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Incidence of Hypoglycaemia in a Paediatric Emergency Ward in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Authors CNO and IOG designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors CNO and IOG managed the literature searches, analyses of the study. Both authors read and approved the final manuscript.

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ABSTRACT

Objective: The study was conducted to determine the incidence of hypoglycaemia and some associated factors in children presenting as emergency in Aba, Nigeria.
Materials and Methods: This was a hospital based prospective descriptive study conducted in the children's emergency ward (CHEW) of Abia State University Teaching Hospital (ABSUTH), Aba over a ten month period. Three hundred and eight children aged twenty nine (29) days to sixteen (16) years were enrolled. The patients' biodata, detailed history and physical examination findings were recorded in a study proforma. Random blood sugar (RBS) was done on all patients at presentation and subsequently on hypoglycaemic patients using glucometer. Hypoglycaemia was defined as RBS < 2.2 mmol/l. Data analysis was done using SPSS version 11.0. P value < 0.05 was taken as statistically significant for all analyses.
Results: The incidence of hypoglycaemia was 7.5%. Hypoglycaemia was significantly associated with age less than 5 years, interval of more than 4 hours between the last meal and presentation, shorter duration of admission, coma and death.

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Conclusion: The incidence of hypoglycaemia in this study is high and its contribution to mortality significant. Ill looking children particularly those aged less than five years or in coma presenting in emergency units should be mandatorily investigated for hypoglycaemia and managed aggressively if detected.

Keywords: Hypoglycaemia; emergency; children; Nigeria.

1. INTRODUCTION

Hypoglycaemia is defined as blood glucose level less than 2.2 mmol/L (40 mg/dl) [1]. It often complicates emergency clinical conditions and results from loss of appetite, reduced food intake, febrile states, presence of drugs such as quinine and alcohol, insulin over dosage, disease states such as severe malaria, sepsis, gastroenteritis, terminal cancer, and less common conditions such as certain enzyme and endocrine deficiency states including glycogen synthetase deficiency, liver phosphorylase deficiency glucagon deficiency; metabolic disorders including fructose 1, 6 diphosphate deficiency, fatty acid metabolic disorders, glycogen storage disease types I, III, VI amongst others [2-7].

The symptoms and signs of hypoglycaemia are often similar to and overlap those of a primary emergency illness making it difficult to identify and manage the hypoglycaemia effectively particularly if there is no high index of suspicion [8]. Hypoglycaemia complicating emergency conditions often worsens the prognosis of the primary illness when severe and not identified and managed early, possibly resulting in permanent neurological sequelae or even death [9,10]. It therefore becomes necessary to evaluate the incidence of hypoglycaemia in children admitted to the emergency ward and assess if there are any factors associated with its occurrence and outcome, thereby determining the necessity or otherwise of mandatory determination of random blood sugar (RBS) in children being admitted to the emergency ward of hospitals in Nigeria.

2. MATERIALS AND METHODS

This was a prospective study conducted in the children emergency ward (CHEW) of Abia State University Teaching Hospital (ABSUTH) Aba, southeast of Nigeria between June 2013 and April 2014.The hospital serves as a secondary healthcare facility and as a referral centre for citizens of Aba, the commercial nerve centre, and other inhabitants of Abia state and occasionally for neighboring communities of boundary states of Imo, Akwa Ibom and Rivers. The average admission rate in the CHEW is about 360 per annum.

Ethical clearance was obtained from the hospital Ethics Committee before embarking on the study. Children aged above 28 days and not more than 16 years were recruited into the study after full explanation was given to their care givers and their consent for enrolment obtained.

Neonates, children aged more than 16 years, established cases of diabetes mellitus, those with anomalies likely to be associated with hypoglycaemia such as glycogen synthetase deficiency, glycogen storage disease types 1 and 3, fructose 1, 6 diphosphate deficiency and those for whom consent was not obtained were excluded from the study.

The study was conducted by the author with the assistance of 2 adequately trained house officers and a registrar on posting in the CHEW. The competence of the assisting doctors was certified by a prior pilot study which agreed upto 95% of the result of the actual survey. Detailed history and physical examination as specified in the study proforma were conducted on all eligible patients presenting in the emergency room and a primary diagnosis made. Random blood sugar (RBS) test was done by pricking the thumb of the patients with sterile needle and doing a glucometer testing on a drop of blood issuing from the prick. RBS was recorded in millimols/litre. Other investigations were also done as necessary based on the primary diagnosis. Final diagnoses were made from the history, physical findings and laboratory investigation results. Hypoglycaemia was defined as blood glucose level less than 2.2 mmol/l. Those observed to have a blood glucose level less than 2.2mmol/l were recruited as subjects of the study. All the patients had emergency management. Those requiring admission were admitted while those that are not so ill were treated and discharged. All cases of hypoglycaemia were managed using standard protocol [1].

The demographic and clinical data of all the patients participating in the study were recorded in a survey proforma.

Data obtained were analysed with SPSS version 11 software. P value less than 0.05 was taken as statistically significant.

3. RESULTS

The total number of emergency cases seen over the study period was 308; 168 males, and 140 females. Male: female ratio = 1.2: 1. Number of cases that had hypoglycemia was 23, (10 males and 13 females) giving an incidence of 7.5%. Male: female ratio was 1:1.3. Three participants absconded while 7 signed against medical advice; all of them are in the non-hypoglycaemic group. Subsequent analysis was carried out on 298 patients.

Table 1 shows the RBS distribution among the participants. Only 7.5% of the eligible emergency cases had RBS less than 2.2 mmol/l. The range of RBS was 0.8to 14.2mmol/l while the mean was 4.6 mmol/l. The median RBS of all the participants was 5.1 mmol/l while it was 1.4 mmol/l for the hypoglycaemic patients.

Table 2 shows the sex, age and social class distribution of the hypoglycaemic vis a vis the non-hypoglycaemic patients. There was a statistically significant difference in the age distribution between the hypoglycaemic and non hypoglycaemic groups, (p = 0.032) but the differences in the sex and social class distribution between both groups were not statistically significant (P = 0.381; p = 0.281 respectively).

Table 3 shows the time interval between the last meal and presentation, time of presentation, level of consciousness at presentation, and duration of illness in the hypoglycaemic group in comparison with the non hypoglycaemic. Hypoglycaemia occurred significantly more in those patients who had their last meal 4 hours or more before presentation (P = 0.002). Also, altered level of consciousness occurred significantly more in the hypoglycaemic group than in the non-hypoglycaemic (P = 0.001). However, there was no statistical difference between the two groups in the time of presentation (P = 0.361) and duration of illness before presentation (p = 0.874).

The most frequent emergencies amongst the participants were severe malaria 98 (32.9%), sepsis 47(15.8%), acute watery diarrhea 42 (14.1%) as seen in Table 4. Meningitis was associated with hypoglycaemia with statistically significant difference between the hypoglycaemic and non-hypoglycaemic groups (P = 0.023) as shown in Table 4.

Table 1. Radom blood sugar level in the participants

RBS (Mmol/L)	Number	Percentage
<2.2	23	7.5
≥2.2	285	92.5
Total	298	100%

Table 2. Demographic data of participants

Variables	Hypoglycaemic	Non-hypoglycaemic	P-value
Sex	**%**	**%**	
Male	10 (5.9)	160 (94.1)	0.381
Female	13 (10.2)	115 (89.8)	
Age (Years)			
<1	9 (9%)	92 (91%)	0.032
1 – 5	9 (6%)	142 (94%)	
6 – 10	3 (10.3%)	26 (89.7%)	
11 – 15	2 (16.7%)	10 (83.3%)	
>15	0 (0%)	5 (100%)	
Social Class			
Upper	12 (5.9%)	190 (94.1%)	0.281
Lower	11 (11.4%)	85 (88.6%)	

The range of duration of admission in the hypoglycaemic group was < 1 to 15 days with a median of 5 days while the median of duration of admission in the non-hypoglycaemic group was 8 days with a range of < 1 to 23 days. There was a statistically significant difference in the duration of admission between the hypoglycaemic and non-hypoglycaemic patients (P = 0.0001). Twelve (52.2%) of the hypoglycaemic patients died while 11 (47.8%) were alive and discharged home. Significantly more hypoglycaemic than the non-hypoglycaemic patients died during the survey (P = 0.0001) Table 5.

Table 3. Features in the presentation of the hypoglycaemic patients

Features	Hypoglycaemic patients	Non-hypoglycaemic patients	P-value
Time interval between last meal and presentation			
< 4 hours	5 (2.6%)	184 (97.4%)	0.002
≥ 4 hours	18 (16.5%)	91 (83.5%)	
Time of presentation			
Day	13 (9.8%)	120 (90.2%)	
Evening	4 (4%)	95 (96%)	0.361
Night	6 (9.1%)	60 (90.9%)	
Level of consciousness			
Normal	0 (0%)	259 (100%)	
Altered	19 (63.3%)	11 (36.7%)	0.001
Coma	4 (50%)	4 (50%)	
Duration of Illness before presentation (Days)			
< 3	6 (12.2%)	43 (87.8%)	
3 – 7	14 (7.6%)	170 (92.4%)	0.874
8 – 14	2 (3.2%)	60 (96.8%)	
>14	1 (33.3%)	2 (66.7%)	

Table 4. Diagnosis in participants

Diagnosis	Total number	In hypoglycaemic	In non-hypoglycaemic	P-value
Severe malaria	98	9 (9.2%)	89 (90.8%)	0.706
Sepsis	47	8 (17.0%)	39 (83.0%)	0.206
Acute watery diarrhea	42	3 (7.1%)	39 (92.9%)	0.304
Uncomplicated malaria	30	0 (0%)	30 (100%)	0.234
Bronchopneumonia	24	0 (0%)	24 (100%)	0.304
Tonsillitis	16	0 (0%)	16 (100%)	0.402
Acute severe asthma	10	0 (0%)	10 (100%)	0.440
Meningitis	6	2 (33.3%)	4 (66.7%)	0.023
Acute glomerulonephritis	6	0 (0%)	6 (100%)	0.832
Protein energy malnutrition	6	0 (0%)	6 (100%)	0.832
Sickle cell crisis	4	0 (0%)	4 (100%)	0.684
Pertussis	3	0 (0%)	3 (100%)	0.534
Dysentery	2	0 (0%)	2 (100%)	0.624
Enteric fever	2	0 (0%)	2 (100%)	0.624
Urinary tract infection	2	0 (0%)	2 (100%)	0.624

Table 5. Duration of admission and outcome in the hypoglycaemic vis a vis the Non-hypoglycaemic patients

Duration of admission (days)	Hypoglycaemic	Non-hypoglycaemic	P-value
< 1	10 (27.8%)	26 (72.2%)	
1 – 7	6 (2.7%)	2.20 (97.3%)	0.001
8 – 30	7 (19.4%)	29 (80.650%)	
Outcome of Admission Alive and Discharged	11 (4.2%)	250 (95.8%)	
Dead	12 (32.4%)	25 (67.6%)	0.003

There occurred 37 deaths in all the participants. The most frequent diagnoses resulting in death were severe malaria, 15 (40. 5%) and sepsis 12 (32.4%). There was a statistically significant difference between the hypoglycaemic and non-hypoglycaemic groups in frequency of deaths due to sepsis, severe malaria, acute watery diarrhea and meningitis (P = 0.004, P = 0.002, P = 0.001, P = 0.024 respectively) Table 6.

4. DISCUSSION

Hypoglycaemia is a frequent occurrence in children emergencies resulting often from reduced intake and absorption of food due to loss of appetite, vomiting, diarrhea, decreased endogeneous glucose production in malnourished children, and increased glucose consumption due to increased metabolic rate in febrile state and pathogenetic process amongst others [11,12]. Understanding the incidence, associated factors and outcome of hypoglycaemia in emergency setting gives a greater insight into this phenomenon and prepares an attending clinician better to deal more effectively with the problem when identified with improved treatment outcome.

The incidence of hypoglycaemia of 7.5% observed in this study is more than the prevalence of 4.5% observed in a study in Bangladesh [12] and less than 9.2% observed in Minnesota, U.S.A [13]. However the higher occurrence in this study than the Bangladesh study is likely to be due to the fact that the Bangladesh study was hypoglycaemia occurring only in children with diarrhea while ours was the incidence in all emergency cases. Our study incidence is less than the 9.2% observed in Minnesota because the Minnesota study was prevalence of hypoglycaemia in children with dehydration resulting from acute gastroenteritis. Hypoglycaemia has been recorded as occurring significantly more in children with dehydration secondary to acute gastroenteritis [13,14] while our study was conducted on all emergencies.

In this study, there was statistically significant association between age and hypoglycaemia. Mostly infants (age less than one year) (39.1%) and those less than five years (39.1%) had hypoglycaemia in this survey. This is in consonance with previous reports; which indicate that infants and younger children are more prone to developing hypoglycaemia during illness than older children due to their relatively low hepatic glycogen storage and limited substrate for gluconeogenesis [3,14]. Also in disease states particularly those associated with fever as often observed in emergencies, the basal metabolic rate is more increased in younger children and infants with faster consumption of blood glucose and quicker depletion of glycogen storage in the liver and muscles than in older children predisposing them to hypoglycaemia [3].

There were statistically significant associations between level of consciousness and time interval between the last meal and time of presentation with hypoglycaemia in our study. A high proportion (63.6%) of patients in coma in the study had hypoglycaemia.Hypoglycaemia has been reported as being most severe in patients with coma as compared to its other neurological manifestations [6,10,15]. This highlights the need to evaluate for hypoglycaemia in comatose patients particularly in an emergency setting. Prolonged duration of fasting (interval of more than 4 hours between the last meal and presentation of the patient in our study) was significantly associated with hypoglycaemia. This has also been documented in previous studies [15,16]. Peripheral utilization of glucose with time results in hypoglycaemia [3,15].

The most leading emergencies associated with hypoglycaemia in descending order of frequency in our survey were severe malaria, septicaemia and acute watery diarrhea. Hypoglycaemia occurred in 9.2%, 17% and 7.1% of these conditions respectively. However, there was statistically significant association of hypoglycaemia with meningitis (Table 4).

Severe malaria, septicaemia and diarrhea have been observed as leading emergency diagnoses also associated with hypoglycaemia in previous studies [3,15,16]. Severe malaria has been

Table 6. Mortalities in the participants

Diagnosis	Mortalities	In hypoglycaemic	In non-hypoglycaemic	P-value
Sepsis	12	5 (41.7%)	7 (58.3%)	0.004
Severe malaria	15	4 (26.7%)	11 (73.3%)	0.002
Diarrhea	4	2 (50.0%)	2 (50.0%)	0.001
Meningitis	4	1 (25.0%)	3 (75.0%)	0.024

reported to be a common cause of hypoglycaemia in children with falciparium malaria [2,4,17]. The patho-physiological process resulting in hypoglycaemia includes plasma glucose utilization as well as glycogen storage depletion by enormous metabolic demands by the falciparium parasites apart from hyper insulinism and glucose depletion resulting from quinine administration for treatment [2,4,18,19]. Severe hypoglycaemia occurs particularly with cerebral malaria or when there is alteration in the level of consciousness in patients with severe malaria [17]. The glucose level in these categories of patients should be monitored closely.

Sepsis was the second most frequent diagnosis associated with hypoglycaemia in our study. Sepsis has been reported in previous studies as resulting in hypoglycaemia, sometimes with the similarity of their clinical features obscuring the diagnosis of the other after one has been made [8]. The mechanism of causation of hypoglycaemia includes utilization of glucose by the invasive agents as well as by glycogenolytic effect of bacterial endotoxins amongst others [3,6,20].

Hypoglycaemia has been reported as a major cause of mortality in children with diarrhoea [12-14]. Hypoglycaemia occurring in these patients is as a result of failure of gluconeogenesis and not due to inadequacy in response of counter-regulatory hormones of glucagon, epinephrine and norepinephrine [12]. Hence the need to monitor regularly the blood glucose level in children with diarrhea and manage promptly when hypoglycaemia is detected.

Meningitis had statistically significant association with hypoglycaemia in this study. A similar observation has been made previously by Elusiyan in Ife and Offiong in Ilorin [15,16]. Hypoglycaemia is a poor prognostic factor generally in children's illness including meningitis [20].Hypoglycorrhachia occurs in bacterial meningitis and results from reduced glucose transport in the cerebral tissue [3]. In a situation of persistent or worsening hypoglycaemia, hypoglycorrhachia also deepens, worsening the prognosis more severely if not managed gingerly [3]. This therefore necessitates regular evaluation of blood glucose of patients with meningitis with a view to correcting same effectively when hypoglycaemia is detected.

There was statistically significant association between hypoglycaemia and the duration of admission in this survey. Ten (43.5%) of hypoglycaemic patients and 26 (9.5%) of the non-hypoglycaemic group were admitted for less than 24 hours. Previous reports indicating patients with hypoglycaemia having statistically significant shorter duration of admission when compared with the non-hypoglycaemic counterparts have been documented [15,16]. Hypoglycaemia also is significantly associated with death in our study. This observation has been made by several other workers [6,10,12, 13]. The ready explanation for this is the fact that hypoglycaemia associated with any illness makes that condition a severe disease with greater possibility of relatively early death and short duration of admission. Also, hypoglycaemia is more likely to occur in severe illness which is more likely to result in death than in a less serious condition.

Our study demonstrates that septicaemia, severe malaria, diarrhea and meningitis are significantly more likely to result in death when associated with hypoglycaemia than in non-hypoglycaemic patients (Table 6). Septicaemia per se results in severe systemic inflammatory process which on its own is often life threatening and more so when associated with hypoglycaemia which is often severe, frequently resulting in death if not detected promptly and managed aggressively [6,19].

Severe malaria, particularly cerebral malaria has been reported previously to result in severe life threatening hypoglycaemia and death [10,17, 21]. Likewise, hypoglycaemia has been reported as a significant cause of mortality in diarrhoea patients by previous authors [12-14]. Management of patients with diarrhoea should of necessity include regular evaluation of RBS for early detection and prompt management of hypoglycaemia when it occurs.

Hypoglycaemia results in severe pathophysiological consequences in the brain [22]. When these coexist with meningitis the result is often death.

5. CONCLUSION

We found that the incidence of hypoglycaemia was 7.5% amongst children admitted in CHEW and it occurred significantly more in children less than five years of age, the comatose and those with prolonged fasting. Severe malaria, septicaemia, diarrhoea and meningitis were the diagnoses significantly more likely to result in

death when associated with hypoglycaemia. It is advocated that routine testing of the random blood sugar of children presenting in emergency room, particularly young children with prolonged fasting, diarrhea, severe malaria, sepsis or in coma be done promptly and effective management of hypoglycaemia instituted when identified.

6. LIMITATION

Not being able to confirm the random blood sugar result obtained with glucometer testing for the patients with hypoglycaemia in this study with the glucose oxidase evaluation method might affect the precision of the results.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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