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Clinical and epidemiological characteristics of hospitalizations for diabetic ketoacidosis in children and adolescents

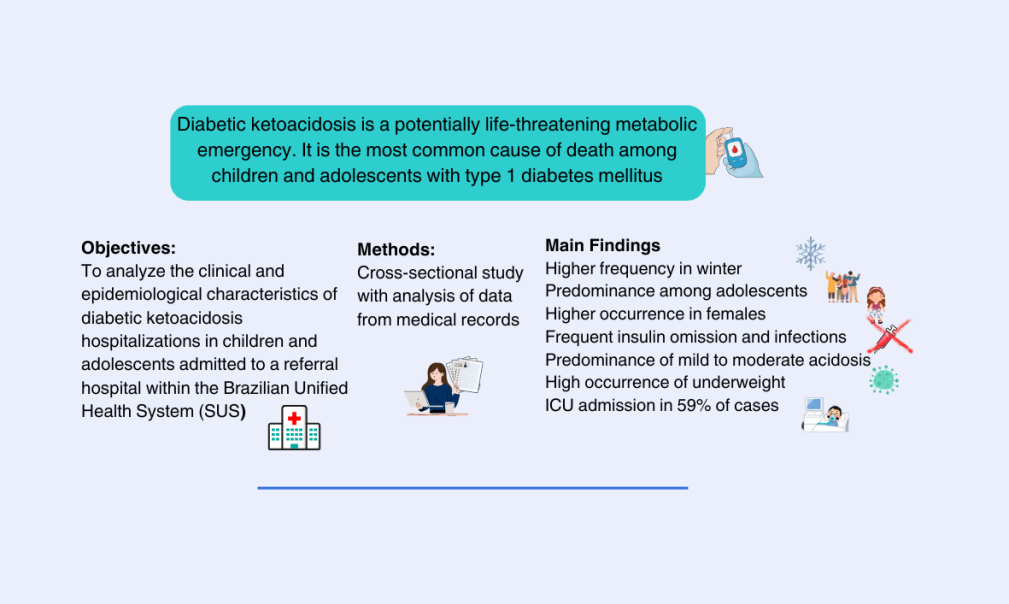
Bruno Kostrzevicz Campos de Oliveira[1] **Ian Mateus da Silva**[1] **Deisi Maria Vargas**[1,2]

[1]Departamento de Medicina, Universidade Regional de Blumenau – FURB. Blumenau/SC, Brasil.
[2]Programa de Pós-graduação em Saúde Coletiva, Universidade Regional de Blumenau – FURB. Blumenau/SC, Brasil.
E-mail: deisivargas@furb.br

Highlights

- *The study analyzed 42 hospitalizations for DKA in patients under 19 years of age.*
- *Most hospitalizations occurred during adolescence and among females.*
- *The clinical presentation varied depending on the presence or absence of a prior T1D diagnosis.*
- *The main precipitating factors were missed insulin doses and infections.*
- *The results indicate potential preventive actions within the context of the Brazilian Unified Health System (SUS).*

Graphical Abstract



Abstract

The aim of this study was to analyze the clinical and epidemiological characteristics of hospitalizations for diabetic ketoacidosis (DKA) in children and adolescents admitted to a reference service of the Brazilian Unified Health System (SUS). This was a cross-sectional study based on the analysis of secondary data extracted from medical records. The variables investigated included sex, age, nutritional status, season of the year, signs and symptoms at admission, predisposing factors, length of hospitalization, ICU admission, complications, degree of acidosis, first decompensation, and therapeutic protocols used. A higher frequency of hospitalizations was observed among adolescents (54.7%), females (57.1%), and during the winter (30.9%). The mean age was 10.1 years. The most prevalent signs and symptoms at admission were dehydration, vomiting, nausea, and abdominal pain. The main causes associated with DKA were infections and missed insulin doses (49.9%). Complications occurred in 50% of cases, with hypokalemia and hyponatremia being the most prominent. Most hospitalizations involved mild or moderate degrees of acidosis (85.8%). First decompensation cases occurred in younger children, usually presenting with classic diabetes symptoms (polydipsia, polyuria, polyphagia). Among patients with a previous diagnosis, nausea and vomiting were more common. The most frequently used treatment consisted of continuous infusion of regular insulin and hydration with 0.9% saline solution. Hospitalizations for DKA were more frequent among female adolescents, especially during the winter. Mild to moderate acidosis predominated, with treatment aligned with current guidelines.

Keywords: Child. Adolescent. Diabetic Ketoacidosis. Type 1 Diabetes *Mellitus*. Health Profile.

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INTRODUCTION

Diabetes *mellitus* (DM) is a chronic disease characterized by persistent hyperglycemia due to defects in insulin secretion and/or action. Type 1 diabetes *mellitus* (T1D) is the most common form of diabetes in children and adolescents and is characterized by an autoimmune destruction of pancreatic beta cells involving lymphocyte and macrophage activity[1].

The incidence of T1D has been increasing among children and adolescents, with an estimated annual growth rate of 3%. It affects approximately 1.1 million individuals aged 0 to 19 years, with an estimated 128,000 new cases each year worldwide, showing significant geographic variations in incidence. In Brazil, 51.5 per 100,000 individuals under the age of 14 are affected, and there is an annual incidence of 7.3 new cases per 100,000 children and adolescents under 14 years of age, making it the second most prevalent chronic disease in childhood[2].

Diabetic ketoacidosis (DKA) is an acute complication that may occur in the course of T1D and carries a risk of death due to a reduction in the effective concentration of circulating insulin, associated with an excessive release of counterregulatory hormones such as glucagon, catecholamines, and cortisol. These hormonal changes trigger a reduction in glucose uptake by insulin-sensitive peripheral tissues and an increase in hepatic and renal glucose production, resulting in hyperglycemia and extracellular hyperosmolarity. This combination of insulin deficiency and increased counterregulatory hormones leads to the release of free fatty acids, which are converted into ketone bodies. When present in excess, these ketone bodies result in ketonemia and metabolic acidosis[3].

Clinically, DKA presents with dehydration and multiple biochemical and electrolyte disturbances, resulting in acidosis, ketosis, and symptoms associated with these changes[3]. DKA treatment requires hospitalization and involves careful fluid replacement, administration of short- or rapid-acting insulin, and electrolyte replacement including potassium, phosphorus, and bicarbonate[3,4].

Diabetic ketoacidosis is the most common cause of death among children and adolescents with T1D, with a mortality rate of approximately 1%. The most common complications of DKA are hypokalemia, hyponatremia, and hypoglycemia. DKA is present in 25% of children at diagnosis and is more common in females[1,3].

Considering the rising incidence of type 1 diabetes *mellitus* (T1D) among children and adolescents and the scarcity of national studies on DKA-related hospitalizations, this study aimed to analyze the clinical and epidemiological characteristics of DKA hospitalizations in children and adolescents treated at a SUS reference hospital located in Blumenau, Santa Catarina.

METHODS

This is a cross-sectional study conducted in a hospital affiliated with the Brazilian Unified Health System (SUS), located in the city of Blumenau, Santa Catarina (SC), which serves as a regional referral center for pediatric hospital care under SUS. Hospitalizations for DKA in children and adolescents from 2012 to 2022 were analyzed. DKA hospitalizations were identified from the hospital's service records based on the ICD-10 code E10.1 for patients under 19 years of age. Hospitalizations were excluded if patients could not be reached after three contact attempts via telephone.

The study examined clinical and epidemiological characteristics and the treatment protocols used. For the epidemiological profile, the following variables were considered: sex (male and female), season of the year, and age group — infants (0 to 1 year), preschoolers (2 to 5 years), school-age children (6 to 9 years), and adolescents (10 to 19 years). Regarding the clinical profile, the following were evaluated: anthropometric data (weight, height, and BMI), nutritional status, signs and symptoms at hospital admission (nausea, vomiting, drowsiness, polyuria, polydipsia, polyphagia, stupor, coma, hyperpnea, abdominal pain, and dehydration), presence of predisposing factors for DKA, duration of diabetes, length of hospitalization, ICU admission (yes or no), length of ICU stay, occurrence of complications (hypoglycemia, cerebral edema, death, hypokalemia, and hyponatremia), severity of diabetic ketoacidosis (mild, moderate, or severe), and first decompensation (yes or no). Hypoglycemia was defined as serum or capillary glucose < 60 mg/dL, hypokalemia as serum potassium < 3.5 mEq/L, and hyponatremia as serum sodium < 135 mEq/L[5]. DKA was classified

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as mild when pH ranged between 7.25 and 7.3 or HCO_3 between 15 and 18 mEq/L; moderate when pH was between 7.0 and 7.24 or HCO_3 between 10 and 15 mEq/L; and severe when pH < 7.0 or HCO_3 < 10 mEq/L[5]. Weight, height, and BMI were converted into Z-scores by age and sex using the Pedz tool available at https://www.pedz.de/de/pedz/bmi.html, and nutritional status was defined according to World Health Organization criteria as follows: thinness, BMI Z-score < -2; eutrophy, Z-score between -2 and +1; and overweight/obesity, Z-score > +1.

Regarding clinical treatment protocols, the study examined intravenous hydration solutions, insulin therapy (route and types of insulin), and the use of sodium bicarbonate.

For statistical analysis, the *EpiData* software was used to calculate measures of central tendency and dispersion for numerical variables and absolute and relative frequencies for categorical variables. Means were compared using Student's *t*-test, and frequency comparisons were performed using the chi-square test. Numerical variables showed normal distribution (Kolmogorov-Smirnov test). The study was conducted in accordance with the Guidelines and Regulatory Norms for Research Involving Human Beings (Resolutions 196/96 of 2012 and 251/1997 of the National Health Council) and was approved by the institutional ethics committee under opinion number 5.816.011. All participants included in the study signed the informed consent form and, when under 18 years of age, the assent form was also signed, both provided via *Google Forms*.

RESULTS

Figure 1 presents the participant flowchart. A total of 42 hospitalizations for DKA were analyzed, involving 26 children and adolescents with T1D. Seven patients were hospitalized more than once during the study period.

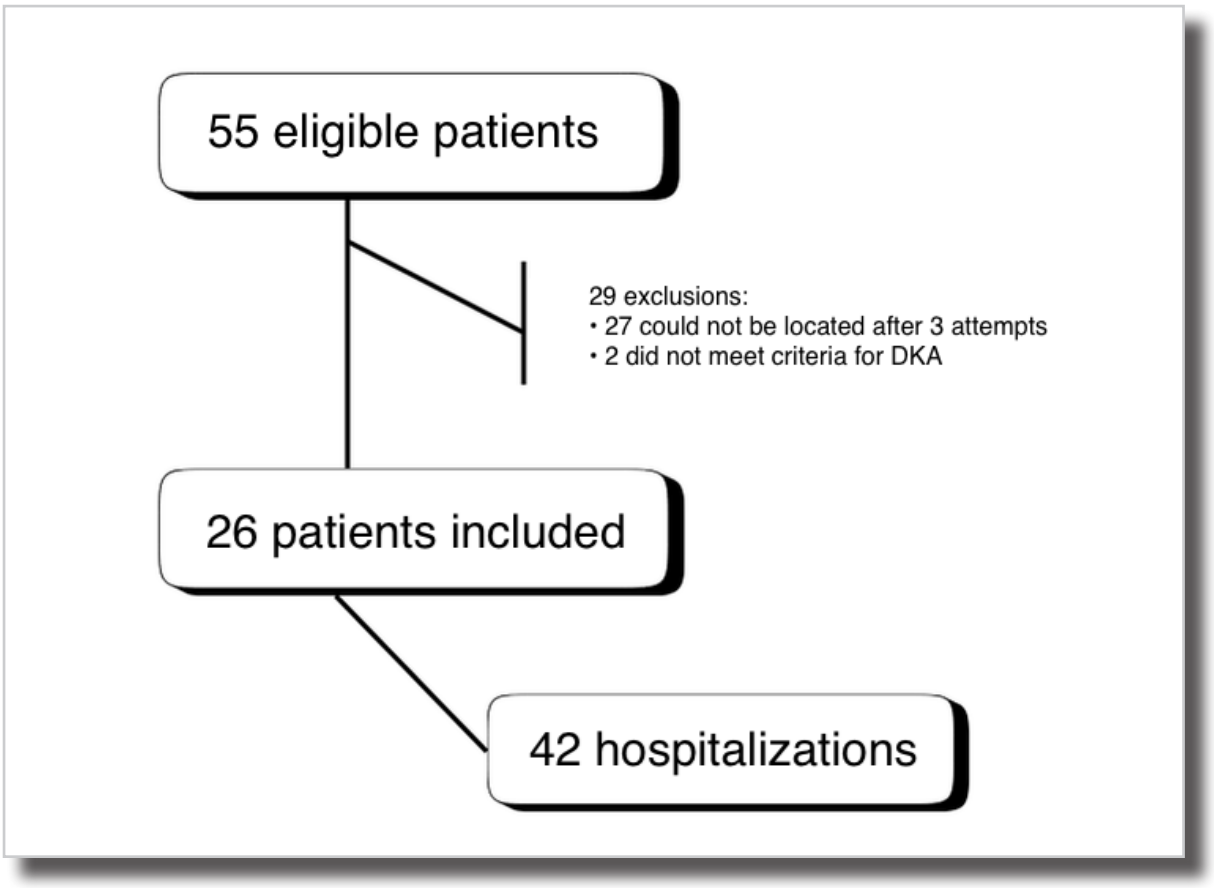

Figure 1 - Flowchart of participants.

Table 1 presents the epidemiological and clinical profile. There was a predominance of hospitalizations among females (57.1%), the mean age was 10.1 years, most cases occurred in adolescents, and the predominant season was winter.

The clinical profile showed that the most frequent signs and symptoms were dehydration, vomiting, nausea, abdominal pain, drowsiness, polydipsia, and polyuria. The most commonly identified predisposing factors were infection and missed insulin doses (49.9%). The mean length of hospitalization was 6.1 days. ICU admission was required in more than half of the total hospitalizations, with an average stay of 1.9 days. In half of the cases, DKA complications occurred, with hypokalemia and hyponatremia being the most frequent. The predominant degrees of acidosis were moderate and mild (85.8%). All hospitalizations with severe DKA occurred in girls. No association was found between age group and severity of acidosis. Eighteen hospitalizations (42.8%) were due to first decompensation, and the mean duration of prior T1D diagnosis in hospitalizations without first decompensation was 56.8 months. The "polys," symptoms specific to T1D, were more frequent in hospitalizations due to first decompensation, while vomiting was more frequent in hospitalizations not related to first decompensation (Table 2). Hospitalizations due to first decompensation occurred in younger patients (7.8 ± 4.4 years *vs.* 12.5 ± 3.5 years; $p < 0.001$), and were less frequent among adolescents (Table 2). Missed insulin doses were more frequent in adolescents (adolescents: 64.7% *vs.* infant/preschool/school-age: 35.3%; chi-square = 6.9; $p < 0.01$). Age group was not associated with severity of acidosis, and severe acidosis occurred predominantly in females (100%). The predominant nutritional status was eutrophic, with low occurrence of overweight/obesity and a high occurrence of thinness.

Table 3 describes the clinical protocols used in the treatment of DKA. The most frequently used intravenous hydration solutions for correction and maintenance were 0.9% saline + 5% dextrose and 0.9% saline alone (73.9%). Intravenous regular insulin was the most commonly used, with limited use of the combination of regular insulin and NPH insulin via subcutaneous route. The most frequently used dose of intravenous regular insulin was 0.1 IU/kg/h, and the use of bicarbonate for acidosis correction was infrequent.

Table 1 - Clinical and epidemiological characteristics of hospitalizations for diabetic ketoacidosis in children and adolescents admitted to a SUS referral hospital. Blumenau, Santa Catarina, 2023.

Variables	Mean ± SD	Min	Max	Median	n (%)
Epidemiological Profile					
Age (years)	10.1 ± 4.5	0.75	18	10	–
Sex	**–**	**–**	**–**	**–**	
Male	–	–	–	–	18 (42.9)
Female	–	–	–	–	24 (57.1)
Age group	**–**	**–**	**–**	**–**	
Infant	–	–	–	–	2 (4.8)
Preschool	–	–	–	–	5 (11.9)
School-age	–	–	–	–	12 (28.6)
Adolescent	–	–	–	–	23 (54.7)
Season of the year	**–**	**–**	**–**	**–**	
Winter	–	–	–	–	13 (30.9)
Autumn	–	–	–	–	11 (26.2)
Spring	–	–	–	–	11 (26.2)
Summer	–	–	–	–	7 (16.7)
Clinical Profile					
Anthropometry					
Weight (Z-score)	-0.5 ± 1.2	-4.5	2.2	-0.49	–
Height (Z-score)	-0.6 ± 1.3	-4.5	4.4	-0.72	–
BMI (Z-score)	-0.2 ± 1.1	-2.83	2.1	-0.34	–
Nutritional status	**–**	**–**	**–**	**–**	
Thinness	–	–	–	–	6 (14.3)
Eutrophy	–	–	–	–	33 (78.6)
Overweight/obesity	–	–	–	–	3 (7.1)

to be continued...

...continuation - Table 1.

Variables	Mean ± SD	Min	Max	Median	n (%)
Signs and symptoms	–	–	–	–	
Dehydration	–	–	–	–	33 (78.5)
Vomiting	–	–	–	–	27 (64.3)
Nausea	–	–	–	–	21 (50.0)
Abdominal pain	–	–	–	–	20 (47.6)
Drowsiness	–	–	–	–	19 (45.2)
Polydipsia	–	–	–	–	16 (38.1)
Polyuria	–	–	–	–	14 (33.3)
Hyperpnea	–	–	–	–	9 (21.4)
Polyphagia	–	–	–	–	7 (16.6)
Stupor	–	–	–	–	6 (14.2)
Coma	–	–	–	–	1 (2.4)
Predisposing factors	–	–	–	–	
Absent/not reported	–	–	–	–	19 (45.0)
Missed insulin dose	–	–	–	–	13 (30.9)
Infection	–	–	–	–	8 (19.0)
Stress	–	–	–	–	2 (4.7)
First decompensation	–	–	–	–	
Yes	–	–	–	–	18 (42.8)
No	–	–	–	–	24 (57.2)
Time since diagnosis* (months)	56.8 ± 36.5	9	144	60	–
Hospital stay duration (days)	6.1 ± 3.7	1	17	6	–
ICU admission	–	–	–	–	25 (59.5)
ICU stay duration (days)	1.9 ± 1.8	0	6	2	–
Complications	–	–	–	–	
Hypokalemia	–	–	–	–	26 (61.9)
Hyponatremia	–	–	–	–	21 (50.0)
Hypoglycemia	–	–	–	–	0 (0.0)
Cerebral edema	–	–	–	–	0 (0.0)
Death	–	–	–	–	0 (0.0)
Degree of ketoacidosis	–	–	–	–	
Mild	–	–	–	–	16 (38.1)
Moderate	–	–	–	–	20 (47.7)
Severe	–	–	–	–	6 (14.2)

Source: study data (2023).

Table 2 - Association between first decompensation, age group, and signs and symptoms in hospitalizations for diabetic ketoacidosis in children and adolescents treated at a SUS referral hospital. Blumenau (SC), 2023.

Variables	First decompensation Yes n (%)	First decompensation No n (%)	p-value
Age group			**0.007**
Infant/Preschool/School-age	15 (60.0)	10 (40.0)	-
Adolescent	2 (11.8)	15 (88.2)	-
Polyuria			**0.010**
Yes	13 (93.0)	24 (86.0)	-
No	1 (0.7)	4 (14.0)	-
Polydipsia			**0.007**
Yes	13 (81.0)	4 (25.5)	-
No	3 (19.0)	22 (84.6)	-
Polyphagia			**< 0.001**
Yes	6 (22.2)	11 (73.3)	-
No	21 (77.8)	4 (26.7)	-

to be continued...

... continuation - Table 2.

Variables	First decompensation Yes n (%)	First decompensation No n (%)	p-value
Vomiting			**0.001**
Yes	6 (22.2)	11 (73.3)	-
No	21 (77.8)	4 (26.7)	-
Nausea			**0.051**
Yes	12 (54.5)	5 (25.0)	–
No	10 (45.5)	15 (75.0)	–
Abdominal pain			**0.952**
Yes	8 (40.0)	9 (40.9)	–
No	12 (60.0)	13 (59.1)	–
Hyperpnea			**0.952**
Yes	5 (44.4)	12 (36.4)	–
No	4 (55.6)	21 (63.6)	–
Drowsiness			**0.408**
Yes	9 (47.4)	8 (34.8)	–
No	10 (52.6)	15 (65.2)	–
Stupor			**0.700**
Yes	15 (41.7)	2 (33.3)	–
No	21 (58.3)	4 (66.7)	–
Coma			**0.219**
Yes	1 (100.0)	16 (39.0)	–
No	0 (0.0)	25 (61.0)	–

Source: study data (2023).
*In months, data present in patients with a prior diagnosis of T1D.

Table 3 - Clinical protocols used for the treatment of diabetic ketoacidosis in children and adolescents hospitalized at a SUS referral hospital. Blumenau (SC), 2023.

Variables	Mean ± SD	Min	Max	Median	n (%)
Intravenous hydration*					
0.9% saline + 5% dextrose	-	-	-	-	24 (57.3)
0.9% saline	-	-	-	-	7 (16.6)
5% dextrose + 0.9% saline	-	-	-	-	3 (7.1)
0.9% saline + 10% dextrose	-	-	-	-	3 (7.1)
0.9% saline + 5% dextrose + 10% dextrose	-	-	-	-	3 (7.1)
10% dextrose + 0.9% saline + 5% dextrose	-	-	-	-	1 (2.4)
0.45% saline	-	-	-	-	1 (2.4)
Insulin					
Regular IV	-	-	-	-	36 (85.7)
Dose					
0.1 IU/kg/h	-	-	-	-	32 (88.9)**
0.05 IU/kg/h	-	-	-	-	3 (8.3)**
0.15 IU/kg/h	-	-	-	-	1 (2.8)**
Duration of use (hours)	21.3 ± 24.9	1	144	16.5	–
Regular + NPH SC	-	-	-	-	5 (11.9)
Regular + glargine SC	-	-	-	-	1 (2.4)
Use of bicarbonate					
Yes	-	-	-	-	5 (11.9)
No	-	-	-	-	37 (88.1)

Source: study data (2023).
*Correction + maintenance solutions; **Relative frequency calculated based on the absolute frequency of the “Regular IV” category.

DISCUSSION

This study analyzed the clinical and epidemiological profile of pediatric patients hospitalized for DKA in a SUS referral hospital. The epidemiological profile showed a higher occurrence of hospitalizations during winter, among adolescents, and in females. The clinical profile was characterized by a predominance of patients with a prior diagnosis of T1D, with missed insulin doses and infections as the main predisposing factors, electrolyte disturbances as the most frequent complications, low occurrence of severe acidosis, ICU requirement in most hospitalizations, and predominance of classic signs and symptoms of decompensated T1D in hospitalizations due to first decompensation.

The mean age at hospitalization was 10.1 years, similar to what has been reported by other services, which showed mean ages ranging from 8 to 10 years[6,7,8,9]. The slight predominance of hospitalizations in winter is related to the higher frequency of respiratory infections during this season[10], as infections are one of the main predisposing factors for DKA[6,7,8,9,11,12]. However, this study did not show a significant predominance of DKA hospitalizations during winter. The city of Blumenau (SC) has an average annual temperature of 19.6 °C, and winter is considered mild, with average minimum temperatures of 13 °C and maximums of 21 °C[13], resulting in a lower frequency of respiratory infections compared to regions with more severe winters[10].

Factors related to the occurrence of DKA described by different services in various countries include age group[14,15,11,12] (adolescence and infancy), female sex[7,16,9,16], infections[9,11,12,14], low socioeconomic and educational levels[9,14,17], ethnic minorities[14,15,16], previous history of DKA[16,17], HbA1c above target[16], missed insulin doses[4,12] and delayed treatment[14]. In this study, the factors associated with DKA were female sex, adolescent age group, missed insulin doses, and infections.

Most previous studies have identified a higher occurrence of DKA in females[7,9,16], although not all studies have confirmed this trend[8,12]. The city of Blumenau has an approximate population of 366,418 inhabitants, with about 87,200 individuals under 19 years of age; of these, approximately 42,600 are female. Thus, there is no predominance of females among children and adolescents in Blumenau that alone would justify this sex difference. The reasons for the higher incidence of DKA in females are not yet fully understood. Greater omission of insulin doses driven by conditions such as diabulimia, anxiety, and depression may be one explanation[18].

We observed that the omission of insulin doses was the most frequent precipitating factor for DKA, followed by infection. Among patients with a prior diagnosis of T1D, insulin omission is the main precipitating factor for DKA[4,12]. Causes of insulin omission include failures in administration (intentional or unintentional), adherence issues, psychosocial disorders, or technical failures in continuous infusion devices[19,20]. We observed that missed insulin doses were more frequent among adolescents. In this stage of life, therapeutic adherence is a challenge. There is increased demand for privacy, resistance to parental supervision, and difficulties in accepting the disease, all of which hinder treatment adherence and glycemic control[21,3]. These characteristics justify the higher occurrence of DKA in this age group.

Infections, on the other hand, induce metabolic stress with the release of pro-inflammatory cytokines that increase blood cortisol levels, resulting in hyperglycemia and consequent glycemic decompensation[3]. The occurrence of infections in children and adolescents with poor treatment adherence represents an accumulation of risk factors for the development of DKA. Therefore, infection prevention becomes an important strategy in reducing the incidence of DKA. In this context, the National Immunization Program includes additional vaccines intended for children and adolescents with T1D. It is the responsibility of healthcare professionals to guide and refer these patients to receive the appropriate immunizations.

We observed a high occurrence of thinness. In southern Brazil, the reported prevalence of thinness is 5.1%, approximately three times lower than that observed in this study[20,22]. Thinness is associated with an increased risk of DKA[8,14], and, conversely, DKA itself can lead to weight loss due to the breakdown of adipose tissue to sustain muscle tissue functionr[18].

The clinical presentation of DKA includes, as main signs and symptoms, polyuria and polydipsia, weight loss accompanied by abdominal pain, nausea, vomiting, drowsiness, and, in some cases, stupor and coma[3,23]. Studies indicate that less specific symptoms, such as abdominal pain, nausea, and vomiting, may also be frequent[23]. In this study, we observed that in hospitalizations due to first decompensation, the classic symptoms of T1D — such as polydipsia, polyuria, and polyphagia — were the most prevalent. Recent studies evaluating the clinical profile of DKA in patients hospitalized for first decompensation have identified a similar pattern[8,9].

Among patients with a prior diagnosis of T1D, the most frequent symptoms were nonspecific, especially nausea and vomiting. It is important to highlight that other clinical conditions may present with similar symptoms, which can delay the diagnosis of DKA. When not diagnosed early, DKA can progress to severe conditions, including severe metabolic acidosis, cerebral edema, and even death[3,4]. Therefore, it is essential to include DKA in the differential diagnosis of nonspecific clinical presentations, especially in children and adolescents with a prior diagnosis. Thus, it is crucial that healthcare professionals involved in the care of children and adolescents with T1D remain attentive to these symptoms and adopt appropriate measures for the early diagnosis and management of DKA.

Nearly half of the hospitalizations analyzed (42.8%) corresponded to cases of first diabetic decompensation, a percentage similar to that reported in the literature, which ranges from 35% to 70%[9,11,12,14,24]. First decompensation was more frequent among children than adolescents, consistent with findings from other national studies[12,24].

The recurrence of hospitalizations due to diabetic ketoacidosis (DKA) constitutes a significant clinical issue. It is estimated that up to 25% of patients are readmitted for a new episode of DKA within 12 months after the first hospitalization[17]. The main risk factors associated with recurrence include low household income, use of public health insurance, Black ethnicity, female sex, adolescence, and the presence of psychiatric disorders[25,26]. In this context, early identification of these factors, combined with the implementation of monitoring and continuous follow-up strategies, is essential for preventing new episodes of DKA.

Regarding the severity of ketoacidosis, it was observed that the vast majority of patients (85.8%) presented with mild or moderate DKA, a proportion higher than that reported in other services, where rates vary between 40% and 70%[12,14,24,27]. Severe DKA was recorded exclusively among female patients. There is evidence in the literature indicating that severe acidosis is more common in girls[23,28]. Younger age is another factor associated with increased DKA severity[8,28]; however, this association was not observed in the present study. The easy access to the public healthcare network in the city of Blumenau, which includes a broad care infrastructure, featuring a pediatric referral hospital and 116 family health teams distributed across 58 physical facilities with 100% territorial coverage, may explain the predominance of mild and moderate acidosis by enabling timely treatment.

The average length of hospitalization for children and adolescents with DKA varies. In the United States and the United Kingdom, it ranges from 2.3 to 2.5 days[26,29,30]. In developing countries, the length of hospitalization tends to be longer, with a mean of 4.6 days and a median of 8, reflecting differences in access, case severity, and available resources[31,32]. In countries with healthcare systems that prioritize in-hospital diabetes education, hospitalization is more prolonged, with medians ranging from 12.7 to 13.1 days, as it includes the education period[33]. In this study, we observed a mean hospitalization duration of 6.1 days. In the service analyzed, patients are discharged only after acquiring sufficient knowledge on the subcutaneous use of insulin and capillary glucose monitoring. In addition, hospital discharge is conditional upon obtaining the necessary supplies, which are generally provided by SUS.

More than half of the hospitalizations included ICU stays, with a mean duration of 1.9 days, similar to that reported by another national service, which ranged from 1 to 3 days[24]. The high rate of ICU admissions compared to other Brazilian services, which reported ICU rates of 9.1%[12] and 28%[27], may be attributed to the absence of intermediate care units at the institution where this study was conducted. Such units could manage cases of mild to moderate acidosis, reducing the need for ICU admission. However, there are services reporting ICU admission rates as high as 85.5%, with an average stay of 3.6 days[8].

The most frequent complications were electrolyte disturbances, hypokalemia and hyponatremia, which are consistent with the literature[8,12,14,24]. No cases of cerebral edema or death were recorded, possibly due to the low occurrence of severe acidosis among the patients evaluated.

DKA treatment protocols aim primarily to correct hypovolemia and electrolyte imbalances, and to gradually reduce blood glucose levels[34,35]. Volume replacement with 0.9% saline solution is the recommended initial approach, and it was adopted in 88% of the hospitalizations analyzed in this study. After initiating fluid therapy, the introduction of 5% dextrose is recommended once blood glucose reaches levels between 200 and 250 mg/dL[34]. In the present study, 57.3% of cases followed this ideal protocol, with initial replacement using 0.9% saline solution and maintenance with 5% dextrose. Regarding insulin therapy, continuous intravenous infusion at a dose of 0.10 IU/kg/h was the most frequently used approach, applied in 76.2% of patients, consistent with the dosage recommended in the literature[35]. The use of sodium bicarbonate was infrequent, reflecting the low incidence of severe

acidosis observed in the study population. Sodium bicarbonate should only be considered in cases of extremely severe acidosis, and only when there is hemodynamic instability that is refractory to standard volume replacement and insulin therapy, due to the increased risk of complications, particularly cerebral edema[4,34,35].

It is important to highlight some limitations of this study. Not all patients hospitalized for DKA could be included due to the lack of response to contact attempts, which reduced the number of hospitalizations analyzed. Therefore, the possibility of selection bias cannot be ruled out, which may limit the generalizability of the findings. Additionally, the accuracy of the nutritional status assessment may have been compromised, as the "height" variable was reported by the accompanying caregiver at the time of admission and not directly measured. For future studies, it is recommended to adopt different strategies to contact participants in order to increase the response rate. Furthermore, to ensure a more accurate assessment of the nutritional status of hospitalized children and adolescents, hospital routines should include direct height measurement. Moreover, some factors associated with DKA identified in other studies could not be evaluated in this study, as it was based on secondary data extracted from medical records. Information such as income, educational level, and ethnicity was not available in the reviewed records.

Findings related to the clinical and epidemiological profile of DKA can significantly contribute to the early diagnosis and management of the condition, especially considering that diagnostic delay is associated with worsening clinical outcomes. In this context, this study highlights the importance of knowledge about the epidemiology and clinical features of DKA as a basis for clinical decision-making.

DKA is considered a potentially fatal metabolic emergency. Understanding its characteristics and associated factors is essential for the development of prevention strategies, health education initiatives, and targeted interventions aimed at reducing the incidence and severity of DKA in pediatric populations. It is crucial to ensure continuous access to insulin and health education, with an emphasis on treatment adherence, infection prevention, and the early recognition of DKA signs and symptoms. In addition, it is critical to identify high-vulnerability groups, such as infants, adolescents, girls, and children and adolescents from low-income and/or low-education households. The implementation of targeted educational initiatives for healthcare professionals – addressing the nonspecific clinical presentation of DKA in certain contexts, risk factors, key predisposing elements, and preventive care strategies – can significantly contribute to improved diagnostic accuracy and reduced adverse outcomes.

CONCLUSION

The epidemiological profile was characterized by a higher frequency of hospitalizations during winter, predominance among adolescents, greater occurrence in females, and a mean age of 10.1 years. Regarding the clinical profile, the most frequent predisposing factors were missed insulin doses and infections, with insulin omission being more prevalent among adolescents. Among patients hospitalized due to first decompensation, classic T1D symptoms such as polydipsia, polyuria, and polyphagia were prominent. In contrast, among patients with a prior T1D diagnosis, nonspecific symptoms such as nausea and vomiting were more common. Most cases presented with mild to moderate acidosis, and electrolyte disturbances were the most frequent complications. The clinical protocols used were consistent with current recommendations, and a high occurrence of thinness was observed.

CRediT author statement

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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