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EPIDEMIOLOGICAL PROFILE OF HEMOGLOBINOPATHIES CARRIERS AMONG THE USERS OF THE BIOCHEMISTRY LABORATORY OF THE FACULTY OF HEALTH SCIENCES OF NIAMEY/NIGER

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Abstract

The aim of this study is to determine the prevalence and gene frequency of Hemoglobin Constant Spring (HbS) and other forms of thalassemia among the users of biochemistry laboratory of the faculty of health sciences of Niamey/Niger. We realized, at the laboratory of biochemistry of the Faculty of Science and Health of Niamey/Niger from 1988 to 2010, a retrospective study which concerned in-patients, external patients and groups of population apparently healthy for which the electrophoresis of the hemoglobin is required were used. An eligible sample of 14.389 subjects was included in the analysis. Data analysis was done by descriptive statistics. The expanding subjects of a defect hemoglobin are among 58.8 %. The hemoglobin S was identified to 54, 96 % under the forms AS, SC, SS. Besides phenotypes, SC and SS which are the most spread, we identified other rare associations of the hemoglobin S, associations' thalassotherapy-sickle cell diseases. The expanding subjects of it ß + thalassotherapy-sickle cell disease represents 1.1 % and occupies the third place among the major sickle cell diseases met in Niger. Although this hemoglobinopathies is not at present curable, complete programs of fight centered on the prevention, the treatment and the support can be set up, at every level, and allow to improve as well the quality of life as the life expectancy of the people suffering from these pathologies. Age and locality factor play a role on Hemoglobinopathies in Niger. The findings indicate that there are serious impacts on children and remain neglected pathologies. The Niger government should focus on funding and providing the treatment and support have to be set up at all the levels, to allow improvement in terms of life quality as well as the life expectancy of the people suffering from these pathologies.

Keywords: Epidemiology Profile, Hemoglobinopathies, Sickle Cell Disease, Niamey.

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1. Introduction

Hemoglobinopathies are genotypic diseases that are characterized by a qualitative or quantitative disorder of the hemoglobin. They are caused by a hereditary transmission of mutant genes that are responsible of the synthesis of the hemoglobin from both parents whore in general in good health. They are divided up into two main categories: the sickle-cell anemia and the thalassemia. Now, the sickle-cell anemia trait is known to be widely spread. It is in some regions of Africa that its prevalence is the highest but it is also found among populations from equatorial Africa, the Mediterranean Basin and Saudi Arabia (Gentlini and Duflo, 1986). The highest rates of sickle-cell anemia prevalence are recorded between the 15th North parallel and the 20th South parallel forming this way what LEHMAN coined the sicklemic belt, reaching between 10 and 40% of the population in some regions (Lehmann and Huntsman, 1974).

In Niger, the findings resulting from hemoglobinopathies screening show a frequency of 19.4 to 22.5% of hemoglobin S and 1.9 to 6% of hemoglobin C (Alain et al., 1992; Cabannes et al., 1987). In most of our countries where sickle-cell anemia is a major public health issue, there are no national programs meant to control this disease. The basic structures that are necessary to take care of the patients are usually lacking, the systematic screening of sickle-cell anemia is not a common practice and the diagnosis of the sickness is usually made only when a serious complication arises. The knowledge about the hemoglobinopathies epidemiologic and molecular related data is at the basis of the understanding of the mechanisms for expressing these diseases and the genotype/phenotype correlations. Therefore, the aim of the present study was to determine the epidemiological profile of hemoglobinopathies of children in Niger.

2. Materials and Methods

The present study was been realized from 1988 to 2010, at the laboratory of biochemistry of the Faculty of Science and Health of Niger. It is a retrospective study. The population considered in this study is made up of hospitalized patients, outpatients, and groups of population apparently looking healthy, for whom the hemoglobin electrophoresis is required for putting together their medical records. The study was approved by the ethics committee of Niger Ministry of Public Health. A total of 14.389 individuals were included in the analysis. Data analysis was done by descriptive statistics. The whole of the data collected are computerized and processed using the 2007 Word and Excel software types.

3. Findings

The first part of the finding depicts characteristics of study population about 53.6% of the study participants were female, and the sex ratio was 1,14. Ages have been specified only for for 86.6% of the cases varied from ten (10) days to eighty seven (87), the mean is 13.54 and the standard deviation is 16± 14.4 years. Concerning the ethnic group, the individuals were not chosen in accordance with rigorous ethnic criteria. In accordance with patriarchy which is the social rule in Niger, we took into consideration the father's sole ethnic group. Thus, as ethnic group is used in our study, only 79% were informed ethnic group wise.

Many different types of haemoglobin (Hb) exist. The most common ones are HbA, HbA2, HbF, HbS, HbC, HbH, and Hb M. Healthy adults only have significant levels of HbA and HbA2.Homozygous means inheriting similar genes from both parents e.g. AA, or SS, or CC, or Tall-Tall, or Short-Short. From 1988 to 2010, 14,389 subjects have had a haemoglobin electrophoresis. We censed 5,931 subjects, or 41.2% who carry anHbA2, normal haemoglobin. HbS is an abnormal form of hemoglobin associated with sickle cell anemia, the subjects carrying HbSamount to 8,458 or 58.8%. Among the subjects carrying normal haemoglobin (HbA2), twentyfi ve (25) cases of AF phenotype or 0.4% were identified (see table 1). Haemoglobin S (HbS) was identified in 7,908 subjects or 54. 96%.

Table 1: Phenotype-based distribution of the subjects

Phenotypes	Number	Rate (%)
AA	5.931	41.2
AS	5.055	35.1
AC	521	3.6
SC	692	4.8
SS	2.038	14.2
CC	29	0.2
SAF or β+ thalasso—sickle-cell anemia	98	0.7
SF or S/PHHF	25	0.2
Total	**14.389**	**100**

Heterozygous means inheriting dissimilar genes from both parents provided one gene is normal i.e. A (normal) & S (abnormal), or AS, SC, SS. Our finding show that in addition to the AS, SC, and SS phenotypes that are the most spread we identified other rare associations of hemoglobin S(HbS), the associations thalasso—sickle-cell anemia. The hemoglobin S (HbS) under the form of the SAF or βthalasso—sickle-cell anemia was found in 98 cases, that corresponding to 0.7%. The rate of hemoglobin F(HbF) varies between 8.3-27% with an average and a standard deviation of 15.4±4.6%. Due to the lack of family surveys, hematologic tests, and clinical signs that allow to better distinguish the two categories of hemoglobinopathies we chose to regroup the subjects carrying a β^{o}thalasso—sickle-cell anemia (SF)and the subjects carrying an association of HbS with a persistent hereditary HbF (S/PHHF). Together, the subjects carrying these two hemoglobinic defects only represent 25 cases, that is to say only 0.2% of the entire population studied.

Hemoglobin C (HbC) ranks second to the hemoglobinS (HbS) in the distribution of hemoglobinopathies in our study. Hemoglobin C (HbC) was identified in 1,242 cases or 8.6%. We also noticed that at the level of sex related distribution female predominates with 55 cases against 44 cases. The difference is nevertheless not significant. Our series also pointed out that 80.6% of the subjects carrying a β^{o}thalasso—sickle-cell anemia are 0 to 25 years old compared to 85.7% with those carrying SC, and 97.4% with those carrying SS, within the same age range.

4. Discussion

The hemoglobin S(HbS) is an important public health issue. It represents the most wide spread hemoglobinopathy in Niger C (Alain et al., 1992; Cabannes et al., 1987). Our study results revealed that hemoglobin S(HbS) represented 55% in Niger, under the AS, SC, SS (table 1). This concurs with the findings of a study conducted in some other African countries showed that hemoglobin S (HbS) prevalence rates is highly; the prevalence rates vary from 20% to 53% whereas in certain regions of Uganda the prevalence rates reach 45%. Within some Baamba tribes living around Rowenzoni and in the plains of Semliki that is close to Uganda, a rate of 53% can be observed. Around this source the frequency diminishes gradually and regularly southwards and northwards: 28% in Kenya, 12% to 17% in Tanzania, 12% in Angola, and 3.5% to 10% in Mozambique (Josiane and Henri, 2004). According to the World Health Organization (WHO), it is estimated that there are 250 million people carrying the genes that are potentially pathogenic and that yearly there are 300,000 children who are born with severe forms of hemoglobinopathies and Close to 5% of the world population carry hemoglobinopathies characteristic genes (WHO, 2006). In sub-Saharan West Africa, the hemoglobin S (HbS) rate varies between 6 and 30%. In the countries where the sickle-cell anemia trait prevalence is above 20% the disease affects about 2% of the population (Josiane, and Henri 2004), and near 50% of the children who are affected by the most severe form of the disease die under the age of five (05), most often following an infection or

a serious anemia are consistent with those of other studies In Tunisia, the hemoglobin electrophoretic study realized for a total of 44, 299 individuals, of which 20, 059 were sent to the hospital for a suspicion of hemoglobinopathies, allowed showing a mean prevalence of carriers of hemoglobinopathies trait to be 4.48% but also to reach 12.50% in some risk zones (Fattoum, 2006). In Togo, the HbS gene prevalence rate is estimated to be 16.1%. In Niger, all the epidemiological and clinical studies carried out in relation with hemoglobinopathies result in a strong prevalence rate of the hemoglobin S (Alain et al., 1992; Cabannes et al., 1987; Diatta, 1981). In our study, the frequency of hemoglobinopathies is 58.8. In Burkina Faso, a study of 28, 226 electrophoreses carried out in 45 schools, 13 villages, and the Saint Camille Medical Center showed, respectively, the following prevalence rates: 39.99%, 28.71%, and 28.30% of hemoglobin S cases (Cabannes et al., 1978)

Table 2: Table of hemoglobinic abnormalities distribution in West Africa

Genotypes	AA(%)	AS(%)	AC(%)	SS(%)	SC(%)	CC(%)
Burkina Faso						
Simpore and Cool [13].						
St Camille Medical Center (N= 10.166)	58.13	12.29	19.28	1.93	6.49	1.81
Schools (N = 23,050)	69.92	8.36	19.18	0.20	0.97	1.37
Villages (N = 5,176)	70.00	6.90	19.16	0.25	1.99	1.70
Ivory Coast						
Cabannes et al. [10]. (newborns, n = 4.000)	79.7	8.7	6.6	0.6	0.4	0.4
Togo						
Mijiyawa al [14]. (rheumatology patients, n = 405)	64.9	15.8	12.1	2.0	4.2	0.5
Togo						
Segbena et al [15]. (newborns, n = 171)	64.3	16.4	15.8	1.1	2.3	0.0
Our findings (N= 14.389) (Users of the FHS Laboratory)	41.2	35.1	3.6	14.2	4.8	0.2

The results also show that over all the 7.572 subjects of our series and of whom the ages are known, 1, 953 carry a sickle-cell anemia SS, or 25.3%. The most affected age range is the one under one (01) year that concerns 52% of hemoglobin SS carriers. After 15 years of age, we notice a sudden drop in the rate of homozygotes SS subjects that goes from 18.7% for the 16-20 age range to a minimal level of 3% within the age range above 25 years. In our series, the oldest subject carrying the SS type was 40 years old. The regional variation has been highlighted by several studies, In Conakry, a descriptive crosscutting and analytical study undertaken among children and adults carrying qualitative hemoglobinopathies showed 353 subjects with a qualitative hemoglobinopathy among which 159 or 45% of male subjects and 194 representing 55% of female subjects. Among them 322 or 91.2% were carriers of sickle-cell trait (SS, AC, AF, and others) and 31 or 8.8% were carriers of major sickle-cell anemia syndromes (SS, SC, CC, and SF). The mean age was 26 years (Loua and Coll, 2011). In Ivory Coast, it is found in a series of 313 sickle-cell anemia SS, the majority of patients with sickle-cell anemia SS within the age group of 1-5 years or 33.9% (Kple, 1981) and 75% of the homozygote SS are identified before they are two (02) years old (Cabanne and Sy-Baba, 1967). It is located the first symptoms appearance between the eighth and the eleventh months of life even if sometimes the diagnosis was done at the age of six (06) months (Hazoume et al., 1975). As regard the phenotype SC, we recorded 635 subjects or 8.4% who are carriers of the double heterozygosity SC. We can observe that a gradual increase in the frequency

of subjects with Hb SC that goes up from 5.2% with those under 1 year to a prevalence rate of 15.4% within the 16-20 years age range. This rate undergoes a decrease in the region of 6.1% within the age group of 21-25 years where the frequency is 9.3%. Absent from the majority of the epidemiologic studies implemented in Africa because of the confusion of it with the sickle-cell anemia AS trait or even with the sickle-cell anemia SS because of the high rate of hemoglobin S, the β+thalasso sickle-cell anemia was nonetheless reported in some surveys conducted among black populations. In a study carried out within Ivoirian ethnic groups observe an average rate of prevalence of about 0.47% which is about 1.3 times lower than the frequency observed in our subjects (Cabannes et al., 1978). The majority of the β+thalasso —sickle-cell anemia carriers noticed that are found within the age range of 5-10 years (Kple, 1981). In our series, the oldest β+thalasso —sickle-cell anemia carrier was 44 years old. In Togo the β hemoglobin structure abnormalities were found in 35.7% of the cases, but in accordance with a study covering 171 newborns. The gene frequency was 0.105 for the βS and 0.091 for the βC (Loua A and Coll, 2011).

Table 3: Age-based distribution of the different phenotypes

		Phenotype														
		AC		AS		SC		SS		CC		SAF		SF+S/	PHHF	Total
Age bracket	N	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%	100
< 1 year	839	28	3.3	319	38	44	5.2	436	52	3	0.4	7	0.9	2	0.2	839
1-5 years	1, 972	97	4.9	920	46.7	135	6.8	797	40.4	5	0.2	11	0.6	7	0.4	1, 972
6-10 years	941	42	4.5	493	52.4	99	10.5	285	30.3	2	0.2	17	1.8	3	0.3	941
11-15 years	746	28	3.8	395	52.9	96	12.8	201	26.9	2	0.2	20	2.7	4	0.5	746
16-20 years	668	42	6.3	380	56.9	103	15.4	125	18.7	2	0.3	11	1.7	5	0.7	668
21-25 years	721	57	7.9	524	72.7	67	9.3	59	8.2	4	0.6	9	1.2	1	0,1	721
> 25 years	1685	152	9	1362	80,8	91	5,4	50	3	10	0,6	18	1.1	2	0.1	1, 685
Total	**7, 572**	**446**	**5.9**	**4,393**	**58.5**	**635**	**8.4**	**1,953**	**25.3**	**28**	**0.4**	**93**	**1.2**	**24**	**0.3**	**7, 572**

Over a total of 7.572 examined subjects we but identified 93 cases of β+thalasso —sickle-cell anemia, this representing 1.2%. The distribution in accordance with the age shows that the most affected age group is that of 11-15 years (i.e. 21.5%) followed by the age range of 6-10 years (i.e. 18/3%). Above 10 years, the percentage of the thalasso —sickle-cell anemia carrier subjects prevalence drops progressively going from 11.8% in the age groups of 1-6 years and 16-20 years, then stabilizes at 2.2% in the 41-42 years age range. The phenotype CC was only found only in 28 cases over the whole 7.572 subjects, or 0.4%, covered by our study and the high frequency (0.6%) is observed with subjects aged 21-25 years or above 25 years. The ethnic group-based distribution of hemoglobinopathies shows that the Gourmantché, Haoussa, Touareg, Kanouri, Zarma-Sonraï and the Peulh ethnic groups are the ones most affected by the hemoglobin S (49.2 to 70.3%). The strong frequencies of hemoglobin C were observed among the Touareg and the Gourmantché with respectively 14.2% and 10.8%. The similar study in Burkina Faso show that, origin of the Gene C, the incidence of the phenotype CC is 2% in the savannah and 0.6% in the Sahelian region (Alain et al., 1992). If the highest prevalence rates of the hemoglobin abnormalities are found in well delimited regions, the migratory flows contributed amply to the dissemination of the disease, which situation renders practically impossible an orientation of the screening on the basis of a mere knowledge of the patient ethnic group origin.

5. Conclusion

Today, hemoglobinopathy is increasingly encountered as a health problem. The aim of this study is to determine the epidemiological profile of hemoglobinopathies carriers among the users of the biochemistry laboratory of the Faculty of Health Sciences of Niamey/Niger. The results of the study demonstrate that hemoglobinopathies are gene related diseases that are the most spread in the African region in general and Niger in particular. The study also shows that in spite of their serious impacts on children they remain neglected pathologies. These findings will have important policy implications for the Niger government to promote prevention-based fighting complete programs, the treatment and support can be set up, at all the levels, to allow improvement in terms of life quality as well as the life expectancy of the people suffering from these pathologies.

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The term.

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b. Heterozygous means inheriting dissimilar genes from both parents provided one gene is normal i.e. A (normal) & S (abnormal), or AC, or AD, or AE
c. Heterozygous means inheriting dissimilar genes from parents irrespective of whether one of the pair is normal or not i.e. AS, SC, CD, SO.
d. Double heterozygote state is when the two dissimilar genes are abnormal, like SC, SD, SBetathal.
e. Genotype refers to the pair of genes inherited from both parents for the same characteristic. If father gives haemoglobin S gene and mother haemoglobin C gene to a child then the genotype for haemoglobin production is SC.