



ORIGINAL ARTICLE

Study of Hemoglobins C and S in Pregnant Women in the Eastern Health District of Abobo

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Abstract

Introduction: Hemoglobinosis C and S are the most common structural abnormalities in West Africa. They worsen the overall health of carriers, particularly in pregnant women, leading to high-risk pregnancies and contributing to maternal and fetal morbidity and mortality. The objective of this study was to investigate hemoglobinopathies C and S in pregnant women.

Methods: This cross-sectional study was conducted from February to December 2022. It focused on pregnant women attending consultations at five health care facilities in the Abobo-East health district. Hemogram analysis was performed using the Sysmex XT 2000i, and hemoglobin electrophoresis at alkaline pH was conducted on the Helena system. Data were collected and analyzed using Microsoft Excel® 2016.

Results: Among the 500 selected patients, the mean age was 28 ± 6 years. 32.8% of women were anemic. 78.2% had normal hemoglobin, while 21.8% had hemoglobinopathies. Qualitative hemoglobinosis accounted for 21.2%, and suspected thalassemias were 0.6%. The prevalence of hemoglobin S and hemoglobin C was 15.2% and 6%, respectively. Healthy AS and AC carriers represented 20% of the study population.

Conclusion: The results of this study show a high prevalence of hemoglobinopathies C and S in community settings. A mandatory national strategy for the screening and management of hemoglobinosis in maternity wards throughout the country would be desirable.

Key words: Hemoglobin C, Hemoglobin S, Pregnancy, Prevalence, Abidjan.

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Introduction

Pregnancy, also known as human gestation, is a period of particular vulnerability for the mother-child pair. According to the World Health Organization (WHO), maternal mortality is very high, with approximately 830 women dying each day globally due to complications related to pregnancy or childbirth (1). These complications include postpartum hemorrhage, high blood pressure (HTA), anemia, which may be due to hemoglobinosis (2;3).

Hemoglobinosis C and S are the most common structural hemoglobin disorders in West Africa (4). In these regions, they represent a significant public health problem (5). The prevalence of individuals carrying hemoglobin S is estimated to be between 12 to 14% in the Ivorian population (6).

Worldwide, 7% of pregnant women are carriers of hemoglobinopathy (3). The presence of hemoglobinosis, especially hemoglobin (Hb) S, in pregnant women leads to high-risk pregnancies. Hb S is responsible for maternal morbidity of 2% and fetal morbidity of 30% (3). Indeed, this hemoglobinosis is associated with several placental vascular complications, including intrauterine growth retardation, preeclampsia, retroplacental hematomas, miscarriages, etc. They also expose the fetus to prematurity, low birth weight, fetal distress, and intrauterine death (7).

In Côte d'Ivoire, screening for hemoglobinosis is included in prenatal assessments but it is not always carried out for various reasons, thereby exposing pregnancy to the aforementioned complications.

Given these observations, this study was initiated with the aim of screening pregnant women with hemoglobinosis S and C in order to improve their management.

Materials and methods

Study site and population

This cross-sectional study was conducted from February to December 2022. It was carried out as part of a project by PASRES (Strategic Support Program for Scientific Research) called "Hypertension and Pregnancy." The project took place in the Abobo-East Health District within the municipality of Abobo. Sample collection and handling took place from February to August 2022, and the data analysis continued until December 2022. The Department of Hematology, Immunology, and Cell Biology at the Faculty of Pharmaceutical and Biological Sciences in Abidjan, Côte d'Ivoire, served as the setting for conducting hemoglobin electrophoresis. Hemogram analysis was performed at the National Institute of Public Health (INSP) in Adjamé, Abidjan, Côte d'Ivoire. The study population consisted of pregnant women seen by midwives in five health facilities in the Abobo-Est health district.

Inclusion criteria

Women residing in Abobo, with an ultrasound-confirmed pregnancy of no more than 20 weeks' amenorrhea (WA) and who had given informed, signed consent were included. Women with non-compliant samples and those absent from the appointment for sample collection and who did not provide blood were excluded from the study.

Study process

Women with 20 WA or less were interviewed in private sessions, during which the project, its aims, and objectives were explained to them. Those who had given their consent were enrolled.

Patient recruitment was done within the selected establishments. The establishments were selected on the basis of the number of prenatal consultations recorded within them during the first half of 2021. These establishments had a number of prenatal consultations which varied between 279 and 552. Thus the sampling was set at 500 patients, with 100 patients recruited in each of the 5 health establishments.

They were assigned a unique code, and completed a questionnaire. This questionnaire was used to collect their personal information as well as medical and gestational history. Subsequently, a blood sample was taken from fasting pregnant women, using venipuncture at the elbow fold, forearm veins, or the dorsal side of the hand. Two purple-capped tubes containing ethylenediaminetetraacetic acid (EDTA) as an anticoagulant were used for the collection. These samples were transported within 6 hours to the INSP laboratory where one tube was used for the complete blood count on, while the other was sent to the laboratory of the Department of Hematology, Immunology, and Cellular Biology at the UFR of Pharmaceutical and Biological Sciences of the Félix Houphouët-Boigny University for alkaline pH hemoglobin electrophoresis on a Helena system.

The principle of the Sysmex XT2000i is based on flow fluorocytometry, impedance combined with the hydrodynamic focusing technique as well as the cyanide-free SLS method for the counting of red blood cells, hemoglobin and platelets. The blood cell count is done taking into account the size, granularity, the calculation of hemocytometric constants and the dosage of hemoglobin by colorimetry.

The principle of hemoglobin electrophoresis on cellulose acetate at alkaline pH is based on the application of an electric current to a blood sample. The different hemoglobins, made up of different amino acids, migrate depending on the charge of the different fractions and the pH of the medium. This procedure divides hemoglobin into its normal and abnormal types, allowing individual measurements of each type. The Emmel test which is a sickling test was carried out to confirm the presence of hemoglobin S.

Anemia was defined as a hemoglobin value below 11 g/dL. It was considered normocytic for a mean corpuscular volume (MCV) between 80-99 fL and microcytic if it was below 80 fL. Anemia was labeled as normochromic for mean corpuscular hemoglobin concentration (MCHC) values greater than or equal to 27 pg and hypochromic if MCHC was below 27 pg. The red cell indices of MCV and MCHC are gotten from the Sysmex machine.

Data were collected and analyzed using Microsoft Excel® 2016.

The survey received approval from the ethics committee.

Results

The table 1 shows the distribution of pregnant women by age, nationality and marital status. The mean age was 28 ± 6 years, ranging from 16 to 47 years. The age group of 20 to 30 years was the most represented. Ivorian patients and those in a relationship predominated.

Concerning biological data, the figure 1 shows the frequency of anemia in patients, and

approximately 1/3 of pregnant women were anemic (32.8%). Normochromic Normocytic Anemia was the most commonly found (60.4%) (Table 2).

In the table 3, almost all patients had Hb A. Hb S and C were found in approximately 16% and 6% of the study population, respectively.

The table 4 showed that hemoglobinosis were found in 21.8% of patients. These were mainly qualitative hemoglobinosis (21.2%).

The heterozygous subjects AS and AC represented 20% of the study population (Table 5). An example of an electrophoretic diagram of hemoglobin on a cellulose acetate plate at alkaline pH is shown in figure 2.

Discussion

In this study, the population consisted of 500 pregnant women residing in the commune of Abobo. The age group of 20 to 30 years was the most represented. The age of the patients ranged from 16 to 47 years with an average age of 28 years \pm 6 years. 83.4% of women were under the age of 35. These figures are quite close to those of the 2021 general population and housing census (RGPH) (8), which reports that the Ivorian population remains very young, with 75.6% of the population being under 35 years old, slightly more than 3 out of 4 people.

Women of Ivorian nationality represented 83.4% of our population, which is slightly higher than the data from the RGPH of 2021, which reported that 78% of the total population was Ivorian. This difference could be explained by the much smaller size of our study sample compared to the census. This obtained rate was roughly equal to the 88% reported by UNICEF in a demographic study conducted in 2019 in the commune of Abobo (9).

The prevalence of anemia was 32.8%, meaning one in three patients. This frequency was similar to that obtained in 2011 by Tounkara (10), who reported a prevalence of 32.7% in his study on pregnant women in Bamako.

According to the World Health Organization (WHO), countries with an anemia prevalence between 20 and 39.9% (11) belong to the group of nations for which anemia is considered a moderate public health problem. The studies by Guindo in 2015 and Camara in 2021 in different regions of Mali respectively obtained prevalences of 33.2% and 31.5%, which were close to our data (2,13). These practically identical results support the findings of this study. These results were lower than those of the WHO in 2015, which, in its report on women of reproductive age, showed that 38% of pregnant women in West Africa were anemic (14). Indeed, the urban setting of our study could explain this difference. Urban populations benefit from better health care and a more balanced diet.

We observed a predominance of normochromic normocytic anemia (60.4%). These results were consistent with those of Isidore (58.5%) in his study on the complete blood count (15). This rate was higher than that obtained by Camara (36.7%) in a survey conducted at the Kenieba referral center maternity (13). The reticulocyte count and myelogram would have allowed a precise etiological approach. However, this could be explained by the fact that the investigation area was heavily exposed to malaria, approximately 63.5%. Indeed, according to a 2020 study on sanitation and disease risk in the Kennedy and Clouetcha neighborhoods in the Abobo district of Abidjan, 80% of households would not have an adequate system for sewage disposal and waste (16). Also, the lack of antimalarial drug prophylaxis during the first trimester of pregnancy exposes our patients to a higher risk of malaria.

Furthermore, the proportion of hypochromic microcytic anemias was not negligible in this study, accounting for 39.6% of cases.

These could be iron deficiency anemias, observed mainly in pregnant women. This rate was similar to that obtained by Isidore in Madagascar with 40.02% (15). Other studies conducted by Bléyé in Ivory Coast in 2006

and Camara in Mali in 2021 found frequencies of 85.5% and 51.90%, respectively, for these hypochromic and microcytic anemias (13,17). They were likely related to iron deficiency, which is a very common etiology of anemia in pregnant women.

The prevalence of hemoglobinosis in the study population was 21.8%. This prevalence is comparable to that described in the literature, which is 21.4% according to Danho *et al* (18).

The determination of hemoglobin phenotypes showed the predominance of carriers, AS and AC traits, accounting for approximately 20%. Our results were comparable to those of Danho with 18.85% in 2020 and Akontionga with 26.7% in 1988, who obtained values that were roughly similar (18,19).

The prevalence of the S gene was 16% in this study. This rate is very close to previous literature data, which ranged between 12 and

14% in the general population in Côte d'Ivoire (20). These figures were also close to the 13.9% obtained by Danho *et al* in their study at the Hematology and Immunology Department of the Treichville University Hospital in 2020 (18). However, this prevalence was higher than that described by Akontionga *et al*, who obtained an Hb S rate of 9.39% in their study conducted in 1988 on pregnant women from 6 maternity hospitals in the city of Ouagadougou (19).

The frequency of the C gene in our study population was 6%. This rate is close to that found by Danho, which is 6.55% (18). Moreover, Akontionga found frequencies of 20% (19). This could be explained by the fact that the distribution of hemoglobin C disease is not homogeneous in the sub-region. Indeed, this hemoglobinosis is predominant in Burkina Faso (21).

Table 1: Distribution of Pregnant Women by Age, Nationality, and Marital Status

Parameters	Frequency (n)	Percentage (%)
Age category		
<20	41	8.2
[20-30[284	56.8
[30-40[157	31.4
[40-47]	18	3.6
Total	500	100
Nationality		
Ivorian	417	83.4
Foreigner	83	16.6
Total	500	100
Marital status		
In a relationship	382	76.4
Single	118	23.6
Total	500	100

Figure 1: Frequency of anemia in patients

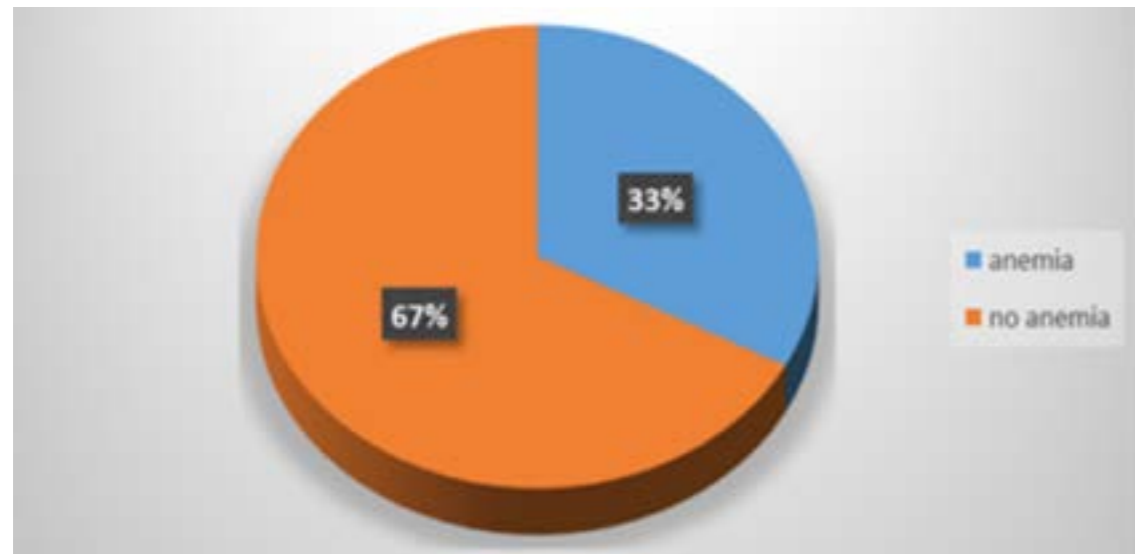


Table 2: Classification of patients by type of anemia

Parameters	Frequency (n)	Percentage (%)
Normochromic Normocytic Anemia	99	60.4
Hypochromic Microcytic Anemia	65	39.6
Total	164	100

Table 3: Distribution of the study population according to the different hemoglobin fractions

Hemoglobin fractions	Frequency (n)	Percentage (%)
Hb A	495	99.0
Hb A2	469	93.8
Hb S	80	16.0
Hb C	30	6.0
Hb F	6	1.2

*Hb: Hemoglobin

Table 4: Distribution of study population by electrophoretic phenotype

Parameters	Frequency (n)	Percentage (%)	
Normal Hb (AA ₂)	391	78.2	
Hemoglobinosis	Qualitative	106	21.2
	Quantitative	3	0.6
Total	500	100	

Table 5: Distribution of hemoglobinosis according to electrophoretic phenotype

Hb	Phenotypes	Frequency (n)	Percentage (%)
Normal Hb	AA ₂	391	78.2
	AS	74	14.8
	AC	26	5.2
	SC	4	0.8
	AFA ₂	3	0.6
Pathological Hb	SAFA ₂	1	0.2
	SSFA ₂	1	0.2
Subtotal		109	21.8
Total		500	100

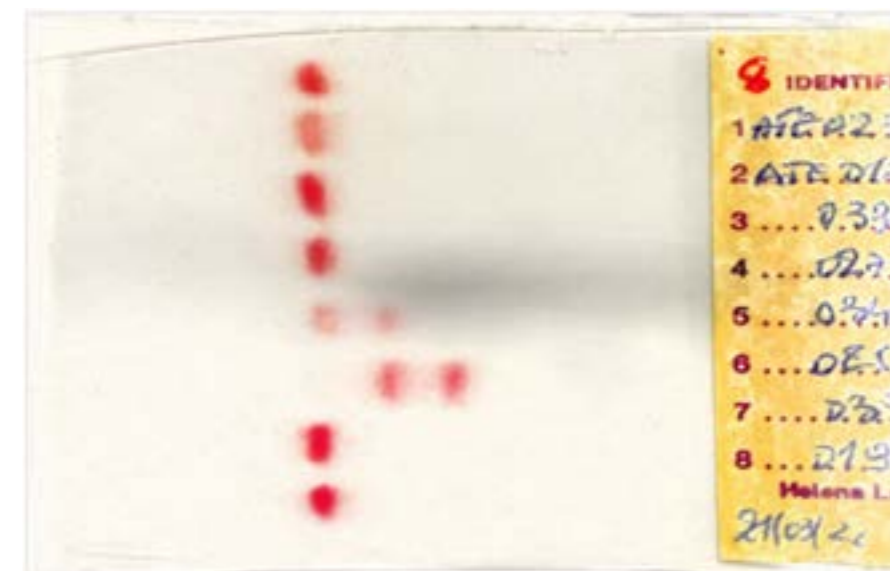


Figure 2: Electrophoretic pattern of hemoglobin on cellulose acetate plate at alkaline pH

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