Indigenous patient perspectives on digital diabetes care remains an important unmet research priority across the continent.

5. Existing research limitations and future perspectives

Although the research on diabetic sarcopenia has made rapid progress in recent years, the overall research system is still imperfect, and there are many deficiencies in clinical evidence, standardized diagnosis and treatment, and translational application. First of all, most of the existing clinical evidence comes from observational cross-sectional studies and small-sample cohort studies, and high-quality, large-sample, multi-center randomized controlled trials targeting elderly T2DM-sarcopenia population are still very scarce, resulting in low level of clinical evidence (Han et al., 2024).

Secondly, there is no unified screening, diagnosis and intervention standard for diabetic sarcopenia in the world. Different studies adopt different diagnostic criteria, inclusion and exclusion criteria, and intervention schemes, resulting in high heterogeneity of existing research results, which is not conducive to the formulation of unified clinical guidelines. In addition, the long-term adherence of elderly patients to exercise and nutritional intervention is poor in real clinical scenarios, which affects the actual intervention effect. At present, few studies have carried out cost-effectiveness analysis of intervention measures, which hinders the transformation of research results into public health policies (Kalinkovich et al., 2024).

Future research directions should focus on the following aspects: carrying out high-quality randomized controlled trials to compare the efficacy of different multi-component intervention schemes; developing simple, fast and low-cost screening tools suitable for primary medical institutions to realize early screening of high-risk groups; carrying out long-term longitudinal cohort studies to clarify the causal molecular mechanism of diabetic sarcopenia; evaluating the health economic value of comprehensive intervention programs; comparing

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the intervention effects of home-based and hospital-based intervention modes; and exploring peripheral blood myokines and novel biomarkers for early diagnosis of diabetic sarcopenia (Guisado-Barrioso et al., 2022).

6. Conclusion

Digital health interventions represent a valuable supplementary strategy to strengthen type 2 diabetes self-management support within South American primary healthcare systems. The existing regional evidence demonstrates that messaging-based and mobile health interventions can improve glycated hemoglobin levels, medication adherence, glucose self-monitoring, and healthy lifestyle behaviors for adults with T2DM. Interventions combining automated digital reminders with ongoing asynchronous clinical review by primary care nursing staff produce the strongest clinical and behavioral outcomes. Nevertheless, multiple contextual barriers limit equitable and sustainable scaling, including variable digital literacy, unstable mobile connectivity, privacy concerns, heavy primary care workforce burdens, and the difficulty of securing ongoing public funding after research projects conclude. Digital tools cannot replace routine primary care, but can extend support between clinic visits for patients living with type 2 diabetes. Policymakers and clinical teams in South America must consider local socioeconomic, infrastructural, and cultural conditions when adapting and scaling these interventions, with intentional focus on reducing digital inequity across vulnerable population subgroups, including older adults, rural residents and Indigenous communities. Further regional research with longer follow-up and equity-focused analysis will continue to refine understanding of how digital health can best support chronic diabetes care across South America.

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