Scientific Research Publishing

Open Journal of Pediatrics, 2025, 15(6), 1216-1223
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

Neonatal Screening and Follow-Up of Sickle Cell Disease in the Neonatology Department of Yopougon/Beago

Berthe Evelyne Lasme-Guillao[1], Roseline N'Guessan-Sika[1*], Tanoh-Kassi François Eboua[1], Jonas Gnahore Gnaoré[1], Aurianne Kossonou[1], Gustave Koffi[2]

[1]Neonatology Department of CHU of Yopougon/Béago, Abidjan, Ivory Coast
[2]Clinical Hematology Department of CHU of Yopougon, Abidjan, Ivory Coast
Email: guilasme@yahoo.fr, *kouameroseline8@gmail.com, ebouatk@yahoo.fr, jonasgnahor@gmail.com

How to cite this paper: Lasme-Guillao, B.E., N'Guessan-Sika, R., Eboua, T.-K.F., Gnahore Gnaoré, J., Kossonou, A. and Koffi, G. (2025) Neonatal Screening and Follow-Up of Sickle Cell Disease in the Neonatology Department of Yopougon/Beago. *Open Journal of Pediatrics*, **15**, 1216-1223.
https://doi.org/10.4236/ojped.2025.156116

Received: October 14, 2025
Accepted: November 18, 2025
Published: November 21, 2025

Abstract

Introduction: Systematic neonatal screening for sickle cell disease has not yet established in Côte d'Ivoire. The objective of this study was to contribute to the implementation of a neonatal screening program for sickle cell disease in order to reduce sickle cell-related morbidity. **Methods:** We conducted a prospective descriptive and analytical study of 974 newborns hospitalized in the neonatal unit at Béago Hospital. **Results:** 52% of the parents of the newborns worked in the informal sector. 46.5% were Mandé and Gour people originating from the north of the country. Maternal electrophoresis was normal in 60% of cases, with abnormal forms being: AS (14%), SC (4%), and SSFA2 (2%). The father's status was unknown in 87% of cases, normal in 4%, with abnormal forms being: AS (6%), SSFA2 (2%), and SC (1%). Family consanguinity was found in 12% of parents. Seventy-seven percent of newborns were born at term. Confirmed hemoglobin electrophoresis of newborns was normal: AA in 67.4%, AS in 15.5%, AC in 7.7%, SSFA2 in 6.4%, SC in 2%, and SAFA2 in 1%. The mortality rate was 9%. During the follow-up in the first three months of life, 57% of newborns presented with anemia. Newborns with an AS electrophoretic status had a significantly higher risk of death ($p = 0.0002$) than those with normal electrophoresis. Those with AS, SAFA2, and SSFA2 electrophoretic statuses had a higher risk of presenting with neonatal bacterial infection ($p < 0.0001$). **Conclusion:** Sickle cell disease constitutes a real public health problem that must mobilize the combined efforts of policymakers, healthcare professionals, and the public to make neonatal screening accessible to all newborns.

Keywords

Screening, Neonatology Sickle Cell

1. Introduction

Sickle cell disease is a genetic disorder characterized by a mutation in the beta-globin gene of hemoglobin. This mutation leads to the synthesis of an abnormal hemoglobin known as hemoglobin S (HbS) [1]. Major Sickle Cell Syndrome (MSCS) results in serious consequences, including acute complications that can be potentially lethal and may occur from the first months of life, as well as chronic complications affecting quality of life and life expectancy. In Africa, the disease is particularly prevalent in Sub-Saharan Africa, where the prevalence of hemoglobin S in the general population sometimes exceeds 30% [2]. The World Health Organization (WHO) has urged member states to develop integrated programs for the prevention and management of sickle cell disease tailored to local contexts [3]. The expected benefits include the prevention of early acute complications for affected newborns, with potential impacts on early mortality and long-term sequelae from these complications. In Côte d'Ivoire, sickle cell disease is a significant public health issue, with an estimated gene prevalence of 12% - 15%, notably with the dual presence of hemoglobins S and C [2]. The Ivorian government declared sickle cell disease a national priority in 1995. Since May 2022, a screening project for sickle cell disease in the infant population [3] has been initiated by the Ivorian Society of Hematology (SIH) in collaboration with the Ministry of Health, Public Hygiene, and Universal Health Coverage (MSHPCMU) in several health centers, including the neonatal unit at Béago Hospital. The overall objective of this study was to contribute to the establishment of a neonatal diagnostic circuit for sickle cell disease and to improve the management of newborns with major sickle cell syndrome in order to reduce morbidity and mortality associated with the condition. The specific objectives were to:

- Determine the prevalence of sickle cell disease among newborns hospitalized in the neonatal unit at Béago.
- Describe the socio-demographic characteristics of the parents of screened newborns.
- Describe the clinical characteristics of the screened newborns.
- Identify factors associated with different electrophoretic statuses.

2. Methodology

We conducted a prospective descriptive and analytical study involving 974 newborns hospitalized in the neonatal unit at Béago. The study took place over a period of 19 months, from October 2023 to May 2025. We employed exhaustive sampling, allowing us to include all newborns admitted to the neonatal unit during the study period who underwent screening for sickle cell disease. The study

variables included: socio-demographic characteristics of the parents (age, region of origin, education level, profession, ethnicity), the electrophoretic status of both parents, consanguinity, the presence of sickle cell disease in siblings, and the diagnosis at hospitalization. A standardized questionnaire was utilized for data collection.

All newborns underwent a rapid diagnostic test, the hemoType SC, which allows for reading results in 10 minutes. This test is user-friendly, requiring minimal technical expertise, is easy to conserve, and is less costly compared to traditional hemoglobin identification techniques. The hemoType SC is a competitive lateral flow immunoassay that incorporates monoclonal antibodies to determine the presence of hemoglobin A, S, and C. It enables rapid detection of hemoglobin phenotypes HbAA, HbSS, HbSC, HbCC, HbAS, and HbAC [4].

Confirmation of positive cases was conducted using the GAZELLE method (hemoglobin electrophoresis following a venous blood draw). This reference test, known as cellulose acetate electrophoresis, quickly, easily, and cost-effectively identifies abnormal hemoglobins. The final results are available after 10 minutes as well.

2.1. Data Analysis

The data were entered into Microsoft Excel version 2016, then exported and analyzed using SPSS version 20. Quantitative variables were described using the mean and standard deviation if their distribution was normal, or by the median and interquartile range if the distribution was skewed. Qualitative variables were presented as frequencies and percentages. The comparison of qualitative variables was performed using the Chi-square test or Fisher's exact test if the conditions for applying the Chi-square test were not met.

2.2. Ethical Considerations and Regulations

The study received approval from the medical and scientific management of the hospital and from the head of the neonatal unit prior to its commencement. Informed parental consent was obtained (using a consent form that was read and signed by the parents of the newborns) before screening each newborn. The study was conducted with respect for patient anonymity to ensure medical confidentiality.

3. Results

3.1. Epidemiological Data

A total of 974 newborns were screened out of 1500 admitted during the study period. The parents were 46.5% Mandé and Gour people from the Northwest and Central-West regions. Fathers worked in the informal sector in 52% of cases, while 61% of mothers did. Maternal electrophoresis results were normal in 60%; the abnormal forms were AS (14%), SC (4%), and SSFA2 (2%). The fathers' status was unknown in 87% of cases, normal in 4%, with other abnormal forms being AS

(6%), SSFA2 (2%), and SC (1%). The majority of newborns, 77%, were born at term.

3.2. Anamnesis Data

Family consanguinity was identified in 12% of parents. There was a history of sickle cell disease in siblings in 13% of cases. The main causes of hospitalization included neonatal bacterial infections (30%), anoxic-ischemic encephalopathy (23%), prematurity (21%), and malaria (18.5%).

3.3. Rapid Diagnostic Test Results (Hemotype SC)

The rapid diagnostic test for sickle cell disease was normal (AA) in 64% of cases. The sickle cell statuses were AS (14%), AC (8%), SC (6%), SS (6%), and CC (2%).

3.4. GAZELLE Results

Using the GAZELLE method, hemoglobin electrophoresis results were normal (AA) in 67.4% of cases; the sickle cell statuses were AS (15.5%), AC (7.7%), SSFA2 (6.4%), SC (2%), and SAFA2 (1%).

3.5. Evolutionary and Therapeutic Data

The condition of newborns during hospitalization improved favorably in 90% of cases, with a mortality rate of 9%. During the follow-up in the three months following hospitalization, 57% of newborns presented with anemia. Folic acid was prescribed in 98% of cases for these newborns.

3.6. Analytical Data

There was a significant association between electrophoretic status and mortality. Newborns with an AS electrophoretic profile had a significantly higher risk of death compared to those with a normal electrophoretic status (see Table 1). Additionally, there was a link between electrophoretic status and neonatal bacterial infection. Newborns with AS, SAFA2, and SSFA2 statuses had a significantly higher risk of presenting with neonatal bacterial infections (see Table 2).

Table 1. Relationship between electrophoretic status and mortality.

Electrophoretic profile	Deaths		Odds Ratio RC (IC 95%)	p
	Yes	No		
AA	71	585	_	_
AS	2	149	9.04 (2.19 -37.29)	0.0002
SC	4	15	0.46 (0.15 -1.41)	0.15
SAFA2	1	9	1.09 (0.14 - 8.75)	0.69
SSFA2	11	52	0.57 (0.29 - 1.15)	0.09

Note: Newborns with an AS electrophoretic profile had a significantly higher risk of death compared to those with a normal electrophoretic status (p = 0.0002).

Table 2. Relationship between electrophoretic status and neonatal bacterial infection.

Electrophoretic profile	Neonatal bacterial infection		Odds Ratio RC (IC 95%)	p
	Yes	No		
AA	554	102	_	_
AS	50	101	36.31 (57.56 -70.98)	<0.0001
SAFA2	2	8	19.97 (7.36 -16.38)	<0.0001
SSFA2	11	52	25.68 (12.96 - 50.88)	<0.0001

Note: Newborns with AS, SAFA2, and SSFA2 electrophoretic statuses had a significantly higher risk of presenting with neonatal bacterial infections ($p < 0.0001$).

4. Discussion

4.1. Socio-Demographic Data

We investigated 974 newborns, of whom 318 were carriers of sickle cell disease, resulting in a prevalence of 32.6% (AS (15.5%), AC (7.7%), SSFA2 (6.4%), SC (2%), and SAFA2 (1%)). This figure was slightly higher than that reported by Cabannes *et al.* [5], who noted a general prevalence of 12 to 14% in Côte d'Ivoire. This difference may be attributed to the fact that our prevalence is hospital-based and monocentric, whereas Cabannes reported a national prevalence. In Senegal, out of 3496 newborns screened, 3180 were healthy and not carriers. 316 were carriers of the hemoglobin S gene representing a prevalence of 9% [6]. The predominance in the northern region could be explained by the high migration from the north to the south in search of employment [7]. The previous politico-military crisis in Côte d'Ivoire, particularly in the northern region, caused massive population displacement toward the south to escape the hostilities of war, which could also account for the high number of people originally from the north [8]. Additionally, this result may also reflect a higher practice of endogamy within this population group [8].

4.2. Hemoglobin Electrophoresis

The sickle cell forms identified included AS (60 individuals, 6%), SSFA2 (15 individuals, 2%), and SC (6 individuals, 1%). Among the phenotypes, AS was the most commonly found in our sample, with proportions of 14% in mothers and 6% in fathers, followed by SC and SSFA2 forms. In Mali, among 2489 newborns, 16 were diagnosed with major sickle cell disease (6 SS and 10 SC); 198 had the sickle cell trait, 139 were AC, and 1 was CC [9]. In this study involving 2420 mothers whose children underwent neonatal screening for sickle cell disease, the frequency of abnormal electrophoretic profiles was found to be 21.3% [9]. In another study, 143 children were heterozygous (15.10%) and 17 were homozygous (1.80%) [10]. Conversely, in Ouagadougou, the hospital frequency of major sickle cell disease among children aged 0 to 15 years was reported as 1.67% in pediatric admissions [11]. The very high proportion of unknown electrophoresis results (87% in fa-

thers) compared to mothers (11%) could be explained by the lack of routine electrophoresis in standard examinations and premarital screening. However, this test is a key recommended part of prenatal assessment for all pregnant women, which may account for the higher unknown results among fathers.

4.3. Consanguinity

Regarding consanguinity, 12% of parents reported a family history of consanguinity. This finding is lower than that of Aka Tanoh [12], who found that 24.7% of children were from consanguineous marriages. This difference may be due to the fact that previous studies primarily focused on known sickle cell children, whereas our study involved newborns whose electrophoretic status was initially unknown.

4.4. Sibling Information

In our study, 65 couples (13%) had at least one child with sickle cell disease. Our results are lower than those of Eloundou [13], who found a 35% occurrence in cases with at least one sibling affected by the disease. This difference could be attributed to the fact that the family history of sickle cell disease was unknown in the majority of cases in our study, leading to underestimation.

4.5. Newborn Findings

Most newborns (746, or 77%) were aged between 0 and 10 days. Anemia was likely related to complications from prematurity or often an infectious pathology. The incidence of neonatal bacterial infection is even higher in premature infants than in full-term newborns [14]. Anemia in general is defined as a decrease in the total amount of circulating hemoglobin (Hb), and more specifically, it corresponds to an Hb level less than −2 standard deviations (SD) from the mean for the age. All newborns experience a decrease in Hb levels known as "physiological anemia." This decrease varies between 9.5 and 11 g/dL around 10 - 12 weeks of age in full-term newborns. In contrast, premature infants experience a more severe and earlier form of anemia called "anemia of prematurity" [15].

4.6. Discussion Results of the RDT and GAZELLE

The difference observed between the rapid diagnostic tests (RDTs) can be explained by the fact that the primary aim of the rapid diagnostic test is to screen for sickle cell disease (a hemoglobinopathy) with results being qualitative (presence or absence). It is based on an immunological method to identify the presence of hemoglobins A, S, and C, but it cannot determine thalassemia. In contrast, the GAZELLE method is quantitative and also enables the determination of thalassemia [16]. The Sickle SCAN and hemoType SC RDTs are sensitive and specific for identifying newborns with a sickle cell phenotype. They meet the quality criteria for RDTs aimed at the diagnostic orientation of sickle cell disease and are particularly useful in endemic countries where access to laboratory equipment is severely limited [4].

4.7. Analytical Study

There exists a correlation between electrophoretic status and mortality. Newborns with an AS electrophoretic profile had a significantly higher risk of death compared to those with a normal electrophoretic status. Most in-hospital deaths occurred within the first few days of admission, which could be attributed to poor condition at admission or inappropriate evacuation conditions relative to the clinical state of the sometimes premature newborns. Additionally, neonatal bacterial infection was the primary reason for hospitalization. The existence of a causal link between neonatal bacterial infection and AS, SAFA2, and SSFA2 electrophoretic profiles warrants confirmation through larger sampling.

5. Conclusion

Sickle cell disease remains a significant public health issue. Neonatal screening has allowed for estimating the hospital prevalence, which was higher than the national prevalence during the study period. The severity and socio-economic impact of sickle cell disease necessitate the generalization of neonatal screening to initiate earlier management and reduce morbidity and mortality.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Renaudier, P. (2014) Physiopathologie de la drépanocytose. *Transfusion Clinique et Biologique*, **21**, 178-181. https://doi.org/10.1016/j.tracli.2014.08.139

[2] Rahimy, M.C. (2005) Problèmes posés par la transfusion chez l'enfant atteint de drépanocytose en Afrique. *Archives de Pédiatrie*, **12**, 802-804. https://doi.org/10.1016/j.arcped.2005.04.038

[3] Société Ivoirienne d'Hématologie-Immunologie Oncologie-Transfusion sanguine (2021) Mise en place d'un projet de dépistage néonatal et de prise en charge de la drépanocytose en Côte d'Ivoire. 27.

[4] Nguyen-Khoa, T., Mine, L., Allaf, B., Ribeil, J., Remus, C., Stanislas, A., *et al.* (2018) Sickle SCAN™ (Biomedomics) Fulfills Analytical Conditions for Neonatal Screening of Sickle Cell Disease. *Annales de biologie clinique*, **76**, 416-420. https://doi.org/10.1684/abc.2018.1354

[5] Cabannes, R., Baba, S. and Beurrier, S. (1984) Etudes des hémoglobines en côte d'ivoire. *Annales de l'Université d'Abidjan*, **108**, 32-39.

[6] Diallo, A.H., Camara, G., Lamy, J.B., Lo, M., Diagne, I., Makalou, D., Diop, M. and Doupa, D. (2019) Towards an Information System for Sickle Cell Neonatal Screening in Senegal. *Studies in Health Technology and Informatics*, **258**, 95-99.

[7] Nasser, S. and Wayarga, C. (2025) Immigration et cohésion sociale en Côte d'Ivoire revue archives internationales, communauté des chercheurs d'Afrique (CCA) Congo. **1**, 449-473.

[8] Institue Nationale de la Statistique (2021) Recensement général de la population et de l'habitat (RGPH). https://www.ins.ci/n/documents/rgph/ABIDJAN.pdf

[9] Diallo, D.A., Guindo, A., Touré, B.A., Sarro, Y.S., Sima, M., Tessougué, O., *et al.*

(2018) Dépistage néonatal ciblé de la drépanocytose: Limites du test de falciformation (test d'Emmel) dans le bilan prénatal en zone ouest africaine. *Revue d'Épidémiologie et de Santé Publique*, **66**, 181-185. https://doi.org/10.1016/j.respe.2018.02.007

[10] Vierin Nzame, Y., Boussougou Bu Badinga, I., Koko, J., Blot, P.H. ad Moussavou, A. (2012) Dépistage néonatal de la drépanocytose au Gabon. *Médecine d'Afrique Noire*, **5902**, 95-99.

[11] Ouédraogo-Yugbaré, S.O., Tiendrebeogo, J., Koueta, F., Sawadogo, H., Dao, L., Ouédraogo, P., *et al.* (2014) Syndromes drépanocytaires majeurs chez les enfants de 0 à 15 ans à Ouagadougou: Marqueurs génétiques et caractéristiques cliniques. *Pan African Medical Journal*, **19**, Article 215. https://doi.org/10.11604/pamj.2014.19.215.3460

[12] Aka-Tanoh, K.A.H., Yao, K.C. and Asse, K.V. (2023) Prise en charge de la drépanocytose de l'enfant de 2017 à 2021 au CHU de Bouaké (Côte d'Ivoire). *Journal africain de pédiatrie et de génétique médicale*, **21**, 42-46.

[13] Moussavou, A., Vierin, Y., Eloundou-Orima, C., Mboussou, M. and Keita, M. (2004) Prise en charge de la douleur drépanocytaire selon les critères de l'Organisation mondiale de la santé. *Archives de Pédiatrie*, **11**, 1041-1045. https://doi.org/10.1016/j.arcped.2004.03.100

[14] Cohen, R., Romain, O., Tauzin, M., Gras-Leguen, C., Raymond, J. and Butin, M. (2024) Infections bactériennes néonatales: Diagnostic, épidémiologie bactérienne et traitement antibiotique. *Journal de Pédiatrie et de Puériculture*, **37**, 190-198. https://doi.org/10.1016/j.jpp.2024.03.007

[15] Ahanda, L., Sandie, A.B., Koki Ndombo, P.O. and Njom Nlend, A.E. (2020) Aspects épidémiologiques, thérapeutiques et pronostiques de l'anémie du prématuré au centre hospitalier d'Essos, Yaoundé, Cameroun. *Journal de Pédiatrie et de Puériculture*, **33**, 279-285. https://doi.org/10.1016/j.jpp.2020.06.005

[16] Assoumanou, M., Issifou, D. and Akpona, A. (2010) Le test de précipitation en milieu réduit: Une alternative au test d'Emmel dans le dépistage de l'hémoglobinose S. *International Journal of Biological and Chemical Sciences*, **4**, 354-361. https://doi.org/10.4314/ijbcs.v4i2.58123