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REVIEW

Educational technologies in literacy training for pregnant women with gestational diabetes mellitus: scoping review

Tecnologías educativas en la alfabetización de mujeres embarazadas con diabetes mellitus gestacional: revisión de alcance

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ABSTRACT:

Introduction: Diabetes Mellitus self-management can be achieved through educational technologies that help healthcare professionals do their job better.
Objective: To map evidence on educational technologies aimed at literacy for pregnant women with gestational diabetes.
Method: This is a scoping review, conducted under the guidelines of the Joanna Briggs Institute and PRISMA-ScR, with no language or time restrictions. The search was conducted in the following databases: PubMed, SCOPUS, LILACS, Web of Science, CINAHL (EBSCO), CAPES Thesis and Dissertation Catalog, IEEE Xplore Digital Library, and Google Scholar.
Results: A total of 6,503 studies were identified, and 13 studies were included after analysis. The English language and randomized clinical trials were predominant. The use of mobile applications, educational films, and web-based interventions was identified. The forms of development and

evaluation of these technologies were predominantly the use of literature and the division into intervention and control groups, respectively.
Conclusion: Technologies with an emphasis on health literacy were used in longitudinal care, covering diagnosis, monitoring, and health promotion.

Keywords: Diabetes, Gestational; Educational Technology; Health Literacy.

RESUMEN:
Introducción: El autocontrol de la Diabetes Mellitus puede realizarse mediante tecnologías educativas que ayuden a los profesionales sanitarios a realizar mejor su trabajo.
Objetivo: mapear evidencias sobre tecnologías educativas dirigidas a la alfabetización de mujeres embarazadas con diabetes gestacional.
Método: se trata de una revisión de alcance, siguiendo las directrices del Instituto Joanna Briggs y PRISMA-ScR, sin restricciones de idioma o tiempo. La búsqueda se realizó en las siguientes bases de datos: PubMed, SCOPUS, LILACS, Web Of Science, CINAHL (EBSCO), Catálogo de Tesis y Disertaciones de CAPES, IEEE Xplore Digital Library y Google Scholar.
Resultados: se encontraron 6503 estudios, de los cuales se incluyeron 13 tras su análisis. Predominaron el idioma inglés y los ensayos clínicos aleatorios. Se identificó el uso de aplicaciones móviles, películas educativas e intervenciones basadas en la web. Las formas de desarrollo y evaluación de estas tecnologías fueron el uso de la literatura y la división en grupos de intervención y control.
Conclusión: las tecnologías con énfasis en la alfabetización en salud se utilizaron en la longitudinalidad de la atención, de manera que abarcaban el diagnóstico, el seguimiento y la promoción de la salud.

Palabras clave: Diabetes Gestacional; Tecnología Educacional; Alfabetización en Salud.

INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most prevalent conditions in pregnancy, affecting 15% to 25% of pregnancies worldwide. This metabolic disease increases the predisposition to other disorders in the mother-fetus pair, such as the risk of cardiometabolic disorders. In Brazil, it impacts about 18% of women, posing challenges for pregnant women, pregnancy, support networks, and health professionals [1,2].

Self-management of this comorbidity can be facilitated through educational technologies (TEs), which serve as support tools that enable the identification of needs and weaknesses in care, allowing for the delivery of quality care. Additionally, TEs expand access to information and facilitate communication between professionals, individuals, and the community. These tools can be developed in print or audiovisual formats[3].

Health literacy (HL) is a prerequisite for satisfactory self-management. It serves as an alternative for behavioral improvement and the prevention of adverse outcomes in pregnancy, as individuals with low levels of HL exhibit limited self-care, which increases the likelihood of poor outcomes. HL is defined as the set of skills and competencies that enable individuals to understand, evaluate, and apply health information, leading to an improved quality of life [4].

Educational technologies with an emphasis on HL play a fundamental role in promoting a satisfactory quality of life and preventing adverse outcomes during pregnancy. The management of GDM primarily depends on a healthy lifestyle, and self-management emerges as a key factor in achieving positive outcomes. These

technologies facilitate access to information, empowering pregnant women to make informed decisions about their health and promoting greater adherence to recommended practices[4,5].

Several studies suggest that Educational technologies can serve as allies in the self-management process of GMD, leading to numerous benefits that can be sustained into the postpartum period[6]. However, there is little discussion of the topic directly related to HL, and that points to the form of development, validation, evaluation, and player satisfaction in the case of games. Therefore, a preliminary search was conducted on the platforms Open Science Framework (OSF), The Cochrane Library, Joanna Briggs Institute Clinical Online Network of Evidence for Care and Therapeutics (JBI COnNECT+), and the Center for Reviews and Dissemination (CRD). This resulted in the absence of a scoping review with the same characteristics.

It should be noted that a scoping review is the most appropriate option for the proposed objective, as its broad scope allows for the mapping of Educational Technologies focused on the literacy of pregnant women with GDM. This aims to improve self-care, which, in turn, contributes to improving the quality of life and clinical status of these women. Therefore, the objective was to map evidence on educational technologies with an emphasis on the literacy of pregnant women with GDM.

MATERIAL AND METHOD

This is a scope review conducted under the recommendations of the *Joanna Briggs Institute* (JBI), following these steps: obtaining the guiding question and objective of the study; providing a replicable search strategy; searching for studies; and extracting, analyzing, and synthesizing these studies[7,8]. The *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA-ScR) *checklist*[9] was also used to ensure a practical methodological approach that meets high standards of evidence. The protocol for this study was registered in the Open Science Framework (OSF) and can be accessed via the link: https://osf.io/nam8w/.

To develop the research question, the population, context, and concept (PCC) mnemonic was used, with the following results: population (pregnant women with GMD), concept (educational technologies), context (health literacy). The guiding question was developed: “What educational technologies exist that emphasize literacy among pregnant women with GDM?”

The search strategy created through the research question was implemented as recommended by the JBI, being carried out through an initial search in the LILACS and PUBMED databases, using the Health Sciences descriptors and the Medical Subject Headings (DECS/MESH): “Diabetes, gestational,” “Technology,” and “Health Literacy,” to find other relevant terms for the construction of the strategy, adding the following descriptors: “Diabetes, gestational,” “Diabetes Mellitus, Gestational,” “Technology,” “Educational Technology,” “Games, Experimental,” “Video Games,” “Health Literacy,” and “Literacy.” The selected descriptors, combined with the Boolean operators “AND” and “OR”, resulted in the search strategy presented in Table 1, considering the specificities of each database.

The search for the theoretical corpus was conducted on August 1, 2024, using PubMed, SCOPUS, LILACS, and Web of Science.

CINAHL (EBSCO), the Thesis and Dissertation Catalog of the journal of the Coordination for the Improvement of Higher Education Personnel (CAPES), and the IEEE Xplore Digital Library, as it is a computer science database. A search was also conducted on *Google Scholar.* It should be noted that this process was carried out with a librarian (Table 1).

Table 1: Strategy for searching the theoretical corpus. João Pessoa, PB, Brazil, 2024.

PUBMED	((((((("Diabetes, gestational") OR ("Diabetes Mellitus, Gestational")) AND (Technology)) OR ("Educational Technology")) OR ("Games, Experimental")) OR ("Vídeo Games")) AND ("Health Literacy")
LILACS	("Diabetes, gestational") OR ("Diabetes Mellitus, Gestational") AND (Technology) OR ("Educational Technology") OR ("Games, Experimental") OR ("Vídeo games") OR ("Health literacy")
WEB OF SCIENCE	((((((ALL=("Diabetes, gestational")) OR ALL=("Diabetes Mellitus, Gestational")) AND ALL=(Technology)) OR ALL=("Educational Technology")) OR ALL=("Games, Experimental")) OR ALL=("Vídeo Games")) AND ALL=("Health Literacy")
SCOPUS	(ALL ("Diabetes, gestational") OR ALL ("Diabetes Mellitus, Gestational") AND ALL ("Technology") OR ALL ("Educational Technology") OR ALL ("Games, Experimental") OR ALL ("Vídeo games") AND ALL ("Health Literacy") OR TITLE-ABS-KEY ("literacy"))
CINAHL (EBSCO)	(ALL ("Diabetes, gestational") OR ALL ("Diabetes Mellitus, Gestational") AND ALL ("Technology") OR ALL ("Educational Technology") OR ALL ("Games, Experimental") OR ALL ("Vídeo games") AND ALL ("Health Literacy")
IEEE XPLORE DIGITAL LIBRARY	("All Metadata":"Diabetes, gestational") OR ("All Metadata":"Diabetes Mellitus, Gestational") AND ("All Metadata":"Technology") OR ("All Metadata":"Educational Technology") OR ("All Metadata":"Games, Experimental") OR ("All Metadata":"Vídeo Games") AND ("All Metadata":"Health Literacy") OR ("All Metadata":"Literacy"))
GOOGLE SCHOLAR (inglês)	"Diabetes, gestational" OR "Diabetes Mellitus, Gestational" AND "Technology" OR "Educational Technology" OR "Games, Experimental" OR "Vídeo games" AND "Health Literacy" OR "literacy"
GOOGLE SCHOLAR (português)	"Diabetes gestacional" OR "Diabetes mellitus gestacional" AND "tecnologia" OR "tecnologia educacional" OR "jogos experimentais" OR "jogos de vídeo" AND "letramento em saúde" OR "alfabetização"
CAPES	"Diabetes mellitus gestacional" AND "tecnologia" OR "tecnologia educacional" OR "jogos experimentais" AND "letramento em saúde"

To compose the review, primary and secondary research, as well as gray literature found in scientific databases in Portuguese, English, or Spanish, were considered, with no time filter applied for publication. Preprints, incomplete studies, and those that did not answer the guiding question were excluded.

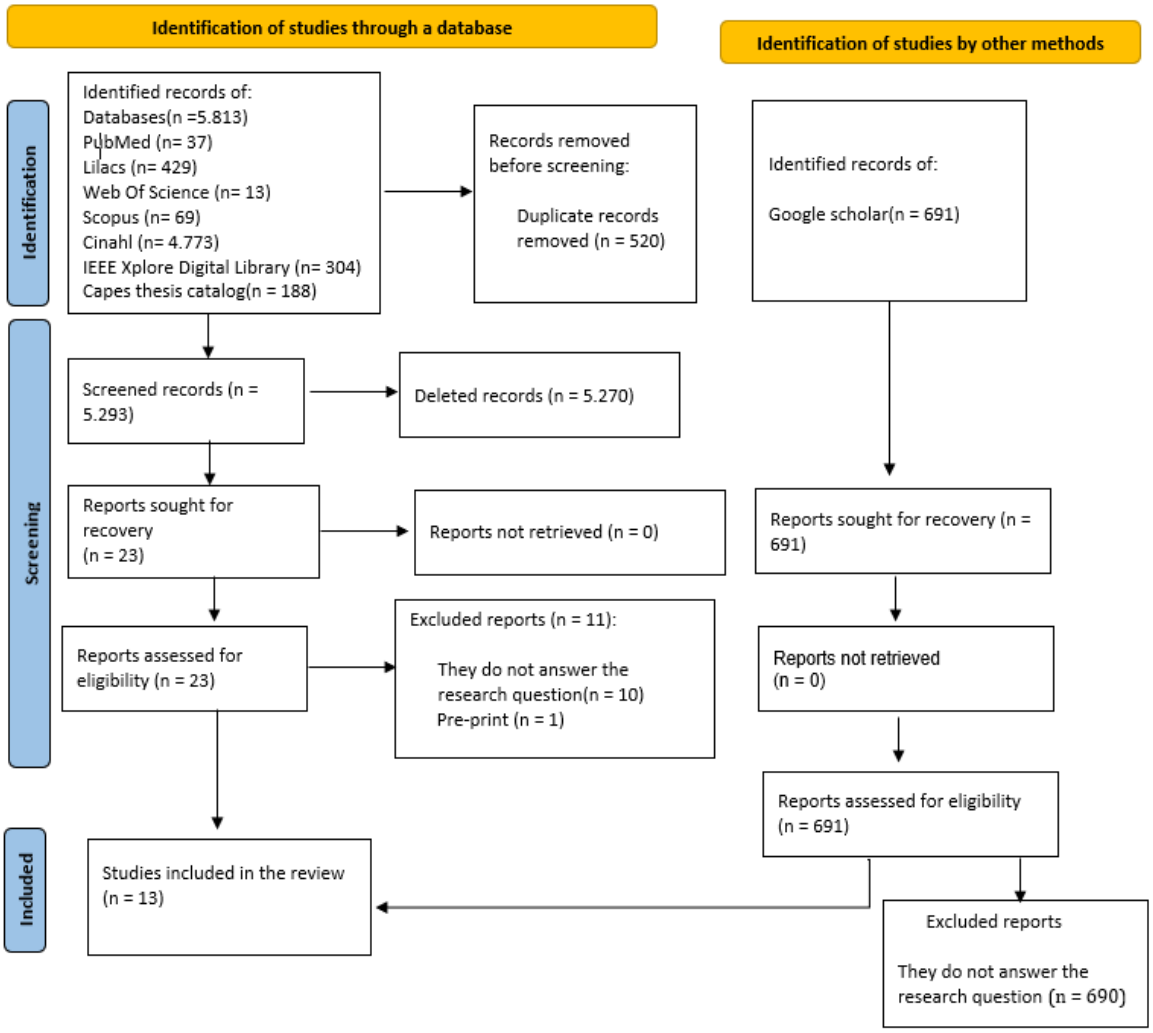
The results were exported to the Rayyan software, where the following steps were performed: exclusion of duplicates, initial screening (based on title and abstract), and final screening (based on full text). The screening was performed by two reviewers using the segmented process offered by Rayyan, so that one reviewer did not have access to the content chosen by the other (blinding). A third reviewer was called in when there was disagreement. After selecting the articles, their references were searched to identify other studies to be included in the research.

To compile the necessary information, a questionnaire structured by the authors was used, which collected the following data: publication details, study design, type of technology, its construction and design, validation and evaluation, and player satisfaction in the case of games.

RESULTS

The selection of results was operationalized using the PRISMA-ScR flowchart (Figure 1) to provide this information in a broad and objective manner.

Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA-ScR) flowchart adapted for study selection. João Pessoa, PB, Brazil, 2024.



The search yielded a total of 6,503 articles, of which 5,813 were identified in databases and 520 were excluded from the *Rayyan software* due to duplication. During the initial screening (title and abstract), 5,270 articles were excluded, leaving 23 for the second screening (full text). This resulted in the inclusion of 12 articles from databases. In line with this, another source was searched, such as Google Scholar, where 691 publications were analyzed (title and abstract), 690 were excluded, and one was viewed in its entirety and included in the review. An analysis of the bibliographic references of the articles included in the sample was performed; however, none were included.

Of the 13 studies analyzed, 12 were published in English, and one was published in Portuguese. In terms of demographics, the participants were from the following continents: Oceania (Australia, 4), Europe (Norway, 2; United Kingdom, 2), America (Brazil, 2), Asia (Israel, 2; India, 1), and Africa (Uganda, 1). It is worth noting that one

of the studies was conducted on two different continents. As mentioned, there was no time frame, with two studies in 2016, 2018, 2019, and 2021, respectively, and one in 2015, 2017, 2020, 2022, and 2024.

The types of studies identified in the 13 articles included randomized clinical trials (n = 6), clinical trial protocols (n = 1), pilot studies (n = 1), methodological studies (n = 2), scope reviews (n = 2), and systematic reviews (n = 1).

The identification of studies and the mapping of evidence, including the type of educational technology, stages and/or requirements used for development, and the validation and/or evaluation process conducted by experts and the target audience, are presented in table 2.

Three types of educational technologies were identified: mobile health applications, educational films, and web-based interventions (websites). The development of these technologies varied, involving the use of scientific literature (such as guidelines and manuals), discussions with experts, and, in some cases, cultural adaptations. Regarding the validation and evaluation process, there was a preponderance of studies focused on effectiveness, with little description of validation.

Table 2: Summary of the articles included in the study. João Pessoa, PB, Brazil, 2024.

ID*	Technology	Development	Validation/Evaluation
A1[10] A10[11] A13[12]	Application Pregnant+	**Construction:** Content discussion with experts, literature review, and use of national and international guidelines. The graphic interface was developed by a professional designer and software development experts, and the target audience was also consulted. **Presentation:** 4 topics (blood sugar, food and drink, physical activity, diabetes), 10 dietary recommendations, transfer of feedback blood glucose values at very high values, showing a graph, and directing directly to nutritional recommendations.	**Assessment A1**: semi-structured questionnaire (pregnant women's experience with the app) and interpretative phenomenological analysis (IPA). **Participants:** 17 women were invited because they were part of the clinical trial intervention group. **Assessment A10:** Divided into two groups (control and intervention) and assessed using a food frequency questionnaire (FFQ) based on the Fit for Delivery study, evaluating the effect on the eating behavior of pregnant women. **Participants:** Women with GDM aged over 18 and less than 33 weeks pregnant. A13: Not described.
A2[13]	Educational film	**Development:** Document review, focus group discussions, interviews with health professionals and pregnant women with and without GDM. Based on	**Evaluation:** The objective is to conduct the study in 30 maternity wards in each country (Uganda and India), randomized into intervention and control groups (stage not yet completed).

ID*	Technology	Development	Validation/Evaluation
		national guidelines and the culturally adapted health belief model. **Presentation:** Local women sharing their experiences, together with health professionals reinforcing key messages.	**Participants:** 10,000 women aged 18 years or older who received prenatal care before 32 weeks of gestation.
A3[14]	Web-based educational intervention (website)	**Construction:** Group of experts (nutritionist, endocrinologist, nurse, midwife, and web designer), using the guidelines of Diabetes Australia and the National Diabetes Services Scheme. **Presentation:** Four modules (What is GDM? Health, nutrition, and exercise; What to do if you are still hungry? A healthy shopping guide).	**Evaluation:** The control group (standard education) and the intervention group (standard education and web-based intervention) were compared. Demographic data, body mass index, blood pressure, maternal glycemic levels/TOTG, and NB birth weight were collected. **Participants:** 116 pregnant women with GDM, aged between 18 and 45, with a single pregnancy, between 28 and 32 weeks, who attended the clinic.
A4[15]	Mobile application prototype	**Construction:** Use of strategies from the document “Tracking and Diagnosis of GDM in Brazil” published by the Pan American Health Organization/World Health Organization, the Ministry of Health, the Brazilian Federation of Gynecology and Obstetrics, and the Brazilian Diabetes Society. Definition of key elements available. Development using the Balsamiq tool. **Presentation:** 4 topics (profile, diabetes during pregnancy, diagnosis of GDM, my glycemic control). Transfer function for glucose values, weight, days of physical activity, diet, and alerts.	It hasn't been described.
A5[16]	DVD educational	**Construction:** A focus group methodology was employed in two distinct populations within an ethnic	**Evaluation:** Divided into two groups (usual care and usual care + DVD). A proprietary questionnaire was used, as well as

ID*	Technology	Development	Validation/Evaluation
		and cultural context to design a comprehensive DVD. The guidelines of the National Institute for Health and Care Excellence (NICE) were followed. **Presentation:** Women living with GDM from diverse ethnic backgrounds, sharing opinions and experiences, along with evidence-based content.	standardized questionnaires: the State-Trait Anxiety Inventory (STAI), Prenatal Distress Questionnaire (PDQ), Diabetes Assessment Scale (ADS), Diabetes Empowerment Scale (DES), and Risk Perception Survey. **Participants:** 150 pregnant women (multiethnic) with GDM and over 16 years of age, in three hospitals in the United Kingdom.
A6[17]	Dnurse app	**Construction:** Not described. **Presentation:** Additional information on diet, exercise, medication, diabetes education, and online instructions. It has a glucose value transfer function.	**Evaluation:** The participants were randomly assigned to two groups (usual treatment and usual treatment plus app). The following outcomes were monitored: general health conditions, compliance, blood glucose levels, glycated hemoglobin levels, weight gain, pregnancy status, and neonatal outcomes. **Participants:** 124 pregnant women diagnosed with GDM between 24 and 28 weeks of gestation and with a single fetus.
A6[17]	myfood24 application	**Construction:** Not described. **Presentation:** Food database containing 45,000 foods, with associated serving size images and immediate nutritional analysis. 24-hour food intake completion feature.	**Evaluation:** Interview with a pragmatic approach and a questionnaire sent by email, containing demographic information, experiences, and attitudes. The usability of technology was evaluated using the *System Usability Score* (SUS) scale. **Participants:** 199 women with GDM who could read and understand English and had not used any medication for GDM, reaching saturation with 12 interviews.
A7[18]	Glucose Buddy app	**Construction:** Not described. **Presentation:** The transferred glucose values generated a daily report for the clinical team, which provided daily feedback via	**Evaluation:** The study was divided into two groups (standard intervention and standard intervention plus app). Demographic and obstetric data were collected. **Participants:** 120 pregnant

ID*	Technology	Development	Validation/Evaluation
		email with tips and changes in insulin use. The app also allowed for questions and answers.	women aged between 18 and 45 years, with a single pregnancy and GDM who spoke English and had access to a clinic before 34 weeks.
A8[19]	Self-care guide pack	**Development:** systematic review, use of guidelines, manuals, and reliable websites (Ministry of Health), and qualitative study with pregnant women living with GDM addressing prerequisites, barriers, and facilitators for education. Experts summarized the findings. **Presentation:** educational DVDs, HOMA software, a logbook, and three educational sessions covering the topics of diabetes, nutrition, blood glucose self-monitoring, physical activity, insulin, mental health, and care during pregnancy, childbirth, and the postpartum period.	**Evaluation:** Divided into two groups (standard intervention and guide package intervention). The self-efficacy questionnaire, based on the self-efficacy scale for diabetic patients, was administered. **Participants:** 152 pregnant women with GDM.
A9[20]	SineDie app	**Construction:** Web-based telemedicine platform functioning as clinical decision support designed to manage DMG treatment. **Presentation:** Remote assessment of all DMG patients visited in the department during the COVID-19 pandemic. Analyzes and provides instant feedback on glucose values via Bluetooth connectivity. If no data is provided within three days, a reminder is sent.	**Evaluation:** Pregnant women were monitored for 16 days. This monitoring included daily glucose measurements, fasting and postprandial glucose levels 1 hour after meals (breakfast, lunch, and dinner), frequency of data transfer, and maternal and neonatal outcomes. **Participants:** 20 pregnant women with GDM.
A9[20]	Habits-GDM application	**Construction:** Based on the health belief model (perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and action tips).	**Evaluation:** The study was divided into two groups (intervention and control), and the following outcomes were assessed: excessive weight gain, glycemic control, and maternal and fetal outcomes. Frequency of use was

ID*	Technology	Development	Validation/Evaluation
		Presentation: Lifestyle coaching program with three components: interactive educational classes, tracking tools (self-monitoring of blood glucose, physical activity, diet, and weight), and coaching. It has a data transfer function.	collected through Google *Analytics Service.* The intervention group was contacted for an interview, which included a questionnaire based on usage analysis and available literature. **Participants:** 170 women with GDM.
A11[21]	Web-based educational intervention (website)	**Construction:** Not described. **Presentation:** 4 modules (food choices, habits/lifestyle, emotions, family and eating, glucose level test).	**Evaluation:** Divided into two groups (control and intervention), the Diabetes Knowledge Scale was adapted for use to evaluate knowledge about GDM, diet, and healthy lifestyle, using a questionnaire (containing demographic information, GDM, blood glucose testing, food, and self-management). **Participants:** 116 pregnant women between the ages of 18 and 45, with single pregnancies, newly diagnosed with GDM, and who understood English.
A12[22]	DiaMonD app	**Construction:** The main characteristics of chronic diseases were defined, as well as the *E-business* process with clinics, hospitals, and technology departments. User-centered design (UCD) and a web-based model were adopted. **Presentation:** Receipt of messages from clinical caregivers based on transferred blood glucose values.	**Evaluation:** Divided into patient and clinical perspectives. Patients were divided into two groups (standard intervention and standard intervention with technology), and an initial questionnaire (demographic and knowledge about technologies) was administered. Four weeks later, a *crossover* occurred. Another questionnaire was administered at the end of the standard treatment and technological solution, as well as at the end of the project, to compare both interventions. Regarding the clinical perspective, professionals responded to an initial questionnaire that assessed health literacy and ultimately overall satisfaction with the technological solution. The Food Frequency Questionnaire (FFQ) was used to assess diet quality, and the modified *Leisure Time Physical*

ID*	Technology Development	Validation/Evaluation
		Activity Questionnaire was used to assess physical activity level. **Participants:** 10 pregnant women with GDM and a GDM test carried out between 26 and 28 weeks, and an obstetrician, an endocrinologist, and a diabetic educator.

*ID=identification

DISCUSSION

There was a predominance of studies in English, which can be explained by the fact that English is the primary language in 57% of the locations where the studies were conducted. In this regard, the continent of Oceania, represented by Australia, had the highest number of articles. This finding may corroborate the notable 14% increase in the incidence of GDM in that country[23].

Regarding the time of publication, articles dealing with TEs combined with HL began in 2015 and were distributed evenly between 1 and 2 per year until 2024, except for 2023, which had none. The term “health literacy” was first observed in the United States in 1970 (24) and has since been the subject of numerous studies. However, its use in the development of technologies for pregnant women with GDM was seen later, as the results suggest.

Randomized clinical trials have predominated, considered the “gold standard” for high-quality evidence, as they provide an objective assessment of the cause-and-effect relationship, thereby justifying the high preference for this scientific method[25].

The present study found the use of mobile health applications (mHealth)[10-12,15,17,18,20,22], educational films [13,16,19], and web-based interventions (websites) [14,19,21] as TEs for GDM.
Mobile health applications have been utilized to provide relevant information, ranging from the etiology of GDM, symptoms, and diagnosis to daily choices for a healthy lifestyle, as well as information on blood glucose levels and their control [10-12, 15, 17, 18, 20, 22]. They are effective in improving diabetes management, gestational weight control, anxiety, depression, and maternal healthcare, among others. However, it is worth noting that the use of these apps is primarily found in high-income countries, which corroborates the need for commitment from middle- and low-income countries also to utilize them[26].

Mobile health apps have transformed the way patients engage in their care, increasing their interest in managing their health conditions. This revolution has also transformed the way healthcare is delivered, as it can also serve as a source of knowledge for professionals [27]. In the field of nursing, apps have been utilized to enhance learning, improve clinical practice, and streamline the patient care process[28].

The ease of self-monitoring, recording information, and providing *feedback* was also highlighted as a beneficial aspect of mobile health-based interventions by women with GDM, due to their ability to reduce the need for hospital travel and promote a sense of

empowerment and self-management[29]. Among the technologies found, the following applications offer these functions: Pregnant+[10-12], Glucose Buddy[18], SineDie [20], DiaMonD[22] (transfer of blood glucose values and feedback), Prototype mobile application [15] (transfer of blood glucose values, weight, and physical activity), Dnurse[17] (transfer of blood glucose values), Habits-GDM[20] (transfer of blood glucose values, weight, physical activity, and diet), and myfood24[17] (transfer of 24-hour food intake).

Educational films are a valuable tool for screening GDM. Their educational interventions aim to strengthen the self-management skills of pregnant women diagnosed with GDM, helping them to acquire the skills necessary to overcome the diagnosis and improper treatment due to a lack of knowledge[13]. They are also effective in reducing anxiety and improving glycemic control in women newly diagnosed with GDM, thereby empowering them and reducing uncertainty and vulnerability[16].

The educational films found with the benefits and purposes mentioned above had varied content: A2[13] (basic physiology, lifestyle, self-management, and problem solving), A5[16] (knowledge about GDM, self-monitoring, insulin administration, body mass index calculation, and diet), A8[19] (self-monitoring, insulin administration, exercise, stress management, and relaxation).

Film-based interventions are associated with improved knowledge in the short term and, in some cases, are even considered superior to the use of printed materials, being seen as a complementary alternative to face-to-face counseling[30].

Digital health through web portals offers security and access at the convenience of users, and after a cost-effectiveness analysis, satisfactory results and costs were also observed[31]. These addressed different topics: A3[14] (knowledge about GDM, diet, and exercise), A8[19] (blood glucose management, exercise, weight assessment, and relaxation), and A11[21] (diet, lifestyle, emotions, and blood glucose management).

Websites are essential for the HL of women with GDM, as they can improve health management and maternal and child outcomes. However, they must be culturally adapted and evaluated for digital literacy to achieve their objective[20] fully.

Technologies with an emphasis on educating pregnant women are a valuable source of information, increasing knowledge about health recommendations and potential challenges. An observational study of 1,920 participants compared the use of a prenatal course app, its completion and non-completion, and suggested that pregnant women who completed the course were 30% less likely to develop GDM, in addition to a reduced risk of fetal distress, abortion, and puerperal infection[32].

The technologies were developed by specialists[10-12, 14], through literature reviews[10-12], systematic reviews[19], the use of guidelines and/or manuals[10-16, 19], a web-based model[12, 20], a health belief model[13, 20], interviews with health professionals and pregnant women with and without GDM[13], and focus groups, through local women recounting their experiences[13] and multiethnic and multicultural pregnant women sharing opinions, experiences, and evidence-based content[16].

As evidenced, there are numerous ways to construct TEs, using various methodologies, among which the preponderant use of literature was observed, to obtain some evidence-based information. In line with this, other TEs used with an emphasis on pregnant women (obstetric violence, vaccination, breastfeeding) were developed in the same way[33-35]. Different forms of development consider cultural factors, with this adaptation capable of increasing interaction with the intended audience[36].

Differences and similarities were noted between the forms of technology assessment. The division between intervention and control groups was used in most studies A2, A3, A5, A6 (Dnurse application), A7, A8, A9 (Habits-GDM application), A10, A11, and A12. A proprietary questionnaire (A5), standardized questionnaire (A5, A12), based on a specific scale (A8, A11), a usability scale (myfood24 application), monitoring of pregnant women (SineDie application), a semi-structured questionnaire (A1), and a questionnaire to assess health literacy and overall satisfaction with the technological solution (A12).

Several studies also employ control group interventions due to their effectiveness in comparing the performance and perceptions of groups that use the technologies, allowing researchers to observe the relationship between the results and the intervention or other factors. It also contributes to a better understanding of self-care and empowerment practices[37].

One limitation is the scarcity of studies that validate these TEs and games with the defined characteristics, which makes it impossible to analyse these issues. They suggest that future studies should be carried out as something to potentially consider.

CONCLUSION

It is noteworthy that none of the articles found provide detailed validation of the presented technology, whether in terms of appearance, relevance, or content. However, the effectiveness of most of them was part of the evaluation presented. This study identified TEs in the form of mobile health applications, educational films, and web-based interventions (websites), which corroborated the literacy of pregnant women with GDM.

These TEs were developed in different ways and with other agents (specialists, target audience, literature search), in some cases considering cultural issues, which are of paramount importance for the use of this TE by the society for which it is intended. Regarding the evaluation process, effectiveness was the most frequently presented, while validation was not described in detail.

LTs based on literacy for pregnant women are used as a means of controlling GDM, enabling assertive choices that result in a pregnancy with fewer risks. Such instruments were used in longitudinal care to cover diagnosis, monitoring, and health promotion, emerging as a tangible possibility to raise individuals' awareness of their shared responsibility, promoting empowerment, which in turn results in autonomy —a key factor in GDM management.

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