

Original Article

# Diabetic Ketoacidosis In Children With Type 1 Diabetes: Behavioral Patterns And Clinical Manifestation As Predictive Factors

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ARTICLE INFO	ABSTRACT
<p><b>Article History</b>            Submit : May 5, 2023            Revised : Jun 16, 2023            Accepted : Oct 30, 2023</p> <p><b>Keywords:</b>            Diabetic Ketoacidosis,            Behavioral Patterns,            Predictive Factors,            Diabetes.</p>	<p><b>Background:</b> Type 1 Diabetes Mellitus (DM type 1) is occasionally becoming more common in Indonesia. According to the Indonesian Pediatrician Association (IDAI), as many as 1220 children in Indonesia had kind 1 DM in 2018. Lack of family education on type 1 DM might be fatal for sufferers. Diabetic ketoacidosis is one of the most prevalent side effects (DKA). Children can die if they do not receive care promptly. This study aims to detect behavioral trends and clinical manifestations in kids with type 1 diabetes to forecast the likelihood of developing DKA.</p> <p><b>Methods:</b> A qualitative phenomenology-based research design was adopted for this study. Unstructured interviews were used to gather the data, which was analyzed using the Van Manen method. Twenty-four participants are selected by saturation when all participant's answers are similar. All data was collected by recording on devices for 45-60 minutes to interview each participant.</p> <p><b>Results:</b> The findings revealed that the individuals' eating habits included consuming sugary drinks, buying prohibited items away from the house without their parent's knowledge, and eating portions that increased over time. Weight loss, frequent drinking, shortness of breath, and diminished consciousness are clinical symptoms.</p> <p><b>Conclusion:</b> The sooner the patient receives assistance to prevent his condition from worsening, the sooner the symptoms and behavioral abnormalities can be recognized.</p>

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## Introduction

High blood sugar levels caused by an inability of the body to create or utilize insulin are a symptom of diabetes mellitus type 1 (DM type 1). Type 1 diabetes is an autoimmune condition in which the body attacks the insulin-producing cells in the pancreas. As a result, the body cannot

manufacture its insulin and must instead rely on insulin from injections or insulin pumps to lower blood glucose levels. Patients with type 1 diabetes mellitus must check their blood glucose levels frequently throughout the day. With type 1 diabetes, diet, activity, and other factors affect how much insulin is needed and when it should



be administered to prevent hyperglycemia ([Rodríguez-Rodríguez et al., 2018](#))

Around 65,000 children under the age of 15 are diagnosed with type 1 diabetes worldwide—80% of those who were diagnosed with diabetic ketoacidosis out of the total above 13%. Saudi Arabia (44.9%), Taiwan (65%), Romania (67%), and the United Arab Emirates (80%) have the highest rates of DKA in people with type 1 diabetes. Sweden (14%) and Finland (22%) had the lowest percentages, followed by Hungary (23%), Canada (18.6%), and Canada ([Fitria Nusantara, Kusyairi, & Hafshawaty Pesantren Zainul Hasan, 2019](#))

The National Record for Diabetes Mellitus in children from the UKK Pediatric Endocrinology PP IDAI increased from about 200 people in 2008 to 580 in 2011. Sub-Section of Pediatric Endocrinology IKA FK UNS/Dr. Moewardi Hospital Surakarta, between 2008 and 2010, has data on sufferers DM aged children. As many as 11 patients with details of four died of diabetic ketoacidosis ([Rizwan Zuhriyah et al., 2016](#))

Although type 1 diabetes mellitus is an incurable condition, with adequate management, people can lead satisfying lives. The objectives of managing diabetes in children are to achieve good metabolic control, avoid acute and ongoing microvascular and macrovascular problems, and provide psychosocial support for the affected children and their families. Diabetic ketoacidosis is a critical complication that frequently happens in kids with type 1 diabetes mellitus. When children develop diabetic ketoacidosis, type 1 diabetes is diagnosed in 30% of them (DKA).

The most frequent acute complication of type 1 diabetes in children is diabetic ketoacidosis (DKA), which is brought on by an insufficient supply of insulin. Patients with DKA who are insulin deficient develop hyperglycemia, which can lead to fluid loss

through the urine, extracellular fluid loss, and electrolyte loss (sodium, potassium, and chloride). Due to this circumstance, DKA patients frequently have severe dehydration. The treatment of DKA entails administering continuous insulin and replacing lost fluids and electrolytes, particularly potassium. Insulin deficiency in newly diagnosed DM patients, noncompliance with insulin administration or anti-diabetic medication use, and increased insulin needs as a result of infection are the causes of diabetic ketoacidosis ([Febrianto & Hindariati, 2021](#))

## Methods

This study's design is a hermeneutic phenomenology approach to qualitative research design. Twenty-four parents from Probolinggo Regency who have children with type 1 diabetes mellitus participated in the study. Unstructured interviews lasting 45–60 minutes recorded on tape were used to gather the data. The results of the interviews were then transformed into data transcripts and subjected to a Van Manen analysis to be presented as themes and sub-themes. This research passed the ethical clearance test on the 1<sup>st</sup> of May 2019, with certificate number/047/STIKes-PZH/V/2019.

## Results

The study's findings provided information on pre-attack indicators and the timing of DKA attacks. Tables and narratives will be used to portray the data according to the specified study objectives:

Table 1. Distribution of Participant Frequencies

<i>Variables</i>	<i>n</i>	<i>%</i>
<i>Age of parent</i>		
- 30-40 years	15	62.5 %
- 41-50 years	6	25 %
- 51-60 years	3	12.5 %
<i>Education</i>		
- Elementary	3	12.5 %
- Junior High School	11	45.8 %
- Senior High School	10	41.7 %
<i>The length child had type 1 DM</i>		
- five years	7	29.2 %
- seven years	8	33.3 %
- nine years	6	25 %
- 12 years	3	12.5 %

**Behavioral Patterns of Type 1 DM Children as Predictors of DKA**

**Theme 1: Eating More Frequently and in Larger Portions**

According to participant interviews, children had different eating habits than usual before developing ketoacidosis; they tended to eat more frequently and in larger quantities. With larger amounts, eating frequency rose from the initial three times per day to five times per day.

**Theme 2: Purchasing restricted meals outside of the house without parents' permission**

According to the interview's findings, kids who typically do not eat anything outside of the diet program start to like buying food that's forbidden to eat but is covertly consumed at school, during prayer, and while playing.

**Theme 3: Consuming Sweet Drinks**

In addition to eating behavior more often and consuming taboo foods outside the home, children also become fond of sweet drinks such as sweet tea, coffee, and sweet fizzy drinks.

**Clinical Manifestations of Type 1 DM Children as Predictors of DKA**

**Theme 1: Urination Frequently**

According to the findings of participant interviews, children tended to urinate more frequently, especially at night, before going into diabetic ketoacidosis. BAK occurrence increases in frequency and number—the typical person BAKs over four times during the night.

**Theme 2: Drink a lot**

Participants reported that before having a ketoacidosis attack, kids complained of being thirsty and drank more frequently than normal, based on the findings of interviews.

**Theme 3: Weight loss**

The interview's findings also revealed that children with type 1 DM lost weight quickly and dramatically. An average person loses 3–4 kg of weight.

**Theme 4: Breathless**

The children show difficulty in breathing or shortness of breath when experiencing diabetic ketoacidosis. This situation made parents panic, so they were taken to the nearest health service.

**Theme 5: Decreased consciousness**

Participants explained that in addition to experiencing shortness of breath, the child also experienced a decrease in consciousness, which made the parents realize that the child had relapsed (experiencing diabetic ketoacidosis).

**Discussion**

**Behavioral Patterns of Type 1 DM Children as Predictors of DKA**

Theme 1: Eating more and more often



People with type 1 diabetes must make changes to their dietary habits to obtain effective metabolic control without sacrificing the calories required for daily activity, development, and puberty. Achieving effective metabolic control is crucial for individuals with type 1 diabetes; dietary modifications are vital in this process. Achieving the desired changes without compromising the essential calorie intake for daily activities, growth, and puberty is paramount. To achieve optimal health, being mindful of your food's quality, timing, and quantity is crucial. Achieving optimal blood sugar levels is possible for individuals with type 1 diabetes by incorporating a well-balanced diet and being mindful of the glycemic index of foods. For optimal health, avoiding sugary and simple carbohydrate-rich foods is crucial, which can lead to undesirable spikes in blood sugar levels. For optimal meal planning tailored to your unique needs and lifestyle as a person with type 1 diabetes, we highly recommend seeking guidance from a qualified nutritionist or diabetes specialist. Achieve effective metabolic control and maintain a healthy balance of calories with appropriate dietary changes, even if you have type 1 diabetes (Ana F N and Achmad K, 2020). One of the behaviors that people with diabetes frequently engage in is their inability to restrain their want to eat whatever they want without considering the food's nutritional value. Consuming foods high in glucose increases the chance that blood glucose levels will rise uncontrollably (Park et al., 2020). Patients may experience consequences from ketoacidosis as a result of this scenario. The secret to effective diet management is maintaining the same intake and diet before and after diagnosis (Rivellese et al., 2008) without ignoring the disease's current stage. This will ensure that the body's nutritional needs are met without leading to

complications from uncontrolled blood sugar levels.

## Tema 2: Buying Restricted Foods Outside the Home Without Parents' Permission

Eating behavior in people with type 1 diabetes mellitus, especially the age of the child, is very difficult to control, especially when the child is outside the home. This situation can be further complicated as they may be tempted by foods high in sugar or carbohydrates that can spike their blood sugar. In addition, children may feel alienated or different from their peers when limiting or regulating their food intake. Therefore, parents and educators need to provide the necessary support and education so that children with type 1 diabetes can manage their eating behaviors well, both inside and outside the home. With the right approach, such children can learn to make healthy food choices and maintain their blood sugar levels, thus effectively controlling their diabetes (Troncone et al., 2020).

Parents tend to arrange their children's food by bringing lunch when the child is going to school, for example, or when there are other activities outside the home. This prevents losing control over children's eating behavior outside the house without parental supervision. Therefore, to support the success of regulating children's eating outside the home, support and cooperation with parties related to children's activities or activities outside the home is needed, such as the school, including teachers and friends at school, neighbors around the house where children play with friends, and also other families (Fitria Nusantara & Kusyairi, 2019)

Patients with diabetes mellitus who do not follow their food plan are more likely to develop problems. The frequency of the issues can vary depending on how closely DM patients follow their food regimen

([Sami et al.](#), 2017). The idea behind the diet that is advised for DM patients is to fulfill three hours, namely the proper time, the amount, and the type of food.

### Theme 3: Consuming sweet drinks

One of the behaviors that predispose children to type 1 diabetes mellitus is the habit of drinking sugary beverages from a young age ([Mishra & Mishra](#), 2011). Young kids love artificially sweetened beverages like ale-ale, rio tea, and similar ones. It may develop into a negative habit that is harmful to children's health if the family does not regulate it. Parents are critical in helping children with diabetes manage their condition successfully. Parents need to know how to oversee their child is eating at home. It is important to constantly work on improving parents' knowledge and skills in caring for diabetic kids to adapt to the needs of kids' growth and development ([Tong et al.](#), 2021). Social media and the world of health are expanding quickly, making it simpler for parents to get as much information as possible to assist child care ([Bozzola et al.](#), 2022).

However, it is important to recognize the information-sharing function of health professionals. Health professionals must strengthen their skills to deliver reliable information regarding developing type 1 diabetes mellitus management since parents often trust information directly from health professionals ([Lehane et al.](#), 2019). The data they get must be accurate for parents' knowledge to increase. Parent. Information can be given in the form of health education, particularly regarding type 1 diabetes mellitus and topics about child care that parents can perform at home to prevent ketoacidosis (KAD) complications in children ([Kusyairi & Fitria Nusantara](#), 2020)

## Clinical Manifestations of Children with Type 1 DM as Predictors of DKA

### Theme 1: Urination Frequently

Patients with type 1 diabetes mellitus who develop complications from ketoacidosis will experience polyuria or a state of frequent urination. This is because glucose encounters obstructions to diffusion through the cell membrane pores and because of increased osmotic pressure in the extracellular fluid, which leads to osmotic water transfer ([Große et al.](#), 2018). the cell; leaving. Diabetes can be treated adequately and following the suggested standard of therapy to prevent diabetic ketoacidosis complications. The majority of the type 1 diabetics in this study were young children who were unable to manage their diabetes care on their own. As a result, the family's role—particularly the cohabiting parents who looked after their children—became crucial in treating DM at home ([Kimbell et al.](#), 2021). Complications are highly correlated with parents' knowledge of diabetes care. Problems can be reduced, and symptoms can be detected early if parents can arrange child care at home and attentively follow therapeutic management.

The success of the diabetes mellitus therapy regimen also depends on the patient's compliance. Children need to be taught early on about diseases and how to take daily care at home. Knowledge can be obtained through health education to patients through information about adjusting insulin during illness, controlling blood glucose and ketone levels, and the importance of medication adherence. With sufficient information about the management of therapy, it is hoped that patients will be aware of the importance of good compliance. An early understanding can be a good habit to support patient compliance ([Westerberg](#), 2013)

## Theme 2: Drink a lot

Diabetic ketoacidosis develops when the body's tissues receive less glucose, which causes hyperglycemia and an increase in fatty acids. As some of these fatty acids are converted to ketones, metabolic acidosis, and ketonuria are brought on. Diabetics' urine, also known as glucosuria, contains glucose. Excess glucose levels cause glucosuria because they are finally eliminated through the urinary tract as urine. This disorder results in the patient having polyuria and polydipsia and is accompanied by an excessive loss of fluid and electrolytes (Ridwan, et al. 2016). The osmotic transfer of water from the inside of the cell to the hypertonic extracellular fluid results in dehydration because the body's cells lose a significant amount of water, which results in dehydration. Therefore, the body's attempt to compensate for dehydration results in polydipsia (excessive thirst). Due to the osmotic diuresis effect, patients with diabetes mellitus tend to drink a lot.

Diabetic ketoacidosis is a common complication for people with type 1 diabetes mellitus, particularly in children who have just been diagnosed. In fact, in the majority of cases of DKA that happened in the past, the child's type 1 diabetes was unknown. Parents must be aware of and understand the clinical signs and symptoms of ketoacidosis as their children's partners in managing diabetes. The earlier it is identified, the sooner the kid will receive medical attention.

## Theme 3: Weight loss

As a result of the body's inability to use glucose as an energy source, protein, and fat are mobilized more often. As a result, patients with diabetes mellitus who are mismanaging their medication or are not receiving treatment will lose much weight and have an energy deficit. Although eating

frequently and in large portions often results in weight loss, this condition is known as polyphagia (Guyton & Hall, 2008). If frequent and effective diabetes treatment is not provided, this metabolic illness can lead sufferers to lose a lot of body tissue and pass away within a few weeks.

One of the foundations of managing diabetes mellitus and a key factor in establishing adequate glycemic control is diet management. Diet treatment seeks to control the body's nutritional requirements following the patient's condition to maintain a proper nutritional status. Regular dietary habits and nutritional intake tailored to individual needs can support healthy metabolism and stable weight maintenance. Patients with diabetes mellitus must satisfy their body's dietary requirements without causing their blood glucose levels to rise. The 3Js, or the right time, the right amount of nutrition, and the right kind of food that has been programmed must all be met for the DM diet idea to work.

Patients with type 1 diabetes mellitus who lose weight have a higher risk of developing DKA. The prevalence of ketoacidosis and body mass index have been linked in several research. Patients with diabetes mellitus who follow diets that are not suitable for them or that are incorrect for them risk having their health deteriorate, leading to complications. Most people with DM make mistakes in diet settings due to a lack of understanding. Patients regulate their diet with the concept of us instead of using a predetermined measuring instrument, and the fear of rising blood sugar due to the patient's lack of nutritional needs and weight loss accompanied by a decrease in body mass index below normal. Patients with diabetes mellitus with a body mass index (BMI) below the standard, average body weight,

and high anion gap are more likely to experience recurrent DKA.

#### Theme 4: Breathless

Switching from carbohydrate metabolism to fat metabolism in people with diabetes can increase the release of keto acids such as acetoacetic acid and -hydroxybutyric acid into the plasma beyond the rate of uptake and oxidation by tissue cells. The excess of keto acids causes the patient to experience severe metabolic acidosis, which is indicated by the presence of Kussmaul respiration in the patient. Kussmaul breathing is deep and heavy breathing that occurs because of the need to increase the excretion of carbon dioxide as a form of compensation for the body against a state of metabolic acidosis ([Manda Sari FE, 2009](#))

Kussmaul breathing is a form of respiratory disorder in the form of a change in the breath that becomes very deep and heavy due to an increase in carbon dioxide excretion; in a state of severe ketoacidosis, it can show a normal or decreased frequency ([Amananda, 2017](#))

The results of the assessment and physical examination in patients with diabetic ketoacidosis who have decreased consciousness show the presence of dehydration, Kussmaul breathing, and the smell of acetone in the breath that leads to the diagnosis of DKA. Patients who experience a state of para metabolic acidosis, come with a characteristic fast and deep breath (Kussmaul breathing) ([Iddi et al., 2017](#))

Patients with type 1 diabetes mellitus frequently have diabetic ketoacidosis. DKA is a common emergency that can result in patient mortality. When DKA patients visit the emergency room, they frequently have respiratory issues in addition to a lower level of awareness. Breathing with unusually heavy and deep inspiration

phases indicates respiratory problems. Patients with severe metabolic acidosis frequently exhibit their typical rapid and deep breathing when they first arrive ([Iddi et al., 2017](#))

#### Theme 5: Decreased consciousness

Decreased consciousness is a condition in which the body experiences a decrease or does not have good sensitivity to oneself, needs, the environment, and the level of response to external and internal stimulation. The main causes of LOC (loss of consciousness) in people with diabetes mellitus are diabetic ketoacidosis, hyperosmolar hyperglycemic state, lactic acidosis, uremic encephalopathy, and hypoglycemia. Acidosis is a condition that affects the excitability of cells and can progress to a decrease in consciousness. In this situation, the loss of consciousness can occur progressively, which can cause the patient to fall into a coma when experiencing severe DKA. This situation is a life-threatening emergency condition ([Huang, 2016](#))

Specific therapy for the state of decreased consciousness in patients with DKA is necessary to reduce the mortality rate for these complications, including correction of dehydration, hyperglycemia- ketonemia, and electrolyte disturbances that occur, identifying precipitating factors and monitoring patients closely ([Huang, 2016](#))

The condition of decreased consciousness in children can be prevented if parents have good knowledge and high sensitivity about the clinical manifestations of ketoacidosis so that children are treated more quickly by being taken to health services before experiencing a decrease in consciousness.

### Conclusion

The behavioral indicators of children with Type 1 Diabetes Mellitus as predictors

of Diabetic Ketoacidosis (DKA) can be observed through certain actions and habits. One such behavior is the tendency to eat more with larger portions, which may be an attempt to compensate for the insulin deficiency in their bodies. Additionally, children with Type 1 Diabetes Mellitus may engage in the act of buying forbidden foods outside the home without their parents knowing, possibly driven by cravings or a desire to fit in with their peers. Another behavioral indicator is the consumption of sweet drinks, which can lead to unstable blood sugar levels. In terms of clinical manifestations, several symptoms may arise in children with Type 1 Diabetes Mellitus who are at risk of developing DKA. These symptoms include urination frequently, excessive thirst, unexplained weight loss, shortness of breath, and a decrease in consciousness or mental alertness. However, with adequate knowledge, understanding, and collaboration between parents and children, the risk of DKA can be mitigated by improving adherence to diabetes management protocols at home.

### Authors Contributions

Author A contributed to compiling articles; Author B contributed to customizing pieces with templates; Author C contributed to submitting articles to journals; Author D contributed to translating the articles into English.

### Conflicts of Interest

There is no conflict of interest.

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