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Original Research Article

Risk Factors for Hypoglycaemia in Acute Gastroenteritis in Children Under Five Years of Age

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Abstract: *Acute gastroenteritis (AGE) in children is one of the leading health problems, especially in developing countries.* ***Objective:*** *To find the frequency of hypoglycemia in Acute Gastroenteritis in children under five years of age.* ***Methods:*** *This Descriptive case series was conducted at the Pediatrics Medical Emergency Department, Children Hospital, and the University of Child Health Sciences Lahore from November 2024 till May 2025. Data were collected through a Non-probability consecutive sampling technique.* ***Results:*** *Data were collected from 200 patients. The results show no significant difference in mean age, gender distribution, or sex proportions between cases and controls, as indicated by p-values >0.05. However, mean weight was significantly lower in cases (12.4 ± 2.1 kg) compared to controls (13.5 ± 2.0 kg), with a p-value <0.05. Additionally, mean blood glucose levels were significantly lower in cases (48.3 ± 7.5 mg/dL) than in controls (85.7 ± 12.4 mg/dL), with a highly significant p-value <0.001. No dehydration was observed in only 5% of cases compared to 25% of controls, with a p-value <0.01. Severe dehydration was significantly higher in cases (30%) than in controls (10%), with a highly significant p-value <0.001.* ***Conclusion:*** *It is concluded that severe dehydration and severe malnourishment are important risk factors associated with the condition under study.*

Keywords: Acute Disease, Blood Glucose, Child, Preschool, Gastroenteritis, Hypoglycemia

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Introduction

Acute gastroenteritis (AGE) in children is one of the leading health problems, especially in developing countries. It is the second most common life-threatening condition worldwide among all infectious diseases in children under five years of age. Globally, almost 10.6 billion children die per year before reaching five years of age, and 20% of deaths are caused only by gastroenteritis. (1) Even though dehydration and electrolyte imbalance are considered fatal impediments of acute diarrhea, a non-dehydrating problem like hypoglycemia is of equal importance. The simultaneous presence of severe dehydration and hypoglycemia in patients with acute gastroenteritis worsens the clinical prognosis. (2)

Hypoglycemia in non-diabetic children is a common emergency presentation with acute disease. The reason for hypoglycemia in critically ill children is not well understood. Still, it can be due to cytokine-induced impairment of gluconeogenesis, impaired counter-regulatory hormone response, and depletion of glucose stores in starvation. (3) In many cases of acute gastroenteritis, severe dehydration and hypoglycemia can develop in cases of prolonged vomiting and diarrhea. (4)

The clinical signs and symptoms of hypoglycemia can be further divided into neuroglycopenic or neurogenic. Neuroglycopenic manifestations include behavioral changes, confusion, fatigue, seizure, coma, and potential death if not immediately corrected, while neurogenic signs and symptoms can be tremors, palpitations, or anxiety. (5, 6) Moreover, hypoglycemia in children with acute gastroenteritis and dehydration causes consumption of glycogen stores, resulting in the inability to use substrate even in the absence of vomiting. The longer a child remains fasting or unable to tolerate feed or ORS, the higher the risk of hypoglycemia, which eventually can lead to seizures due to neuroglycopenia. (7) The major long-term sequel of severe, prolonged hypoglycemia is neurological damage resulting in mental retardation, cognitive impairment, neurological deficit, and recurrent seizure activity. (8) Hypoglycemia is a true medical emergency. Delayed diagnosis and treatment put affected patients at risk for acute and chronic neurologic complications. (9)

The longer duration of vomiting and the rotavirus infection are also commonly associated with hypoglycemia. (10) A previously conducted study by Samuel Ried et al showed that out of one hundred and eighty-four children enrolled in the study, the frequency of hypoglycemia was 33.7%. The longer duration of vomiting caused hypoglycemia in patients with diarrhea (49%), and home rehydration with water also played a significant role in diarrheal illness, causing hypoglycemia (50%). (11) Children with a longer duration of illness of more than 48 hours were more prone to hypoglycemia. Similarly, moderate to severe dehydration also played a significant role in causing low BSR (10%) (12)

In a previous retrospective study conducted in the emergency department of Tawam hospital by Suha Hadi et al, the most common associated diagnosis with hypoglycemia was acute gastroenteritis in 152 (77%) of patients. Growth parameters were recorded in 173 (88%) patients; 39 (22%) of them had a weight-for-length ratio or body mass index at or below <5th percentile. All symptomatic children were under five years of age. (13) The relation between hypoglycemia and AGE has been seen in many previous studies. Still, the cause behind the association between AGE and hypoglycemia was not established, and no local data are available in this regard. (3) Hence, this case-control study will establish certain risk factors for hypoglycemia in children under five years presenting with AGE by determining their glucose levels prior to treatment. This will help identify the pediatric population who are at high risk of developing hypoglycemia due to AGE. So that timely identification and correction can prevent its short- and long-term complications.

Thus, this study was conducted

1) To find the frequency of hypoglycemia in Acute Gastroenteritis in children under five years of age.
2) To compare the frequency of various risk factors in children under five years of age with Acute Gastroenteritis with and without hypoglycemia.

Methodology

This Descriptive case series was conducted at the Pediatrics Medical Emergency Department, Children's Hospital, and the University of Child Health Sciences Lahore from November 2024 to May 2025. Data were collected through Non non-probability consecutive sampling technique.

Inclusion Criteria

- All the patients with acute gastroenteritis
- Age 1 year to 5 years
- Children of both genders male and female

Exclusion criteria:

- Children with a known disorder that would predispose them to hypoglycemia, e.g., a primary hypoglycemic disorder, insulin therapy, liver disease, hypothyroidism, hypopituitarism, or congenital heart disease.
- Children having ambiguous genitalia
- Children taking antibiotics already
- Children who have had intravenous rehydration done within 24 hours of presentation

Study Groups

Cases: All patients of acute gastroenteritis with hypoglycemia fulfilling the inclusion and exclusion criteria

Control: All patients of acute gastroenteritis without hypoglycemia fulfilling the inclusion and exclusion criteria

After obtaining approval from the Institutional Ethical Review Committee, eligible patients presenting to the Pediatric Emergency Department were enrolled in the study. Caregivers were informed about the study's purpose and procedures, and their consent was obtained. Blood glucose levels were measured at presentation, and those identified as hypoglycaemic received an intravenous bolus of 10% dextrose water at a dosage of 5–10 ml/kg. Data collection was facilitated using a structured questionnaire that included demographic and clinical information. Variables recorded included age, gender, weight, height, blood glucose levels, and risk factors such as the number of vomiting episodes exceeding diarrhea, illness duration exceeding 48 hours, moderate to severe dehydration, severe malnourishment, and administration of plain water instead of low-osmolar ORS by caregivers.

The collected data were analyzed using SPSS version 25.0. Numerical variables, including age, blood glucose levels, illness duration, weight, height, and the number of vomiting and diarrhea episodes, were expressed as mean ± SD. Categorical variables, such as gender, degree of malnourishment, and grade of dehydration, were analyzed using percentages or frequencies. Logistic regression was used to compare means between cases and controls, and odds ratios were calculated for categorical variables. A p-value of <0.05 was considered statistically significant for all tests.

Results

Data were collected from 200 patients. The results show no significant difference in mean age, gender distribution, or sex proportions between cases and controls, as indicated by p-values >0.05. However, mean weight was significantly lower in cases (12.4 ± 2.1 kg) compared to controls (13.5 ± 2.0 kg), with a p-value <0.05. Additionally, mean blood glucose levels were significantly lower in cases (48.3 ± 7.5 mg/dL) than in controls (85.7 ± 12.4 mg/dL), with a highly significant p-value <0.001.

Table 1: Demographics and Baseline Characteristics Table

Variable	Cases (n=100)	Controls (n=100)	p-value
Mean Age (years)	3.2 ± 1.1	3.3 ± 1.0	>0.05
Male (%)	60%	55%	>0.05
Female (%)	40%	45%	>0.05
Mean Weight (kg)	12.4 ± 2.1	13.5 ± 2.0	<0.05
Mean Blood Glucose (mg/dL)	48.3 ± 7.5	85.7 ± 12.4	<0.001

The data reveal a significantly longer duration of illness in cases (56 ± 10 hours) compared to controls (42 ± 9 hours), with a p-value <0.01. Cases also experienced significantly more episodes of vomiting (7.2 ± 2.1) than controls (4.8 ± 1.6), with a p-value <0.05. However, the mean episodes of diarrhea were similar between cases (5.0 ± 1.8) and controls (5.2 ± 1.7), showing no significant difference (p-value >0.05).

Table 2: Clinical Presentation Table

Variable	Cases (n=100)	Controls (n=100)	p-value
Duration of Illness (hours)	56 ± 10	42 ± 9	<0.01
Episodes of Vomiting (mean)	7.2 ± 2.1	4.8 ± 1.6	<0.05
Episodes of Diarrhea (mean)	5.0 ± 1.8	5.2 ± 1.7	>0.05

Moderate to severe dehydration was more prevalent in cases (70%) compared to controls (40%), with an odds ratio (OR) of 3.5 (95% CI: 2.0–6.0, p < 0.01). Severe malnourishment was also significantly higher in cases (45%) versus controls (20%), with an OR of 3.4 (95% CI: 1.8–6.2, p < 0.001). Additionally, using plain water instead of ORS was more common among cases (60%) compared to controls (25%), with an OR of 4.5 (95% CI: 2.5–8.2, p < 0.001).

Table 3: Risk Factors for Hypoglycaemia Table

Risk Factor	Cases (%)	Controls (%)	Odds Ratio (OR)	95% CI	p-value
Moderate to Severe Dehydration	70%	40%	3.5	2.0–6.0	<0.01
Severe Malnourishment	45%	20%	3.4	1.8–6.2	<0.001
Plain Water Instead of ORS	60%	25%	4.5	2.5–8.2	<0.001

Normal nutrition was observed in only 20% of cases compared to 55% of controls, with a highly significant p-value <0.001. Severe malnourishment was significantly more prevalent in cases (45%) than in controls (20%), also with a p-value <0.001. However, mild malnourishment showed no significant difference between cases (35%) and controls (25%), with a p-value >0.05.

Table 4: Nutritional Status of Children

Nutritional Status	Cases (n=100)	Controls (n=100)	p-value
Normal Nutrition	20%	55%	<0.001
Mild Malnourishment	35%	25%	>0.05
Severe Malnourishment	45%	20%	<0.001

No dehydration was observed in only 5% of cases compared to 25% of controls, with a p-value <0.01. Severe dehydration was significantly higher in cases (30%) than in controls (10%), with a highly significant p-value <0.001. However, mild dehydration (25% in cases vs. 35% in controls) and moderate dehydration (40% in cases vs. 30% in controls) showed no significant differences (p-value >0.05).

Table 5: Dehydration Levels in Participants

Dehydration Level	Cases (n=100)	Controls (n=100)	p-value
No Dehydration	5%	25%	<0.01
Mild Dehydration	25%	35%	>0.05
Moderate Dehydration	40%	30%	>0.05
Severe Dehydration	30%	10%	<0.001

Discussion

Hypoglycaemia is a serious complication in children with acute gastroenteritis, especially under the age of five, as it can lead to life-threatening outcomes if not promptly recognized and managed. The present research focused on different causes of hypoglycaemia such as nutritional intake, dehydration indices, duration of illness, and caregivers' behaviours, offering important knowledge about its prevention and treatment. Hypoglycaemia was found to be strongly associated with other features as severe malnutrition, long duration of the illness, frequent vomiting often and poor rehydration procedures (5). Hypoglycaemia was prevalent and prominent in eleven patients, many of whom suffered from severe malnutrition, particularly in the hypoglycaemic group, raising the valuable suggestion of nutritional insufficiency in glycometabolic disorders during infectious diseases (14). This is similar to previous studies, which showed that children who are malnourished have lower concentrations of glycogen, which affects their capability to maintain normal blood glucose levels when under stress due to diarrhoea and vomiting (15).

The fifth cause was dehydration because systemic moderate and severe dehydration was observed mostly in cases with hypoglycaemia. This disturbs organic functions and glucose metabolism due to interactions between fluid and electrolytes, which are worsened by dehydration (16). The likelihood of hypoglycaemia was greater in children with severe dehydration in comparison to those with no or mild dehydration; the children herein had 3.5 odds of hypoglycaemia as those without or those with mild dehydration. Caregiver practices also played a central role (3). Thirty-nine percent of the caregivers in the hypoglycaemic group used plain water instead of low-osmolar ORS. Although this practice did not replace fluids and sodium lost, it diluted the blood Glucose, thus increasing the chances of hypoglycemia. On the other hand, 15 children who received proper rehydration from their caregivers were also not likely to develop hypoglycemia, and this called for appropriate counseling of the caregivers (17). These results support prior studies focusing on nutritional status, fluid intake, and feeding practices as significant predictors of outcomes in children with A/G. Nevertheless, this investigation enriches the above knowledge by translating such risk aspects into their odds ratios and pointing to the caregivers' precise knowledge and practice deficiencies. The study has its merit in these procedures; the inclusion and exclusion criteria reduced the confounding factors. This way, the method enabled having control and a relevant contrast, increasing the results' validity (18). However, there are some limitations to the present study, including the following: The study was conducted in a single centre and therefore its results may not be generalizable to another setting. The case findings also raise awareness about early childhood and the identification of children at risk, along with early intervention. Health care providers should ensure children diagnosed with acute gastroenteritis are screened for malnutrition and dehydration. Education of the caregivers on the right use of the ORS and the health consequences of giving plain water is paramount. Therefore, reaching these fundamental behavioral change messages by launching public health campaigns at the community level is important.

Conclusion

It is concluded that severe dehydration and severe malnourishment are significant risk factors associated with the condition under study. Cases exhibited markedly higher rates of these conditions compared to controls, highlighting the critical need for interventions focused on hydration and nutritional support.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-24)
Consent for publication
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Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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