A CROSS-SECTIONAL STUDY OF THE PREVALENCE OF SICKLE CELL DISEASE AMONG CHILDREN OF UNDER THE AGE OF FIVE YEARS AT HERI MISSION HOSPITAL IN BUHIGWE DISTRICT – KIGOMA, TANZANIA

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Abstract

Background:

Sickle cell disease has become a common inherited haemoglobin disorder. Various reports have shown that a high mortality rate of children under five years of age was reported in the year 2022 in Tanzania. This research aimed to determine the prevalence of sickle cell disease (SCD) amongst children under five years of age and their family history at Heri Mission Hospital in Buhigwe District, Kigoma.

Methods:

A convenient cross-sectional study was carried out to enroll 204 children under the age of five years at Heri Mission Hospital. The collected data were subjected to analysis of variances using the statistical package for Social Sciences (SPSS) version 28.0.1.0 software (SPSS Inc., USA). The Chi-square test was utilized in comparing proportions and frequency of occurrence Haemoglobin (Hb) in the variables at $P < 0.05$ as the significance of variance.

Results:

The prevalence of SCD among children under five years was 28.3% (103/364). Among the positively tested with SCD, the majority were female at 71.7% (65/91), whereas males were 28.3% (26/91). Family records of the children with SCD showed that the proportional of SCD was significantly higher among family members with SCD 73.1% (38/52) than none SCD (14/52) 26.9% ($X2 = 7.513$, $P < 0.05$).

Conclusion:

The findings in this research showed a high rate of SCD amongst children under five years, and the family history of the victims showed it's inheritable.

Recommendation:

Health awareness and proper mitigation strategies need to be addressed on how to curb the SCD in Buhigwe District and Tanzania as a country.

Keywords: Sickle Cell Disease (SCD), Prevalence, Buhigwe district, Haemoglobin (Hb), Submitted: 2023-02-24 Accepted: 2023-03-09

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1. INTRODUCTION

Sickle cell disease (SCD) is an inherited blood disorder of global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development [1, 2]. SCD is very common among pregnant women and children under the age of five years [3]. People who have SCD have low red blood cells than the normal range and they often become tired more quickly as compared to people with normal blood counts. Other signs include loss of appetite, yellow eyes, dark urine, and an enlarged spleen [4].

Medical research recommends that if a child's blood count falls very low, a blood transfusion may be needed otherwise extremely low blood count can result in heart failure and death if not treated in time [5]. Generally, people with SCD have the most severe anemia, there are times when a child's blood count may fall much lower than usual and it's accompanied by a fever or an infection, thus, the body stops making new cells, or the cells are destroyed quicker than usual thus making the eyes look more yellow and the urine look darker [2, 4, 6]. In Europe, reported risk factors for death include infections, low haemoglobin, fetal haemoglobin (HbF), high white blood cell count, and hemolysis [7].

The magnitude of sickle cell disease in children, as indicated in the World Health Organisation (WHO) reports, both in developed and developing nations is alarming [8]. Although the population prevalence of SCD in the world is not well-known studies have suggested that if average survival for SCD reaches half the African norm, over six million Africans will be living with SCD [9, 10].

The World Health Organization estimates that 70% of SCD deaths in Africa are preventable with simple, cost-effective interventions such as early identification of SCD patients by newborn screening (NBS) and the subsequent provision of comprehensive care [10]. As of the year 2022, Tanzania has been ranked among the 20 countries that have achieved a reduction of 57% in mortality of children under the age of five years old [11]. Despite this observation, still there is no sufficient research data that has been documented to disclose the prevalence of sickle cell disease in various provinces and their districts in Tanzania, therefore calling for studies on the prevalence of sickle cell disease.

World Health Organization suggests that countries will need to develop policies to directly reduce the mortality of children due to non-communicable diseases (NCDs) especially SCD so as to fall below 50/500 live births [12]. A recent study in a tertiary hospital in Tanzania reported a median survival of 33 years in the SCD population [11, 13]. This suggests that in some areas of Tanzania, there is an increased survival in SCD, which will result in a high prevalence of SCD among the population. Currently, there is no study that has been carried out in Kigoma to determine the burden of SCD. This study aimed to determine the prevalence of SCD among children of less than five years of age at Heri Mission Hospital in the Buhigwe district, Kigoma.

2. METHODS

2.1. Area of study

The study was carried out at Heri Mission Hospital in Buhigwe district, Kigoma region, Tanzania (4°26'41.1"S 29°47'37.0" E). According to the household population census conducted in Tanzania in the year 2022, Buhigwa District has a population of 338, 274 people [14]. Being the only Hospital in Buhigwe District and its strategic location near the Burundi border, Heri Mission Hospital receives a high number of patients from both Tanzania and Burundi for medical services.

2.2. Study Design and population

A cross-sectional study was conducted on 364 patients (182 males and females) that were between 0 to 5 years of age group in both the outpatient Department (OPD) and in-patient Department (IPD) at Heri Mission hospital from August to October 2022. The sampling was done equally on both gender; male and female. The sampling size of the study population was determined with the formula;

$N = Z^2\ P(1\text{-}P)/\ E^2$

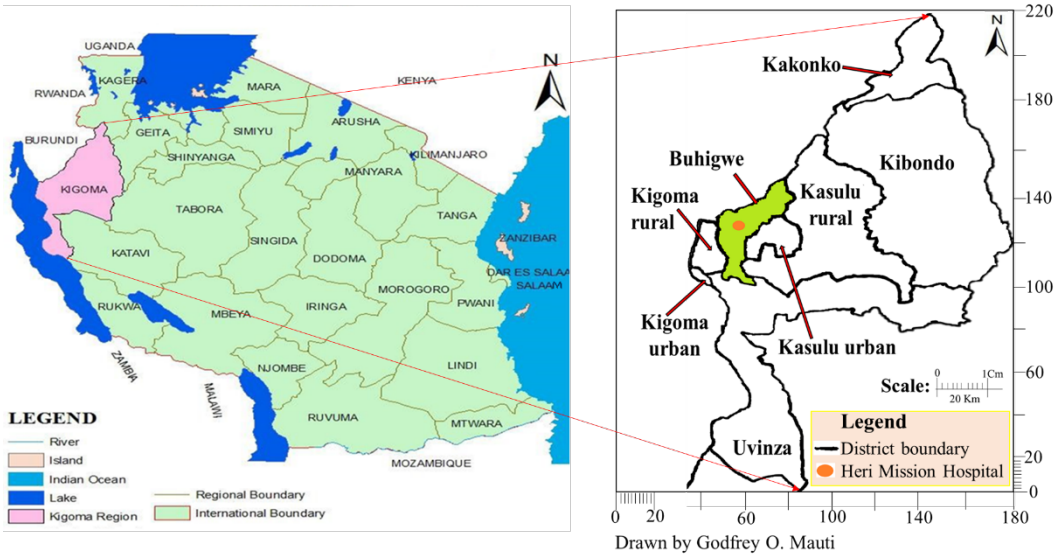

Figure 1: Map of Tanzania, Buhigwa District and exact location of Heri Mission Hospital, picturedrawn by Godfrey O. Mauti

Where; N = desired sample size, Z = 1:96 (standard normal deviation at 95% confidence interval), P = estimated prevalence of sickle cell disease to be 10.1%, and W = margin of error to be 5%.

Patients within the age group of 0 to 5 years that were critically ill were excluded from the study as only those who satisfied the inclusion criteria were enrolled in the study even though some patients lacked properly documented family history records.

2.3. Blood sample collection and testing

To determine the prevalence of SCD, a capillary whole blood sample was collected by a nurse from a child's fingertip or heel by selecting a suitable puncture site using a new lancet and following the Standard operating procedures (SOPs). The sample is then sent to the medical laboratory for screening the form of hemoglobin that underlies sickle cell anemia so as to determine if a patient has SCD or SCT (carrier status). In the laboratory, the blood drop is subjected to a complete blood count (CBC) to test screens for anemia. Blood that had a Mean Corpuscular Volume (MCV) in the CBC was also identified to contain SCD since it contains abnormal hemoglobin such as beta-thalassemia traits. Results were reviewed along with the child's parent to ensure participation in the study and documented accordingly.

2.4. Factors associated with sickle cell disease

Data were collected from the parent of the children who participated and were found positive, this involved using pretested questionnaires that had social-demographic, economic factors, behavioral factors, physical measurements, and biochemical parameters with close-ended questions to gather qualitative data from the selected individuals.

2.5. Data analysis

Analysis of variance was performed using SPSS version 28.0.1.0 software (SPSS Inc., USA). Descriptive statistics by crosstabs were used to summarize the sickle cells measured and displayed as tables, charts, and graphs. The Chi-square test was used to compare proportions and frequency of sickle cell occurrence in the variables at $P < 0.05$ level of significance.

2.6. Ethical consideration

This study was approved by the Department of Microbiology and the Health Ethical Committee, Faculty of Medicine and Pharmaceutical Sciences, Kampala International University in Tanzania, no.131/FMPS/MPI/2022, on May 23rd, 2022.

3. RESULTS

3.1. Prevalence of sickle cell disease among children under the age of five years old

In this study, out of the 384 potential children aged 0 to 5 years that attended Heri Mission hospital from August to October 2022 only 364 children were enrolled. The laboratory results showed that 28.3% (103/364) of the children were positive for SCD. Among the positively tested with SCD 71.7% (65/91) were female and males accounted for 28.3% (26/91). Tabulate results showed that a high number of children with SCD were from the inpatient department (IPD) with 35.3% (64/182 children), as compared to the outpatient department (OPD) which had 15.7% (39/182 children). Laboratory results on the tested samples for SCD showed that the female children were more in terms of SCD positive as compared to the male children, they had 37.7% (65/182 female children) and 14.3% (26/182 male children), respectively. Tabulated results showed that the children aged between 4 and 5 years were found to be affected with SCD as those of the age group of 2 to 3 years, were 33.3% (43/129 children) and 20.7% (28/103 children), respectively (Table 1).

3.2. Frequency of sickle cell disease among the family members

In our study, the data collected by questionnaires concerning family medical history from the parents of the children who were found positive with SCD showed that the proportional of SCD was significantly higher among family members with SCD 73.1% (38/52) than none SCD (14/52) 26.9% ($X^2 = 7.513$, $P < 0.05$) (Table 2).

4. DISCUSSION

Various surveys have been carried out in Tanzania concerning the prevalence of SCD in major cities like Dar es Salaam, Dodoma, Morogoro, and Mwanza [11, 15, 16], but none has been done in rural towns, thus this was the first survey carried at a hospital located in the remote town of Buhigwe district. In this study, 364 patients in age 0 – 5 years were enrolled as the study sample size. This study population was estimated after analyzing the statistical data of patients in age 0 – 5 years attending Heri Mission hospital monthly from January 2022 to July 2022 whereby the data showed that an estimated 128 children aged 0 – 5 years out of a total the 3000 children who attend both OPD and IPD tested positive for SCD. Due to inconsistency in the attending population, a margin error of 5% was allowed in the study sample size.

This study showed an SCD prevalence of 33.3% in children between 4 to 5 years which is high when compared to similar studies at Amana Referral Hospital and Mnazi Mmoja Regional Hospital located in Ilala District, Dar es Salaam where children between the age group of 3 to 5 years tested positive with SCD recorded 14.9% (24/161 children) and 9.6% (11/115 children), respectively [11]. Some of the reasons for the high prevalence of SCD in Buhigwe district as compared to Ilala District might be due to poor delivery of health services since Ilala District is served by many private and public hospitals including Amana referral hospital while Buhigwe district has only Heri Mission Hospital [17]. This leads to a deficit in health service delivery, thus preventing patients' especially pregnant women from getting tested for SCD at the right time during child delivery for easy prevention.

This study's findings recorded 15.7% of children with SCD from the OPD were relatively higher as compared to Bugando Medical Centre in Mwanza with 8.3% (16/192 children), Tumbi Regional Referral Hospital in Pwani with 6.3% (10/159 children) and Morogoro Regional Referral Hospital at Morogoro with 5.7% (8/140 children) [18–20]. This study's findings on the frequency of sickle cell disease among the family members indicate that Heri Mission Hospital lacks family records of the patients who were positive for SCD.

Research done by Koka et al. reports that the residents in Buhigwe District and the surrounding depend only on Heri Mission Hospital, thus having to cover a long distance to get medical services, especially expectant women [17]. The situation differs from the Mwanza, Kibaha, Ilala, and Morogoro Districts of Tanzania which are served

Table 1: Distribution of Sickle cell disease (SCD) among children under the age of 5 years at Heri Mission Hospital.

		Number (N) of participants	Number of children with SCD	% of children with SCD
Departments	IPD	182	64	35.3
	OPD	182	39	15.7
	Total	364	103	28.3
Genders	Female	182	65	35.7
	Male	182	26	14.3
	Total	364	91	25
Age groups	0-1 year	132	35	21.6
	2-3 year	103	28	20.7
	4-5 year	129	43	33.3
	Total	364	106	29.1

*Inpatient department (IPD); Outpatient department (OPD)

Table 2: Frequency of sickle cell disease among the family members

	N	**SCD (%)**	**X** ^{2}	**P -value**
Child has SCD and at least one of the parents or siblings has SCD	38	73.1	7.513	0.006
Child has SCD but none of the parents or siblings has SCD	14	26.9		
Total	52	100		

*($N = 52$), ($P < 0.05$) using Chi-square test

by several private and public health facilities [20–22], this gives proper prenatal and post-natal services to expectant women. Such a situation prevents such women from getting proper medical attention and checks for various inheritable diseases before child delivery as some end up doing home delivery with the help of midwifery there after attending a hospital as an outpatient for medical checkups of the born child [10]. Such incidences increase the chances of finding children in OPD with inheritable diseases like SCD. Furthermore, it interferes with patients' records in the hospital due to inconsistency in the attending of medical checkups. According to World Health Organization, checkups and screening for sickle cell status should is done before or during pregnancy, and also it is done for newborn babies as early as 24 to 48 hours after birth [7, 23]. Apart from proper health records of the parent and the newborn, such checkup also provides appropriate mitigation of SCD once its identified.

This study has shown that most of the children with SCD were coming from a family with a history of SCD thus, indicating that inheritable Haemoglobin disorders are common among the community in the Buhigwe district, Kigoma. A report by Yu and Mandal et al. shows that over 12% worldwide population is at risk for Haemoglobin disorders and thus at least every clan and family has one child affected by sickle cell disease (SCD), sickle cell traits (SCT) or another abnormal hemoglobin gene (hemoglobin C or β-thalassemia) [13, 24]. Finally, the presence of SCD among children from a family with no history of having SCD has been reported in this study. According to the World Health Organisation factors such as malnutrition and infections with hookworms result in the acquisition of SCD

among children in the population and community as well [23, 25].

5. CONCLUSION AND RECOMMENDATIONS

The prevalence of SCD is very high, particularly in children from a family with a history of SCD among the family members. This indicates that inheritable disorder is common in the community. This study recommends another similar study with a bigger sample size in the Kigoma region to determine the prevalence of SCD, furthermore, the nation requires to provide health education and awareness to people on how to reduce and prevent SCD.

6. LIMITATIONS OF THE STUDY

This study was limited by time duration and financial constraints to run a large sample size.

7. DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon request.

8. CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

9. AUTHORS' CONTRIBUTIONS

All authors have significantly contributed to the present review. All authors are in agreement with the content of the manuscript.

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11. LIST OF ABBREVIATIONS

CBC: Complete Blood Count
Hb: Haemoglobin
IPD: In-patient Department
MCV: Mean Corpuscular Volume
NBS: New Born Screening
OPD: Outpatient Department
SCD: Sickle Cell Disease
SCT: Sickle Cell Traits
SPSS: Statistical Package for Social Sciences
WHO: World Health Organisation

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References

[1] D. Asiimwe, G. O. Mauti, R. Kiconco, Prevalence and risk factors associated with type 2 diabetes in elderly patients aged 45-80 years at Kanungu District, Journal of Diabetes Research (2020) 5152146–5152146.
[2] W. I. Egesa, G. Nakalema, W. M. Waibi, M. Turyasiima, E. Amuje, G. Kiconco, . . Asiimwe, D, Sickle Cell Disease in Children and Adolescents: A Review of the Historical, Clinical, and Public Health Perspective of Sub-Saharan Africa and Beyond, International Journal of Pediatrics (2022).
[3] D. Jain, P. Atmapoojya, R. Colah, P. Lodha (2019).
[4] S. Farooq, F. D. Testai, Neurologic complications of sickle cell disease, Current neurology and neuroscience reports 19 (4) (2019) 1–8.
[5] S. Uyoga, P. Olupot-Olupot, R. Connon, S. Kiguli, R. O. Opoka, F. Alaroker, . . Williams, T. N (2022). [link].
URL https://doi.org/10.1016/S2352-4642(22

[6] G. O. Mauti, Antibacterial Potency of Allium sativum, Psidium guajava, Zingiber officinale Roots against the Food Poisoning Strains (Escherichia coli 0157: H7 and Staphylococcus aureus), Tanzania Journal of Science 48 (4) (2022).
[7] D. Diallo, G. Tchernia (2002).
[8] J. Makani, A. N. Komba, S. E. Cox, J. Oruo, K. Mwamtemi, J. Kitundu, . . Williams, T. N, Malaria in patients with sickle cell anemia: burden, risk factors, and outcome at the outpatient clinic and during hospitalization, Blood, The Journal of the American Society of Hematology 115 (2) (2010) 215–220.
[9] D. M. Ogato, E. M. Mauti, G. O. Mauti, B. Ambrose, D. Keno, Anticancer activity of Eugenia jambolana seeds against Hep2 cell lines, The Journal of Phytopharmacology 4 (6) (2015) 295–298.
[10] J. Mburu, I. Odame, Sickle cell disease: Reducing the global disease burden, International journal of laboratory haematology 41 (2019) 82–88.
[11] E. E. Ambrose, T. Latham, P. Songoro, M. Charles, A. Lane, S. E. Stuber, . . Smart, L. R, Hydroxyurea with Dose-Escalation to Reduce Primary Stroke Risk in Children with Sickle Cell Anemia in Tanzania: Primary Results of the Sphere Trial, Blood (2022) 447–448.
[12] B. Aygun, I. Odame, A global perspective on sickle cell disease, Pediatric blood & cancer 59 (2) (2012) 386–390.
[13] A. K. Mandal, A. Mitra, R. Das (2020).
[14] R. Rugeiyamu, The Tanzania Housing and Population Census 2022: A Panacea for Local Service Delivery and Development Drawbacks, Local Administration Journal 15 (1) (2022) 1–13.
[15] D. M. Kambasu, J. Rujumba, H. M. Lekuya, D. Munube, E. Mupere, Health-related quality of life of adolescents with sickle cell disease in sub-Saharan Africa: a cross-sectional study, BMC haematology 19 (1) (2019) 1–9.
[16] A. Jonathan, H. Tutuba, W. Lloyd, J. Ndunguru, J. Makani, P. Ruggajo, . . Balandya, E, Healthcare Workers' Knowledge and Resource Availability for Care of Sickle Cell Disease in Dar es Salaam, Tanzania. Frontiers in Genetics 12 (2022) 2890–2890.
[17] P. M. Koka, H. R. Sawe, K. R. Mbaya, S. S. Kilindimo, J. A. Mfinanga, V. G. Mwafongo, . . Reynolds, T. A (2018). [link].
URL https://doi.org/10.1186/s12913-018-3609-5
[18] R. H. Simbauranga, E. Kamugisha, A. Hokororo, B. R. Kidenya, J. Makani, Prevalence and factors associated with severe anaemia amongst under-five children hospitalized at, Bugando Medical Centre 15 (1) (2015) 1–9.
[19] J. Jung, L. E. Matemba, K. Lee, P. E. Kazyoba, J. Yoon, J. J. Massaga, . . Park, Y, Optical characterization of red blood cells from individuals with sickle cell trait and disease in Tanzania using quantitative phase imaging, Scientific reports 6 (1) (2016) 1–9.
[20] S. Nkya, L. Mtei, D. Soka, V. Mdai, P. B. Mwakale, P. Mrosso, . . Makani, J, Newborn screening for sickle cell disease: an innovative pilot program to improve child survival in Dar es Salaam, Tanzania. International health 11 (6) (2019) 589–595.
[21] S. Flessa, The costs of hospital services: a case study of Evangelical Lutheran Church hospitals in Tanzania, Health Policy and Planning 13 (4) (1998) 397–407.
[22] S. V. Manyele, H. A. M. Ngonyani, E. Eliakimu, The status of occupational safety among health service providers in hospitals in Tanzania, Tanzania journal of health research 10 (3) (2008) 159–165.
[23] G. S. Cisneros, S. L. Thein, Recent advances in the treatment of sickle cell disease, Frontiers in physiology 11 (2020) 435–435.
[24] S. Yu, Haemoglobin: Physiology and Hemoglobinopathy, in: Blood Substitutes and Oxygen Biotherapeutics, Springer, 2022, pp. 45–51.
[25] G. O. Mauti, E. M. Mauti, G. A. Ouno, B. Maronga, Antibacterial activity of Garlic, Tulsi, Bitter guard and Cinnamon extracts against wound pathogens, Journal of Scientific and Innovative Research 4 (4) (2015) 178–181.

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