

What children know about diabetes acute complications? Insights for diabetes education*

O que crianças sabem sobre complicações agudas do diabetes? Insights para educação em diabetes

¿Qué saben los niños sobre complicaciones agudas de diabetes? Perspectivas para la educación diabética

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ABSTRACT

Objective: to identify the knowledge and attitudes of school-aged children with diabetes facing acute complications. **Method:** exploratory study design with a qualitative approach, which used puppets as a data collection strategy. Children aged between seven and 12-years having experience with the disease for at least one year, followed-up at a Childhood Outpatient Clinic from Santa Catarina, Brazil, were interviewed. Analysis followed deductive content analysis. **Results:** participants demonstrated poor management of hyperglycemia episodes which could prevent diabetic ketoacidosis. The knowledge about hypoglycemia is higher due to its frequency; however, it has been the result of a deficient self-care with poor adult supervision. **Conclusions:** lack of understanding and inadequate management was evidenced, in especial, during the hyperglycemia and when the children are away from their parents. The nurses should promote education to immediate actions in acute complications. Educational materials focused on these clientele will contribute to enhance knowledge and abilities.

Descriptors: Diabetes mellitus, type 1; Diabetic ketoacidosis; Hypoglycemia; Pediatric nursing; Qualitative research

RESUMO

Objetivo: identificar conhecimentos e atitudes de crianças escolares com diabetes tipo 1 frente complicações agudas da doença. **Método:** estudo exploratório, qualitativo, que utilizou fantoches como estratégia de coleta de dados. Crianças entre 7 e 12 anos, com pelo menos um ano de diagnóstico, seguidas em ambulatório infantil de Santa Catarina, Brasil, foram entrevistadas. Análise de conteúdo dedutiva foi realizada. **Resultados:** participantes demonstraram pobre conhecimento e manejo dos episódios de hiperglicemia, o que poderia prevenir a cetoacidose diabética. Os conhecimentos sobre hipoglicemia são maiores, pois ocorrem com frequência, porém têm sido resultado de autocuidado deficiente com pobre supervisão de adultos. **Conclusões:** falta de entendimento e manejo inadequado das complicações foi evidenciado, em especial na hiperglicemia e quando longe dos cuidadores. O enfermeiro deve promover educação de crianças e famílias para ações imediatas e

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efetivas perante complicações agudas. Materiais educativos, direcionados a esta clientela, contribuirão para maior conhecimento e desenvolvimento de habilidades.

Descritores: Diabetes mellitus tipo 1; Cetoacidose diabética; Hipoglicemia; Enfermagem pediátrica; Pesquisa qualitativa

RESUMEN

Objetivo: identificar conocimientos y actitudes de escolares con diabetes tipo 1 frente a las complicaciones agudas de la enfermedad. **Método:** estudio cualitativo exploratorio que utilizó títeres y fueron entrevistados niños entre 7 y 12 años, con al menos un año de diagnóstico, en una clínica infantil en Santa Catarina, Brasil. Se realizó un análisis de contenido. **Resultados:** hay escaso conocimiento y manejo de los episodios de hiperglucemia, lo que podría prevenir la cetoacidosis diabética. El conocimiento sobre la hipoglucemia es mayor, ya que ocurre con frecuencia, pero ha sido el resultado de un autocuidado deficiente con una supervisión adulta deficiente. **Conclusiones:** falta comprensión y manejo adecuado de las complicaciones, especialmente en la hiperglucemia y cuando está lejos de los cuidadores. El enfermero debe promover la educación de los niños y las familias para acciones inmediatas y eficaces frente a las complicaciones agudas. Los materiales educativos contribuirán a esto.

Descriptor: Diabetes mellitus tipo 1; Cetoacidosis diabética; Hipoglucemia; Enfermería pediátrica; Investigación cualitativa

INTRODUCTION

Type 1 Diabetes (T1D) is a chronic disease with autoimmune origin combined with nonspecific environmental factors, which results in insulin deficiency and hyperglycemia.¹ It is a most common chronic health condition that affects the pediatric population despite it can occur at any age.¹⁻² There are approximately 1.2 million children and adolescents under 20 years old with T1D worldwide, with approximately 184,100 new cases per year.¹

Changes in glycemic levels, such as hyperglycemia and hypoglycemia can lead to metabolic dysfunctions in children and adolescents, which when uncontrolled lead to health complications with risk of death.³⁻⁴

Hyperglycemia without and with ketones, which can lead to diabetic ketoacidosis (DKA) and hypoglycemia are the main acute complications of T1D.¹ DKA is present in approximately 25% of T1D diagnosis cases and may be the cause of hospital readmissions due to non-adherence to treatment, infections, difficulty in accessing health care services or diabetes technologies and due poorer psychological well-being.⁵

Similarly, hypoglycemia is a scary and troublesome situation, which in its most severe form can lead to seizures, coma and death.⁴ There is three stages of hypoglycemia: clinical hypoglycaemia alert (54-70 mg/dl), clinically important hypoglycaemia (<54 mg/dl) and severe hypoglycaemia (severe cognitive impairment requiring external assistance.⁶ In long-term hypoglycemia, hypoglycemia of repetition, hypoglycemia of late identification and in treatment complications, brain changes can occur such as neurocognitive impairment, memory and concentration difficulties.⁴

The literature considers education as an important factor empowerment for parents as well as for children and adolescents. Although children aged 7-12 can have limited knowledge on the management of hyperglycemia with or without ketones, at this age group child develops physical, cognitive, and social skills, acquire autonomy, and have better relationships with their peers. The educational approach should enable young people to identify symptoms and deal with unforeseen diabetes events.⁷ In this sense, school-aged children should have the opportunity to be educated with parents on at diagnosis and ongoing to progressively take responsibility in

diabetes management over 12 years old, getting knowledge and practical skills in problem solving, self-care and achieve goals.⁸

To add to the existing literature about children's understanding of acute diabetes complications, which in turn expands the possibilities of diabetes education aimed at the pediatric clientele, we conducted a qualitative study that included the following research questions: What do school-aged children with T1D know about hyperglycemia/DKA and hypoglycemia? How do children with T1D manage these acute complications? Our goal was to identify the knowledge and attitudes of school-aged children with T1D facing hyperglycemia/DKA and hypoglycemia.

METHOD

This was an exploratory study, with a qualitative approach, which used puppets as interaction strategy with children to data collection. The main researchers had developed studies using this data strategy, which promoted meaningful interaction with participants.⁹⁻¹⁰ The study was approved by the Institutional Review Board (Human Research Ethics Committee - CEPESH - UFSC) on August 20th, 2018, report n°2.832.041. All parents of study participants provided written informed consent, and children assented their participation.

Participants were recruited from an outpatient pediatric diabetes clinic in Santa Catarina state, located in southern Brazil. We included children aged seven to 12 years with at least 1 year of T1D duration to explore children's knowledge and attitudes in managing T1D acute complications. Those with neurological or language deficits that could interfere with the data collection strategy were not included. All the children have endocrinology follow-up with doctors, but the clinic does not provide multidisciplinary appointments. We used a

convenience sample and collected data from March to August 2019.

The researchers gradually entered the research site and made the first contact with the parents of the potential participants who met the inclusion criteria of the study, inviting them to participate. Parents and children, when accepting to participate in the research, received information about the objectives, method of data collection, possible risks, and benefits of their participation. The researcher offered parents the option to stay with their children during the activity, which took place in the appointment's offices. No guardian remained in the offices. Participants were guaranteed confidentiality and anonymity and asked for permission to record the interview. None of the participants/guardians refused to participate.

Data was collected through interviews, mediated using puppets. The use of puppets in research with children has been highlighted as an appropriate method of data collection that contributes to the trustworthiness and success of the interviews. Puppets and scenarios tend to motivate children to express themselves on issues that may be difficult for their chronic condition.¹¹⁻¹² It is important that the researcher is able to respond to children's interactions during the interview, interacting with the puppets and scenery, in addition to participating in the preparation of these materials.^{10,12}

The researchers made an apron that simulated a scenario with houses and a hospital. They also made puppets with rubber material, in different colors and characteristics. The interviewer received training and a pilot study was conducted prior to data collection to define whether the strategy and the guiding questions were suitable to extract rich data able to answer the research questions. Figure 1 illustrates the material made for this study.



Figure 1. Puppets and scenery made for interviews with children.
Source: authors, 2018.

At the beginning of the interview, parents answered a sociodemographic questionnaire to characterize the participants. Then, the researcher wore the apron and the puppet that represented them and asked the child to do the same. The participant was able to choose the puppet of their preference to represent them and other puppets that represented people of their life, to add to the conversation.

The interview was conducted by guiding questions that followed the objectives of the study, such as: "What do you understand about hypoglycemia?"; "How did you treat hypoglycemia symptoms?"; "Do you know how to treat

hyperglycemia?" "What do you understand about ketoacidosis?"; The researchers made notes in a field diary about the environment, posture, interaction, and participation of children with the puppets, which contributed to the data analysis. None of the interviews had to be repeated. A preliminary analysis of findings contributed to identifying the saturation of data and consequently to optimizing the sample size.¹³ The interviews were recorded and fully transcribed and lasted between 12 and 23 minutes.

The study used the Consolidated Criteria for reporting Qualitative Research (COREQ) checklist. Results were analyzed following deductive content analysis guidelines.¹³ Each interview and

transcribed text was discussed among the researchers to promote self-awareness and to evaluate the trustworthiness of data. The responses were evaluated following three main phases: preparation, organization, and reporting of results. In the preparation phase, the transcripts were read several times until the co-researchers became acquainted with the contents. The units of analysis were also defined. During the organization phase, a categorization matrix was developed. The data was organized, and important sections were classified, coding them for a reading of the homogeneities and differentiations, which allowed the comparison between the sets. Significant sections of the interviews were grouped and compared in the units of analysis, creating subcategories and then major categories.¹⁴ The categorization matrix

represented what was intended in the research goals.¹³ The researchers discussed the content concerning data accuracy and relevance. In case of a disagreement, they consulted the content obtained with collaborators, coming to a consensus, which guaranteed the rigor of the research. Finally, in the reporting phase the content of categories described the results.

RESULTS

A total of 10 children participated in the study. Of the participants, 80% attended public schools and all reported the mother as the person responsible for daily diabetes care. Table 1 shows the clinical characterization of the participants.

Table 1: Child characteristics. Florianópolis, SC, Brazil. 2019

Child Characteristics (N=10)	N (%/SD)
Age in years (mean, sd)	9.9 (1.6)
7 - 9 years old	4 (40)
10 - 12 years old	6 (60)
Sex (number, %)	
Male	6 (60)
Female	4 (40)
A1C (mean, sd)	9.2 (1.7)
Diabetes duration in years (mean, sd)	3.2 (1.1)
Insulin treatment (number, %)	
NPH + Regular	1(10)
Basal + Bolus	9 (90)
Glucose monitoring	
Freestyle Libre®	2 (20)
Blood glucose meter	8 (80)
Carbohydrate counting	3(30)
Physical activity practice (3 times per week)	9(90)
Hospitalization due diabetes complications since diagnosis (DKA, hyperglycemia)	5(50)

N = total number; SD = standard deviation
 Source: research data, 2018.

Two categories were created after content analysis: Hyperglycemia and ketoacidosis: “what I know”, “how I treat it” and Experiences with hypoglycemia: “what I learned from hypoglycemia”, “how I treat it”.

Figure 2 illustrates the categories and their subcategories. Participants' quotes illustrated the findings reflecting the children's voice. The quotes are identified by participant's age and sex.

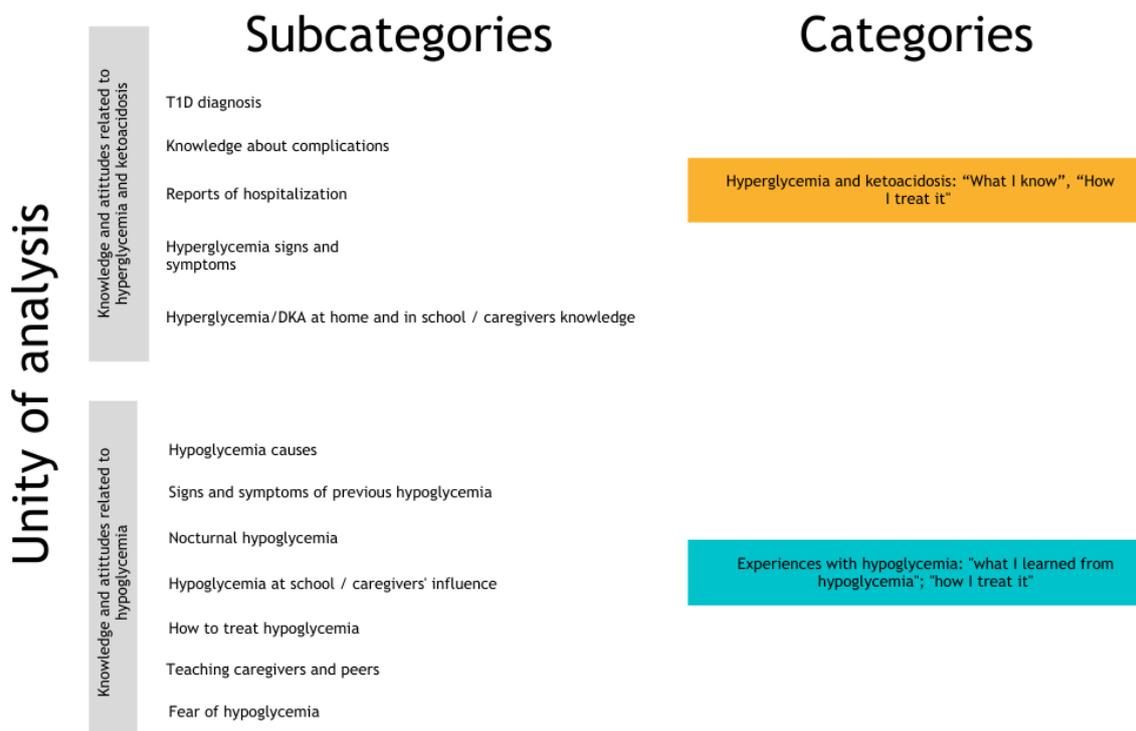


Figure 2. Content analysis findings: Unit of analysis, categories, and subcategories
 Source: research data, 2018.

Hyperglycemia and ketoacidosis: “what I know”, “how I treat it.”

The children were asked about their diabetes diagnosis experience to identify whether it occurred with DKA, or the child knew about this situation. The participants reported symptoms of prolonged hyperglycemia and its complications:

I was very thirsty, wanting to pee, very tired, had a headache and lost weight fast. I felt it every day. I almost passed out. My mother took me to the hospital and my blood sugar was 400. I had a really, really bad headache. (M1)

Most participants reported that parents, noticing the changes presented, sought health care help. Ninety percent of the children said that they remained hospitalized for seven to 12 days at the time of diagnosis. Two of them required hospitalization in intensive care units (ICU), which suggests the presence of

severe DKA. A participant recounted her experience using the hospital scenario:

My exam was very abnormal [referring to the blood glucose test]. My mother showed it to the doctor in my town and he sent it here [referring to the referral center] because it had to be urgent, which was very serious. I was at risk of getting other diseases in other parts of my body, affecting my vision and things like that. The kidneys. Some parts of the body could lose movement, paralyze. Arms, legs. (P1)

One participant, when trying to explain the symptoms of the DKA experienced, spoke using the puppet, about the relationship between the acidity of blood and the difficulty of venipuncture. The testimony shows the difficulty of understanding what was happening to the body.

I went straight to the ICU. Then my blood started to turn acidic, and they [referring to healthcare professionals] were not able to collect the blood. (P2)

Most children reported that they do not know how to name high blood glucose or do not know the term ketoacidosis. Children who knew what DKA meant were those who had been hospitalized due to the complication. However, they associated DKA only with increased blood glucose, without knowing how to explain exactly why it happens. Some statements brought reasons such as missing insulin doses, or not adhering to the diet. One participant associated the increase in blood glucose with emotional changes:

It is when I get angry (P3).

The children explained that an increase in blood glucose levels that are significantly abnormal can cause complications. A child, using the puppet, said:

If my diabetes gets high, I can pass out. If diabetes gets 700. (M2)

Children reported symptoms such as abdominal pain, nausea and vomiting, dizziness, and headache when they were asked what they feel when they have high blood glucose. Participants reported that their attitudes to correct high blood glucose values (hyperglycemias) are to administer an insulin dose, according to the correction scheme prescribed by the doctor. A participant explained using the puppet:

[When my blood glucose is 415] I take insulin. Eight units of regular. There is a sheet that the doctor gave us that has the numbers there, below 70 is two units, above 70 is three. (M2)

One child, when talking about an episode of hyperglycemia at school, said that left school for home alone and without the presence of parents. At home, the child drank water with ice to feel

better. At home scenario, the child said using the puppet:

I went home, had some ice water and I went to sleep. I couldn't stand because I was very sleepy. I slept all morning. I drank another cup of water with ice. I couldn't stand up. I went to bed, layed down again. Then I had a very strong urge, I went to vomit, and I kept vomiting. There was no more water in my blood. (P4)

A participant, at home scenario, explained that needs help from a health care service in the face of hyperglycemia:

If I get a HI, I have to go straight to the hospital to see what's going on. If I get [a blood glucose reading of] 400, I have to apply a lot, a lot of Humalog. (M3)

Experiences with hypoglycemia: “what I learned from hypoglycemia”, “how I treat it.”

Children were more comfortable talking about hypoglycemia. Most reported that they had hypoglycemia more frequently, compared to hyperglycemia/DKA.

At least once every other day [referring to the occurrence of hypoglycemia]. (P2)

All participants reported having heard the term “hypoglycemia” and the majority knew how to associate hypoglycemia with low blood glucose. However, children show difficulties in understanding how this complication occurs. A child expressed, using the puppet, concern regarding lack of understanding:

Now my diabetes is very low. I don't eat, I don't do anything, and it gets low every day. I do not understand this. (P4)

Participants pointed out several reasons for the occurrence of hypoglycemia. Among them, they emphasized playing, practicing sports or physical activity at school. However,

children demonstrated that they did not understand the relationship between hypoglycemia and physical activity.

[My blood glucose is low] because, when I am active, I play (...) it is low, but I can't explain. (M2)

A child, using the puppet, mentioned errors in carbohydrate counting as a cause of hypoglycemia experienced:

Because I applied too much insulin. It was not lack of eating. I eat too much. I thought I had a lot of carbohydrates. My mother also thought that broccoli had carbohydrates. Then, she told me to apply a lot [referring to the amount of insulin]. (M5)

The symptoms most reported by the participants during a hypoglycemia were dizziness, weakness and shaking. A child, using the puppet, associated blood glucose values with symptoms and the possible complications could experience, including the perception of death:

You feel tired and weak. You can't move very well. The blood glucose is at 50, 60. Then when it reaches about 40 you go into a coma. (...) Coma is when you can't move completely. You are very, very weak. You can't breathe properly, and it looks like you're going to die. (M5)

A child reported the experience of frequent nocturnal hypoglycemia, with delusions and amnesia. The child told us, at house scenario:

I woke up at night screaming and thinking there was someone in my bed. But there was no one. So, I had to eat some candy. A lot of times this has happened. When that happens, I never remember anything. (P3)

Children reported episodes of hypoglycemia that occurred when they depended on third parties' understanding of their diabetes care. Some statements

expressed the lack of understanding of teachers and nannies about how to prevent, identify and support the correction of hypoglycemia episodes. A participant reported that did not feel well, during a class, with symptoms of hypoglycemia. The teacher did not allow to leave the classroom, must returning to seat. The child said, at school scenario:

I was very sleepy. I was dizzy and weak. I asked the teacher if I could go [referring to leaving the classroom to get food]. The teacher said no. I sat. I laid my head on the desk and slept. Then I woke up in the principal's office [after hypoglycemia treatment]. My sister went to school to pick me up. (P3)

A child said he had his insulin before lunch, but he did not eat because of a delay in preparing the meal by the nanny. The child left his house for school without eating and had hypoglycemia there. The participant remembered, using the puppet:

It was because I had insulin at lunch and didn't eat anything [referring to the cause of hypoglycemia]. Because my mother works every other day, and I stay with the nanny. The nanny made the food very late, and it was not enough for me, my sister and my cousin to eat. (M6)

The children were asked whether they would be able to explain to adults or colleagues what should be done to help them during an episode of hypoglycemia. Most children reported that they would not be able to explain to someone what actions to take. However, all the children said that they need to eat something sweet to increase their blood glucose, when asked about their own attitudes. They said that according to the glycemia values, they decide the amount of candy to be eaten. Candies, 'brigadeiro' (condensed milk with cocoa powder), a glass of chocolate milk, water with sugar and fruits were examples of foods used to treat hypoglycemia.

Participants reported that, together with their parents, they administer insulin to correct what is eaten, to avoid blood glucose, rise above what is necessary in a hypoglycemia correction. In a situation like this, the insulin dose administered varies according to the food used for hypoglycemia correction and to the blood glucose values after correction. A child explained at the house scenario:

I was playing outside and told my mom I was feeling bad. She measured my blood sugar and gave me a cookie. I eat something sweet or something healthy [referring to the food he has to correct hypoglycemia]. I play again if the blood glucose gets a little high. She applied it [referring to the insulin injection given by the mother], I ate and then I played. (M3)

DISCUSSION

This study presented the children's voice related to their knowledge and attitudes about hyperglycemia/DKA and hypoglycemia. The findings showed important key points to be highlighted in pediatric diabetes education programs. No differences were observed related to knowledge among participants from different age groups.

Children who have been hospitalized for DKA demonstrated some experience with this diabetes complication. However, they demonstrated poor management of some hyperglycemia episodes which could prevent hyperglycemia with ketones or DKA hospitalizations. According to the literature, DKA is the most common manifestation of T1D in young children and failure to recognize this condition can cause serious consequences or even lead to death. The risk of DKA increases in children with established T1D and poor metabolic control, limited access to medical services and others.¹⁵ Children's statements in this study reported symptoms that mark hyperglycemia without ketones, the evolution to hyperglycemia with ketones, or had episodes of DKA even after diagnosis.

The participants, even those who had experienced DKA before, had difficulty explaining hyperglycemia and its complications. The children's statements expressed their errors in relation to knowledge and management behaviors, corroborating with studies that discuss the difficulty of children and caregivers to understand how this complication occurs.¹⁶

The most serious clinical complication of DKA is cerebral edema, related to high rates of mortality and morbidity.¹⁷ This fact emphasizes the need to promote campaigns and to educate children about initial symptoms of diabetes to avoid hyperglycemia with ketones or DKA or even to manage it correctly.^{15,17}

Most participants said they have never heard about DKA, even with an average of three years of diagnosis. Although children did not know how to explain what DKA is, they correctly pointed out situations known to them that can lead to hyperglycemia. Insulin deficiency, either by omission or error in dose administration, intake of large amounts of carbohydrates and physical or psychological stress, were listed reasons. For one of the participants in this study, the complication resulting from hyperglycemia could lead him to acquire other diseases such as loss of visual acuity and paralysis of limbs. Fear and anxiety can arise at this time, complicating treatment, and children's adherence.¹⁸

Regarding the management that are taken by children in cases of hyperglycemia, most of the participants reported they perform insulin administration together with the caregivers, according to the prescribed medical regimen. In this study, participants demonstrated insecurity to manage hyperglycemia when away from home. None of the participants reported performing blood glucose monitoring more frequently, monitoring and maintaining salt and water hydration, insulin adjustments or checking for ketones during a hyperglycemia episode, according to recommendations of hyperglycemia

management. For some children, a hyperglycemia episode checked by blood glucose monitoring demands hospital's visit. Blood ketone monitoring by patients is not a usual diabetes care routine in Brazil. This is because patients have difficulty obtaining ketone meters and strips through the public health care system.¹⁹ Despite this, diabetes management on sick days includes checking for ketones and are part of international diabetes guidelines to avoid severe DKA.^{8,20}

It is important to clarify for children during diabetes education sessions that an episode of DKA can occur with established diabetes, especially during illnesses.^{8,20} In this sense, educational activities promoted by the health care team and aimed at teaching children with T1D how to treat signs and symptoms of hyperglycemia with or without ketones are important. It is essential that children know diabetes first aid, especially when they are away from home. The multidisciplinary team must also plan the education of parents and the extended family regarding the essential supplies for handling complications.

It is recommended DKA should not be addressed just at the time of diabetes onset or hospitalizations, but throughout diabetes treatment.²¹ Such complex phenomena.¹⁵ place challenges for health professionals when explaining hyperglycemia and DKA to children. In this sense, diabetes education must be carried out continuously by qualified professionals focused on the particularities of the clientele throughout the course of the disease, with a focus on avoiding risky behaviors.^{22,20} Play activities such as drawings, games, videos, educational booklets and even classes produced by the children themselves are strategies recommended by the literature. These are resources that facilitate the understanding of the disease, especially hyperglycemia and DKA, both for children and their peers.^{21,23}

Most children demonstrated understanding hypoglycemia episodes as opposed to DKA. For them, this is due to

the frequent episodes of hypoglycemia experienced, which corroborates with the literature.²⁴ With regard to hypoglycemia episodes, most children reported hypoglycemia because of errors in carbohydrate counting, taking insulin without having lunch, embarrassment at school, and nocturnal hypoglycemia, with delusions and amnesia. It is essential that caregivers and health care teams guide children with T1D and their caregivers in understanding that hypoglycemia has different classifications and severity levels and should not occur frequently. It is crucial to identify hypoglycemia precipitating factors to reduce risks and complications.²⁵

A boy showed anxiety and fear regarding hypoglycemia consequences such as coma and death. Fear of hypoglycemia is not only related to the physical consequences of the complication, but also the fear of social embarrassment, due to the bodily and cognitive changes that occur during a hypoglycemia episode.²⁶ From another point of view, this study highlights the child's fear of embarrassment and shyness that can negatively influence their behavior, as they hinder their actions for quick and effective correction. In this study, we identified the social embarrassment related to the child's mediation with third parties, facing an episode of severe hypoglycemia that occurred in the school setting. The child did not confront the teacher when her right to leave the classroom was denied. Although she was aware of her health problem, she failed to correct hypoglycemia and fainted as a result. Social embarrassment directly interferes with the child's ability to deal with episodes of hypoglycemia.

Participants of this study reported that they would not be able to explain to someone what should be done to help them during an episode of hypoglycemia, which can become more difficult if the episode is followed by social embarrassment. Diabetes education for children about hypoglycemia should increase communication between the child, teachers, peers, and caregivers and

provide them correct solutions to treat the different stages of hypoglycemia.²³

Deficits in diabetes education, abrupt changes in food intake, inappropriate insulin dosage, lack of adequate correlation between insulin doses and change in food intake are some of the causes that can lead to hypoglycemia.²⁷ Two situations draw our attention: the administration of insulin to correct what is eaten, in an attempt to avoid blood glucose, rise above what is expected during hypoglycemia; and the use of milk and foods with high fat content to correct a hypoglycemic episode. Education strategies about hypoglycemia, its definition, levels and how to manage it correctly are important to empower children to face hypoglycemic episodes, particularly in scenarios without their parents, improving the efficiency in correcting hypoglycemia and reducing complications in these scenarios.

One limitation of this study is that the data was collected with 10 children from one clinical setting. Therefore, the results are certainly not generalizable, but they can help with planning of educational interventions at this centre. Also, information on the frequency of hypoglycemia and severe hypoglycemia of the participants is missing to know the real situation of this complication occurrence. Moreover, these data contribute to the literature with children's perspective about acute diabetes complications and their management, which can promote researchers' views and insights with respect to this important topic.

FINAL CONSIDERATIONS

Although children demonstrated some knowledge about the acute complications, our study points out flaws in children's understanding regarding the warning symptoms of hyperglycemia and the correct self-treatment to prevent DKA and manage hypoglycemia, especially when children are away from their main caregivers. Play-based and age-appropriate strategies can empower the child to have appropriate and quick attitudes to cope with diabetes

complications. Consequently, it is possible to avoid hospital admissions especially on T1D on-set.

The use of puppets contributed positively to allowing greater involvement between child and researcher. The puppets creatively transported the children from the interview environment into a safe space where they felt free to share their experiences and opinions.

It is relevant that the health care professionals bring up the acute complications of diabetes with children during hospital admissions or outpatient consultations, which can prevent errors in the treatment of hypoglycemia and the management of hyperglycemia with or without ketones. Some actions that may guide these educational strategies are to develop educational materials with the goals of informing children about hyperglycemia and DKA symptoms and its correct management, how to proceed when children are in other scenarios such as school, a relative or friend's house. Future materials must be developed meeting age-appropriate language and children's health literacy. Another is to carry out educational sessions such as lectures and workshops with children to assist them to develop clear communication regarding acute symptoms and their needs with teachers, nannies, and others. Moreover, to explain how people can help them in urgent situations.

Such strategies, in addition to helping to reduce these complications, will provide an opportunity to reduce fear, anxiety and insecurities in diabetes treatment. These actions will contribute to diabetes education programs and good results of multidisciplinary initiatives.

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