Use of diabetes technologies in the primary school environment: a scoping review protocol

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ABSTRACT

Objective: The objective of this scoping review is to map the literature on the use of diabetes technologies in the primary school environment by children with type 1 diabetes (T1D) and/or their parents.

Introduction: T1D is a complex chronic disorder that is one of the fastest growing diseases in childhood. Technological advances in recent times have seen a growth in the use of diabetes technologies. Despite these advances, having T1D still places challenges on parents' and children's school experiences. Furthermore, the literature on the use of diabetes technologies during the primary school day is under-investigated.

Inclusion criteria: This review will consider peer-reviewed primary research studies or systematic reviews that include children with T1D aged 6 to 12 years who use diabetes technologies in the primary school environment and/or their parents.

Methods: This review will be conducted in accordance with JBI methodology for scoping reviews and will be reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. Following an initial limited search, a full search strategy was developed using index terms and key text words. This strategy will be used across relevant databases, including Embase, MEDLINE (Ovid), CINAHL (EBSCOhost), and Web of Science Core Collection for the full scoping review. There will be no limitations on language or year. Two reviewers will independently screen titles, abstracts, and full-text articles and extract relevant data using the JBI data extraction instrument. Data will be presented in a descriptive manner, supported by tables and charts, and accompanied by a narrative summary.

Keywords: child; diabetes technology; parents; primary school; type 1 diabetes

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Introduction

Type 1 diabetes mellitus (T1D) is a complex chronic autoimmune disorder that leads to elevated blood glucose levels and disturbances in carbohydrate, fat, and protein metabolism.[1] Successful daily management is essential to prevent significant acute life-threatening events as well as other short- and long-term micro/macrovascular complications.[2] T1D is also one of the most common and fastest growing chronic health conditions in childhood, with more than 1.2 million children and adolescents with T1D globally, and over half of these (54%) are under the age of 15 years.[3]

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Diabetes management includes life-long daily interventions to achieve optimum glycemic control, including blood glucose monitoring, administration of insulin, adjustments to carbohydrate or insulin intake for physical activity, and management of hypoglycemic and hyperglycemic events.[4] The fundamentals of T1D management have remained unchanged since the discovery of insulin in the 1920s.[5] However, in recent times, the use of advanced technology has become an integral part of T1D management,[6] resulting in a technological revolution in the routine use of advanced diabetes technologies in children.[7] There is also clear evidence to support their use in children, with benefits including effective glycemic control, increased quality of life, and the prevention of associated complications.[8] Additionally, further significant technological growth is likely in

the years ahead,[8] with as many technological advances expected in the next 5 years as there have been in the past 5 years.[9]

For the purposes of this scoping review, the term diabetes technology will be used to address the hardware, software, and devices used in the treatment and management of diabetes. This includes the use of continuous subcutaneous insulin infusion devices (CSII); real-time, flash, or continuous glucose monitors (CGMs); and hybrid devices that both monitor glucose and deliver insulin.[10–12] To date, research has been conducted globally, in numerous areas of T1D management; however, despite technology becoming an increasingly essential and beneficial part of T1D disease management in children, a diagnosis of T1D in childhood and having a young child with T1D who is too young to self-care in school, can place challenges on parents and on the children themselves,[12] as disease management can be complex and can vary with age and stage of development.[13] Studies in relation to children having T1D demonstrate that it can affect the child's school experience from an academic, social, and emotional perspective.[14,15]

Parents can find the care practices all-encompassing, relentless, and demanding, with additional challenges to physical, psychological, and emotional well-being reported.[16] Management of T1D remains too complex for young children to undertake independently; therefore, parents invariably take on these responsibilities[17,18] until the children themselves are old enough to self-care.

During the school day, direct parental support is not readily available to children, who still require the support of an adult, such as school staff.[14,18] Optimal outcomes depend on the provision of appropriate supervision and support to facilitate intensive diabetes management during school hours, allowing children to fully participate in all school activities, which represents a major part of a young child's life.[10]

Additionally, the complexity of care in relation to diabetes technologies has increased in both the home and school settings due to the burden of managing the additional equipment, which is always worn on the body.[19] Thus, the integration of the use of diabetes technology into the school setting is essential to ensure effective disease management[20] and to safely meet individualized care needs for long-term well-being and optimal academic performance.[4,18,21]

Studies have demonstrated the benefits of using diabetes technology in the school setting; a study on the impact of real-time CGM use showed that parents, students, and teachers reported an increase in their ease of managing diabetes in the classroom.[11] The use of diabetes technology in the primary school setting from the perspective of parents has revealed that collaborative partnerships between school staff and parents facilitated the use of diabetes technology, such as CSII.[19]

Studies regarding the impact of insulin pump therapy on the lives of young children and their parents showed an overall increase in lifestyle flexibility and greater ability to participate in school activities while maintaining glycemic control.[22] Participants in Hilliard *et al*.'s study reported the benefits of the remote monitoring capability of CGM devices, and how it facilitated constructive interactions between parents and other caregivers, such as the child's school.[23]

A preliminary search of the following databases was conducted in December 2022: CINAHL, Embase, *JBI Evidence Synthesis*, and the Cochrane Database of Systematic Reviews. Two reviews were found. Luo *et al*.[24] conducted a systematic review, synthesizing the experiences and perspectives of parents on the combined use of CSII and real-time CGM to manage T1D in their children. Alvarenga *et al*.[25] carried out a systematic mapping review of the use of CSII in children and adolescents with T1D. These reviews, although relevant to this scoping review from a conceptual perspective, do not specifically examine the use of diabetes technologies in relation to the population (ie, parents and children), or in relation to the context of the primary school setting.

Therefore, the objective of this scoping review is to describe and map the body of literature that exists on the use of diabetes technologies during the primary school day. Specifically, the review will focus on who uses T1D technology, the benefits and challenges of T1D technology. These objectives, in this era of advancing technologies in diabetes management, will detect any gaps in the literature from the perspective of the child and/or their parents. This will inform future research in the areas of diabetes health and school-related service provision, ensuring that it is both relevant and reactive to the needs of young primary school-aged children and their parents.

Review question

What literature exists on the use of diabetes technologies during the primary school day by children aged 6–12 years with T1D and/or their parents?

The review will have a specific focus on the following sub-questions:

i) Who uses T1D technologies?
ii) What types of T1D technologies are used?
iii) What are the benefits and challenges of using T1D technologies?

Inclusion criteria

Participants

This scoping review will consider studies that include children aged between 6 and 12 years who have T1D, who use diabetes technology, and/or parents of children aged between 6 and 12 years who have T1D, who use diabetes technology.

Concept

The core concept to be examined in this scoping review is the use of diabetes technologies. These technologies include CSII devices; real-time, flash, or continuous glucose monitors; and other more advanced emerging technologies, such as hybrid devices that both monitor glucose and deliver insulin.[10–12] Studies that examine who uses T1D technologies, different types of diabetes technologies, and the benefits and challenges of using T1D technology during the primary school day will be included.

Context

This review will consider studies that explore the use of diabetes technologies in the primary school context. Although global standards vary, primary education is normally intended for children aged 6 to 12 years of age, who spend a considerable amount of time in school, typically amounting to 5 to 6 hours per day.[10,21]

Types of sources

This scoping review will consider any peer-reviewed primary research studies or systematic reviews that meet the inclusion criteria. These studies can be qualitative, quantitative, or mixed methods in nature. Unpublished or gray literature will also be considered for inclusion.

Methods

The proposed review will be conducted in accordance with the JBI methodology for scoping reviews[26,27] and in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).[28]

Search strategy

The 3-step search strategy will be used to locate published and unpublished literature, as recommended by JBI.[26,27] The subject librarian at the authors' institution was recruited to assist in the development of the search strategy. Thus, an initial limited search of CINAHL (EBSCOhost) and Embase was conducted in March 2022 to identify relevant literature using the subject heading terms, "Type 1 diabetes," "insulin pump," "insulin technology," "continuous glucose monitor," "child," "parents," and "primary school." Once the initial search was completed, a full search strategy was developed for Embase using index terms and keywords contained in the titles and abstracts of relevant literature (see Appendix I). A second search utilizing all the identified keywords and index terms will be undertaken across all relevant databases, including Embase, MEDLINE, CINAHL, and Web of Science for the full scoping review. Finally, the reference lists of the identified literature will be searched for additional sources. Gray and unpublished literature will be identified through a search of reference lists and key diabetes websites. There will be no language or date limitations. Google Translate will be used to translate the titles and abstracts of non-English articles, and if they are deemed suitable for inclusion, the article will be translated in full using reputable academic translation services.

Study/Source of evidence selection

All studies retrieved from the database searches will be collated and uploaded to EndNote v. 20.4.1. (Clarivate Analytics, PA, USA). Duplicate studies will be removed, and potentially relevant papers will be retrieved in full. Their citation details will be imported into Covidence v. 2.0 (Veritas Health Innovation, Melbourne, Australia) before the screening of titles and abstracts begins. This will be carried out independently by 2 reviewers against the inclusion criteria, and studies that are deemed eligible will be retrieved in full. Pilot testing will be carried out

on a random sample of 25 titles and abstracts.[28] These will be screened by the team against the inclusion criteria. Any discrepancies will be discussed, and modifications will be made to the inclusion criteria if necessary. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer. Reasons for the exclusion of full-text studies will be provided in an appendix. The results of the search will be presented in a PRISMA flow diagram.[29]

Data extraction

The review team will extract data from the relevant literature using questions in the draft data extraction instrument, as per the JBI guidelines[26] (see Appendix II). The extracted data will include details related to the inclusion criteria (participants, concept, and context), the methods used in the studies, and the key findings relevant to the review question. Pilot testing of the data extraction tool will be carried out by 2 members of the team before data extraction begins, as recommended by JBI.[26] Any disagreements will be resolved via discussion or with a third reviewer. The draft data extraction instrument will be revised as necessary during the data extraction process, with the details of any modifications outlined in the full scoping review. Authors of papers will be contacted to request missing or additional data, where required.

Data analysis and presentation

Data will be analyzed and presented in a descriptive manner, with the use of tables and charts, accompanied by a narrative summary. This will ensure that there is a logical and descriptive summary of the results that aligns with the objective of the scoping review.

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Author contributions

TON and EH conceptualized the idea, TON drafted the manuscript and all revisions. EH and SPB-C reviewed the drafts and contributed to the editing of the manuscript.

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Appendix I: Search strategy

Embase

Search conducted on January 17, 2023

#	Query	Results retrieved
S12	S7 AND S11	1043
S11	S8 OR S9 OR S10	610,613
S10	'parent'/exp AND ('child'/exp OR 'primary school'/exp OR 'elementary student'/exp)	159,781
S9	((primary* OR elementary*) NEAR/3 (student* OR child* OR pupil* OR parent* OR mother* OR father* OR school*)):ab,ti	57,143
S8	primary school'/exp OR 'elementary student'/exp OR 'school child'/exp	429,316
S7	S3 AND S6	13,603
S6	S4 OR S5	166,711
S5	brittle diabet*':ab,ti OR 'diabetes mellitus type 1':ab,ti OR 'insulin dependent diabetes mellitus':ab,ti OR 'insulin-dependent diabetes mellitus':ab,ti OR 'juvenile onset diabetes mellitus':ab,ti OR 'diabetes mellitus, type i':ab,ti OR 'diabetes type 1':ab,ti OR 'diabetes type i':ab,ti OR 'juvenile diabet*':ab,ti OR 'juvenile dm 1':ab,ti OR 'early onset diabetes mellitus':ab,ti OR iddm:ab,ti OR 'type 1 diabet*':ab,ti OR 'type i diabet*':ab,ti	114,366
S4	'insulin dependent diabetes mellitus'/exp	139,509
S3	S1 OR S2	38,498
S2	'insulin pump*':ab,ti OR 'continuous subcutaneous insulin*':ab,ti OR 'continuous glucose monitor*':ab,ti OR 'emerging tech*':ab,ti OR 'intermittent glucose monitor*':ab,ti OR 'glucose sensor*':ab,ti OR 'accu chek spirit':ab,ti OR 'd tron':ab,ti OR 'd tronplus':ab,ti OR 'dana diabecare':ab,ti OR 'deltec cozmo':ab,ti OR 'h-tron plus':ab,ti OR 'h tronplus':ab,ti OR 'insulin infusion pump*':ab,ti OR 'insulin infusion system*':ab,ti OR 'la fenice':ab,ti OR 'minimed 508':ab,ti OR 'minimed 530g pump*':ab,ti OR 'minimed paradigm':ab,ti OR 'onetouch ping':ab,ti OR 't:slim x2':ab,ti OR 'v-go':ab,ti OR 'closed-loop glucose control system*' OR 'hybrid closed-loop system*'	34,575
S1	'insulin pump'/exp OR 'continuous glucose monitoring system'/exp	12,470

Appendix II: Data extraction instrument

Scoping review title	Use of diabetes technologies in the primary school environment: A scoping review protocol
Review objectives	To map the literature regarding the use of diabetes technologies in the primary school environment by children with Type 1 Diabetes (T1D) and/or their parents.
Review questions	What literature exists regarding the use of diabetes technologies during the primary school day by children aged 6-12 years with T1D and/or their parents, with specific focus on who uses T1D technologies, the benefits, and challenges of using T1D technologies, and the impact of T1D technology on disease management by children and/or their parents during the primary school day.
Inclusion/exclusion criteria	
Population	Children aged between 6 and 12 years who have T1D, who use diabetes technology. and/or Parents of children aged between 6 and 12 years who have T1D, who use diabetes technology.
Concept	Diabetes technologies
Context	The primary school environment
Evidence sources details and characteristics	
Citation details (eg, author/s, date, title, journal, volume, issue, pages	
Country	
Context	
Participants/population size of sample	
Types of evidence source, research approach/design	
Details/results extracted from source of evidence (in relation to the concept of the scoping review)	
What type of diabetes technologies are being used by children in the primary school environment?	
Who uses type 1 diabetes technologies in the primary school environment?	
What are the benefits of the use of diabetes technologies in the primary school environment?	
What are the challenges of using diabetes technologies in the primary school environment?	
What is the impact of using type 1 diabetes technology on disease management in the primary school environment?	