

EDUCATIONAL TECHNOLOGIES DEVELOPED BY NURSES FOR TYPE 1 DIABETES IN CHILDREN: AN INTEGRATIVE REVIEW

TECNOLOGIAS EDUCACIONAIS ELABORADAS POR ENFERMEIROS PARA DIABETES TIPO 1 EM CRIANÇAS: REVISÃO INTEGRATIVA

TECNOLOGÍAS EDUCATIVAS DESARROLLADAS POR ENFERMEROS PARA LA DIABETES TIPO 1 EN NIÑOS: UNA REVISIÓN INTEGRADORA

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Objective: Aim: to identify the educational technologies developed by nurses for the health education of children with type 1 Diabetes Mellitus in the scientific literature. **Method:** integrative review, which analyzed national and international articles indexed in the databases available at the *Medical Literature Analysis and Retrieval System Online* via the *National Library of Medicine – National Institutes of Health*, *Biblioteca Virtual em Saúde* and *Cumulative Index to Nursing and Allied Health Literature*. **Results:** the study included 12 publications, highlighting educational technologies, such as Comic books, Therapeutic toys, Workshops, Videos, Booklets, Simulations, Video games, Skill checklists, Skill training, Intensive coaching and Educational applications. **Final considerations:** the scientific evidence revealed that the educational technologies identified in the health education process promote playful and interactive learning, developing skills and competencies so that children and their families can assume diabetes care effectively.

Descriptors: Child. Nursing. Health Education. Educational Technology. Diabetes Mellitus, Type 1.

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Objetivo: identificar, na literatura científica, as tecnologias educacionais elaboradas por enfermeiros para a educação em saúde da criança com Diabetes Mellitus tipo 1. Método: revisão integrativa, que analisou artigos nacionais e internacionais indexados nas bases de dados disponíveis na Medical Literature Analysis and Retrieval System Online via National Library of Medicine National Institutes of Health, Biblioteca Virtual em Saúde e Cumulative Index to Nursing and Allied Health Literature. Resultados: o estudo incluiu 12 publicações, destacando tecnologias educacionais, como História em quadrinhos, Brinquedo terapêutico, Oficinas, Vídeos, Cartilhas, Simulação, Videogame, Checklist de habilidades, Treinamento de habilidades, Coaching intensivo e Aplicativo educacional. Considerações finais: as evidências científicas revelaram que as tecnologias educacionais identificadas no processo de educação em saúde promovem um aprendizado lúdico e interativo, desenvolvendo habilidades e competências, para que as crianças e família assumam o cuidado do diabetes de maneira eficaz.

Descritores: Criança. Enfermagem. Educação em Saúde. Tecnologia Educacional. Diabetes Mellitus Tipo 1.

Objetivo: identificar, en la literatura científica, las tecnologías educativas desarrolladas por enfermeros para la educación en salud de niños con Diabetes Mellitus tipo 1. Método: revisión integradora, que analizó artículos nacionales e internacionales indexados en las bases de datos disponibles en Medical Literature Analysis and Retrieval System Online via the National Library of Medicine – National Institutes of Health, Biblioteca Virtual em Saúde and Cumulative Index to Nursing and Allied Health Literature. Resultados: el estudio incluyó 12 publicaciones, subrayando tecnologías educativas como Cómics, Juguetes terapéuticos, Talleres, Vídeos, Cartillas, Simulaciones, Videojuegos, Listas de control de habilidades, Entrenamiento de habilidades, Coaching intensivo y Aplicaciones educativas. Consideraciones finales: la evidencia científica reveló que las tecnologías educativas identificadas en el proceso de educación para la salud promueven el aprendizaje lúdico e interactivo, desarrollando habilidades y competencias para que los niños y sus familias puedan asumir eficazmente el cuidado de la diabetes.

Descriptores: Niño. Enfermería. Educación en Salud. Tecnología Educacional. Diabetes Mellitus Tipo 1.

Introduction

Type 1 Diabetes Mellitus (T1DM) is a chronic disease defined by progressive insulin insufficiency, consisting of the partial or total destruction of β cells in the pancreatic islets of Langerhans⁽¹⁾. The causes of this destructive process are not fully understood, and there may be a combination of genetic and environmental factors to trigger the autoimmune reaction⁽²⁾.

T1DM has a high prevalence among children and adolescents, with more than 600 thousand cases worldwide, in the age group of 0 to 14 years old⁽²⁾. In Brazil, in 2021, the prevalence of T1DM in this same age group accounted for 51 thousand cases, highlighting the country in 3rd place in the world ranking⁽²⁾. The incidence of T1DM has been increasing in the last few decades, showing an overall increase of 3% per year, particularly among children under 5 years of age⁽¹⁾.

Living with T1DM is a challenge for the child and the whole family because, in addition to the multiple daily insulin injections and glucose monitoring, there is a risk of acute complications,

such as hypoglycemia, diabetic ketoacidosis and suboptimal metabolic control, which can lead to poor growth and early onset of circulatory complications⁽²⁾. Experiencing a chronic disease in childhood generates feelings of fear and insecurity in the family, mainly due to the difficulty in dealing with the unpredictable situations that this new condition can entail⁽³⁾. In this sense, care is prolonged, requiring permanent care actions in relation to treatment and factors that may aggravate the health condition of the child⁽³⁾.

The family often adjusts its activities to maximize the well-being of the child with diabetes, which favors the treatment and monitoring of the chronic disease⁽⁴⁾. The treatment of diabetes requires family members, especially those who assume responsibility for care, to acquire specific knowledge about the composition of food, signs and symptoms of hypoglycemia and hyperglycemia, as well as training in the preparation and administration of medications⁽⁵⁾. Accordingly, it is essential that nurses include health education actions in their professional practice, in order to

provide the family with an adequate preparation to carry out these activities⁽⁶⁾.

Nurses, when developing educational activities about diabetes, should focus their actions on the needs of children and their families, helping them to live with the chronic condition, providing knowledge about the disease, treatment, risk factors and complications, and, mainly, developing skills so that the family can assume care management. When mediated by educational technologies (ET), health education actions make the teaching and learning process more dynamic and collaborative⁽⁷⁾, favoring learning.

In the context of T1DM, different ET can support the educational actions of health professionals, facilitating the learning and adherence of these individuals, minimizing the existing difficulties in relation to the understanding of care⁽⁸⁾. Accordingly, nurses, as agents of the health education process, develop educational technologies that support their care and educational actions, especially in the context of diabetes, seeking to facilitate the promotion of knowledge to children and their families so that they develop competencies and skills that make them able to assume care management.

Educational technologies are products that arise from materialized processes, produced through experience and research⁽⁹⁾. They may be not very scientifically disseminated, remaining accessible only at the local level, usually where the studies were held, which limits the possibility of benefiting a greater number of people. Therefore, it is crucial to make these educational support tools widely known and reaffirm their importance.

Thus, there is a need to know the ET developed and applied by nurses in the educational processes of children with T1DM and their families so that these methodologies can be introduced, multiplied and used by professionals who work in the care of this population as a facilitating instrument for teaching and learning. In light of the foregoing, this study aims to identify the educational technologies developed by nurses for the health education of children with T1DM in the scientific literature.

Method

This is an integrative literature review, consisting of six steps: definition of the research question; sampling in the literature; categorization of the studies; evaluation of the included studies; interpretation of the results; and presentation of the integrative review⁽¹⁰⁾.

In the first step, the guiding question was defined: *What educational technologies have been developed by nurses for the health education of children with T1DM?* The PICo strategy, an acronym for population (P), the phenomenon of interest (I) and context (Co), was used here⁽¹¹⁾. Accordingly, the following were defined: P – Child/Nursing; I – Health Education/Educational Technology; and Co – T1DM.

In the second step, literature sampling was established, where searches were carried out in databases available in the *Medical Literature Analysis and Retrieval System Online* (MEDLINE) via the *National Library of Medicine – National Institutes of Health* (PubMed), *Biblioteca Virtual em Saúde* (BVS) and *Cumulative Index to Nursing and Allied Health Literature* (CINAHL). Specific descriptors were used for each Health Sciences database from the VHL, PubMed, DeCS/MeSH and CINAHL *headings*. These descriptors were combined with Boolean AND and OR connectors.

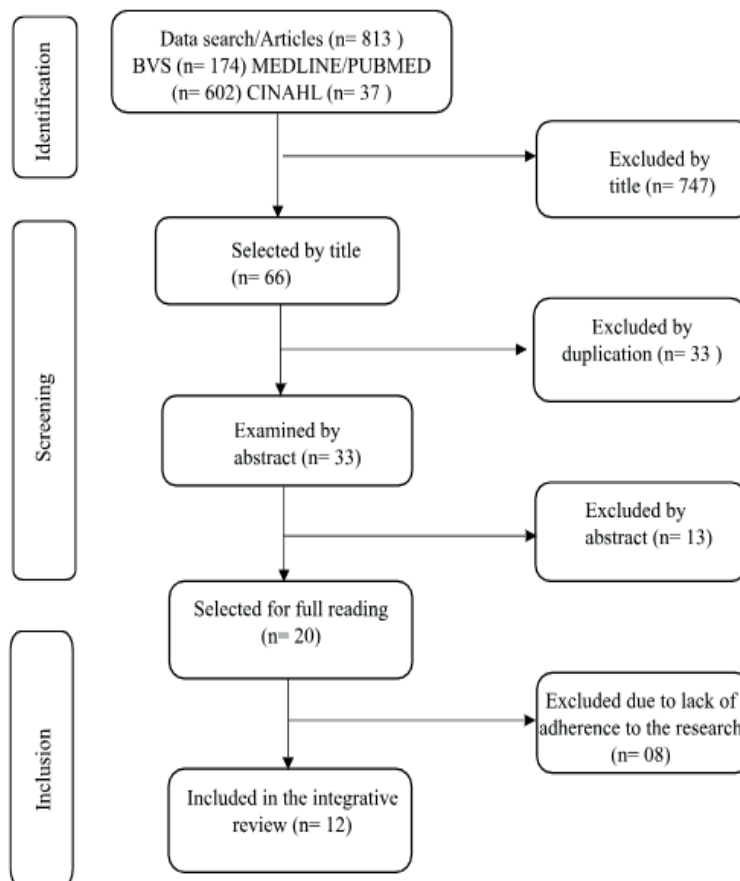
On the BVS portal, the search strategy was: “Criança” OR “Enfermagem” AND “Educação em Saúde” OR “Tecnologia Educacional” AND “Diabetes mellitus tipo 1”. On the PubMed portal, the strategy was used: “Children” OR “Nursing” AND “Educational technology” OR “Health education” AND “Diabetes mellitus, type 1”. In the CINAHL database, the following strategy was used: “Children” OR “Nursing” AND “Educational technology tools” OR “Health education” OR “health promotion” AND “Diabetes mellitus, type 1” OR “type 1 diabetes”. The studies found were exported to an Excel table, in folders for each database. Data collection took place in November 2022, with a time frame from 2017 to 2021, in Portuguese, English and Spanish.

The inclusion criteria for selection were articles available in full for free and that addressed educational technologies developed by nurses

for childhood diabetes in the title, abstract or topic. Articles aimed exclusively at people with type 2 Diabetes Mellitus or adult patients were excluded.

The flowchart below depicts the result of the process of identification, screening and selection of the studies (Figure 1)⁽¹²⁾.

Figure 1 – Informative flowchart of the phases of the integrative review anchored in PRISMA, 2022



Source: Own elaboration

In the third step, categorization of the studies, an instrument was used with the following elements: year of publication, authors, country of origin, study type, evidence level, study aims, educational technology and results. The categorization of the studies was introduced in two summary tables.

In the fourth step, evaluation of the included studies, the classification by evidence level was used, according to the *Agency for Healthcare Research and Quality* (AHRQ), classified into six levels: level 1, evidence resulting from the meta-analysis of multiple controlled and randomized clinical studies; level 2, evidence obtained in individual studies with an experimental design;

level 3, evidence from quasi-experimental studies; level 4, evidence from descriptive studies (non-experimental) or with a qualitative approach; level 5, evidence from experience or case reports; level 6, evidence based on expert opinions⁽¹³⁾.

In the fifth step, interpretation of the results, synthesis and categorization were carried out, according to the ET addressed. The categorization was guided with the purpose of answering the research question and optimizing the step of results discussion.

In the sixth step, presentation of the integrative review, the main points identified in the data analysis were addressed in a descriptive way,

exposing the key points of the studies included in the review and the ET identified, used in the health education process of children with T1DM and their families.

Regarding ethical and legal aspects, it should be underlined that this study was not submitted to the Research Ethics Committee, as its scientific profile (integrative review) does not require ethical evaluation, in accordance with Resolution nº 466/2012. Nevertheless, with regard to the principles of authorship, all literature used to construct the article was duly cited and referenced.

Results

The final sample comprised 12 publications, 7 (58.3%) international journals and 5 (41.7%) national journals. The countries of origin of the publications that made up the sample were: Brazil, seven (58.3%); the United States of America, four (33.4%); and Indonesia, one (8.3%). Regarding

the year of publication, there were: four (33.4%) in 2017, three (25%) in 2018, two (16.7%) in 2019, one (8.3%) in 2020 and two (16.7%) in 2021.

As for the methodological design and evidence level, six qualitative studies with level 4 (50%) were highlighted; three randomized clinical trials with level 1 (25%); two quasi-experimental studies with level 3 (16.7%); and one psychometric study with level 1 (8.3%).

Concerning the age range of the study participants, a predominance of children aged 7 to 12 years was observed in 58% of the articles (A1, A3, A4, A5, A6, A8 and A12) and the remaining studies did not specify age, using the terms *children*, *adolescents*, *parents* and *caregivers*.

Tables 1 and 2, below, display the characterization of the studies included in this review, allowing the evidence found to be described and, subsequently, grouped into categories, according to the type of ET found.

Table 1 – Characterization of the studies according to title, authors, year, country, study type and classification according to the evidence level, 2022

Code	Title	Author/Year/Country	Study design/ evidence level
A1 ⁽¹⁴⁾	Conceptual framework for designing video games for children with type 1 diabetes	Sparapani VC, Fels S, Kamal N, Nascimento LC (2019) Brazil	Methodological research Level 4 (continued)
A2 ⁽¹⁵⁾	Avaliação de tecnologia educativa para crianças com diabetes: estudo metodológico	Ribeiro ALT, Araújo EF, Pinho IVOS, Melo MC, Martins RGG, Lara CCQ (2021) Brazil	Methodological study Level 4
A3 ⁽¹⁶⁾	Brinquedo terapêutico instrucional no cuidado cultural da criança com diabetes tipo 1	Santos PVP, Oliveira QMV, Gomes ILV, Rocha MFF (2018) Brazil	Qualitative study Level 4
A4 ⁽¹⁷⁾	Oficina educativa baseada em atividades lúdicas melhora o automonitoramento glicêmico entre crianças	Kaneto LA, Damião EBC, Verissimo MDLÓR, Rossato LM, Toriyama ATM, Szylyt R (2018) Brazil	Quasi-experimental study Level 3

Table 1 – Characterization of the studies according to title, authors, year, country, study type and classification according to the evidence level, 2022 (continued)

Code	Title	Author/Year/Country	Study design/ evidence level
A5 ⁽¹⁸⁾	A Preliminary Study on “PRISMA” Education in Improving Self-Management and Level of Compliance in Children with Type-1 Diabetes Mellitus	Priska E, Agustini N, Allenidekania, Rustina Y (2019) Indonesia	Quasi-experimental study Level 3
A6 ⁽¹⁹⁾	Construção de cartilha sobre insulinoaterapia para crianças com diabetes mellitus tipo 1	Moura DJM, Moura NS, Menezes LCG, Barros AA, Guedes MVC (2017) Brazil	Methodological study Level 4
A7 ⁽²⁰⁾	CDE Perspectives of Providing New-Onset Type 1 Diabetes Education Using Formal Vignettes and Simulation	Ramchandani N, Johnson K, Cullen K, Hamm T, Bisordi J, Sullivan-Bolyai S (2017) United States of America (USA)	Qualitative descriptive research Level 4
A8 ⁽²¹⁾	Checklists for Assessing Skills of Children With Type 1 Diabetes on Insulin Injection Technique	Ortiz La Banca R, Rebutini F, Alvarenga WA, de Carvalho EC, Lopes M, Milaszewski K, Nascimento LC (2021) United States of America (USA)	Psychometric study Level 1
A9 ⁽²²⁾	Uma maneira divertida de aprender sobre diabetes: usando brincadeiras terapêuticas em um acampamento brasileiro	La Banca RO, Brandão MCM, Sparapani VC, Souza NS, Neves ET, Cavicchioli MGS, et al (2020) Brazil	Qualitative descriptive research Level 4
A10 ⁽²³⁾	Home-based vs inpatient education for children newly diagnosed with type 1 diabetes	Clapin H, Hop L, Ritchie E, Jayabalan R, Evans M, Browne-Cooper K, et al (2017) United States of America (USA)	Randomized controlled clinical trial Level 1
A11 ⁽²⁴⁾	A structured 1-year education program for children with newly diagnosed type 1 diabetes improves early glycemic control	Hawkes CP, Willi SM, Murphy KM (2017) United States of America (USA)	Randomized controlled clinical trial Level 1

Table 1 – Characterization of the studies according to title, authors, year, country, study type and classification according to the evidence level, 2022 (conclusion)

Code	Title	Author/Year/Country	Study design/ evidence level
A12 ⁽²⁵⁾	New-Onset Diabetes Educator to Educate Children and Their Caregivers About Diabetes at the Time of Diagnosis: Usability Study	Bernier A, Fedele D, Guo Y, Chavez S, Smith MD, Warnick J, et al (2018) United States of America (USA)	Pragmatic parallel randomized clinical trial Level 1

Source: Own elaboration

Table 2 – Characterization of the studies according to study aim, educational technology and result, 2022 (continued)

Code	Study aim	Educational technology	Result
A1 ⁽¹⁴⁾	To introduce a conceptual theoretical framework for the development of video games for children with DM1.	Conceptual framework for video games	The conceptual framework proposed a video game with six phases, each addressing a stage of behavioral change and aligned with ^(continued) and preferences of the participating children.
A2 ⁽¹⁵⁾	To describe the process of developing and validating educational technology to promote the care of children with diabetes.	Comic book	The comic was created with the help of a graphic designer, based on the demands of the situational diagnosis and the literature review, validated by experts.
A3 ⁽¹⁶⁾	To analyze the experience of children with type 1 diabetes in the techniques of glycemic monitoring and insulin application mediated by therapeutic toys.	Instructional therapeutic toy (rag doll)	The children expressed doubts about insulin therapy and checking their blood glucose. They showed interest in the therapeutic toy-mediated guidance and asked questions about insulin rotation, location and administration.
A4 ⁽¹⁷⁾	To evaluate the efficacy of an educational workshop based on fun activities to improve the glycemic self-monitoring technique of children with type 1 diabetes.	Educational workshop	Greater frequency was observed in self-monitoring of blood glucose, changing the lancet, alternating puncture sites, calibration and checking the date and time of the monitor. Pre- and post-intervention comparisons showed that the steps were compliant and showed significant improvement.
A5 ⁽¹⁸⁾	To determine the effect of PRISMA education on self-management and the level of adherence in children with T1DM.	Animated videos	There was an improvement in self-management after the PRISMA education. Nevertheless, there was a need for more in-depth explanation so that the children could better understand the material provided.

Table 2 – Characterization of the studies according to study aim, educational technology and result, 2022

(conclusion)

Code	Study aim	Educational technology	Result
A6 ⁽¹⁹⁾	To describe the process of creating an educational booklet on insulin therapy for children with T1DM.	Educational booklet	Production of the educational booklet with the active participation of the children and guided by the theoretical framework of Piagetian Constructivism.
A7 ⁽²⁰⁾	To describe the perspectives on the education of parents of newly diagnosed children, training diabetes management skills through simulation.	Educational patient simulator	Simulation education was effective in the teaching-learning process of family members about type 1 diabetes, compared to other teaching strategies, especially for those with more difficulties.
A8 ⁽²¹⁾	To evaluate the evidence of content validity in two checklists on injection technique performed by children.	Checklist for assessing the skills on the part of the child to administer insulin	The checklists showed the order of the technique and steps for injecting insulin and allowed the children's skills to be quantified.
A9 ⁽²²⁾	To describe how Playgroup Sessions (PS) carried out by nurses in a Brazilian camp can improve young people's understanding of T1DM.	Instructional therapeutic toy	Group activities for children and adolescents with PS, providing knowledge of diabetes and promoting dialog between campers and research nurses.
A10 ⁽²³⁾	To compare the inpatient care model with a hybrid in-home model, examining medical and psychosocial outcomes, knowledge of diabetes and length of stay.	Practical skill training	Children with a recent diagnosis received diabetes education at home and the control group remained hospitalized. There was no difference in outcomes or diabetes knowledge, but the average length of re-hospitalization was lower in the intervention group.
A11 ⁽²⁴⁾	To determine the effect of this program on glycated hemoglobin (HbA1c) and how this effect is mitigated by socioeconomic status.	Educational program with intensive coaching	HbA1c was significantly lower in the intervention group at 6, 12 and 18 months, but not at 24 months after diagnosis. This effect was not observed in the control group.
A12 ⁽²⁵⁾	To introduce and evaluate the usability and efficacy of an animated educational application designed to complement diabetes care among children newly diagnosed with T1DM and their parent caregivers.	Educational application (NODE)	The intervention group demonstrated greater knowledge acquisition than the control group; however, this additional knowledge gain was not statistically significant.

Source: Own elaboration

The evidence found in the publications was categorized according to the type of ET found: digital educational technologies, printed educational technologies and educational technologies programs and training.

Digital educational technologies

In this category, three (25%) digital educational technologies (A1, A5 and A12)^(14,18,25) were grouped, which are described as follows:

The animated videos (A5)¹⁸ are part of an educational tool called PRISMA education. Its use made it easier for the children to understand the materials and repeat the lessons they had not previously understood. In addition, the children were more interested and motivated to learn because they enjoyed the visualization of animated images in the video. Consequently, there was an improvement in self-management, reaffirming that education on diabetes control influences the self-management level and treatment adherence of the patient.

The conceptual framework for video games (A1)¹⁴ was developed to design video games for children with T1DM, considering the theories of behavioral change in health and the needs and preferences identified by the participating children. By playing a video game that incorporates all of the steps outlined in this conceptual framework, children received interventions tailored to their needs at different levels. This increased the likelihood of reaching a greater number of children in a variety of situations.

The educational application (A12)²⁵ addresses basic diabetes self-management topics, such as: what is diabetes, glucose monitoring, insulin, hypoglycemia, hyperglycemia, nutrition, exercise and diabetes and personal management plan. It was considered a viable intervention to promote the acquisition and retention of knowledge about diabetes for family members and children with a recent diagnosis, and it can be easily used at home after hospital discharge. It was emphasized that the tool should be used in association with the standard treatment provided by health professionals, and not replace it.

Printed educational technologies

In this category, three (25%) printed educational technologies (A2, A6 and A8)^(15,19,21) were grouped, introduced descriptively as follows:

The comic book (A2)¹⁵ was based on the theoretical framework of Piagetian Constructivism, using a playful and comprehensive approach, aiming to be useful and easy to apply to children with T1DM and, thus, facilitate adherence to their self-care practices. In addition to contributing to diabetes education in children and adolescents, it is intended to cooperate with the work process held by nurses, collaborating for the adequate management of T1DM.

The educational booklet (A6)¹⁹ was designed based on the active participation of children with T1DM and on the theoretical framework of Piagetian Constructivism, which describes the phases of cognitive development. This perspective of knowledge construction aims to provide active and interactive reading. Accordingly, the booklet introduces games, riddles and collages. This type of technology found works as a support for professionals, children and families so that they can overcome doubts and difficulties, in such a way as to act positively in the health-disease process.

Checklist for assessing skills (A8)²¹, developed for use by health professionals that, through direct observation of the procedure, aims to measure the skills of children with T1DM during an insulin injection, enabling the continuous evaluation of the progress of pediatric patients until they achieve independence in diabetes self-care. This type of instrument is used when the order of the steps is important for the execution of a task and does not allow the substitution of one step for another.

Educational technologies programs and training

In this category, six (50%) educational technologies of programs and training (A3, A4, A7, A9, A10 and A11)^(16-17, 20, 22-24) developed by nurses in health education actions were grouped, which are described as follows:

Instructional therapeutic toy/rag doll (A3)¹⁶ was used as a teaching and guidance strategy during outpatient care for children with T1DM, considering the act of playing during care. The rag doll made it possible to identify the sites of insulin application, as well as lipodystrophy related to inadequate or absent rotation. This activity promoted approximation and effective communication with the child in the educational approach, improving his/her coexistence with insulin therapy and glycemic monitoring procedures and, thus, increasing his/her skills in terms of self-care.

Educational workshop (A4)¹⁷ carried out with school-age children with T1DM, at the hospital outpatient clinic, aiming to improve self-monitoring of blood glucose (SMBG). Each child participated in a single session. Four stations were created with activities, with storytelling and puzzles, a bingo game, a memory game and a board game. All activities contained questions related to the practice of SMBG, for example: *What should be done before pricking a finger?* and *What is the name of the device used to measure blood glucose?* The educational workshop proved to be effective in improving the practice of SMBG in children.

Educational patient simulator (A7)²⁰ was carried out with the training of parents or guardians of children with newly diagnosed T1DM on hypoglycemia, hyperglycemia and diabetes management, using a patient simulator dummy, associated with formal diabetes education; and compared to a control group of caregivers who received only formal education. The patient simulator made the process interactive and individualized, as caregivers were not only listening, but participating and thinking.

An instructional therapeutic toy with theater, figures and drawings (A9)²² was developed in a diabetes camp in Brazil, with children and adolescents (9-17 years old). The group discussions fostered confidence for the campers to share experiences with the nurses and peers, allowing the young people to learn in a fun way about diabetes.

Concerning the practical skill training (A10)²³, the study addressed and compared the hospital

care model with a hybrid home-based alternative. There was no difference in medical outcomes or knowledge about diabetes. Nevertheless, the average time of readmission was shorter for the intervention group. Accordingly, with appropriate support, children newly diagnosed with T1DM could be safely treated at home after practical skill training.

An educational program with coaching (A11)²⁴ was developed during the first year after diagnosis, with the aim of supporting families as their understanding of this chronic disease and its management evolved. The study suggested that additional structured education and support in the first year of diagnosis may improve short-term outcomes in children with T1DM, but this effect may not persist after discontinuation of intensive training.

Discussion

This review made it possible to identify 12 ET designed for the education of children with T1DM and their families. The theme of ET focuses mainly on monitoring of blood glucose, insulin application, resolution of problems related to acute complications and healthy lifestyle habits, such as a balanced diet and physical exercise. This data corroborates other studies that indicate that the health education process should stimulate self-care, changes in habits, thus enhancing the autonomy of the subjects and enabling better therapeutic adherence, especially in the case of people with chronic diseases⁽²⁶⁾.

The results showed that the technologies used in health education in the context of childhood diabetes, regardless of the type, aim at the knowledge and development of skills of the children and their families, with the consequent development of the autonomy of children, who will become responsible for their self-care. These results cooperate with the current production of educational technologies aimed at children with chronic diseases and their families, which usually involve computers, media or audiovisual material, booklets, manuals, children's stories and educational games⁽²⁾.

In this research, as well as in another study⁽²⁷⁾, it was possible to show that digital educational technologies, such as animated videos⁽¹⁷⁾, video games⁽¹⁶⁾ and educational applications⁽²⁴⁾, play an important role in the management of T1DM, as they promote knowledge, stimulate self-care and improve children's quality of life.

Digital ET are effective in acquiring knowledge about themselves and about the context in which they are inserted, which makes children able to understand how their own actions influence their health pattern and exert changes in these environments and in their own behaviors⁽²⁸⁾. An advantage is the fact that this type of ET found brings together visual and auditory resources, which encourage the individual's participation in health education actions, facilitating learning. On the other hand, it has limitations when considering that access to the internet or even to digital devices is not unrestricted to the entire population⁽²⁸⁾.

Concerning printed educational technologies, addressed in three studies of the review (A2, A6 and A8)^(15,19,21), authors emphasize the importance of a participatory approach in the development of these ET, with a view to addressing the difficulties reported for the construction of new knowledge. The written material reinforces the oral information already received and produces meanings for the users, contributing to behavioral changes⁽²⁹⁾. Therefore, printed educational materials are easy to view and use, offering support to children with chronic diseases and their families, especially in home care, where there are no health professionals to provide support⁽³⁰⁾. Considering the issue of internet accessibility, printed ET are a relevant option, given their ease of access.

Educational technologies, such as programs and training, group the Therapeutic Toys^(16,22), Educational Workshop⁽¹⁷⁾, Patient Simulator⁽²⁰⁾, Practical Skill Training⁽²³⁾ and Educational Program with Coaching⁽²⁴⁾. These studies condense health education actions developed by nurses with children with T1DM and/or their families, proposing the acquisition of knowledge and practical skills essential to the care of children with T1DM.

By using ET in diabetes education actions with children and their families, it is intended to promote the solidification of the knowledge offered, reduce existing doubts and favor the appropriation of information transmitted by educators⁽³¹⁾. As an example, there is the Therapeutic Toy, since a study developed in Brazil⁽³²⁾ highlighted that this type of approach expands knowledge about the disease and facilitates the practical training of essential skills for diabetes care, such as glycemic monitoring and insulin application, because the playful-therapeutic intervention promotes the exchange of experiences between children and health professionals.

After a child has been diagnosed with T1DM, the family should be prepared by the health team to manage the current condition, seeking to promote a good understanding of the interactions among diet, physical activity and insulin administration. The use of educational technologies increases the training of family members and caregivers for the proper management of the disease and enhances the self-care of children with T1DM, according to their intellectual level, making this process more effective⁽³³⁾.

Another important point to be considered in the educational technologies and teaching methodologies used for diabetes education during childhood is the age range of the children. In this sense, when intended for children up to 2 years of age, those responsible assume the total management of diabetes and count only on the cooperation of children; from 3 to 5 years of age, caregivers are in charge of the total management of diabetes and rarely is given responsibility to children; from 6 to 12 years old, more responsibility is given to children, always counting on the supervision of those responsible, such as carbohydrate counting, checking blood glucose for exercise, among others⁽³⁴⁾. The family trained for the proper management of diabetes care will effectively contribute to the learning and self-care performance of the child⁽³⁴⁾. Therefore, the fact that the ET introduced in this review are mostly applied to the age group of 7 to 12 years

is justified, due to the higher probability of self-care of T1DM.

Experts from the American Diabetes Association propose a division of priorities in the management of T1DM, according to the stage of development of children, which indicates school age as an opportune phase to stimulate cognitive skills. The child can be the protagonist of his/her self-care to the extent that he/she demonstrates maturity and skills to develop a certain task and take responsibility for it⁽³⁵⁾. The process should be started from the moment the child begins to develop his/her skills and self-efficacy for the diabetes self-care plan, respecting the uniqueness of each situation⁽³⁶⁾.

Children with T1DM demand the acquisition of new skills, knowledge and behavioral changes⁽³³⁾. On a daily basis, children and families are presented with numerous challenges to adapt to the current reality and therapeutic regimen, such as periodic examinations and consultations, multiple daily insulin injections, glycemic monitoring, healthy eating habits, the need for regular physical activity, fear of complications from hyperglycemia or hypoglycemia, as well as the growing responsibility for self-care⁽³⁷⁾.

Obtaining knowledge about diabetes and specific skills by family members facilitates adherence to treatment and acceptance of the changes generated and required by the chronic disease of the child, since, with a better understanding of the disease, treatment can become more effective and it will then be easier to live constructively with the disease⁽³⁸⁾.

The results obtained with this study corroborate the importance of access to information for children and families from the diagnosis of T1DM, aiming to construct knowledge about the health-disease process. In this sense, in order to promote health education effectively, it is essential that professionals dedicate themselves to investigating and adopting new ET, as these tools play a crucial role in facilitating access to relevant information about health care, especially in the context of T1DM⁽³⁹⁾. Making use of an ET as a teaching tool from the moment of diagnosis ensures the active participation of

these individuals and the improvement of care⁽⁴⁰⁾. Knowledge provides the training of these families, enabling them to assume care; and, for children, little by little, to achieve the independence and autonomy required for self-care⁽⁴¹⁾.

This review identified as a limitation the restricted number of studies related to the study aim, hindering a broader analysis of the theme.

Regarding the implications for nursing practice, this review provides a synthesis of the ET described in the pertinent literature, which can be replicated, adapted and used by nurses in their health education interventions aimed at children with diabetes and their families.

Final considerations

The evidence in the scientific databases revealed that the main ET identified in the health education process of children with T1DM and their families were: Comic book, Therapeutic toy, Educational workshop, Animated videos, Educational booklet, Simulation with mannequin, Conceptual framework for video games, Checklist for assessing skills, Practical skill training, Intensive coaching and Educational application. These tools are useful for many aspects of diabetes management.

Health actions supported by ET promote the development of self-care and family support required for the management of T1DM, as they facilitate knowledge about the disease and the entire context that surrounds it. Accordingly, ET are strategic tools that can be used by health professionals in different contexts and environments. They provide knowledge about the health-disease process and promote playful and interactive learning, developing skills and competencies for children and families to assume diabetes care effectively.

Collaborations:

- 1 – Conception and planning of the project: Patricia Carli Morgado and Liliane Faria da Silva;
- 2 – Analysis and interpretation of the data: Patricia Carli Morgado, Liliane Faria da Silva,

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3 – Writing and/or critical review: Patricia Carli Morgado, Liliane Faria da Silva and Rosane Cordeiro Burla de Aguiar;

4 – Approval of the final version: Patricia Carli Morgado, Liliane Faria da Silva and Rosane Cordeiro Burla de Aguiar.

Conflicts of interest

There are no conflicts of interest.

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