

Frequency and Predisposing Factors to Hypoglycaemic Events: Experiences at a Diabetes Youth Camp in Sub-Saharan Africa

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Abstract:

Background: Early detection and management of hypoglycaemia is an integral part of care in diabetes camps.

The objective of this report was to present the frequency of hypoglycaemic events and possible predisposing factors in a diabetes camp in Nigeria.

Methodology: The blood glucose recordings for twenty one children and adolescent aged 6 years to 19 years who attended a weekend diabetes camp were analyzed. Further information about subjects was retrieved from completed pre camp documents.

Results: Eight (38.1%) campers had hypoglycaemia and 7(43.8%) of the episodes occurred at 2am check. Hypoglycaemia was recorded in 17(7%) of 252 blood glucose recorded with a rate of 0.4 per camper/day. The mean insulin unit/kg/day was significantly higher in children with hypoglycaemia compared with those without ($p=0.03$). 40% of campers with HBA1C less than 7.5 had hypoglycaemia and the mean HBA1C and BMI Z score of campers with hypoglycaemia was lower than in those without. This finding was however not statistically significant. Fifty percent of younger campers aged 6 to 12 years had hypoglycaemia compared to 35% of older campers. There was no statistically significant relationship between age, sex, duration of diabetes and occurrence of hypoglycaemia.

Conclusion: More than a quarter of campers had hypoglycaemia. Mean insulin dose was significantly higher in campers who experienced hypoglycaemia compared to those who did not. Frequency of hypoglycaemia was higher at 2 am check and following hiking before lunch.

Keywords: Diabetes camp, hypoglycaemia, predisposing factors

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Introduction

Hypoglycaemia is a common cause of morbidity in children and adolescents with type 1 Diabetes Mellitus (T1DM) and can sometimes lead to fatalities. (1) In children with diabetes, blood glucose less than 70mg/dl (4.0mmol/l) is used as threshold for recognizing and initiating treatment for hypoglycaemia.(2) The occurrence of hypoglycaemia is almost inevitable with intensification of glycaemic control to reduce macro vascular complications. Children with T1DM suffer several episodes of hypoglycaemia which may range from asymptomatic to severe symptoms and few cases coma and death.

Children with Type 1 DM experience several episodes of hypoglycaemia per year with few severe episodes. In a review of hypoglycaemic episodes in a diabetes camp in Australia, 9.1% of blood glucose records were in the hypoglycaemic range. (3) Risk factors for hypoglycaemia in children with diabetes vary and include age, glycaemic targets, insulin regimen, exercise, time and associated illnesses. An estimated 2- 10% of deaths in people with Type 1 DM are attributed to severe prolonged hypoglycaemia. (4, 5)

The classification of hypoglycaemia in people with diabetes is based on severity of symptoms and response needed for successful treatment into mild, moderate and severe.(1,6) Symptoms in some children may be widely varied and may be difficult to detect both by child or care givers leading to the need for regular confirmatory blood glucose monitoring either using frequent intermittent monitors with glucometers or more advanced technology which include the glucose sensors for continuous glucose monitoring.

In diabetes camps for children, risk for hypoglycaemia could be high and has necessitated production of strict management programmes to ensure frequent monitoring, prevention and early detection and treatment of hypoglycaemia. Camp educational programmes are also focused on making campers responsible for recognition of hypoglycemic symptoms and avoid or treat such conditions. The understanding and insight into the occurrence of hypoglycaemia in diabetic camps for children will help in further planning and care.

The aim of this report is to present the frequency of hypoglycaemic events amongst children at a diabetes camp in Port Harcourt, Nigeria and identify possible predisposing factors.

Methodology

The Port Harcourt Diabetes Camp was the first camp for children aged between 6 and 19 years living with diabetes sponsored by the World Diabetes Federation in collaboration with the Youth with Diabetes South Africa.

Children from three selected states in the southern and Eastern part of Nigeria were invited to attend the weekend camp which held from Friday 19th August 2016 to Sunday 21st August 2016. The camp was fully residential.

All children who attended the camp completed a structured camp form giving details on demographics and details on diabetes history. Each camper at arrival at the camp had an initial evaluation and a file for documentations of events during camp handed over to the group leaders at the camper. All campers were assigned to a Pretrained group leader with knowledge in testing and treating hypoglycaemia.

As part of initial evaluation, weight, height and initial blood glucose was performed at arrival

based on internationally accepted standard. Every camper in the course of the camp had a minimum of six scheduled blood glucose test every day and whenever necessary. Blood glucose was done with the Roche Accu-check glucometers and strips donated by Roche diagnostics. Glucometers were standardized daily. HBA_{1c} was determined by the in2it analyzer standard kits. Every child also had three scheduled meals and snacks daily. Every group leader had a hypoglycemia kit for management of hypoglycaemic events once identified.

Data analysis was analyzed using SPSS 20.0 (Chicago IL). Frequencies, percentages, mean and standard deviation were used to describe data. Chi square and T test was used to identify relationships and compare means.

All campers submitted signed informed consent forms from parents on or before arrival at camp. Camp protocols and activities were approved by University Teaching Hospital. Campers were briefed on camp activities and consent and assents to participate obtained.

Ethical approval for this study was obtained from the ethics committee of the University of Port Harcourt Teaching Hospital.

Results

Twenty one children and adolescents living with diabetes attended the camp with a mean age of 14.93±3.54, mean duration of diabetes of 3.21 ±2.08 years with a range of 1 year to 9 years. There were 11(52.4%) females. All campers except one were on twice daily insulin. Mean daily dose of insulin received by campers was 35.57±21.69 units/day with range of 10 to 81units /day and mean daily insulin per kilogramme body weight of 0.79±0.43iu **Table 1** shows the descriptive characteristics of parameters of campers with diabetes. Duration of diabetes, Weight, BMI percentile and HBA_{1c} were higher in females, but there was no statistically significant difference in these parameters between males and females.

Table 1 Descriptive Characteristics of Parameters for Campers with Diabetes

Means	Total subjects(21)	Male(10)	Female (11)	P- value
Age	14.93±3.5	14.88±3.6	14.98±3.6	0.950
Duration of DM	3.21±2.1	2.75±1.9	3.6±2.3	0.342
Weight	49.91±15.9	46.1±10.6	53.36±19.4	0.308
Height Z score	-1.01±1.8	-1.44±1.66	0.61±1.9	0.302
BMI	21.27±4.0	19.81±2.36	22.59±4.79	0.114
BMI P	59.71±30.4	49.78±31.58	68.73±27.52	0.158
Insulin dose/day	35.57±21.69	37.0±13.85	34.27±27.66	0.782
Insulin/kg/day	0.79±0.43	0.87±0.33	0.76±0.47	0.555
HBA _{1c}	7.52±2.1	7.09±1.80	8.28±2.19	0.190

There were 252 blood glucose determinations over the 42 child camp days. Seventeen (7%) episodes of hypoglycaemia were recorded in 8(38.1%) campers and giving 0.4 per camper/day. Seven (43.8%) episodes occurred at 2am checks. Five (62.5%) children who had hypoglycaemia had 2 or more episodes but there was no episode of severe hypoglycaemia. Frequency of hypoglycaemia reduced as camp progressed. **Table 2 shows** clinical and biochemical characteristics of campers with and without hypoglycaemia. The insulin daily dose and insulin per kilogramme was higher in those with hypoglycaemia, however this difference was statistically significantly different with insulin dose per kg ($p=0.03$). The mean HBA1c level was also lower in campers with hypoglycaemia but this finding was not statistically significant. **Table 3** shows the frequency and likelihood of hypoglycaemia against some parameters. Hypoglycaemia was recorded in 50% of campers less than twelve years compared to those above 12years. A considerable number of campers 40% with HBA1c less than 7.5% also experienced hypoglycaemic episodes. 4(66.7%) of campers receiving more than 1.0IU/kg of insulin compared to 2(22.2%) of campers receiving less 0.7 iu/kg had hypoglycaemia, these findings were however not statistically significant. Table 3 also shows that frequency of hypoglycaemia reduced as camp progressed in days and frequency was highest at 2am and before lunch.

Table 2 shows clinical and biochemical characteristics of campers with and without hypoglycaemia

Mean	Hypoglycaemia present	Hypoglycaemia absent	Total	Pvalue
Age	14.9 ±4.03	14.95±3.39	14.93±3.54	0.97
Height Z score	-1.13±2.21	-0.93±1.61	-1.01±1.81	0.82
BMI Z score	0.32±1.19	0.5±1.28	0.43±1.20	0.75
Duration of Diabetes	3.06±1.97	3.31±2.21	3.21±2.21	0.80
Insulin/day	46.00±18.35	29.15±21.71	35.57±21.69	0.08
Insulin/kg	1.04±0.36	0.63±0.42	0.78±0.44	0.03*
HBA1c	6.5±18.35	8.19±1.86	7.56±2.06	0.07

*Statistically significant

Table 3 shows the frequency and likelihood of hypoglycaemia with some parameters

Parameters	Total (n=21)	Hypoglycaemia present(% of total)	OR/Pvalue
Age group			0.59/ 0.62
6- 12 yrs	4	2(50%)	
13-19yrs	17	6(35.3)	
HBA1c			2.31/0.32
<7.5	10	4(40%)	
7.6-8.5	5	3(60%)	
>8.5	6	1(16.7%)	
Duration of DM(yrs)			2.33/0.31
<3	6	2(33.3%)	
3-5	13	6(46.2%)	
>5	2	0(0.0%)	
Dose of Insulin/kg			3.10/0.21
<0.7iu	9	2(22.2%)	
0.7-1iu	6	2(33.3%)	
>1.0iu	6	4(66.7%)	
Frequency of Glucose estimation			
Day 1	72	6(0.08%)	
Day 2	147	11(0.07%)	
Day 3	21	0 (0.00%)	
Time of Glucose estimation			
Before Breakfast	42	3 (0.07%)	
Before lunch	21	5 (0.24%)	
Before dinner	42	1(0.02%)	
2 am	41	7(0.17%)	

Discussion

Hypoglycaemia occurs with different frequency in children with diabetes. This frequency may increase with increasing activity usually experienced in diabetes camps. In this report, 38% of campers developed hypoglycaemia during the course of the camp. Though hypoglycaemia occurred at different times, a higher frequency was associated with blood glucose recorded before lunch on second day of camp following high intensity hiking and games. This finding supports the hypothesis that frequency of hypoglycaemia may increase with camps which involves more physical activities compared to routines. Physical exercise induces hypoglycaemia by increasing the uptake of glucose by muscles, increasing the sensitivity of insulin and increasing absorption of insulin from injection sites due to increased blood flow with exercise. (4, 7) There are scarce reports on hypoglycaemia during camps in African children. In a study on impact of pioneer diabetes camp experience on glycaemic control among children and adolescents with Type 1 Diabetes in Sub- Saharan Africa, Mesmin et al reported hypoglycaemia during a five day camp in 74.3% of campers.8 This finding was much higher than the report in this study. The reason for the higher frequency may be attributed to many

factors not immediately obvious but one possible explanation may be due to higher section of physical activities in longer duration camp compared to our camp. The frequencies of hypoglycaemia in blood test done for glucose in camps vary and are usually less than 10%. In a Georgian camp in America, 2.6 % of blood glucose test revealed hypoglycaemia while 9.1% was reported in a review of 10 consecutive diabetes camp held in the same facility in Australia.(3, 9). In this report, 7.1% of blood glucose test were in the hypoglycaemic range. No subject in our study had severe hypoglycaemia and they all responded to oral glucose treatment, similar to reports in other studies. Several risk factors have been reported for hypoglycaemia in children living with Type 1 Diabetes. In this study, we found that the mean insulin dose per kilograms body weight was significantly higher in campers with hypoglycaemia compared to those without hypoglycaemia. Campers receiving more than 1.0iu/kg/day were three times more likely to develop hypoglycaemia although this finding was not statistically significant. This finding may go to support the fact that the conventional risk factor for hypoglycaemia in people living with diabetes as is known is based on the premise that relative or absolute therapeutic hyperinsulinaemia with low glucose in the circulation is the sole determinant of hypoglycaemia. (4, 10)

In this report, we found that the mean HBA_{1c} was lower in campers with hypoglycaemia and almost half of the campers with HBA_{1c} of less than 7.5% had hypoglycaemic episodes. The role of HBA_{1c} levels in identifying risk for hypoglycaemia in people living with diabetes has shown various conclusions. The finding in this study was supported by Davis and colleagues who noted a rising incidence of hypoglycaemia in a large group of children with T1DM whom he followed up for four years.(11) Kimberly and colleagues (12) in looking at insight into hypoglycaemia in paediatric T1DM also noted low HBA_{1c} as a description of risk for severe hypoglycaemia, but as reported by Carlson et al(13) and in a study on Korean children living with Type 1 Diabetes,(14) there was no statistically significant association between HBA_{1c} level and occurrence of hypoglycaemia similar to the finding in this study. The lower HBA_{1c} recorded in subjects with hypoglycaemia may not be solely accounted for by hypoglycaemia, however, determination of other reasons for low HBA_{1c} such as anaemia, haemoglobinopathy and possible use of other drugs were not looked at and may require further evaluation.

Although there was a higher prevalence of hypoglycaemia in children less than 13 years in this study, there was no statistically significant association between age, sex, duration of diabetes and occurrence of hypoglycaemia in our study similar to reports by Carlson et al (13) and Gunasekera and Ambler (3) In the study by Gunasekera and Ambler in Australia(3) on safety and efficacy of blood glucose management practices at a diabetes camp, frequency of hypoglycaemia was unaffected by sex, age, duration of diabetes and number of daily dosages of insulin which support most of the findings in this study. The American Diabetes Association (ADA) has advocated that important goal in managing diabetes in children both at home and during camp is to avoid extremes values of blood glucose especially hypoglycaemia.(15) There was no report of severe hypoglycaemia in campers who developed hypoglycaemia and episodes of hypoglycaemia reduced with days at the camp. These episodes of hypoglycaemia also provided teaching moments for both campers and volunteer staff.

Limitation of Study: This study had some limitations which included number of participants which would limit generalization of the study finding. Data on other factors that can influence development of hypoglycaemia such as insulin, carbohydrate ratio, and exercise quantity were not looked at.

Conclusion

Hypoglycaemia was common but there was no severe episode. There was a significant difference in the mean

insulin per kilogram per day between campers with hypoglycaemia and those without. However no clinical or demographic factors were significantly associated with occurrence of hypoglycaemia in the campers.

There will be need for larger study to look at camp activities and other clinical influence on blood glucose levels in children at diabetic camps in our region.

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