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Growth Indices and Serum Zinc Levels of Children with Sickle Cell Disease Seen At the University College Hospital, Ibadan

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Authors' contributions

This work was carried out in collaboration between all authors. Author JN designed the study, wrote the protocol, draft of the manuscript, collected study data and did the analyses and write up of result. Authors BB and AO managed the literature searches and were involved in the draft write up, data analysis and writing up the study findings. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aims: The study determined the serum zinc levels of children with Sickle cell disease (SCD) and its relationship to their growth.
Study Design: Comparative cross-sectional study.
Place and Duration of the Study: This study was conducted between November 2012 and February 2013 at the Paediatric outpatients clinic, University College Hospital (UCH), Ibadan, Nigeria.
Methodology: Weight, height and serum zinc were compared between SCD subjects and Haemoglobin A (Hb A) controls. The association between zinc deficiency and growth indices was assessed. A total of 104 SCD subjects and 103 Hb A children were studied.
Results: The mean weight-for-age z-scores in SCD and controls were -0.6 ± 1.3 and -0.4 ± 1.5 respectively (p=.292). Using WHO reference z-scores 16.4% and 9.7% of SCD subjects and

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controls respectively were underweight (*p*=.513) and, 17.3% and 15.5% of SCD subjects and controls respectively were stunted (*p*=.347). The mean serum zinc in SCD subjects was 76.6 ± 16.5 μg/dl compared to 82.2 ± 23.3 μg/dl in controls (*p*=.05). A significantly higher proportion of SCD subjects ≥ 10 years of age had zinc deficiency compared to those less than 5 years of age (51% versus 15.2%, *p*< .001). Zinc deficiency was not associated with being underweight (p=.614), stunted (*p*=.23) or wasted (*p*=.19) in SCD subjects.

Conclusions: Weights and heights of SCD subjects and controls are not significantly different in the UCH. Mean serum zinc levels of children with SCD are lower than in controls but there is no association between zinc deficiency and underweight or stunting. There is a higher prevalence of zinc deficiency in children with SCD aged 10 years and older. More studies are needed to determine the magnitude of growth impairment in SCD in Nigeria as well as to establish its relationship with serum zinc in these children.

Keywords: Serum zinc; growth; sickle cell disease; children.

1. INTRODUCTION

Sickle cell disease (SCD) is the most common inherited disorder in people of African descent [1,2]. Sickle cell disease primarily affects the red blood cells leading to chronic haemolytic anaemia with variable multisystemic manifestations [3,4].

Most children with SCD have detectable growth retardation that affects weight more than height by the age of 2 years [5] Normal height may be achieved by adulthood but weight remains lower than those of controls [5] Sadarangani et al. [6] in Kenya utilized the National Centre for Health Statistics (NCHS) references and found lower mean weight for age and weight-for-height z scores in Sickle cell anaemia (SCA) subjects but did not find any difference in the height-for-age z scores between SCA and controls. A similar study in Yemen using the WHO reference z-scores noted low weight, height and Body Mass Index (BMI) for age z-scores in 45%, 54% and 35% of children with SCD, respectively [7]. There are few studies in Nigeria evaluating the growth profiles of children with SCD. Oyedeji [8] in a study among children with SCA aged 9 months to 17 years noted that their heights and weights fell below the 3rd centile of standard growth curves for Nigerian elite children. Animashaun et al. [9] also noted lower mean weight for age but did not find any difference in in the height-for-age z scores between SCA and controls in Lagos, Nigeria.

Plasma zinc has been documented to be low in patients with SCD in separate studies [10,11]. However, studies in children with SCD have yielded mixed results with a majority indicating lower levels in SCD with few others showing no difference from levels in control subjects. Phebus et al. [12] found significantly lower serum zinc in children with SCD in steady state compared to controls with mean serum zinc in SCD subjects of 77.8 +/- 9.9 compared to 82.2 +/- 9.8 micrograms/dl (p<.05) in Hb A controls. SCD subjects greater than or equal to 12 years of age were also noted to have significantly lower zinc levels than those less than 12 years [12]. Zinc deficiency in children with SCD in that study was thought to be related to factors such as increased urinary zinc excretion, chronic intravascular haemolysis, and/or zinc malabsorption. Prasad et al. [10] also demonstrated lower zinc concentration in the lymphocytes and granulocytes of SCD subjects.

Studies in Nigeria have yielded mixed results. Ogunrinde et al. [13] in Zaria, analyzed erythrocytes for zinc concentration in children with SCA in a steady state and observed that the mean erythrocyte zinc concentration in SCA subjects was lower than that of the Hb A controls. They also found an age related increase in erythrocyte zinc in both controls and SCA subjects. However, erythrocyte zinc estimation has not been sufficiently validated to permit its use as a diagnostic criterion for zinc deficiency [14]. In contrast Temiye et al. [15] found no significant difference in mean serum zinc among controls and SCA children in steady state.

Micronutrient deficiency especially zinc, has been implicated as one of the possible causes of impaired growth in children with SCD [10,16]. The study by Ogunrinde et al. [13] however found no relationship between erythrocyte zinc and growth deficits in SCD subjects. This was in keeping with the findings of Finan et al. [17] and Abshire et al. [11] in the United States (US). Zemel et al. [18] in the US studied 42 prepubertal children aged 4-10 years with SCA who were

randomized to receive either 10 mg elemental zinc in cherry syrup (zinc group) or cherry syrup alone (control group). After 12 months, the zinc group had significantly greater mean increase in overall height, sitting height, knee height and arm circumference.

This study was therefore designed to determine the prevalence of zinc deficiency using serum zinc which is the best biomarker for assessing the risk of zinc deficiency as it reflects dietary zinc intake, responds consistently to zinc supplementation and reference data are available for age and sex groups [14,19-21]. The study also assessed the relationship between serum zinc levels and growth indices of these children.

2. MATERIALS AND METHODS

This was a comparative cross-sectional descriptive study carried out in the University College Hospital (UCH), Ibadan between November 2012 and February 2013. The sample size for the study was determined using standard formula for population study [22], using the prevalence rate of zinc deficiency in Osun state (representative of southwestern Nigeria where the study was carried out) [23].

The subjects comprised 104 children aged between two and fourteen years who had SCD and were in steady state. The control group consisted of 103 apparently well children whose haemoglobin phenotype was AA and matched for age and sex with the SCD subjects. They were recruited from the Paediatric Haematology-Oncology clinic of the UCH. The study was approved by the Joint Health Research and ethics committee of the University of Ibadan and the University College Hospital.

To be included in the study participants should have been fed at least 4 hours and not more than 8 hours before collection of blood samples. Samples were mainly between 1100 and 1200 Greenwich Mean Time (GMT). Subjects excluded were those on zinc-containing medications or transfused with blood or blood products in the previous 3 months before enrolment in the study in order to avoid contribution of zinc from blood donor. Additionally, controls had no evidence of chronic disease including protein energy malnutrition. The controls were were largely siblings of the SCD subjects whose phenotypes where already known to the parents (who had been made aware of the study prior to its onset) and subsequently confirmed during analysis of their sera as well as some children accompanying their ill siblings to the Children Emergency Room.

Details of information extracted was entered into a proforma. Meals, which contain items such as plantain, red beef, sea foods, egg, milk, cocoa products and fish were classified as having high zinc content. While cereals made out of maize products like pap, custard® and Cerelac®, rice, beans contain moderate zinc. Food items made from cassava product like *garri*, *fufu* are classified as having traces or low zinc content. Each food items taken was classified as having high, moderate or low zinc content [24]. A detailed physical examination was carried out to determine the presence of pallor, jaundice, hepatosplenomegaly, signs of malnutrition especially in the skin, hair, buccal mucosa and eyes in children.

Weights, heights, mid upper arm circumference (MUAC), skin fold thickness (subscapular and triceps) using a Holtain skin caliper and body mass index were measured from which z-scores were derived for analysis. Furthermore, underweight (WAZ), wasting (WHZ), stunting (HAZ) and overall nutritional status (ONS-composite of WAZ, WHZ, HAZ) were defined at cut-off points of z-scores < -2SD below the median of the reference population based on the WHO Child Growth Standards [25].

Five millilitres of blood was collected from each subject by venepuncture after appropriate skin preparation with a 21-gauge stainless steel needle with a polypropylene syringe (Norm-Ject; HenkeSass Wolf GMBH, Germany). Two millilitres of blood was transferred into a sodium ethylenediamine-tetra-acetate (EDTA) bottle for Packed cell volume (PCV), and haemoglobin electrophoresis. Haemoglobin electrophoresis was performed by a chief laboratory scientist in the UCH, Ibadan using the Shandon Southern Electrophoresis instrument (*Model 2692, Pittsburg, USA*). The test haemoglobin was determined by comparing its location on the cellulose acetate paper in the tris solution (hydroxymethyl with amino methane buffer pH 8.6) with the controls [26].

Serum zinc estimation: Three milliliters of venous blood were syringed into a zinc-free serum bottle (previously washed clean of possible zinc contamination by leaving them soaked in 10% nitric acid for 24 hours and rinsed

three times with deionised water) and allowed to clot for separation of serum. Serum zinc levels were measured at the Central Science Laboratory, Obafemi Awolowo University, Ile-Ife, Nigeria using a flame atomic absorption spectrophotometer (AAS) a Hitachi model 180-80 by the Chief laboratory scientist. The absorbance of various dilutions of known concentrations of standard solution of zinc was first determined. The concentrations of the metal were plotted against the corresponding absorbance (calibration curve). The absorbance of the test solutions was then determined and the corresponding concentrations in parts per million (ppm) were extrapolated from the calibration curve and converted to µg/dl by multiplying by 100. Three readings of the absorbance were taken for each specimen and the average reading was calculated before the concentration was read from the graph [27].

Serum zinc varies across different age groups but age and sex specific cut offs are available [28]. Four key factors that affect the interpretation of serum zinc levels are age, sex, fasting status and time of day of blood collection [28]. In a reanalysis of a previous large study to determine the lower cut off of serum zinc concentration, zinc levels was noted to increase with age and was higher in males greater than ten years compared to females [28]. Serum zinc value in the fasting state and in the morning were also higher than those in the non-fasting state and in the afternoon. The diurnal variation in circulating zinc concentrations is largely a result of metabolic changes after meal consumption, although it may also arise as a result of normal circadian variations in metabolism [28,29]. Meal consumption is thought to stimulate the release of a protein, leucocyte endogenous mediator (LEM), which is released from activated phagocytes and which enhances hepatic uptake of zinc [29]. The lower cut off figures for zinc deficiency in the morning non-fasting state which was assessed in this study were 65 µg/dl in children less than ten years; 70 µg/dl for boys ten years and above and 66 µg/dl in girls who were equal to or older than 10 years of age [28].

2.1 Data Analysis

Data was analysed using the SPSS version 16.0 statistical package (SPSS for Windows Inc. Chicago, LL, USA, 2008). The data was entered into a microcomputer, cleaned and z-scores of weight for age and sex, height for age and BMI for age generated using the WHO Anthro and AnthroPlus software developed using the WHO Child Growth Standards and WHO Reference [30]. Frequency distributions were generated for categorical variables.

The means, medians and modes were computed for continuous variables, while categorical data were represented by proportions. The difference between two means was assessed using student t-test, while one way analysis of variance was used where there were more than two means. Pearson chi-square or Fisher's exact test was used to compare categorical data. The level of statistical significance of each test was set at $p < .05$.

3. RESULTS

A total of 207 children comprising 104 with SCD and 103 with Hb A were studied. Among the SCD subjects, 96 (92.3%) were of Hb SS phenotype. The age range of both the SCD subjects and controls was from 24 to 168 months. The mean ± one standard deviation (1SD) of the children with SCD was 91.7 ± 49.5 months while that of the control group was 96.2 ± 50.2 months (t=0.654; p = .51). The male to female ratio was 1:1.3 in both the sickle cell disease patients and controls (p = .94). The mean age ± standard deviation of the Hb SS subjects was 93.1 ± 50.1 months while that of Hb SC subjects was 74.8 ± 39.8 months (t=1.000; df=102; p=.32). The male to female ratio of Hb SS subjects was 1:1.3 while that of Hb SC subjects was 1:1. Although the mean weight of the control patients were more than the SCD subjects there was no statistically significant difference in mean heights of the two groups (Table 1). However, the control subjects had a mean packed cell volume of 32.8±3.0% which were significantly higher than the SCD group who had a mean packed cell volume of 24.3± 3.4% (Table 1).

Table 1. Mean demographic and laboratory parameters of subject and controls

Parameters	SCD n =104	Controls n= 103	p-value
Age (months)	91.7(49.5)	96.2(50.2)	.51
Weight (kg)	23.1(9.8)	25.0(12.5)	.04+
Height (cm)	120.1(22.1)	120.2(28.5)	.07
BMI (kg/m^2)	15.8(2.3)	16.1(2.0)	.33
PCV (%)	24.3(3.4)	32.8(3.0)	<.001+

PCV: Packed cell volume, SD: Standard Deviation,
+Significant at p<0.05

The mean weight-for-age z-score and mean weight-for-height z-score of SCD subjects were lower than those of controls but these differences were not statistically significant (Table 2). Similarly, mean z-scores for height, BMI, Skin fold thickness and MUAC did not differ significantly between SCD subjects and controls. Occipito-frontal circumference (OFC) z-score was higher among SCD subjects compared to controls (p=.03). The growth parameters showed that 16.4% of SCD subjects were underweight compared to 9.7% of controls based on z-scores (x^2=2.010, p=.16). Furthermore, 17.3% of the SCD subjects were stunted compared to 15.5% of controls (x^2=0.119, p=.73) while 15.4% and 10.7% of the SCD subjects and controls respectively had low BMI (x^2=0.802, p=.37). Similarly, when the weight for height of the study participants were compared 16.4% of SCD subjects were wasted compared to 10.7% of controls based on z-scores (x^2=1.421, p=.23).

The mean serum zinc level was 76.6 ± 16.5 μg/dl in the SCD group while that of the control group was 82.2 ± 23.3 μg/dl (t = -1.997; p=.05). The mean serum zinc in SCD subjects <10yrs of age (79.2 ± 11.3 μg/dl) were lower than those of controls (82.8 ± 20.4 μg/dl) but the difference between both groups was not statistically significant (p=.21). Similarly, there was no statistically significant difference in the mean serum zinc between SCD and controls greater than ten years of age (71.47 ± 22.68 versus 81.13 ± 27.81 μg/dl, respectively; p=.11). The percentage of children with zinc deficiency (based on age and sex specific criteria) did not differ significantly among the SCD and controls (24% and 28.2%, respectively; x^2=0.455, p=.50).

Among the SCD subjects prevalence of zinc deficiency was significantly higher in children greater than or equal to 10 years of age compared to younger children (p=.001). There was no significant difference in the prevalence of zinc deficiency across the different age groups among the controls (Table 3). Among SCD subjects less than 10 years of age 68(97.1%) of them consumed moderate and high zinc

Table 2. Comparison of growth parameters in SCD and Controls

Variables	SCD n=104	Controls n=103	t-test	p-value
Mean WAZ(SD)	-0.6(1.3)	-0.4(1.5)	1.056	.29
Mean HAZ(SD)	-0.6(1.6)	-0.8(1.9)	-0.986	.33
Mean WHZ(SD)	-1.1(1.3)	-0.8(1.6)	1.204	.24
Mean BMIZ(SD)	-0.7(1.4)	-0.5(1.6)	1.176	.24
Mean OFCZ(SD)	0.3(0.9)	-0.2(1.1)	2.215	.03[+]
Mean MUACZ(SD)	-0.5(0.8)	-0.2(0.8)	-1.693	.09
Mean TSFTZ(SD)	-4.7(1.0)	-4.8(1.0)	0.693	.53
Mean SSFTZ(SD)	-3.8(1.3)	-4.2(1.3)	0.914	.36

WAZ: Weight for age z score; HAZ: Height for age z score; WHZ: Weight for height z score; BMIZ: Body mass index z score; [+]Significant at p<0.05; SD: Standard Deviation; OFCZ: Occipito Frontal Circumference z-score; MUACZ: Mid Upper Arm Circumference z score; TSFTZ: Tricep Skin Fold Thickness z-score; SSFTZ: Subscapular Skin Fold Thickness z-score; MUAC and OFC were calculated for children between 2-5 years of age

Table 3. Zinc level across different age groups in study subjects

Age (yrs)	No of patients n=104	Normal zinc n (%)	Zinc deficient n (%)	p-value
SCD				
2 to < 5	33	28(84.8)	5(15.2)	<.001[a+]
5 to < 10	38	35(92.1)	3(7.9)	
≥ 10	33	16(48.5)	17(51.5)	
Total	104			
Controls				
2 to < 5	31	26(83.8)	5(16.2)	.21[a]
5 to < 10	36	24(66.7)	12(33.3)	
≥ 10	36	24(66.7)	12(33.3)	
Total	103			

[a]Pearson chi square; [+]Significant at p<.05

Table 4. Relationship between growth indices in study subjects and serum zinc

Variable	SCD				Controls			
	Total	Zinc deficient n (%)*	Normal zinc n (%)	p-value	Total	Zinc deficient n (%)*	Normal zinc n (%)	p-value
WAZ								
Normal	87	21(24.1)	66(75.9)	0.614[a]	93	25(26.9)	68(73.1)	.29[a]
Underweight	17	4(23.5)	13(76.5)		10	4(40.0)	6(60.0)	
Total	104				103			
HAZ								
Normal	84	22(26.1)	64(73.9)	0.228[a]	86	23(26.7)	64(73.3)	.33[a]
Stunted	20	3(15.0)	15(85.0)		17	6(35.3)	10(64.7)	
Total	104				103			
WHZ								
Normal	79	11(13.9)	68(86.1)	0.188[a]	91	22(24.2)	68(75.8)	.34[a]
Wasted	25	6(24.0)	19(76.0)		12	7(58.3)	6(41.7)	
Total	104				103			

WAZ: Weight for age z score; HAZ: Height for age z score; WHZ: Weight for height z score; [a]Fisher exact test

containing meals compared to 32(97.0%) of SCD subjects ≥ 10 years of age who also consumed moderate and high zinc containing meals (x^2=0.964; *p*=.62).

The mean serum zinc among underweight SCD subjects was 77.8 ± 11.7 µg/dl and 76.2 ± 17.4 µg/dl among normal weight SCD subjects (t=0.365, *p*=.07). Similarly, mean serum zinc among SCD subjects who were stunted was 78.2 ± 15.0 µg/dl and 75.7 ± 16.8 µg/dl in those with normal height (t=0.598, *p*=.55). As shown in Tables 4 above, there was no statistically significant association between the presence of growth deficit in WAZ, HAZ, WHZ and the finding of zinc deficiency (using age and sex dependent reference values) among both SCD and controls.

4. DISCUSSION

The aetiology of growth retardation in SCD is complex and includes multiple factors such as the child's haematological and cardiovascular status, social factors and endocrine function as well as altered metabolic and nutritional status [5,8,31]. However there is paucity of studies on growth impairment in SCD from the developing world including Nigeria. In the present study underweight, stunting and wasting were noted in 16.4%, 17.3% and 16.4% of SCD subjects which were higher than the values in controls (9.7%, 15.5% and 10.7%, respectively) although the differences were not statistically significant. Previous studies in Nigeria by Ogunrinde et al. [13] and Emodi et al. [32] had shown lower mean weight and heights in SCD subjects compared to controls but these were not compared to international reference standards. Our study similarly revealed lower mean weights in SCD subjects compared to controls. However comparison of SCD subjects and controls using z-scores did not yield any statistically significant difference in mean weight and height of the two groups of children in our study.

Previous studies in Africa had shown variable findings in the different growth parameters. Animashaun et al. [9] in Lagos, Nigeria and Sadarangani et al. [6] in Kenya utilized the NCHS references and found lower mean weight for age and weight-for-height z scores in SCA subjects but did not find any difference in the height-for-age z scores between SCA and controls. Chawla et al. [33]. in the United States found that most SCD subjects aged 2 to 19 years had acceptable weights when compared to the general population and attributed this to improved clinical treatment alternatives such as chronic transfusion programme and the use of hydroxyurea. The absence of a significant difference in the prevalence of growth deficits among SCD subjects and controls in the present study is probably attributable to the effect of improved nutrition narrowing the margins between SCD and Hb A controls as well as improved health education and access to health care.

The present study demonstrated that SCD subjects had lower mean serum zinc level compared with Hb A controls. The mean serum zinc of 76.6 µg/dl among SCD subjects in this study compared favourably with value of 89 µg/dl in an Iranian study [11] but was markedly higher

than results from a previous study in Nigeria among Hb SS subjects (32.3 µg/dl) by Temiye et al. [15] However the result of this study remains in keeping with the report of zinc deficiency in SCD subjects compared to controls as previously shown in Nigerian studies by Akinkugbe [34] in Ibadan albeit in a smaller subset of subjects (twenty) and Ogunrinde et al. [13] Zinc deficiency in SCD is thought to be of multifactorial aetiology. Significant loss of zinc from red cell which is an important storage site for zinc as a result of chronic haemolysis may be contributory [12]. Also, defective zinc homeostasis as a result of excessive excretion of zinc in urine or abnormal renal tubular reabsorption of zinc due to the sickling phenomena may also explain the low serum zinc in patients with SCD [12]. In spite of the finding that mean serum zinc in SCD children was lower than that in controls the prevalence of zinc deficiency in the SCD subjects in the present study was not significantly different from that in the controls. This might raise question about the applicability of the cut-off values for zinc deficiency used in the study to the Nigerian population. Another reason for the lack of a significant difference in the prevalence of zinc deficiency in the two groups could be that zinc deficiency is a public health problem in Nigeria with a prevalence of 20% among children under five years of age with the severity being more marked in rural areas (26%) compared to 17% in urban centres [23].

The percentage of children with zinc deficiency when stratified showed that a higher proportion of children with SCD $\geq$ 10 years had zinc deficiency compared to younger SCD subjects. In SCD children less than 5years the prevalence figure of 15.2% in this study did not reach the 25% prevalence set by the International Zinc Nutrition Consultative Group as an indicator of zinc deficiency risk of significant public health importance [35]. It is however close to the national prevalence of zinc deficiency among under fives living in the urban centres in Nigeria of 17% [23]. However the prevalence of zinc deficiency among older children $\geq$ 10 years of age (51.5%) markedly exceeds the international cut off point for significant zinc deficiency similar to a previous finding among older SCD subjects [12].

The findings of this study revealed that zinc deficiency in SCD subjects was not associated with growth deficits in WAZ, HAZ and BMI for age z-scores. This is consistent with findings noted by Finan et al. [17] and Abshire et al. [11] in the US. This might suggests that zinc deficiency may not significantly contribute to growth deficit in SCD and there is a need to explore the impact of other factors in the aetiology of growth impairment in SCD.

5. CONCLUSIONS

The present study did not show any significant difference in the prevalence of growth deficits among SCD subjects and controls, however the monitoring of growth and nutritional status remains an essential component of wholistic care in SCD. In general the prevalence of zinc deficiency did not differ statistically between SCD subjects and controls. However a higher proportion of SCD subjects older than 10 years had zinc deficiency compared to controls. Zinc deficiency in SCD subjects was not associated with deficits in weight, height or body mass index in the study population. More studies are needed to establish the relationship between age and zinc deficiency in SCD especially in view of the high prevalence of zinc deficiency found among SCD subjects older than ten years of age in this study.

6. LIMITATIONS

The assessment of the dietary intake of the study participants was difficult and likely less accurate due to recall bias and difficulty in quantification of the feeds as consumed as well as the zinc content of the feeds. Due to cost, urinary and stool zinc losses which may reflect on serum zinc levels could not be estimated.

CONSENT

Written informed consent from parent(s) or caregiver(s) was obtained before recruiting each child into the study. The study was explained to the parents/caregivers in the language they understood. Parents were informed of their freedom to refuse to participate in or withdraw from the study at any point in the course of the study without any negative consequence on them or their children. They were also informed that their refusal or withdrawal from the study would not exclude their children from necessary treatment (Appendix II).

ETHICAL APPROVAL

Ethical clearance was obtained from the Joint Ethical Committee of the University of Ibadan-

University College Hospital Ibadan Ethical Review Committee (Appendix I).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX I

ETHICAL APPROVAL

INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT)
COLLEGE OF MEDICINE, UNIVERSITY OF IBADAN. IBADAN, NIGERIA.
Director: Prof. A. Ogunniyi, B.Sc(Hons), MBChB, FMCP, FWACP, FRCP (Edin), FRCP (Lond)
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UI/UCH EC Registration Number: **NHREC/05/01/2008a**

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Growth Indices and Serum Zinc Levels of Children with Sickle Cell Disease seen in the University College Hospital, Ibadan

UI/UCH Ethics Committee assigned number: UI/EC/12/0169

Name of Principal Investigator: **Dr. N. E. Jacob**

Address of Principal Inves r tigator: Department of Paediatrics,
University College Hospital, Ibadan

Date of receipt of valid application: 20/06/2012

Date of meeting when final determination on ethical approval was made: **N/A**

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and given *full approval by the UI/UCH Ethics Committee.*

This approval dates from 11/10/2012 to 10/10/2013. If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the* UI/UCH EC *assigned number and duration of* UI/UCH EC *approval of the study.* It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC early in order to obtain renewal of your approval to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. *No changes are permitted in the research without prior approval by the* UI/UCH EC *except in circumstances outlined in the Code. The* UI/UCH EC *reserves the right to conduct compliance visit to your research site without previous notification.*

UI/UCH EC
1 OCT 2012
APPROVED

Professor A. Ogunniyi
Director, IAMRAT
Chairman, UI/UCH Ethics Committee
E-mail: uiuchirc@yahoo.com

APPENDIX II

CONSENT

Paediatrics Department,
University College Hospital,
Ibadan.

Dear Sir/Ma,

I wish to ask for your consent to allow your son/daughter participate in this ongoing study titled "Growth Indices and Serum Zinc levels in Children with Sickle Cell Disease seen in the University College Hospital, Ibadan".

The reason for this study is to enable me determine the number of children with sickle cell disease who are growth impaired and have poor nutritional status. I will also determine the level of zinc in your child's blood. Zinc is one of the small (trace) elements present in natural; food. Zinc is important for normal growth and low levels of zinc is known to affect people with sickle cell disease causing low weight gain and poor wound healing.

Determining your child's growth indices and his/her zinc level will assist us to take better care of your child.

The study will require taking five mls of blood which will not be injurious to your child's health. I will wear gloves while collecting the sample and a new needle will be used during the process. The cost of the test will be borne by me and the results will be made available to you and your doctors who are looking after your child.

If you agree for your child to take part please sign in the space provided below there will be no penalty for refusal or withdrawal of your child/ward from the study at any point in time.

Thank you for your cooperation

Yours faithfully,

I am willing to allow my child/ward take part in the study.

Name: . . . . Signature & Date:. . . . .

Assent for older children:

Phone no: .. . .

Witness: ……

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/16362