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RESEARCH ARTICLE

PREVALENCE OF HEMOGLOBINOSIS IN SCHOOL ENVIRONMENTS: CASE OF THE CITY OF ABENGOUROU IN IVORY COAST

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Abstract

Introduction : Hemoglobinosis are hereditary conditions prevalent throughout the world. In Ivory Coast, according to the work of Cabannes (CABANE, 1979), the prevalence of hemoglobins S and C is 12%. These conditions frequently associated with anemia constitute a public health problem.Most data on hemoglobinosis still come from hospital information systems, and not from community settings. It is in this context that our study takes place, the general objective of which is to characterize anemia and hemoglobinosis S and C in schools.

Methodology: This was a cross-sectional study. It was carried out with students registered for the 2020-2021 academic year in three primary schools in the Abengourou department (eastern Ivory Coast). For each participant, a venous blood sample was used to carry out biological examinations, namely the hemogram, the rapid diagnostic orientation test (HemoTypeSCTM) and the electrophoresis of hemoglobin on cellulose acetate at alkaline pH.

Results: We identified 298 children aged on average 9 ± 2 years (5 to 15 years) and a sex ratio of 1.1.The average hemoglobin level was 10.99 ±1.08 g/dL with extremes from 5.60 g/dl to 13.70 g/dl. The prevalence of anemia was 73.49%. It was mainly a moderate anemia of the normochromic normocytic type.The prevalence of hemoglobinosis was 15.77% with a prevalence of 7.72% and 8.05% respectively for Hb S and Hb C. There were 1.68% for major sickle cell syndromes, 6.04% of AS trait and 7.05% of AC trait.

Conclusion: The prevalence of hemoglobinosis in schools in the Abengourou region was high with 16% of hemoglobinosis. We identified 13% of healthy AC and AS carriers. The continuation of this work in the community environment and throughout the Ivorian territory will allow the updating of data and advocacy for the mobilization of resources with a view to better management of hemoglobinopathies.

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Introduction:-

Hemoglobinosis correspond to abnormalities that affect the protein part of hemoglobin (Hb). They are divided into two groups: qualitative anomalies or hemoglobinosis and quantitative anomalies or thalassemias. Thalassemias correspond to a partial or total defect in the synthesis of Hb polypeptide chains. The anomaly can relate to the chain α, β, or δ and β at the same time; it will be respectively an α, β or δ/β-thalassemia (ARYA, 2012). Hemoglobinosis are characterized by structural abnormalities of a globin chain. This generally involves the substitution of one amino acid in the β chain of globin by another. In hemoglobin S or sickle cell disease, glutamic acid (Glu) in position 6 is replaced by a valine (Val) (β6 Glu→Val). Hemoglobinosis C is due to the substitution of glutamic acid by a Lysine (β6 Glu→Lys) (ARYA, 2012). These pathologies are endemic in the Antilles, the Mediterranean, Asia and certain regions of Africa. However, due to migratory movements of populations, they are increasingly encountered in all countries of the world.

According to the World Health Organization 5% of the world's population is affected by sickle cell disease, making this pathology a public health problem(WHO, 2009). Hemoglobinosis C, originating from the Voltaic plateau, has a prevalence that exceeds 15% in West Africa (Piel, 2013).

In Ivory Coast, the work of Cabannes dating from 1979 noted that the prevalence of Hb S in the Ivorian population was 12% with 2% of major forms (CABANNE, 1979). For Hb C, studies by Cabannes and Danho in hospital settings respectively reported prevalence rates of 2.63% (Cabannes, 1972) and 6.55% (Danho, 2020).

These hemoglobinosis are serious single-gene disorders in homozygotes that have a negative impact on the health, growth and development of children of all ages. Heterozygotes are most often asymptomatic. These subjects who are called healthy carriers -AS or AC- can transmit the abnormal allele to their descendants. It is therefore imperative to carry out screening combined with genetic counseling to prevent the spread of these conditions.

Although many African countries are affected, most data on hemoglobinosis still come from hospital information systems, not population-based systems. The general objective of our study was to characterize anemia and hemoglobinosis S and C in schools.

Material and Methods:-

Material:-

This cross-sectional study took place in the department of Abengourou in the east of Côte d'Ivoire, precisely in the villages Affalikro and Niablé in collaboration with the LYA Foundation “Living with Sickle Cell Disease” (FLVD) from February 2, 2021 as of April 12, 2021. The analyzes of the samples were carried out at the Affalikro hospital, at the facultyof Pharmaceutical and Biological Sciences of the FélixHouphouëtBoigny University and at a privatelaboratory in Abidjan (Medical Imaging Center of Abidjan)

Study population

The study population consisted of students from the 3 selected primary schools. The estimate of the minimum sample size for the prevalence surveys was calculated using the SCHWARTZ formula, a minimum number of n = 196 participants(Estimated prevalence of hemoglobinosis S and C 15% (Girot, 2004).

Students of both sexes attending these schools who had given their assent were included in the study; whose parents had previously consented. In total, 298 children were included in the study.

Methods:-

Venous blood samples were taken at the bend of the elbow on a tube containing the anticoagulant ethylene diamine tetraacetic acid (EDTA) for the production of the complete blood count, the rapid diagnostic orientation test (TROD) in HemoTypeSC strips and hemoglobin electrophoresis.

The blood count was carried out using the URIT 3000 PLUS automatic machine from URIT Medical Electronic.

In order to determine the hemoglobin phenotype of the participants, we systematically used the HemoTypeSC which is a rapid diagnostic test for hemoglobinosis S and C. The samples for which abnormal hemoglobin were confirmed by hemoglobin electrophoresis on cellulose acetate; this using the RAL SCANION manual electrophoresis system.

A survey sheet made it possible to collect socio-demographic, clinical and biological data.

Data Analysis

Data were collected from Microsoft Excel® 2013 software and analyzed with the free software R (version 4.0.2) and R studio (version 1.3.1073). The variables were described in terms of mean (±standard deviation) and percentage depending on their nature.

Results:-

The average age of the participants was 9±2 years with a minimum of 5 and a maximum of 15 years. The most represented age group was 5 to 10 years old with 54.36%. The sex ratio in favor of men was 1,1. The largest proportion was that of children inhigh level class (40,94%)

The average Hb level was 10.99±1.08 g/dL with extremes from 5.60 to 13.70 g/dL.

The prevalence of anemia was 73.49% in our study population. In the majority of cases (66.21%) it was a normochromic normocytic anemia of moderate intensity (56.62%).

The prevalence of hemoglobinosis in our study population was 15.77% with 7.72% for sickle cell anemia and 8.05% for hemoglobinosis C.

The hemoglobinosis trait was reported in 13.09% of schoolchildren; major forms of hemoglobinosis (CC, SSFA2, SFA2) were diagnosed in 2.69% of participants.

Discussion:-

Sociodemographic data

The present study involved 298 schoolchildren aged 5 to 15, all recruited in the Abengourou department. The sex ratio within our study population was 1.1. This value is close to the data from the primary education administration for the entire region (Comoé District) which is 1.16 (Ministry of Planning for Ivory Coast, 2022).The average age of our study population was 9 ±2 years with 45% of participants being between 10 and 15 years old. This average age is relatively high given that the theoretical age range in Côte d'Ivoire for primary school is 6 to 11 years old. This is partly explained bythe fact that a high proportion of children (19%) don't have administrative identity documents from birth (birth certificate), strongly contributes to a delay in schooling (Ministry of Planning for Ivory Coast, 2022).

Characteristics of the blood count

The average Hb level in our study population was 10.99 ±1.08 g/dL(5.6 to 13.7).Anemia was found with a prevalence of 73.49% (Tables II and III). It was mainly a normochromic normocytic anemia (66.21%). Regarding the intensity of anemia, we mainly had moderate anemia (56.62%) and 4 children (1.83%) had severe anemia. It should be noted that these figures are close to those obtained at the national level for children under 5 years old. Indeed, in Côte d'Ivoire, three quarters of children aged 6-59 months (75%) are affected by anemia: 25% have the mild form, 46% have the moderate form and 3% suffer from severe anemia (national institute of statistics, Ivory Coast, 2021). Along the same lines, in 2015, a multicenter study concerning different French-speaking African countries found for Côte d'Ivoire, 78% of children aged 6 months to 2 years were anemic, including 7% severely (DIOUF, 2015). Anemia in Ivorian's children had also been reported in different age groups with prevalence of 50% and 46% respectively in children under 5 years old and those of school age with an average Hb rate of 11 .2 g/dL (±15) for the latter (Asobayire, 2001).

The preponderance of normochromic normocytic anemia in our study population could be due to the fact that the area of investigation is known to be strongly affected by malaria. Indeed, the Comoé District records an incidence rate for this pathology above the national average (Ministry of Planning for Ivory Coast, 2022).

Hemoglobinphenotypes

The prevalence of hemoglobinosis in the study population was 15.77%; with a prevalence of Hb S at 7.72% and that of Hb C at 8.05% (Figure 1). The hemoglobin trait (AS and AC) was 13.09% in our study (Table VI). In 2020, a cross-sectional, retrospective and descriptive study carried out over 8 years at the Central Laboratory of the Treichville University Hospital in Abidjan noted a prevalence of hemoglobinosis of 21.4% with 13.69% of Hb S and 6.55% of Hb C. The hemoglobin trait (AS and AC) in this study was 18.85% (Nicaise, 2020). In 2003, a study carried out in an urban area in Côte d'Ivoire among children aged 0 to 5 years found 22.10% hemoglobinopathies with 9.64% Hb S and 6.95% Hb C (Tolo, 2003). In 2001, a community study carried out in 4 regions of Côte d'Ivoire found a prevalence of 9% for both Hb S and Hb C (Asobayire, 2001). An older study but which served as a reference for a long time found in a hospital environment in 1972, a prevalence of Hb S at 12% and that of Hb C at 2.63% (Cabannes, 1972). It should be noted that this fluctuation in the prevalence of hemoglobinosis is influenced by the hospital origin or not of the population studied as well as the region studied. Indeed, the distribution of hemoglobinosis is not homogeneous across the Ivorian territory.

Concerning major sickle cell syndromes, they were found in 5 children or 1.68% (Table VI). The Treichville University Hospital team found 2.26% of major sickle cell syndromes (Nicaise, 2020). This difference in prevalence may be linked to the community origin of our study population.

Table I:- Distribution of Age Group And School Level According To Gender.

	Women (%) n=142	**Men (%) n=156**	**Total (%) n=298**
Age range			
5 à 10 years	67 (22,48)	95 (31,88)	162 (54,36)
10 à 15 years	75 (25,17)	61 (20,47)	136 (45,64)
Schoollevel			
CP	37 (14,42)	58 (19,46)	95 (31,88)
CE	38 (12,75)	43 (14,43)	81 (27,18)
CM	67 (22,48)	55 (18,46)	122 (40,94)

Table II:- Characteristics Of Hemogram Parameters.

	Hb	**VGM**	**TCMH**	**CCMH**	**GB**	**PN**	**LY**	**Monocytes**
	g/dL	fL	Pg	g/dL	$10^3/mm^3$	$10^3/mm^3$	$10^3/mm^3$	$10^3/mm^3$
Average	10,99	79,70	25,31	31,81	8,18	3,21	4,12	0,86
Standard deviation	1,08	5,71	2,07	0,80	3,36	1,39	2,24	0,47
Minimum	5,60	61,20	18,50	28,60	3,30	1,10	1,50	0,10
Maximum	13,70	98,60	31,20	34,00	49,00	11,40	34,10	6,00

Table III:- Distribution According To The Type And Intensity Of Anemia.

	Effective	**%**
Interpretation of hemoglobinlevel		
Anemia	219	73,49
Normal	79	26,51
Type of anemia		
Normocyticnormochromicanemia	145	66,21
Microcytichypochromicanemia	74	33,79
Intensity of anemia		
Moderateanemia	124	56,62
Mildanemia	91	41,55
Severeanemia	4	1,83

Table IV:- Variation in Leukocyte Formula And Platelets.

	Effective (n = 298)	**%**
Hyperleucocytose	6	2,01
Leucopénie	4	1,34

Neutropénie	21	7,05
Neutrophilie	2	0,67
Hyper-lymphocytose	41	13,76
Thrombocytose	31	10,40
Thrombopénie	15	5,03

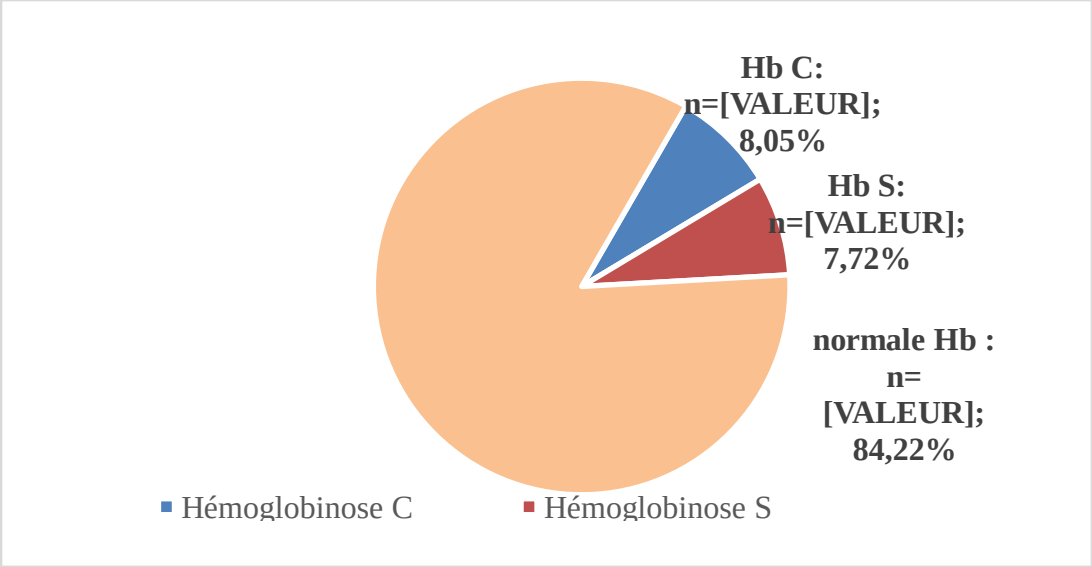

Figure 1:- Distribution According to The Presence Of Hemoglobinose.

Table VI:- Distribution According to Hemoglobinic Phenotype.

Hemoglobinphenotype	Effective	%
AA_2	251	84,23
AC	21	7,05
AS	18	6,04
CC	3	1,01
$SSFA_2$	3	1,01
SFA_2	2	0,67

Conclusion:-

There are several types of hemoglobinosis: hemoglobinosis S, also called sickle cell disease, and hemoglobinosis C. Sickle cell disease is the first genetic disease widespread in the world. It constitutes a public health problem for sub-Saharan African countries, particularly in Ivory Coast.

The prevalence of hemoglobinosis found in eastern Côte d'Ivoire among school-age children is 17%, or 8% for Hb C and 9% for Hb S. This result highlights the need for genetic counseling and the introduction of systematic neonatal diagnosis of these hereditary diseases to prevent their spread.

The continuation of this work in the community environment and throughout the Ivorian territory will allow the updating of data and advocacy for the mobilization of resources with a view to better management of hemoglobinopathies.

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