# Post-Neonatal Hypoglycaemia and Paediatric Emergency Room Admissions: A Study In The University Of Port Harcourt Teaching Hospital.

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**Abstract:**

**Background:** Hypoglycaemia, a common complication of many childhood diseases, significantly increases disease-related morbidity and mortality. The objective of this study is to determine the prevalence, morbidity pattern and outcomes of hypoglycaemia at admission of post-neonatal children in the Children's Emergency Ward (CHEW) of the University of Port Harcourt Teaching (UPTH).

**Methods:** All post-neonatal children admitted into the UPTH CHEW from September 2007-January 2008 who met the inclusion criteria were prospectively studied using a pre-tested proforma which obtained their sociodemographic and clinical data. In all subjects, plasma glucose was determined on admission (using glucometer and glucose oxidase tests) before management. Data analysis was with EPI Info version 6.04 and statistical significance was set at 0.05.

**Results:** Three hundred and seventy children aged 1month-15 years (mean 36.7±40 months) with 272(78.9%) under-fives were studied. Their plasma glucose levels ranged from 1.0-12mmol/l with 19(5.1%) children among whom were 15(78.9%) under-fives being hypoglycaemic (plasma glucose-1.0-2.4mmol/l, mean 1.4 ± 0.2mmol/l). All cases of hypoglycaemia were detected by both methods of estimation. The commonest diseases diagnosed in the study population, irrespective of the plasma glucose level, were malaria, anaemia and diarrhoea. Overall, 49 (13.2%) children of whom 7(14.3%) were hypoglycaemic died. Hypoglycaemia was associated with longer hospital stay and higher mortality rate (36.8%) (p=0.001).

**Conclusion:** Hypoglycaemia, detectable by bedside glucometer test, significantly increases morbidity and mortality associated with common childhood diseases. There is therefore a need for its prevention, early diagnosis and prompt management in all paediatric care settings, especially in resource-limited countries, as recommended in the Integrated Management of Childhood Illness algorithm.

**Keywords:** Hypoglycaemia; Post-neonatal; Paediatric emergencies; Nigeria.

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## INTRODUCTION

Hypoglycaemia, defined as whole blood glucose concentration of less than 40mg/dl (2.2mmol/l) or a plasma glucose level less than 45mg/dl (2.5mmol/l) [1, 2] is a biochemical disorder with no characteristic clinical features. In children, hypoglycaemia can complicate any disease and its prevalence varies with the disease and ranges from 6.4% to 7.3% in childhood admissions after the neonatal period[3, 4]. In the tropics, risk factors for hypoglycaemia in children include infectious diseases such as malaria, septicaemia, diarrhoea and meningitis. Other risk factors are poor nutritional status, late presentation to health facilities and use of potentially toxic herbal mixtures such as cow's urine concoction used in Western Nigeria for treatment of convulsion[3-7]. Hypoglycaemia worsens the outcome of childhood illnesses with increased mortality especially within 24 hours of admission. The mortality rate associated with hypoglycaemia ranges between 20% and 30% in treated patients and 100% in untreated ones[3, 4, 6]. Hypoglycaemia in children also leads to long term neurologic sequelae such as mental retardation, cognitive impairment, recurrent seizures and varying degrees of personality changes. The incidences of these sequelae were reported to be between 15% and 51% in different studies[8, 9]. However, the situation in the South-South region of Nigeria where the University of Port Harcourt Teaching Hospital is located is largely unexplored hence the need for this study to determine the prevalence and common morbidities in children with hypoglycaemia on admission in the University of Port Harcourt Teaching Hospital. The findings of this study are expected to contribute to the reduction of morbidity and mortality from common childhood diseases through the prevention, early detection and management of hypoglycaemia.

## MATERIALS AND METHODS

This was a prospective study of all children aged over 1 month who met the inclusion criteria and were consecutively admitted into the Children's Emergency Ward (CHEW) of the University of Port Harcourt Teaching Hospital between September 2007 and January 2008. A pretested study proforma was used to obtain the sociodemographic and clinical data on all eligible children. Each recruited child was examined and managed using standard protocols and guidelines in use in the Department. Venous blood was collected from each child for the estimation of random blood sugar using the glucose oxidase method in the Chemical pathology Laboratory of the hospital and the glucometer strips by the bedside. Additionally, all hypoglycaemic children (plasma glucose level < 2.5mmol/l) received boluses of 10% dextrose water infusion (2ml/kg)and were maintained on 3.6-4.8ml/kg/hour of 10% dextrose water to provide 6-8mg

glucose/kg/minute until oral feeds are established and two consecutive plasma glucose estimations showed normal values(≥ 2.5mmol/l). Each child was followed up to determine the outcome of admission in the Emergency Room or Children's ward. All children were transferred to the ward within 24-48 hours of admission into the CHEW if they were considered clinically stable. The outcome of management was recorded as well and discharged, dead or discharged against medical advice (DAMA). The duration of admission at discharge or death and final diagnosis were also recorded. Data analysis was done using EPI INFO Version 6.04. The significance level for each item analysed was $p < 0.05$.

## RESULTS

Three hundred and seventy children comprised of 211 (57.0%) males and 159 (43.0%) females aged 1-180 months with a mean age of 36.7±40 months (modal age range 12-35months) were studied. Two hundred and ninety two (78.9%), were aged less than five years (Table I). The blood sugar ranged from 1-12.3mmol/l (mean 3.7±1.9mmol/l). Nineteen children (5.1%) aged 3-84months (mean 32.7±29.3months) comprised of 10 males and 9 females (male: female ratio=1.1:1) were hypoglycaemic. The mean plasma glucose level of the hypoglycaemic children was 1.4±0.2mmol/l (range 1.0-2.4mmol/l). Fifteen (78.95%) hypoglycaemic children were aged less than five years with 8(42.1%) being infants. The mean ages of the hypoglycaemic and non hypoglycaemic (36.7±40 months) children showed no statistically significant difference ($^2$ =6.4, df=4, p= 0.168). The mean plasma glucose levels among the hypoglycaemic males (1.9±0.4mmol/l) and females (1.8±0.1mmol/l) were also not statistically significantly different ($^2$ =0.76, df=4, p= 0.788) (Tables I-II).

The main diagnoses in the study population were malaria (46.22%), anaemia (26.22%), diarrhoea (14.86%), pneumonia (13.24%) and malnutrition (12.97%). Similarly, among the children with hypoglycaemia, the major diagnoses were malaria (42.11%), diarrhoea (42.11%) anaemia (21.05%) and malnutrition (15.79%). Renal failure, diagnosed in 5.41% of the study population, occurred in 21.05% of the hypoglycaemic children (Tables III-IV). Many children had multiple morbidities; however, hypoglycaemia was more likely to complicate diarrhoeal illnesses, renal failure and status epilepticus, (Table III). Concerning the duration of stay in hospital of the hypoglycaemic children, 4(28.57%) of the 14 children with known outcome died within 48hours of admission. Only one child was discharged well and alive within one week of admission (Table V).

Among the children, 301(81.4%) were discharged home well, 20(5.4%) left against medical advice while 49(13.2%) died including 7(36.8%) who were hypoglycaemic (Table VI). The differences in the outcomes were statistically significant ($^2$ = 29.5, df =2, p= 0.0000039).

Plasma glucose estimates by the glucometer test ranged from 1.1 16mmol/l. All hypoglycaemic children detected by the glucometer method were also detected by the laboratory

TABLES:

Table I: Age and Sex Distribution of Study Population

| Age(month) | Male | Female | Total (%) |
|---|---|---|---|
| <12 | 61 | 39 | 100(27.0) |
| 12-35 | 67 | 77 | 144(38.9) |
| 36-59 | 29 | 19 | 48(13.0) |
| 60-120 | 43 | 20 | 63(17.0) |
| >120 | 11 | 4 | 15(4.1) |
| Total (%) | 211(57.0) | 159(43.0) | 370(100) |

Table II: Age Distribution of Hypoglycaemic and non hypoglycaemic children

| Age (months) | Hypoglycaemic (% Total) | Non Hypoglycaemic ( % Total) | Total |
|---|---|---|---|
| <12 | 8(42.1) | 92(26.2) | 100 |
| 12-35 | 3(15.8) | 141(40.2) | 144 |
| 36-59 | 4(21-1) | 44(12.5) | 48 |
| 60-120 | 4(21.1) | 59(16.8) | 63 |
| >120 | 0(0.00) | 15(4.3) | 15 |
| Total (%) | 19 (100) | 351(100) | 370 |

Table III: Morbidity Pattern in the Study Population

| Comorbidity | With hypoglycaemia | | No Hypoglycaemia | | Total | Percent | | | P value |
|---|---|---|---|---|---|---|---|---|---|
| | Freq | Percent | Freq | Percent | | | c2 | DF | |
| Malaria | 8 | 4.68 | 163 | 95.32 | 171 | 46.22 | 0.02 | YC | 0.8943 |
| Anaemia | 4 | 4.12 | 93 | 95.88 | 97 | 26.22 | 0-07 | YC | 0.7967 |
| Diarrhoea | 8 | 14.55 | 47 | 85.45 | 55 | 14.86 | | FET | 0.0029 |
| Pneumonia | 1 | 2.04 | 48 | 97.96 | 49 | 13.24 | | FET | 0.2546 |
| Malnutrition | 3 | 6.25 | 45 | 93.75 | 48 | 12.97 | | FET | 0.72359 |
| HIV/AIDS | 0 | 0.00 | 32 | 100.00 | 32 | 8.65 | | FET | 0.39145 |
| Meningitis | 2 | 6.67 | 28 | 93.33 | 30 | 8.11 | | FET | 0.65963 |
| Heart Failure | 0 | 0.00 | 24 | 100.00 | 24 | 6.49 | | FET | 0.62391 |
| Renal failure | 4 | 20.00 | 16 | 80.00 | 20 | 5.41 | | FET | 0.01493 |
| Sickle cell anaemia | 0 | 0.00 | 15 | 100.00 | 15 | 4.05 | | FET | 1.00000 |
| Septicaemia | 1 | 16.67 | 5 | 83.33 | 6 | 1.62 | | FET | 0.27277 |
| S/epilepticus | 2 | 66.67 | 1 | 33.33 | 3 | 0.81 | | FET | 0.00728 |

*Statistically significant
AIDS (Acquired immune deficiency syndrome)
SCA (Sickle cell anaemia)
HIV (Human immunodeficiency syndrome

Table IV: Morbidity pattern of the hypoglycaemic children

| Comorbidity | Frequency | Percent |
|---|---|---|
| Malaria | 8 | 42.11 |
| Diarrhoea | 8 | 42.11 |
| Anaemia | 4 | 21.05 |
| Renal failure | 4 | 21.05 |
| Malnutrition | 3 | 15.79 |
| Meningitis | 2 | 10.53 |
| S/epilepticus | 2 | 10.53 |
| Pneumonia | 1 | 5.26 |
| Septicaemia | 1 | 5.26 |
| HIV/AIDS | 0 | 0.00 |
| Heart Failure | 0 | 0.00 |
| Sickle cell anaemia | 0 | 0.00 |

Table V: Duration of Admission/ Outcome in Hypoglycaemic Children

| Duration of admission (days) | No Discharged | No DAMA | No that Died |
|---|---|---|---|
| < 1day | 0 | 0 | 2 |
| 1-2days | 0 | 0 | 2 |
| 2-7days | 1 | 1 | 2 |
| 7-28days | 6 | 4 | 1 |

DAMA: Discharge against medical advice

Table VI: The Outcome of Management of Children in the Study

| Outcome | Hypoglycaemia (%) | Non Hypoglycaemic (%) | Total |
|---|---|---|---|
| Well and discharged | 7(36.8) | 294(83.8) | 301(81.4) |
| DAMA | 5(26.3) | 15(4.3) | 20(5.4) |
| Died | 7(36.8) | 42(12) | 49(13.2) |
| Total | 19(100) | 42(12) | 370(100) |

DAMA= Discharged against medical advice

Table VII: Specificity and Sensitivity of glucometer blood glucose result compared to laboratory results.

| | Positive glucometer | Negative glucometer | Total |
|---|---|---|---|
| Number with hypoglycaemia | 18 | 1 | 19 |
| Number without hypoglycaemia | 0 | 351 | 351 |
| Total | 18 | 352 | 370 |

Sensitivity= 18/19 x 100 =94.74%

Specificity = 351/351x 100 = 100%

glucose oxidase method. Table Vll (Shows the specificity and sensitivity of glucometer compared to glucose oxidase test).

**DISCUSSION**

Under-five mortality caused mainly by infectious diseases and malnutrition has remained high especially in developing countries in spite of the availability of low cost but evidence based interventions which can significantly reduce their impacts on child survival[10]. In addition to the roles of acute respiratory infections, diarrhoea, malaria and malnutrition as the main causes of presentation in outpatient care facilities hence their inclusion as the target disease conditions for the Integrated Management of Childhood Illness Algorithm, the present study has further established the roles of these conditions in hospital admissions in resource limited settings like Nigeria[3, 4, 11]. There is therefore a need to accelerate the efforts to control these conditions. Hypoglycaemia was more likely to occur as shown in this study in children with diarrhoea, renal failure and status epilepticus. The emergence of HIV/AIDS as one of the main reasons for emergency ward admissions suggest the high burden of HIV/AIDS in Nigeria and its increasing contribution to under-five morbidity and mortality[12]. The high susceptibility of under-fives to these preventable and easily treatable diseases support the use of under-five mortality rate to assess global development attainments and the adoption of under-five years age group for the Integrated Management of Childhood Illness (IMCI) strategy[13].

Although the relationship between hypoglycaemia and renal failure is not clearly defined, the high prevalence of hypoglycaemia in children with acute renal failure seen in this study has also been noted in other studies[3, 14]. This finding may however be a reflection of the severity of the illness such as diarrhoea. Hypoglycaemia, although having no specific symptoms, has been confirmed in this study to contribute to increased hospitalisation and deaths among children, especially in the first few years of life. Although hypoglycaemia is readily preventable by ensuring appropriate feeding of sick children, especially those most at risk, the infants, and parents have continued, largely due to ignorance, to withhold foods from ill children. This explains why in IMCI, all severely ill children are treated to prevent hypoglycaemia and mothers are encouraged to continue feeding all ill children[15]. Furthermore, the fact that hypoglycaemia has no specific symptoms and can complicate a number of diseases makes it essential for early diagnosis and prompt treatment to reduce associated morbidity and mortality as has been reported in other studies[3, 4, 7]. The high mortality of 36.8% reported in the hypoglycaemic children may suggest that hypoglycaemia is a poor prognostic feature of many childhood diseases and highlights the need for in addition to prevention, its prompt diagnosis and treatment. However, the standard glucose oxidase test is cumbersome and requires skilled manpower and equipment and may not be easily accessible in resource-limited settings with a high burden of childhood diseases. It is therefore gratifying that the simple side laboratory test using the glucometer which is readily available and affordable is both sensitive and specific. The estimated costs for an average glucometer and accessories are glucometer-fifteen thousand Naira ($100), quarterly replacement of batteries each costing N500 ($3) and strips ((N4500/50 strips which can be split and used for up to 100 tests). This therefore offers an easily affordable method of testing all ill children for hypoglycaemia and allows for an effective monitoring of children with this potentially fatal condition even in resource-limited settings.

The 5.1% prevalence of hypoglycaemia found on admission in children admitted to the CHEW in this study was similar to 6.4% reported by Elusiyan[3] in Ile Ife Nigeria and 7.3% by Osier et al [4] in Kenya. This was however much higher than 1.9% prevalence reported in Spain[16]. Additionally, this study has recorded a high prevalence of hypoglycaemia in children below five years which is similar to the findings in previous reports[3, 4, 7]. The higher prevalence of hypoglycaemia in under-fives may be due to the more frequent occurrences of illness in this age group and their dependence on others for their food intake[3, 11, 13]. However, in this study, hypoglycaemia was seen more in children aged 1-12months which is at variance with

the findings by other workers who noted it more in children aged between 1 and 3 years[3, 4]. This difference may be attributed to the lower incidence of cerebral malaria in the current study, a condition which is usually associated with hypoglycaemia and commoner in children aged 1-3years[17, 18].

Although most of the children in this study were reported to have been discharged well and alive, they were not followed up to determine the occurrence of neurologic complications such as brain damage.

In conclusion, highly preventable childhood diseases continue to plaque under-fives in resource-limited settings. HIV and AIDS is now an emerging contributor to increased under-five morbidity and mortality necessitating the wide scale implementation of their control measures. Children under-five years of age remain susceptible to many conditions including hypoglycaemia. It is therefore important not only to widely apply available prevention and treatment interventions for possible precipitating disease conditions but to also ensure that hypoglycaemia is prevented, diagnosed early and appropriately managed in all ill children to reduce its associated morbidity and mortality. The value of glucometer as a simple cost effective bedside test in resource limited settings cannot be overemphasised.

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