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Prevalence of Hypoglycaemia in Children admitted into the Emergency Paediatric Unit of University of Abuja Teaching Hospital Gwagwalada, Nigeria

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***Abstract*— Objectives: The Objective of this study was to determine the prevalence of hypoglycaemia among children admitted in Emergency Paediatrics Unit of University of Abuja Teaching Hospital, Gwagwalada.Method: This was a prospective descriptive study where 379 children admitted into Emergency Paediatrics Unit who met the inclusion criteria were recruited into the study. A study proforma was used to obtain the patients biodata, clinical parameters and socio-demographic characteristics. Blood samples were collected and plasma glucose was determined using glucose oxidase method before commencement of management. Hypoglycaemia was defined as plasma glucose of <45mg/dl. . Data analysis was done using the statistical package for social sciences version 20 and statistical significance was set at p-value<0.05.Results: A total of 379 children aged one month to 17 years were studied over a period of one year. About seventy percent (68.6%) of the patients in the study were aged five years and below. Twenty four (24) children had hypoglycaemia giving a prevalence of 6.3%.The mean age of patients with hypoglycaemia was 3.69 years while that without hypoglycaemia was 4.05 years.Severe malaria, sepsis and severe acute malnutrition are the most common diseases associated with hypoglycaemia. Hypoglycaemia was found to be significantly associated with mortality (p= 0.001).Conclusion: Hypoglycaemia was found to complicate many childhood diseases, and it contributes to childhood mortality significantly in paediatric emergency care setting.**

***Index Terms*— Hypoglycaemia, Mortality, Plasma glucose, Prevalence.**

I. INTRODUCTION

Hypoglycaemia is the most common metabolic abnormality in childhood and is associated with neurological damage and death.[1] The importance of hypoglycaemia in children lies in the fact that if recurrent and prolonged, it is capable of causing severe retardation to the developing brain, recurrent seizure activity and even death.[2–4]

Hypoglycaemia points to the presence of an underlying cause since glucose is the fundamental energy source of the cell, disorders that impacts on its availability or utilisation can cause hypoglycaemia.[5] World Health Organisation (WHO) currently defines hypoglycaemia as blood glucose of <45mg/dl (<2.5mmol/l) in sick children and 54mg/dl in severely malnourished children.[6] The two most commonly used methods of measuring blood glucose are: glucose oxidase colorimetric method and glucose meter capillary method.[7] Children are particularly prone to developing hypoglycaemia in a wide variety of diseases such as childhood malnutrition, malaria and other infectious diseases.8–14 In resource poor countries, hypoglycaemia may be aggravated by local conditions such as poor nutrition, malaria, diarrhoea, delay in presentation to hospital, use of potentially toxic herbal preparation and lack of diagnostic facilities.[11–18]

Hypoglycaemia is common in critically ill non diabetic children and is associated with increased morbidity and mortality in intensive care units.[19] Prevalence of hypoglycaemia has been reported in paediatrics admissions in both tropical and western countries, Faustino et al[19] reported a prevalence of 7.5% in USA, while 7.1% was reported in Mozambique,[20] 7.3% in Kenya,[21] 3.2% in Tanzania[22]and 3.1 in Madagascar.[23] In these same populations, the presence of hypoglycaemia was associated with increased mortality.Similar studies among paediatrics admissions in Southern Nigeria showed prevalence of 6.4% in Ile-ife,[24] 5.6% in Lagos,[25] 5.1% in Port Harcourt[26] and 10.1% in Aba.[27]

Hypoglycaemia remains a serious problem in paediatrics practice.[28] The extent to which this metabolic anomaly poses a problem in paediatric practice is yet to be fully appreciated in the developing nations, owing to several disease conditions associated with hypoglycaemia. Furthermore, the common clinical variables associated with hypoglycaemia among paediatrics patients also needs to be identified in clinical practice. The aim of this study was to determine the prevalence of hypoglycaemia at admission in Emergency Paediatrics Unit of University (EPU) of Abuja Teaching Hospital (UATH) Gwagwalada.

II. METHOD

The study was carried out in EPU of UATH Gwagwalada Nigeria. All children admitted into the EPU are eligible for recruitment into the study except for patients with diabetes mellitus or if consent was denied. This consisted of children between the ages of One month to 17 years. The study proposal was submitted to the Medical Ethics Committee of the UATH, Gwagwalada for review and approval was obtained before the commencement of the research. Signed written informed consent was obtained from the parents / guardian of each child before their recruitment into the study. Assent was also obtained from children aged 7 years and

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above.

The patient's demographical data, history and clinical findings were recorded in the study proforma. The procedure of obtaining blood sample was explained to the patients and caregivers, and strict asepsis processes were observed. Two millilitre of blood was drawn by the investigator or trained assistant from a peripheral vein into a fluoride oxalate bottle.The samples were labelled and plasma separated immediately after collection by centrifuging at 3000 revolutions for 10 minutes before it is stored in plain bottles in the refrigerator at 4oC. Plasma samples were analysed daily at the Chemical Pathology Laboratory of UATH.

The glucose estimation was done using glucose oxidase method and the machine used was a Spectrophotometer (Spectron 20D, 722-2000) at a wave length of 505nm. Hypoglycaemia was defined as blood glucose of <45mg/dl. All patients with plasma glucose of <45mg/dl received 200mg/kg (2ml/kg of 10% dextrose) of glucose water infusion as bolus intravenously followed by continuous glucose infusion at a rate of 6-8mg/kg/min.Glucose infusion was discontinued when two consecutive plasma glucose values measured 2 hours apart were normal, and when patient tolerates oral feeds. The underlying conditions necessitating the emergency admissions were documented and patients were managed according to standard protocol. The outcome of admission were recorded as discharged, death of left against medical advice.

Data generated were analysed using SPSS version 20. Means and standard deviation were used to describe quantitative variables, while qualitative variables were presented in tables. For categorical data, association between variables were tested using Chi square or Fisher's exact tests as appropriate. For all statistical tests the p-value for significance was set at <0.05 using 95% confidence interval.

III. RESULTS

A total of 400 patients were enrolled into the study over a period of 12 months from February 2015 to January 2016. Three hundred and seventy nine (379) had complete results from blood glucose analysis using glucose oxidase method and were included for further analysis. There were 210 (55.4%) males and169 (44.6%) females giving a male to female ratio of 1.2:1. The age ranged from 1 month to 17 years, with a mean and standard deviation of 4.02 ± 4.20 years. Two hundred and sixty (68.6%) were aged five years and below.

The recorded glucose values ranged from 15.0mg/dl to 368.0mg/dl with a mean of 105.9 ± 40.2mg/dl. Of the 379 samples processed 24 (6.3%) were found to be <45mg/dl giving a prevalence of 6.3%. The highest prevalence of hypoglycaemia 11(7.8%) out of 142 occurred in children aged one to five years.

The socio-demographic variables analysed were age, gender, type of caregiver and social class. None was found to have statistically significant association with hypoglycaemia. Table IThe admission characteristics were compared between children with and without hypoglycaemia. Time interval of last meal before presentation, use of traditional medication and loss of consciousness were found to be significantly associated with hypoglycaemia (x2 = 48.892, p-value = 0.001), (x2 11.331, p-value = 0.015) and (Ft=6.942, p-value= 0.008) respectively. Table II.

Among patients with hypoglycaemia, the most frequent diagnoses were severe malaria (25.0%), and sepsis (16.7%), followed by severe acute malnutrition (SAM) (12.5%). None of the diagnosis in the study population had a statistically significant relationship with hypoglycaemia. Table III. A total of 50 out of 379 patients in the study population died during the period of the study. The case fatality rate of patients with hypoglycaemia (9 of 24) was 37.5% compared with 12.2% (41 of 335) among those without hypoglycaemia. The difference in outcome was statistically significant (x2 = 13.219, p-value=0.001) Table IV. Twenty (5.3%) left against medical advice, none of which had hypoglycaemia at presentation.

Table I:Association between socio-demographic characteristics and hypoglycaemia

Characteristics	RBS		χ^2	p-value
	<45mg/dl N= 24 n (%)	≥45mg/dl N=355 n (%)		
Age group (yrs)				
<1	6 (25.0)	101 (28.5)	$\chi^2$0.832	0.842
1-5	11 (45.8)	142 (40.0)		
>5	7 (29.2)	112 (31.5)		
Gender				
Male	11 (45.8)	199 (56.1)	$\chi^2$0.951	0.329
Female	13 (54.2)	156 (43.9)		
Caregiver type				

Both Parents	14 (58.3)	195 (54.9)	$\chi^2$1.484	0.829
Mother	7(29.2)	104 (29.3)		
Father	1 (4.2)	34 (9.6)		
Non related Guardian	2 (8.3)	18 (5.1)		
Related Guardian	0 (0.0)	4 (1.1)		
Olusanyas' social classification				
Upper Class	3 (12.5)	68 (19.2)	Ft 5.609	0.061
Middle Class	3 (12.5)	108 (30.4)		
Lower Class	18 (75.0)	179 (50.4)		

Key: p value <0.05 is taken be significant (*), RBS- Random Blood Sugar, Ft – fisher's exact

Table II:Association between admission characteristics and hypoglycaemia

	<45mg/dl N=24 n (%)	≥45mg/dl N=355 n (%)	Total N=379 N(%)	χ^2	p-value
Duration of illness (Days)					
<1	0	6	6(1.6)	1.626	0.653
1-7	14	224	238(62.8)		
8-30	9	98	101(26.6)		
>30	1	27	28(7.4)		
Time interval of last meal (hrs)					
<12hrs	12 (50.0)	331 (93.2)	343 (90.5)	$\chi^2$48.892	<0.001*
≥12	12 (50.0)	24 (6.8)	36 (9.5)		
Pre admission orthodox medication					
Yes	20 (83.3)	292 (82.3)	312 (82.3)	$\chi^2$0.018	0.893
No	4 (16.7)	63 (17.7)	67 (17.7)		
Traditional medication					
Yes	3 (12.5)	6 (1.7)	9 (2.4)	Ft 11.331	0.015*
No	21 (87.5)	349 (98.3)	370 (97.6)		
Temperature (^{o}c)					
≤37.5	8 (33.3)	139 (39.1)	126 (33.3)	$\chi^2$2.855	0.240
>37.5	16 (66.7)	216 (60.8)	253 (66.7)		
Dehydration					
No	19 (79.2)	283 (79.7)	302 (79.2)	$\chi^2$0.004	0.948
Yes	5(20.8)	72(20.3)	77 (20.8)		
Nutritional Status					
Wasting (WHZ< -2SD)	9 (37.5)	99(27.9)	108 (28.5)	$\chi^2$4.289	0.058
Normal	9 (37.5)	262 (41.4)	271 (71.5)		

Loss of Consciousness					
Yes	4 (16.7)	21 (5.9)	25 (6.6)	Ft6.941	0.008*
No	20 (83.3)	334 (94.1)	354 (93.3)		

Key: p value <0.05 is taken be significant (*), RBS- Random Blood Sugar, Ft- Fisher's Exact

Table III:Association between morbidity pattern and hypoglycaemia

Clinical Diagnosis	RBS		χ^2	p-value
	<45mg/dl n (%)	≥45mg/dl n (%)		
Acute bacterial meningitis				
Yes	2 (8.3)	10 (2.8)	Ft 0.555	0.356
No	22 (91.7)	345(97.2)		
Retroviral disease				
Yes	2 (8.3)	8 (2.3)	Ft 0.007	0.935
No	22 (91.7)	347(97.7)		
SAM				
Yes	3 (12.5)	21 (5.9)	Ft 0.140	0.722
No	21 (87.5)	334(94.1)		
Acute diarrhoeal disease				
Yes	2 (8.3)	38 (10.7)	Ft 1.468	0.389
No	22 (91.7)	317(89.3)		
Bronchopneumonia				
Yes	2 (8.3)	33 (9.3)	Ft 0.938	0.545
No	22 (91.7)	322(90.7)		
Malignancy				
Yes	1 (4.2)	6 (1.7)	Ft 0.124	0.538
No	23 (95.8)	349(98.3)		
Sepsis				
Yes	4 (16.7)	32 (9.0)	Ft 0.030	0.772
No	20 (83.3)	323(91.0)		
Severe malaria				
Yes	6 (25.0)	45 (12.7)	$\chi^2$0.152	0.697
No	18 (75.0)	310(87.3)		
Typhoid Fever				
Yes	2 (8.3)	16 (4.5)	Ft 0.675	0.425
No	22 (91.7)	339(95.5)		

Key: RBS- Random Blood Sugar, Ft – fisher's exact

Table IV:Association between hypoglycaemia and outcome of management

	Outcome of management			
	DISCHARGED	DEATH	Chi-square	p- value
<45mg/dl	15	9	11.921	0.001
≥45mg/dl	294	41		

Key: p value <0.05 is taken to be significant (*)

IV. DISCUSSION

The study population comprised predominantly children under the age of five years (68.6%) and the male gender (55.4%), and these findings are similar to studies in Ile-Ife,[24] Aba,[27] Port Harcourt[26] all in Nigeria, and Kenya.[21]

The prevalence of hypoglycaemia in this study was 6.3%. This study compares well with the prevalence of 6.4% by Elusiyan *et al*[24] at Ile-Ife and 5.1% by Jaja *et al*[26] at Port Harcourt. Similar results were 6.45% by Persad *et al*[29] in USA, 7.1% by Solomon *et al*[20] in Mozanbique and 7.3% by Osier *et al*[21] in Kenya. Lower rates of 3.2% by Nadjm *et al*[22] in Tanzania a 3.1% by Sambany *et al*[23] in Madagascar were reported, while Okoronkwo *et al*[27] at Aba, Nigeria reported a higher rate of 10.1%. While plasma samples were used for analysis in the present study, Okoronkwo *et al*[27] used capillary samples. This could explain the high prevalence reported in their study. Nadjm *et al*[22] restricted their study to only febrile children less than five years of age, while Solomon *et al*[20] in Mozambique included neonates in their study. The prevalence rates obtained by these researchers may not represent the true prevalence of hypoglycaemia in post neonatal children.

Although a number of socio-demographic factors have been shown to be associated with hypoglycaemia, this study did not observe a significant association between ages, gender and caregiver status with hypoglycaemia. These observations are similar to findings by Elusiyan *et al*[24] and Jaja *et al*[26] where age and gender were not significantly associated with hypoglycaemia, while Okoronkwo *et al*[27] on the other hand found a significant association between age and hypoglycaemia in their study. This could be due to the differences in percentage of children under the age of five years (68.6%) in this study compared 88.9% in Okoronkwo's work. There was also no significant relationship between socio-economic class and hypoglycaemia. This is similar to Okoronkwo *et al*[27] findings where social class was not found to be significantly associated with hypoglycaemia.

This study has also shown that duration of illness before presentation, use of orthodox premedication, temperature at presentation, dehydration at presentation and wasting were not significantly associated with hypoglycaemia. This is similar to findings of Elusiyan *et al*[24] and Okoronkwo *et al*.[27] Similar studies in Kenya[21] and Madagascar[20] did not find a significant relationship between duration of illness and hypoglycaemia. One would have expected a significant relationship between hypoglycaemia and wasting but why this is not so in this study is not clear. This finding is in contrast with the study of Osier *et al*[21] where hypoglycaemia was found to have a significant relationship with wasting. Reid *et al*[30] also reported hypoglycaemia complicating dehydration in children with acute gastroenteritis

Our study has shown that time interval of last meal greater than twelve hours before presentation have a significant relationship with hypoglycaemia., this is in conformity with findings by earlier workers.[15,20,21,24,27,31,32] This is to be expected as glycogen store which is at marginal level in children is easily exhausted with prolonged fast,[33] coupled with defective gluconeogenesis in most childhood diseases.

Among the various admission characteristics that were documented in the present study, loss of consciousness was found to have a significant relationship with hypoglycaemia. This is similar to the findings of Osier *et al*[21] in Kenya, Madagascar[23], Nigeria[24] and several other studies[31,32,34] where unconsciousness were found to be associated with hypoglycaemia. This could be explained by the fact that the primary disease may itself set up the machinery for hypoglycaemia and consequently leading to neuroglycopenia resulting inunconsciousness or it may potentiate the effect of hypoglycaemia arising from other factors.

The present study has shown that hypoglycaemia can complicate many childhood diseases. This is in agreement with findings of other workers.[9,10,12,14,35] Among the various disease conditions reported in this study where hypoglycaemia was more frequently observed were malaria, sepsis and SAM, however, there was no significant relationship between hypoglycaemia and these disease conditions. This was in contrast with the studies done by Okoronkwo *et al*[27] and Solomon *et al*[20] where meningitis and malaria were found to have a significant association with hypoglycaemia. Malaria as a common risk factor for hypoglycaemia in this study agrees with previous studies, [20,21,24,27,31,32] this is probably due to impairment of hepatic gluconeogensis.[31]

The outcome of management in the present study showed a worse prognosis in the hypoglycaemic group. Overall, the mortality in the hypoglycaemic children was 37.5% compared with 12.2% in the non-hypoglycaemic group. Similar Nigerian studies reported mortality rates of 36.8% at Port Harcourt,[26] 28.6% at Ife[24] and 50.0% at Aba, while Mozambique[20] and Kenya[21] reported 28.0% and 20.0% respectively.

It may be difficult to conclude that hypoglycaemia alone is responsible for deaths in this study population, however, it could be inferred that the presence of hypoglycaemia in a patient signifies high disease severity and therefore should be

managed aggressively.[28,36] Although it is generally agreed that hypoglycaemia is associated with mortality,[19,21,24,27] the extent with which it contributes to mortality needs more studies.

V. CONCLUSION

Hypoglycaemia was found to complicate many childhood diseases, and it contributes to childhood mortality significantly in paediatric emergency care setting. It is therefore essential that children are screened routinely for hypoglycaemia in emergency care settings and offered prompt treatment

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Conflict of Interest Statement

We declare that we have no conflict of interest

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