East African Medical Journal Vol. 96 No. 3 March 2019
THE PREVALENCE OF MALNUTRITION, ANAEMIA AND MALARIA AMONGST UNDER 5-YEAR-OLD CHILDREN WITH SICKLE CELL DISEASE ADMITTED AT A REFERRAL HOSPITAL IN WESTERN KENYA

Cynthia Pauline Aluoch Auma, Bachelor of Medicine and Bachelor of Surgery with Information Technology, Maseno University, School of Medicine, P. O Box 527 - 40105, Maseno. Eddy Johnson Owino, Bachelor of Food, Nutrition and Dietetics, Kenyatta University, School of Public Health and Applied Human Sciences, P.O. BOX 3803- 40100, Kisumu.

Corresponding author: Cynthia Pauline Aluoch Auma, Bachelor of Medicine and Bachelor of Surgery with Information Technology, Maseno University, School of Medicine, P. O Box 527 – 40105, Maseno. Email: aluochcynthia16@gmail.com

THE PREVALENCE OF MALNUTRITION, ANAEMIA AND MALARIA AMONGST UNDER 5-YEAR-OLD CHILDREN WITH SICKLE CELL DISEASE ADMITTED AT A REFERRAL HOSPITAL IN WESTERN KENYA

C. P. A. Auma and E. J. Owino

ABSTRACT

Background and objectives: **Sickle cell disease (SCD) is a common autosomal recessive haemoglobinopathy disproportionately affecting Sub-Saharan Africa leading to early childhood mortality. The study set out to assess the nutritional status, presence of anaemia and malaria, medication use and health seeking behaviour of children under five years with SCD.**

Methods and study design: **A cross-sectional study of 15 children with S.C.D presenting at Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH). Data gathered from questionnaires were analysed using Statistical Packages for Social Sciences (SPSS) version 23.**

Results: **Fifteen children, mean age 3.22 years (average age at SCD diagnosis 1.62 years) participated in the study. 20% of them had severe acute malnutrition, all were anaemic with an average haemoglobin level of 7.1 ± 1.59 g/dl. Only 26.7% of them were diagnosed with malaria. All the children, 100% were on folate and proguanil with 60% being on penicillin V prophylaxis and 46.7% on hydroxyurea. Most, 80% of the children were enrolled in a SCD clinic. Health professionals were the major source of information on SCD (100%) followed by radio 60%. A majority, 93.3% of the respondents wanted to have more information on SCD**

Conclusions and recommendations: **Sicklers are predisposed to malnutrition disorders thus their growth and nutritional status should be regularly assessed as part of comprehensive care. Newborn screening and oral prophylactic penicillin use should be encouraged in reducing childhood morbidity. Health professionals should leverage their popularity as the major source of information on SCD, to continue counselling guardians on SCD and encourage drug adherence.**

INTRODUCTION

Sickle cell disease (SCD) is a common autosomal recessive haemoglobinopathy. Sub-Saharan Africa is disproportionately affected, accounting for 75% of the world's SCD population (1). SCD is associated with high rates of early child hood mortality in Africa (2). In North America, simple interventions such as newborn screening and infection prophylaxis have significantly decreased childhood mortality (3).

SCD is commonly associated with malnutrition, impaired growth, and delayed puberty (4). In the Twi dialect of Ghana, children with SCD are described as "*Woaye ndwedwendwedwe*", meaning stunted in growth and likened to sugarcane in its knotted or segmented form (5). Proposed pathophysiology of malnutrition in SCD include protein hyper metabolism, decreased dietary intake likely from interleukin-6-related appetite suppression, increased cardiac energy demand/expenditure, and increased red cell turnover (6). This manifests as increased resting energy expenditure. However, despite SCD being increasingly viewed as a neglected tropical disease, there is paucity of data on the relationship between SCD and nutrition in the African context (7).

Hydroxyurea therapy is recommended in SCD treatment even in infants, beginning 9 months of age regardless of disease severity (8). It decreases frequency of painful crisis and other acute SCD complications by inducing fetal haemoglobin (8). However, it's use is still limited in low resource settings due to knowledge gaps such as absence of treatment guidelines (9). The World Health organization noted that most SCD national policies are inadequate with many deaths occurring in under-fives thus recommended hydroxyurea in the Essential Medicines for Children in treatment of haemoglobinopathies (10). In Kenya, the Ministry of Health recommends hydroxyurea use only in severe SCD (11).

Early studies indicated SCD is most common among the Luo and Luhya ethnic groups accounting for more than 80% (Luo 58.4%, Luhya 23.9%) of sicklers in Kenya (12). This study was thus carried out in Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), a regional referral hospital in Kisumu that serves a predominantly Luo and Luhya population.

The specific objectives of the study were to assess:

- the nutritional status of children with SCD
- anaemia in children with SCD
- malaria in children with SCD
- medication use in SCD and adherence rates
- health seeking behaviour among guardians of sicklers

MATERIALS AND METHODS

This was a hospital based cross sectional study of children admitted at Obama Children's Ward in Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH), a regional referral hospital located in Kisumu County. The Obama ward provides paediatric services to children within Kisumu and other surrounding counties.

The study subjects included children aged 0-5 years already diagnosed with SCD currently admitted at JOOTRH. Informed written consent was obtained from the guardian/ parents in their preferred language of communication. Ethical approval was obtained from Maseno University Ethics Review Committee (MUERC).

A structured questionnaire was administered to the participants who gave written consent. Nutritional status was assessed using mid upper arm circumference measurement (MUAC). Clinical data such as current haemoglobin level and malaria test results was obtained from their medical records. Data gathered was analysed using Statistical Package for Social Sciences (SPSS) version 23.

RESULTS

Demographic data of the study participants: The demographic characteristics of study participants were analyzed (Table 1). The mean age of the children who participated in the study was 3.22 ± 0.91 years, the youngest child being 1.8 years old. Most of the children were Luo (80%), 93.3% were Christian with 53.3% coming from Kisumu County. The average age at diagnosis was 1.62 ± 1.05 years.

Table 1

Demographic characteristics of study participants

		Female	**Male**	**Total**
		n=9	**n=6**	**n=15**
Current age, Years n (%)	Mean (range)	3.18(1.8-5)	3.28 (2.5-4)	3.22 (1.8-5)
Age at diagnosis, Years n (%)	Mean (range)	1.29(0.25-3)	2.11(1- 3.5)	1.62 (0.25-3)
Tribe, n (%)	Luo	8 (88.9)	4 (66.7)	12 (80.0)
	Luhya	0 (0.0)	1 (16.7)	1 (6.7)
	Kisii	1 (11.1)	1 (16.7)	2 (13.3)
Religion, n (%)	Christian	9 (100.0)	5 (83.3)	14 (93.3)
	Muslim	0 (0.0)	1 (16.7)	1 (6.7)
Relation of respondent to child, n (%)	Mother	9 (100.0)	4 (66.7)	13 (86.7)
	Father	0 (0.0)	1 (16.7)	1 (6.7)
	Other	0 (0.0)	1 (16.7)	1 (6.7)
County of residence, n (%)	Kisumu	5 (55.5)	3 (50.0)	8 (53.3)
	Siaya	2 (22.2)	0 (0.0)	2 (13.3)
	Homabay	1 (11.1)	0 (0.0)	1 (6.7)
	Migori	1 (11.1)	2 (33.3)	3 (20.0)
	Vihiga	0 (0.0)	1 (16.7)	1 (6.7)
Malaria	Positive	1 (11.1)	3 (50.0)	4 (26.7)
	Negative	8 (88.9)	3 (50.0)	11 (73.3)

Children (n=15) with SCD were enrolled into the study. Data is presented as absolute number (n) and proportions (%).

Nutritional status of the children: Based on the mid upper arm circumference (M.U.A.C), 20% of the children had severe acute malnutrition, 26.7% were at risk while 53.3% were well nourished.

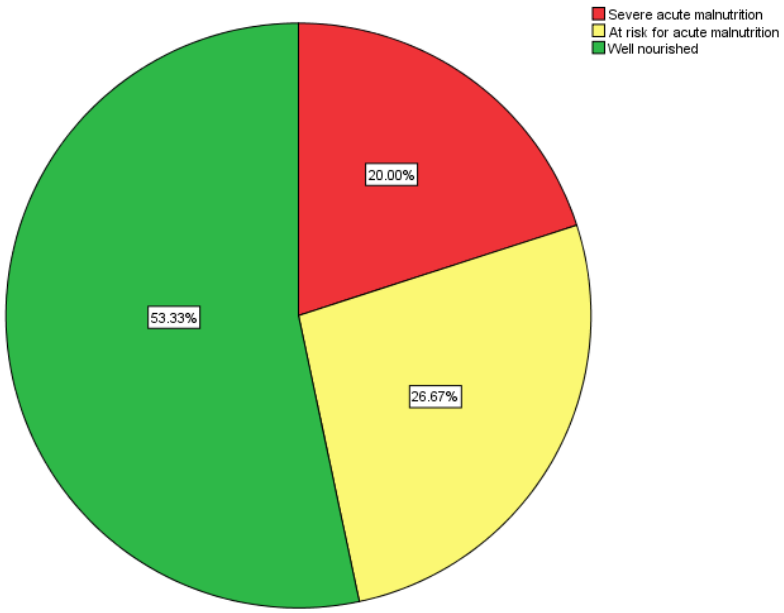

Figure 1: MUAC of children under 5 years

Anaemia in sickle cell disease: All, (100%) the children were anaemic. The mean haemoglobin level was 7.1 ± 1.59 g/dl, with the lowest at 4.5 g/dl, highest at 9.2 g/dl. Most of the children, 53.3% had mild anemia (7.1-10g/dl), 40% moderate anemia (5.1-7g/dl) with 6.7% having severe anemia (<5g/dl).

Malaria in sickle cell disease: Only 26.7% of the children were diagnosed with malaria during the study period. All the children, 100% slept under a long-lasting insecticide treated net (LLITN) at home.

SCD medication use and adherence rates: All the children, 100% were on folate and paludrine with 60% being on penicillin V prophylaxis and 46.7% on hydroxyurea. However, drug adherence was variable with 85.7% of the children on hydroxyurea using it irregularly.

Table 2

Medication used in sickle cell disease

Medication	No. of patients, n(%)	Regular use, n(%)	Irregular use, n(%)
Folate	15(100.0)	14 (93.3)	1 (6.7)
Paludrine/ proguanil	15 (100.0)	12 (80.0)	3 (20.0)
Penicillin V	9 (60.0)	6 (66.7)	3 (33.3)
Hydroxyurea	7 (46.7)	1 (14.3)	6 (85.7)

Children (n=15) with SCD were enrolled into the study. Data is presented as absolute number (n) and proportions (%).

Guardians health seeking behaviour: Most, 80% of the children were enrolled in a SCD clinic. About 40% of the guardians reported they only took their child to hospital when moderately sick. Health professionals were the most common (100%), source of information on SCD followed by the radio at 60%. Almost all the guardians 93.3% wanted more information on SCD.

Table 3
Health seeking behavior of guardians/ parents

		Frequency, n (%)
Child attends SCD clinic n (%)	Yes	12 (80.0)
	No	3 (20.0)
When child taken to hospital, n (%)	Mildly sick	4 (26.7)
	Moderately sick	6 (40.0)
	Severely sick	5 (33.3)
Source of SCD information, n (%)	Health professionals	15 (100.0)
	Radio	9 (60.0)
	Television	3 (20.0)
	Print media	3 (20.0)
	Community members	3 (20.0)
Need more information on SCD, n (%)	Yes	14 (93.3)
	No	1 (6.7)

Guardians of children (n=15) with SCD were enrolled into the study. Data is presented as absolute number (n) and proportions (%).

DISCUSSION

About 75% of the world's SCD population is in Sub-Saharan Africa (1). SCD is associated with high rates of early child hood mortality in Africa (2). The World Health organization noted that most SCD national policies are inadequate with many deaths occurring in under-fives, adolescents and pregnant women (10). Interventions including research and improved healthcare provision can help reduce the burden of SCD in Africa (10). This study therefore set out to assess the burden of SCD among children under five years, one of the vulnerable populations greatly affected by SCD.

The mean age of the children who participated in the study was 3.22 ± 0.91 years, mean age at diagnosis of SCD was 1.62 ± 1.05 years. A Cameroonian study of SCD children revealed their average age at diagnosis was 14 months (1.17 years) (13) while in the Al Saqladi *et al.* study it was 1 year (7), which is quite similar to our study. Kenya, like Cameroon lacks an effective new-born screening program which delays diagnosis to when children become symptomatic (13). Effective identification of SCD through new-born screening significantly reduces early disease morbidity and mortality (9). Most of the children were Luo 80%, with mothers, 86.7% being the primary caregivers. Most African communities are largely patrilineal in

nature with mothers being the primary caregivers (14).

Based on MUAC measurements, 20% of the children had severe acute malnutrition, 26.7% were at risk while 53.3% were well nourished. All the children,100% were anaemic (Hb<10g/dl). The mean haemoglobin level was 7.1 ± 1.59 g/dl, with most of the children, 53.3% having mild anemia. A study of children with SCD in Accra revealed that 38% of them were malnourished, almost all (98.3%) were anaemic with a mean haemoglobin of 7.8 ± 1.4 g/dl (15). Another study in Kilifi revealed a mean haemoglobin level of 7.3g/dl in sicklers (16).This is quite similar to our findings. Increased hemolysis decreases red cell count resulting in anemia. In SCD, there is increased catabolism necessitating increased nutrient demand (6). This may lead to increased dietary energy and protein requirements among sicklers. SCD produces a form of protein energy malnutrition due to increased energy demand. Sicklers might consume diet deemed sufficient for non-sicklers but it might still be inadequate to maintain normal body functions and metabolism as catabolism exceeds anabolism (6). In a study of African-American children with SCD, they were noted to have poor nutritional status, impaired growth, and delayed puberty (4). They also had muscle wasting with deficits in fat (energy) stores and protein stores. Families of sicklers should be taught about the nutritional needs of their children. Multiple nutrient supplementation (6) including calcium-rich foods and antioxidants nutrients especially vitamin C and E (15) are beneficial in sicklers. The monitoring of growth and nutritional status of sicklers is an essential requirement for comprehensive care as it facilitates early diagnosis of growth failure and nutritional intervention (7). A nutritional approach in SCD management can improve the clinical outcome and quality of life of sicklers (6).

Sickle cell trait (HbAS) has been demonstrated to be 90% protective against severe malaria (17). In comparison, HbSS was popularly believed to be associated with increased risk of mortality from malaria (18) with intensive malaria control measures being encouraged to improve survival. An increasing body of evidence suggests that SCD could be protective against malaria (16) (19) (20). Our study revealed that only 26.7% of the participants were diagnosed with malaria.

SCD is associated with high rates of early child hood mortality in Africa (2). In North America, simple interventions such as newborn screening and infection prophylaxis have significantly decreased childhood mortality (3). In our study, all the children were on folate and paludrine with varying levels of adherence, 93.3% and 80% respectively. A Kilifi study revealed 92% adherence on folate and paludrine (16). These results are quite similar to our study. Folate supplementation is recommended to compensate for the chronically increased hemolysis and haematopoeisis in sicklers (15).Expert opinion recommends hydroxyurea in SCD treatment even in infants, beginning 9 months of age regardless of disease severity (8). WHO recommended hydroxyurea in the Essential Medicines for Children in treatment of haemoglobinopathies (10) yet hydroxyurea use was still poor in our study. Only 46.7% were on hydroxyurea, out of which only 14.3% used it regularly. This limited use of hydroxyurea could be attributed to knowledge gaps such as (a) paucity of data on the magnitude and impact of SCD in low-resource settings; (b) absence of treatment guidelines documenting safety and benefits in low-resource settings; and (c)

inexperience on dosing and toxicities among healthcare providers (9). In Kenya, the Ministry of Health recommends hydroxyurea only for severe SCD cases, defined as: (a) more than 3 pain crises yearly, (b)stroke, (c) more than 2 blood transfusions yearly, (d) acute chest syndrome (11). Penicillin V uptake was at 60%, out of which only 66.7% of the children used it regularly. Oral prophylactic penicillin up to the age of 5 years is strongly recommended (8) in SCD management as it decreases childhood mortality (2). Healthcare providers need to consider initiating more patients on penicillin and hydroxyurea and sensitize guardians on the importance of drug adherence in preventing SCD complications.

Many African communities associate SCD with early death, supernatural spirits and poverty due to high cost of health care (5) (14). A majority, 80% of the children attended SCD clinic. About 33.3% of the guardians only brought their child to hospital when severely sick which could be due to financial strain, poor knowledge or stigma. All the guardians, 100% received information on SCD from health professionals, followed by radio (60%), with television, print media and community members accounting for 20%. Most (93.3%) guardians wanted more information on SCD. This depicts a large information gap. Healthcare workers should continuously counsel families affected by SCD. Community members can bear a strong influence on guardians' perceptions on SCD. Some lay people advise guardians not to count their sickler children among their other children as they are going to die anyway leading to guardians neglecting them (5). Families with children with SCD may face a lot of stigma resulting in some guardians refusing to accept the diagnosis, hiding away and only bringing their child to hospital when seriously ill (5). Mothers tend to be stigmatised and blamed for SCD in their children (14). This can be counteracted if parents are counselled on the concept of "healthy carrier" status thus accept the contributing roles of both parents (14). Health professionals were the major (100%) source of information on SCD to guardians. They should exploit their influence to educate guardians about SCD and allay fears generated by myths surrounding the disease.

CONCLUSION AND RECOMMENDATIONS

SCD remains a major public health burden especially in Africa where it is associated with high childhood mortality yet most African Countries, including Kenya lack a comprehensive SCD policy program. More needs to be done to mitigate the impact of SCD including:

- new-born screening programs for early diagnosis. Many children are diagnosed with SCD only when they become symptomatic.
- monitoring of growth and nutritional status to ensure early nutritional intervention. 20% of the children had severe acute malnutrition with 26.7% being at risk of malnutrition.
- provision of penicillin prophylaxis to all under-fives, initiating more children on hydroxyurea and encouraging drug adherence. Only 60% of the children were on penicillin V prophylaxis, 46.7% on hydroxyurea with variable drug adherence.
- continuous counselling of families by health professionals to dispel misconceptions about SCD based on myths and improve health seeking behaviour. Almost all the guardians,

93.3% wanted more information on SCD.

This study had some limitations due to the hospital based cross sectional design and small sample size. However, despite these limitations, the data provides some insight into the burden of sickle cell disease among children under five years in low resource settings.

REFERENCES

1. Piel FB, Hay SI, Gupta S, Weatherall DJ, Williams TN. Global Burden of Sickle Cell Anaemia in Children under Five, 2010–2050: Modelling Based on Demographics, Excess Mortality, and Interventions. PLoS Med [Internet]. 2013 Jul 16 [cited 2020 Jan 23];10(7). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3712914/
2. Grosse SD, Odame I, Atrash HK, Amendah DD, Piel FB, Williams TN. Sickle Cell Disease in Africa. Am J Prev Med. 2011 Dec;41(6):S398–405.
3. Quinn CT, Rogers ZR, McCavit TL, Buchanan GR. Improved survival of children and adolescents with sickle cell disease. Blood. 2010 Apr 29;115(17):3447–52.
4. Barden EM, Kawchak DA, Ohene-Frempong K, Stallings VA, Zemel BS. Body composition in children with sickle cell disease. Am J Clin Nutr. 2002 Jul;76(1):218–25.
5. Dennis-Antwi JA, Culley L, Hiles DR, Dyson SM. 'I can die today, I can die tomorrow': lay perceptions of sickle cell disease in Kumasi, Ghana at a point of transition. Ethn Health. 2011 Aug;16(4–5):465–81.
6. Hyacinth HI, Adekeye OA, Yilgwan CS. Malnutrition in Sickle Cell Anemia: Implications for Infection, Growth, and Maturation. J Soc Behav Health Sci [Internet]. 2013 Jan 1 [cited 2020 Mar 10];7(1). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3848498/
7. Al-Saqladi A-WM, Cipolotti R, Fijnvandraat K, Brabin BJ. Growth and nutritional status of children with homozygous sickle cell disease. Ann Trop Paediatr. 2008 Sep;28(3):165–89.
8. Yawn BP, Buchanan GR, Afenyi-Annan AN, Ballas SK, Hassell KL, James AH, et al. Management of sickle cell disease: summary of the 2014 evidence-based report by expert panel members. JAMA. 2014 Sep 10;312(10):1033–48.
9. McGann PT, Tshilolo L, Santos B, Tomlinson GA, Stuber S, Latham T, et al. Hydroxyurea Therapy for Children with Sickle Cell Anemia in Sub-Saharan Africa: Rationale and Design of the REACH Trial. Pediatr Blood Cancer. 2016 Jan;63(1):98–104.
10. Regional Committee for Africa 60. Sickle-Cell Disease: a strategy for the WHO African Region. 2011 May 26 [cited 2020 Feb 25]; Available from: https://apps.who.int/iris/handle/10665/1682
11. Ministy of Health. Basic Paediatric Protocols [Internet]. 4th ed. Kenya: Ministy of Health; 2016. Available from: https://www.psk.or.ke/public/uploads/file/c0d3675787d651dedbf4a0edfc9a2898.pdf
12. Aluoch JR, Aluoch LH. Survey of sickle disease in Kenya. Trop Geogr Med. 1993 Mar;45(1):18–21.
13. Ngo Um SS, Seungue J, Alima AY, Mbono R, Mbassi H, Chelo D, et al. A cross sectional study of growth of children with sickle cell disease, aged 2 to 5 years in Yaoundé, Cameroon. Pan Afr Med J [Internet]. 2019 Oct 13 [cited 2020 Jan 23];34. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6945666/
14. Marsh VM, Kamuya DM, Molyneux SS. 'All her children are born that way': gendered experiences of stigma in families affected by sickle cell disorder in rural Kenya. Ethn Health. 2011 Aug;16(4–5):343–59.
15. Boadu I, Ohemeng A, Renner LA. Dietary intakes and nutritional status of children with sickle cell disease at the Princess Marie Louise Hospital, Accra – a survey. BMC Nutr. 2018 Aug 23;4(1):33.
16. Sadarangani M, Makani J, Komba AN, Ajala-Agbo T, Newton CR, Marsh K, et al. An observational study of children with sickle cell disease in Kilifi, Kenya. Br J Haematol. 2009 Sep;146(6):675–82.

17. Williams TN, Mwangi TW, Wambua S, Alexander ND, Kortok M, Snow RW, et al. Sickle Cell Trait and the Risk of Plasmodium falciparum Malaria and Other Childhood Diseases. J Infect Dis. 2005 Jul 1;192(1):178–86.

18. Molineaux L, Fleming AF, Cornille-Brøgger R, Kagan I, Storey J. Abnormal haemoglobins in the Sudan savanna of Nigeria. III. Malaria, immunoglobulins and antimalarial antibodies in sickle cell disease. Ann Trop Med Parasitol. 1979 Aug;73(4):301–10.

19. Aidoo M, Terlouw DJ, Kolczak MS, McElroy PD, ter Kuile FO, Kariuki S, et al. Protective effects of the sickle cell gene against malaria morbidity and mortality. Lancet Lond Engl. 2002 Apr 13;359(9314):1311–2.

20. Aluoch JR. Higher resistance to Plasmodium falciparum infection in patients with homozygous sickle cell disease in western Kenya. Trop Med Int Health. 1997;2(6):568–71.