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Original Research Article

Prevalence of Hypoglycaemia among Children Admitted Into the Emergency Paediatrics Unit of a Tertiary Hospital

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ABSTRACT

Background: Hypoglycemia is a medical emergency. Unless promptly identified and treated, it can lead to irreversible brain damage with risk of long term neurologic sequelae or death.
Objectives: To determine the prevalence of hypoglycemia among children presenting to the Emergency Paediatric Unit (EPU) of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto.
Methods: This was a descriptive cross sectional study conducted between 1st June and 31st August, 2013. Blood glucose, in addition to other relevant laboratory investigations, was measured for each patient at the time of admission into EPU using rapid glucose test strips mounted in a glucometer.
Result: Of the 152 children that were admitted into EPU during the study period, 7 patients had hypoglycemia (<2.2mmo/l), giving a prevalence of 4.6%. Six (85.7%) of the 7 children with hypoglycaemia were under the age of 5 years (mean age 18.6 ± 14.7 months), with significant female preponderance (1:2.5). Hypoglycaemia occurred in children with severe malaria, diarrheal disease and protein energy malnutrition. Overall mortality rate was 7.9%, but no death occurred in those with hypoglycaemia.
Conclusion: Hypoglycaemia does occur especially in sick under-five children presenting to our paediatric emergency unit. Routine blood glucose monitoring of at risk patients at the time of admission is therefore recommended.
Key words: *Hypoglycaemia, Prevalence, Emergency Paediatrics Unit, Children, Sokoto, Nigeria.*

INTRODUCTION

Hypoglycaemia is one of the most common metabolic emergencies in children. [1] It is generally diagnosed when whole blood glucose level falls below 2.2mmol/L (40mg/dl) or when measured plasma glucose is less than 2.5mmol/L (45mg/dl). [2] The maintenance of normal blood glucose concentration is essential for optimum brain development and function. This is because glucose is an obligate metabolic substrate for cerebral energy metabolism. [3,4] It also plays a critical role in membrane lipid and protein synthesis in the brain, thus enabling myelination and providing structural proteins that are important for brain growth. [2]

Children are vulnerable to hypoglycemia due to their limited glycogen storage reserve and relatively less efficient mechanisms for glucose homeostasis compared to adults. [1] While an adult can maintain blood glucose level within normal limits even after several weeks of fasting, a child's blood glucose falls steadily during fasting and can reach hypoglycemic threshold within relatively short duration of 24-48hours. [2] Severe medical illnesses such as malnutrition, malaria and other infections can also lead to hypoglycemia in

children. [1,5-7] This can occur through various mechanisms including disease-induced anorexia, abnormal losses from persistent vomiting and diarrhoea, increase glucose consumption and impaired glucose regulatory processes such as gluconeogenesis and glycogenolysis. [1,5-7]

Hypoglycemia usually presents with acute nonspecific symptoms such as headaches, visual disturbances, lethargy, irritability, inability to concentrate, mental confusion or loss of consciousness. [2] The major long term sequelae of severe, prolonged hypoglycemia are recurrent seizures, speech and language impairment, learning disability and mental retardation. [2,8-10] These are associated with increased morbidity and limitations of the child's ability to attain his/her full adult potentials. [1] It has been shown that even asymptomatic hypoglycemia can potentially results in adverse neurologic damage. [1,8] This fact emphasizes the need for prompt recognition and treatment of this metabolic problem. [6,11]

As highlighted by Elusiyan *et al,* [2] the prevalence of hypoglycemia in emergencies varies from practice to practice. Prevalence rates ranging between 4.1 % and 18.3 % have been reported among sick children on admission with diverse medical conditions. [5,6,12-15] This wide variability may be due to differences between study cohorts or methods of glucose assay. The present study was therefore conducted to determine the prevalence of hypoglycemia among sick children admitted into our Emergency Paediatric Unit, with a view to making comparison with data from other related studies.

MATERIALS AND METHODS

This is a descriptive cross-sectional study conducted from 1st June to 31st August 2013, among children admitted into the Emergency Paediatrics Unit (EPU) of UsmanuDanfodiyo University Teaching Hospital (UDUTH), Sokoto. The hospital is a tertiary health facility located in Sokoto, Northwestern Nigeria and serves as a referral Centre for patients from Sokoto state and other neighboring states of Kebbi, Niger and Zamfara. Study subjects comprised of all children aged 1month to 14years who were admitted in EPU of UDUTH, Sokoto during the study period. Children whose caregivers refused to give consent for participation in the study were excluded.

Eligible patients were recruited consecutively as they presented to our EPU over the study period. For each of the patients, a pre-designed interviewer-administered questionnaire was used to collect information on socio-demographic characteristics. Other clinical data including presenting symptoms, duration of illness, anthropometric indices, clinical diagnosis and associated co-morbidities were also recorded.

Random blood sugar (RBS) testing was performed in all the patients using bed-side glucometer (*Finetest Auto-coding™ Premium*, Infopia *Co, Ltd., South Korea*), according to manufacturer's instructions: the pulp of the thumb was first sterilized using a cotton-wool and methylated spirit, and allowed to air dry. A sterile 30 G lancet was then used to prick the pulp of the thumb. The glucometer was switched on and a test strip was inserted into the sensor of the glucometer. The test strip was used to make contact with whole blood, which flows into the test strip by capillary action. Results were read accordingly and hypoglycemia was defined as blood glucose level of < 2.2 mmol/L.

Other relevant investigations performed included urinalysis, haematocrit, serum electrolytes, urea and creatinine. All patients detected to have hypoglycaemia were managed according to recommended guidelines. [2] Approval for the study was obtained from the Health Research and Ethics Committee of UDUTH, Sokoto.

Data was entered into SPSS version 20. Summary statistics was presented as means and standard deviation for quantitative data while appropriate tables

and charts were used to illustrate qualitative variables. Test of significance was performed using Chi-square or, where indicated, Fishers Exact test. Differences between means were compared using student's t-test. A p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 152 subjects were enrolled for the study, comprising 89 males and 63 females (M: F = 1.4: 1). Their mean ± SD age was 32.6 ± 35.5 month (Median-18month, Range of 1-156 months). Majority of the patients were within the age group of 1months-5 years (See Fig. 1).

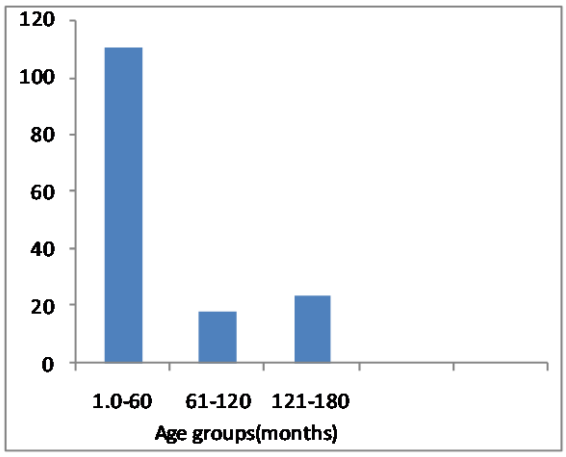

Figure 1: Bar Chart showing the age distribution of study subjects

Only Seven of the 152 subjects studied had hypoglycaemia (<2.2mmol/l) at presentation, giving a prevalence of 4.6%. Six (85.7%) of the 7 children with hypoglycaemia in the study were under the age of 5 years (mean age 18.6 ± 14.7 months). As shown in table 1, the prevalence of hypoglycaemia was higher (5.5%) in children ≤ 5 years compared to those older than 5 years (2.4%). The difference was however not statistically significant (p=0.67).

Table 1: Prevalence of hypoglycaemia among the study subjects by age groups

Age (years)	Hypoglycaemia		
	Present n (%)	Absent n (%)	Total (n) %
<5.0	6 (5.5)	104 (94.5)	110 (72.4)
>5.0	1 (2.4)	41 (97.6)	42 (27.6)
Total	7 (4.6)	145 (95.4)	152 (100.0)

Among the patients with hypoglycemia, there was a notable female preponderance (5 females, 2 males) with M: F ratio being 1:2.5. The prevalence of hypoglycemia was also higher in females-7.9% (5/63) than males 2.2% (2/89).

Patients with and without hypoglycaemia had similar, overlapping symptoms at presentation including fever, vomiting, diarrhea, convulsion and cough, with no statistically significant difference between them (see Table 2). Similarly, there was no significant difference in the duration of illness between patients with hypoglycaemia and those without hypoglycaemia (11 ± 11.7 days Vs 16.7 ± 65 days respectively, t =0.2297, df= 150, p= 0.82).

Table 2: Presenting symptoms in children with and without hypoglycaemia

*Presenting symptom	Present n (%) N=7	Absent n(%) N=145	p-value
Fever	6 (85.7)	130 (89.7)	0.55
Vomiting	3 (42.9)	90 (62.1)	0.43
Diarrhea	3 (42.9)	48 (33.1)	0.68
Convulsion	2 (28.6)	28 (19.3)	0.62
Cough	1(14.3)	25 (17.2)	1.0
Others	1(14.2)	27 (18.6)	1.0

*A patient may have more than one symptom

The patients were admitted on account of the following clinical conditions: Severe malaria, Protein Energy Malnutrition (PEM), Diarrhoeal disease, measles, Respiratory tract infections and other miscellaneous conditions (fig 2). Of the seven children diagnosed with hypoglycaemia, 4 (57.1%) were those with severe malaria while 2 (28.6%) and one (14.3%) patients had PEM. and Diarrhoeal disease respectively. The prevalence of hypoglycaemia was 10.5% (2/19), 5.7% (4/70) and 4.2% (1/24) among children with PEM, severe malaria and diarrhoeal disease respectively (table 3).

Table 3: Prevalence of hypoglycemia by clinical diagnosis among the study subjects

Medical illnesses	Present n (%)	Absent n (%)	Total n (%)
Severe Malaria	4 (5.7)	66 (94.3)	70 (100.0)
Protein Energy Malnutrition	2 (10.5)	17 (89.5)	19 (100.0)
Diarrhoeal disease	1 (4.2)	23 (95.8)	24 (100.0)
*Others	0 (0.0)	39 (100.0)	39 (100.0)
Total	7 (4.6)	145(95.4)	152 (100.0)

*Others-Bronchopneumonia, Measles, Renal failure, Sepsis, Heart failure, febrile convulsions, Sickle Cell vaso-occlusive crises

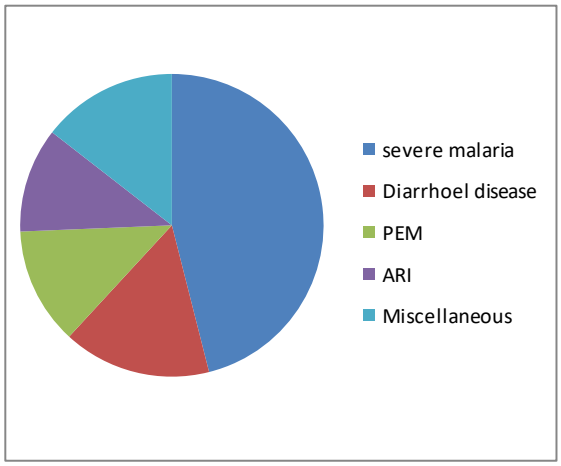

Figure 2: Pie chart showing the pattern of medical conditions in patients admitted into the Emergency Paediatrics Unit

It is of note that 3 (1.97%) of the study patients were found to be hyperglycemic (RBS >11.1mmol/L), but they all had normal urinalysis and their blood glucose level returned to normal on subsequent testing before hospital discharge.

Overall mortality among the study subjects was 7.9%, but no death occurred among children with hypoglycaemia.

DISCUSSION

The present study showed that hypoglycaemia occurred in 4.6% of children admitted into our Emergency Pediatrics Unit. This finding further reaffirms the conclusions of earlier studies that hypoglycemia does occur in children presenting with severe medical illnesses. [5,6,11] Our result was comparable to that of Jaja *et al* [11] in Port Harcourt and Oyenusi *et* al [12] in Lagos, who reported prevalence rates of 5.1% and 5.6% respectively. Other workers have reported variable prevalence rates, ranging from 3.1% to as high as 18.3%. [5,6,13,14,16,17] This variation may be due to differences in the cut-off limit used for definition of hypoglycaemia, the methods of glucose assay, or due to differences between the study cohorts. The higher prevalence rate of 18.3% reported by Onyiruka *et* al, [5] for example, was obtained among a selected cohort of under-five children with severe malaria. In addition, the study used a higher cut-off limit of <2.6mmol/L to define hypoglycaemia [5] unlike the present study that used a lower limit of < 2.2mmol/ L.

Age has been shown to be an important demographic risk factor for hypoglycaemia. [1,7,8] The incidence is highest in young children and decreases with increasing age, being extremely rare in adolescents. [7,8] In the present study, more than 80% of the children with hypoglycaemia were under the age of five years. Previous studies in Nigeria had also observed hypoglycaemia to be more prevalent in younger children below 5years compared with older age group. [11,16] Plausible explanations for this observation include lower glycogen storage reserve and increased peripheral glucose consumption due to higher metabolic rate in younger children. [1,16] Female preponderance in the prevalence of hypoglycaemia was also noted in this study, and this was consistent with what was previously reported by other workers. [5]

Hypoglycaemia has been shown to complicate various diseases in the tropics especially severe malaria, pneumonia, Diarrhoeal diseases, Septicaemia and Protein Energy Malnutrition (PEM). [6,11,12,14,15] In the present study, PEM, Severe malaria and Diarrhoeal diseases were the most common conditions associated with hypoglycemia. In a similar study by Onyearuga *et* al [16] in Abia, the three most common conditions associated with hypoglycaemia in their paediatrics emergency units were severe malaria, septicaemia and diarrhoeal diseases. Several studies have investigated the occurrence of hypoglycaemia among children with specific diseases. [13,18,19] Among a cohort of children with Diarrheal diseases, prevalence rates of 4% and 4.9% have been reported by Ntia and Onyiriuka respectively. [13,18] In children with severe malaria, hypoglycaemia was also found to be relatively common. [5,20-22]

The mechanisms of hypoglycaemia in severe malaria and various other medical illnesses have been well explained in

literature. [1,2,19] Factors implicated in the pathogenesis of malaria-induced hypoglycaemia include increased glucose consumption by the host as well as the parasite, increased anaerobic glycolysis, cytokine-induced impairment of hepatic gluconeogenesis and depletion of glycogen stores due to starvation. [2,5,23] Hyper-insulinaemia resulting from quinine therapy has additionally been implicated. [2,23,24] In children with malnutrition, inadequate intake due to severe anorexia, persistent vomiting and associated diarrhoea coupled with low glycogen stores and high glucose turnover contribute remarkably to the high incidence of hypoglycaemia in these patients. [1,2,25] To a variable extent, combination of the aforementioned mechanisms also plays a role in children with diarrhoeal diseases.

This study showed that patients with and without hypoglycemia had similar presenting symptoms. This finding further highlights the non-specificity of clinical features of hypoglycaemia, which presents a management challenge in settings where facilities for laboratory testing are not available. [15] Presumptive diagnosis and treatment, though undesirable, may have to be relied upon as an alternative. The use of portable and easy-to-use glucometers has significantly minimized this challenge.

Unlike some studies that demonstrated increased mortality in children with hypoglycaemia, [6,15-17,19] no death was recorded among any of our patients with hypoglycaemia. Nevertheless, it is difficult to draw conclusion from this study regarding the effect of hypoglycaemia on mortality in view of the small number of children with hypoglycemia and possible effect of confounding factors.

CONCLUSION

Children presenting to emergency paediatric unit with severe medical illnesses especially PEM, severe malaria and diarrhoeal diseases are at risk of hypoglycaemia. Routine screening of such patients is therefore recommended at the time of presentation, as this will enable prompt treatment of affected patients and prevent potential complications.

Study limitations: Hormonal assay for insulin and counter-regulatory stress hormones could not be determined for our patients. This might give insight into the underlying pathophysiologic mechanisms of hypoglycaemia.

Conflict of interest: Nil

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