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ORIGINAL ARTICLE

Frequency of Common Risk Factors of Recurrent Diabetic Diabetic Metabolic Acidosis among Children

WASIM ABBAS[1], FARMAN ULLAH[2], ASFAND TARIQ[3], TAJ MUHAMMAD[4], NIGHAT JABEEN[5], ZARMAST KHAN[6]
[1]*Consultant paediatrician, Paediatric department, Thehsil Head Quarter Hospital Nowshera Virkaan, Gujranwala, Punjab*
[2]*Associate Professor, Department of Paediatrics, Gomal Medical College Dera Ismail Khan*
[3]*Assistant Professor of Paediatrics, Shaikh Zayed Hospital Lahore*
[4]*Assistant Professor, Department of Paediatrics, Gomal Medical College Dera Ismail Khan*
[5]*Assistant professor Pediatrics, Al Tibri Medical College, Karachi*
[6]*Associate Professor of Paediatrics, NiaziMedical and Dental College, Sargodha*
Corresponding author: Farman Ullah, Email: Ufarman310@gmail.com

ABSTRACT

Background: Diabetic metabolic acidosis (DKA) is a serious dilemma for diabetics that arises when the body cannot create sufficient insulin**.** associated withboth the main subtypes of diabetes. It is characterized by an elevation in blood glucose concentrations, combined with the presence of ketones and acidosis symptoms. The frequency of DKA episodes among children with T1DM can vary widely depending on several factors, such as age and duration of the disease, adherence to treatment regimens, frequency of medical visits, and access to health care. The frequency of common risk factors for recurrent DKA has not been well studied.

Objective: To estimate the prevalence/frequency of common risk factors of recurrent Diabetic metabolic acidosis in infancy,toddlers,preschoolers and teenaged with diabetes.

Method: This epidemiological study explored the relationship between Type 1 Diabetes Mellitus (T1DM) and risk factors associated with life-threatening recurrent diabetic metabolic acidosis. Careful examination of medical records, laboratory results, physical exams and more were conducted on 0-18 year old children admitted to a public reference/tertiary care hospital in Pakistan over one year's time.Through bivariate and multivariate Poisson regression analysis, researchers sought to uncover patterns in age groups as well as doctor visits frequencies rate and treatment plans related to T1DM development among infancy, toddler hood through preteen years.

Results: Our study of 456 patients uncovered a connection between infections, consistent healthcare visits, following prescribed medication instructions, and DKA episodes. Significantly higher rates of multiple DKA incidents were observed among those who had missed one or more medical appointments compared to regular attendees. Of the participants surveyed 63% reported taking their medication as instructed while 24% admitted to missing doses or not heeding dosage directions correctly. These results emphasize that proper management is key in preventing severe health complications such as diabetes-related acidosis attacks for diabetes sufferers worldwide

Conclusion: Our data suggest that recurrent DKA in children with T1DM can vary significantly based on numerous factors, including age, disease duration, medical visit frequency, and medication adherence. Therapies may be able to alleviate this. To understand the impact of recurrent DKA rates in T1DM children, additional research is required.

Keywords: Frequency of common risk factors; recurrent diabetic diabetic metabolic acidosis; children with type 1 diabetes mellitus

INTRODUCTION

Pakistan has the world's highest diabetes rate at 25%.This alarming statistic suggests that the country's healthcare system needs to be improved for diabetics.33 million adults in Pakistan have diabetes and this number is expected to rise to 57 million by 2045.The number of people living with diabetes is highest in China (140 million) and India (74 million). In particular,type 1 diabetes can be life-threatening, and it is crucial that those with it are properly treated.In Pakistan,diabetes will be the cause of 400,000 deaths by 2021.

Pakistan is ranked third worldwide for the third-highest diabetes prevalence with estimate,38% increase from 2019 by IDF. A 70% increase since 2019. In 2021, diabetes will be responsible for 400,000 deaths in the country- the highest number over the north mediteranian region.Type 1 diabetes mellitus (T1DM) usually occurs due to insulinopenia either secondary to the autoimmune process (as in most cases) or idiopathic.(1,2).Insulin-producing beta-cells of the pancreas are attacked by the body's immune system during an autoimmune process that causes type 1 diabetes. As a consequence, the body generates little or no insulin.The mechanisms of this damaging process are not entirely known, but it is believed that a combination of hereditary predisposition (provided by a large number of genes) and an environmental trigger, such as a viral infection, prompt the autoimmune response. The illness may develop at any age, but children and young people are the most susceptible. Childhood type 1 diabetes is one of the most prevalent chronic disorders. In addition to older children, type 2 diabetes is becoming increasingly prevalent in certain nations as childhood obesity and overweight grow more prevalent. Living with type 1 diabetes is challenging for a kid and their family even within countries where they have access to several daily injections or an insulin pump, glucose monitoring, systematic diabetes education, and top-notch medical care.Inadequate glycemic management may lead to poor progress and the development of cardiovascular (or "vascular") concerns at an early age, in addition to the acute complications of hypoglycemia (abnormally low blood glucose) and DKA.To ensure proper diabetes management, avoid metabolic complications, and reduce the risk of long-term vascular damage, families of children with type 1 diabetes must have access to high-quality medical care, education, and support services.

Furthermore, a child's successful diabetes management may depend on the social support of family and friends.They could live a normal life with regular insulin treatment, persistent blood glucose monitoring, education, and support. and delay or prevent many diabetes complications.Although we treat a large number of children with Type 1 diabetes in Pakistan, we do not have local data about the exact incidence or prevalence of the disease there. According to the International Diabetes Federation, in 2022, 26.7% of adults in Pakistan will be affected by diabetes. Among the country's most neglected health issues is DKA.

Listed in Figure 1.1 are the typical signs and symptoms of type 1 diabetes. However, if the typical clinical picture of excessive thirst (polydipsia), frequent urination (polyuria), and weight loss is absent, the diagnosis may be made later or even not at all. Extreme fatigue, unhealing wounds, increased hunger (polyphagia), and blurred vision are additional indications of type 1 diabetes. These signs and symptoms frequently appear quickly, usually within two to three weeks, and can be very severe.

Research into the common risk factors of recurrent diabetic diabetic metabolic acidosis among children in Pakistan has become increasingly important due to the rising prevalence of type 1 diabetes in the region. Results from a number of studies have demonstrated that inadequate glycemic control, not taking insulin as prescribed, and insufficient medical attention are the most frequent causes among children diagnosed with recurrent diabetic diabetic metabolic acidosis. In addition, other studies found that sub optimal carbohydrate intake and nephropathy were also frequent risk factors associated with recurrent diabetic diabetic metabolic acidosis in this population. Consequently, more comprehensive awareness campaigns and improved healthcare measures should be prioritized to limit the risk of developing recurrent diabetic metabolic acidosis in Pakistani children with type 1 diabetes.An increased risk of recurrent DKA has been consistently linked to poor glycemic control,as indicated by high HbA1c levels. As a result, it's critical for people with diabetes to closely monitor their blood sugar levels and work towards the recommended target levels.

Infections: Respiratory and urinary tract infections, in particular, frequently cause DKA.People with diabetes should adhere to fundamental health and hygiene rules to avoid getting sick, such as washing their hands frequently, avoiding close contact with sick people, and seeking medical attention if they think they might have an infection

Stress: Stressful situations can interfere with insulin management and result in DKA, such as hospitalization or schedule changes.Therefore, it's crucial to be aware of how stress can affect blood sugar levels and take action to lessen stress when possible. Additionally, people with diabetes need to closely monitor their blood sugar levels and take the necessary actions to keep their blood sugar under control.(7,8,9)

Non adherence to insulin therapy: Children and adolescents who do not follow their insulin therapy regimen, whether it be due to forgetfulness, disobedience, or other factors, are more likely to experience recurrent DKA.To prevent the recurrence of DKA, people with DKA and those who care for them must pay close attention to their insulin regimens, diet, and exercise.(10,11,13)

Lack of access to healthcare: Children and teenagers living in areas with poor access to healthcare are more likely to suffer from recurrent DKA because they can't get help when needed. People with diabetes should schedule regular appointments with their healthcare provider, follow any prescribed insulin therapy strictly, and pay close attention to their diet and exercise to maintain control of their blood glucose.Adolescents and children with behavioral issues, such as substance abuse or mental health problems, may find it challenging to adhere to the suggested diabetes management plan, increasing their risk of recurrent DKA.Therefore, the person with DKA and their carers must be both aware of any risk factors that could result in recurrent DKA and take action to prevent it.

Objective: To estimate the prevalence/frequency of common risk factors of recurrent metabolic acidosis in infants and teenagers with IDDM as well as NIDD.

MATERIAL AND METHODS

At a public/tertiary care hospital in Pakistan, 480 people with insulin dependent diabetes mellitus, were enrolled for a combined retrospective and prospective analysis from June 1, 2020, to May 31, 2021. All patients with type 1 diabetes admitted between June 1, 2020, and May 31, 2021, were included in the study.The study was limited to those with type 1 diabetes and did not include patients with hypoglycemia resulting from other conditions.Patients were diagnosed with diabetes if their fasting blood sugar was 126 mg/dL or 200 mg/dL in conjunction with hyperglycemia,drinking excessively, losing weight, and eating excessively.A blood sugar level of 250 mg/dL or above was considered to be diabetic (19). Based on general health, bicarbonate levels of less than 18 mmol/L, acidification (arterial pH 7.3), and ketosis or Acetonuria, DKA is diagnosed (20). It was classified as mild (PH=7.25-7.35 and HCO3=15-18) or moderate (PH=7.15-7.25 and HCO3=10-15) With relation to arterial blood bicarbonate and pH (HCO3), and the length of treatment depended on how long it took to correct the DKA.

pH>7.3, absence of nausea and vomiting, serum sodium between 135 and 145 mEq/L, and HCO3>15 or Pco2>16 were regarded as DKA resolution (1,2,3).

Upper and lower respiratory infections, gastroenteritis, urinary tract infections, and poor compliance, which included not injecting insulin, forgetting to inject insulin, or receiving the incorrect insulin dose for hyperglycemia, were risk factors (4).

Studies of the files, blood culture, and urine revealed the existence of infections.

Additionally, the number of acute complications was noted for each patient.

The required information included the number and duration of hospital stays, age, gender, newly discovered or confirmed cases of pre-existing diabetes, and the correlation between the parents,the reason for admission (diabetic ketosis, high blood sugar, or hypoglycemia), the intensity and length of metabolic ketosis, glycemic levels while in the hospital , the severity of acidosis, the season of referral, where you live, and the co-infection.

Patients' weight was recorded with an accuracy of 100 g on a weighing scale, and their heights were measured with a precision of 1 mm on a stature calculating board.

BMI is determined by dividing your weight in kilograms by your height in meters. But it's important to remember that BMI doesn't show how healthy and fit a person is overall.

When SPSS version 23 was used to look at the data, the mean, standard deviation, number, and percentage were used to describe the quantitative variables.

A X ^{2}/X-square test twas conducted to assess the relationship between qualitative and quantitative variants, while ANALYSIS OF VARIANCE was performed on quantifiable variables within the three groups.

The significance level of p0.05 was considered to be significant.

RESULTS

This study looked at 480 diabetic patients, 230 of whom were new, and 255 of whom had been seen before. The patients were found to have a mean age of 7.1 years, 3.27 years, 8.37 years, and 3.51 years when they were diagnosed and admitted to the hospital.in the age brackets of five to eight years, more than eight years, and older, respectively.20.3%, 19.7%, and 60% of patients were female, making up 302 patients (62.9%). Those hospitalized ranged in age from 2 months old on the low end to 17 years old on the high end. Patients had a mean body mass index of 16.98 3.82 kg/m2, a mean height of 127.646+/- 22.974 cm, and a average body weight of 28.96+/- 12.58 kg.statistically significant (p 0.001) correlation between patients' gender and the underlying medical condition that led to their hospitalization (hyperglycemia, hypoglycemia, or diabetic diabetic metabolic acidosis).

Table 1. Demographic information of hospitalized patients with type 1 diabetes

Variables	Hyperglycemia (n=213)	Hypoglycemia (n=46)	Diabetic ketoacidosis (n=221)	p-value
	Number(%)	Number(%)	Number(%)	
Age				
Less than 5 years	38(17.8)	7(15.2)	49(22.2)	
5-7 years	39(18.3)	11(23.9)	48(22.7)	0.471
Greater than or equal to 8 years	136(63.8)	28(60.9)	124(56.1)	
Gender				
Boy	100(46.9)	14(30.4)	64(29.0)	<0.001
Girl	113(53.1)	32(69.6)	157(71.0)	
Weight* (kg)	29.6±13.9	27.9±10.5	28.4±11.8	0.596
Height* (cm)	129.1±23.8	127.9±23.5	126.1±22.3	0.496
Body mass index* (kg/m2)	17.0±5.2	16.6±1.7	17.0±2.8	0.848

*Numbers are reported as Mean±SD.

Autumn had the highest hospitalization rate (30.4%, 146 patients). Diabetic diabetic metabolic acidosis hospitalized 221 patients (46%). The number of patients hospitalized with hyperglycemia was 213 (44.4%), and the number of patients hospitalized with hypoglycemia was 45 (9.6%). A kin relationship existed between the Twenty-seven percent of patients' parents. Among those who had type 1 diabetes, 14.7% had a family history of the disease. A total of six families had two or three children infected. There were 141 cases (29.3%) of concomitant infections. There were 25, 23, and 93 patients, respectively, with gastroenteritis, urinary tract infection, and upper or lower respiratory tract infection. The average number of hospitalization days per patient was 5.36 2.92. The patients' total mean blood glucose level was 420.29191.20 mg/dL. Compared to city dwellers, villagers had a higher rate of hospitalization (1.92x2.53), and the number of hospitalizations and days of hospitalization were longer in villagers than in cities. Diabetes-related hospitalizations resulting from DKA, hypoglycemia and hyperglycemia were 5.61%, 26.9% and 5.08% per 100 patients per year, respectively. In addition to hypoglycemia, 14%, 14.6% and 14.7% of patients were hospitalized twice or more for DKA and hyperglycemia, respectively. The hospitalization season, disease status, concomitant infection, number of hospitalization days, and blood sugar level were significantly related to the cause of hospitalization (p0.05) (Table 2).

Table 2. Factors examined in hospitalized patients with type 1 diabetes

Variables	Hyperglycemia (n=213)	Hypoglycemia (n=46)	Diabetic ketoacidosis (n=221)	p-value
	Number(%)	Number(%)	Number(%)	
Season				
Spring	66(31.0)	16(34.8)	50(22.7)	
Summer	41(19.0)	17(37.0)	46(20.9)	0.008
Autumn	60(28.2)	6(13.0)	80(36.4)	
Winter	46(21.6)	7(15.2)	44(20.0)	
Average age* (years)	8.8±3.6	8.8±3.4	7.8±3.3	0.006
Disease status				
New	85(39.9)	2(4.3)	139(62.9)	<0.001
Known	128(60.1)	44(95.7)	82(37.1)	
Kin relationship				
Related	59(34.9)	20(46.5)	54(25.6)	0.012
Non-related	110(65.1)	23(53.5)	157(74.4)	
Positive history of type 1 diabetes in the family	62(29.7)	8(17.4)	44(20.7)	0.050
Residence				
City	128(61.0)	33(71.7)	142(64.3)	0.370
Village	82(39.0)	13(28.3)	79(35.7)	
Concomitant infections	42(22.7)	6(15.8)	93(47.7)	<0.001
Days of hospitalization*	4.1±2.4	2.5±1.3	6.6±2.1	<0.001
Blood sugar* (mg/dl)	397.8±150.7	79.8±104.0	510.2±151.4	<0.001
Number of hospitalizations				
Once	182(85.4)	42(91.3)	190(86.0)	0.571
Twice or more	31(14.6)	4(8.7)	31(14.0)	

*Numbers are reported as Mean±SD.

It has been our experience that our patients with diabetes frequently suffer from acute complications (diabetic diabetic metabolic acidosis and severe hypoglycemia).diabetic metabolic acidosis is said to be linked to the majority of newly diagnosed cases of diabetes. Many patients failed to administer insulin adequately, and many were infected simultaneously.The incidence of diabetic metabolic acidosis was determined to be 8 per100 diabetic patients per year, according to an analysis by Shraga et al.,and 5% of patients experienced a recurrence of diabetic metabolic acidosis.diabetic metabolic acidosis happens more often in female patients than in male patients.Female patients who suffered diabetic metabolic acidosis were also more likely to experience a recurrence than their male counterparts.One possible explanation is that women are more prone to ignore their doctor's advice when it comes to controlling their diabetes, which increases their chance of having serious complications. A greater mortality rate was also seen in DKA (6). Hospitalizations due to DKA were recorded at a rate of 5.61 per 100 patients in this study, which is greater than the rate reported in the previous study.

Furthermore, the incidence of diabetic metabolic acidosis was higher in females, with 13.7% of patients having diabetic metabolic acidosis twice or more per year. Karges et al. research .'s of 31,330 people with diabetes indicated that 4.81 per 100 people with DKA were hospitalized annually. We found that the proportion of females hospitalized with DKA was higher than that of males. Our study found that individuals with diabetic metabolic acidosis were most often aged eight and up (55.4%). Variation in reported rates of diabetic metabolic acidosis among research may reflect methodological discrepancies between studies or patient heterogeneity concerning diet, daily blood sugar control, insulin regimens, etc. (4).

Diabetic diabetic metabolic acidosis and very low blood sugar were common in our patients.

The development of severe diabetic metabolic acidosis has been associated with the majority of newly diagnosed cases of diabetes. Many people with diabetes did not take their insulin as prescribed and were simultaneously infected.

Despite having a high incidence of diabetes, countries like Sweden, Australia, and the United States have low rates of secondary DKA and recurring DKA. On the other hand, secondary/recurrent DKA is more common in various East and Southeast Asian countries. Most likely, this is because fewer people have convenient entry to high-quality medical treatment and diabetes education. This means that the symptoms of DKA may go unrecognised. Further, they may delay seeking care, which can increase the number of people who experience secondary or recurring DKA. Age, location, income, diet (especially the lack of fruits and vegetables), exercise, and the use of insulin pumps are all factors that contribute to poor blood sugar management in people with diabetes. A long history of poorly controlled diabetes has been linked to a younger age at diagnosis, according to several studies (16-18). For this reason, glycemic control relies heavily on prompt treatment and proactive diabetes care to forestall the occurrence of subsequent DKA. The younger a person is when they are diagnosed with diabetes, the longer they will have to deal with it, increasing the likelihood that they will experience DKA again and again. As a result, early diagnosis and treatment are essential for maintaining stable blood sugar levels.

From a sample of 118 individuals with diabetes in India, 62.7% were female in the study by Varadarajan et al.

In our study, we also found that the average age of onset for DKA was 8.5 years. UTIs, skin infections, pneumonia, bronchitis, and sepsis accounted for 61 cases (56%). One study found that infections were the cause of 35% of all new instances of diabetes. In 48% of cases, a coexisting infection was reported as the cause of diabetic metabolic acidosis in patients with known diabetes; in 14% of cases, infection and poor compliance were recorded as the causes; and in 36% of cases, poor compliance was reported as the sole cause. The incidence of skin infections was greater in previously diagnosed patients than in newly identified ones. Patients impacted by infections fared worst (13).

The average age of onset of diabetic diabetic metabolic acidosis was reported to be 7.83.3 years in this study. Twenty percent of individuals with diagnosed diabetes experienced diabetic metabolic acidosis due to inadequate insulin treatment. In addition, pulmonary infections were the most common kind of DKA infection among the hospitalised patients (representing 29.3% of all DKA infections). Cengiz et al. observed that 49% of the 13487 people with diabetes in their study were female. The average

lifespan of a diabetic is six years, and a high percentage of diabetics are between the ages of 13 and 18. Our patients had a higher rate of recurrent DKA.

Patients who are diagnosed with diabetes at a younger age have a greater chance of experiencing DKA in the future. More patient-focused research is needed to determine the root cause of these occurrences (14,15).

Patients in the study by Westerberg et al., which included 28770 people with diabetes, had a mean age of 13.963.93 years and were predominantly male (52.1%). The annual rate of new cases of diabetes was 6.29 per 100 people. Only 4.85% of the cases had experienced only one episode of DKA, while 1.3% had experienced two or more bouts. Females and foreign-born people had greater rates of DKA and hospitalised days. Diabetic diabetic metabolic acidosis was also more likely in patients with older ages at diagnosis and longer durations of diabetes (3). We found differences between this study and our own in terms of gender-based prevalence, mean age, and percentage of hospitalisation.

High rates of diabetic metabolic acidosis (55.5%) were seen in the study by Alijanpour Aghamaleki et al., in which nearly half of the patients were male. Patients had a mean age of 8.573.27 years old, and summer saw the highest rate of hospitalisation. A total of 103 people were diagnosed with diabetes for the first time, while another 25 already had the disease.

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