

# Anemia: Prevalence and Characteristics Among Koranic School Children in Dakar, Senegal

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## Abstract

### Background and objectives

Anemia are highly prevalent among two billion people in the world. It affects especially low-middle income countries where prevalence of 50% are found in children under 4 years old and 45% in school children. This study aimed to determine the prevalence of anemia and iron deficiency among children in Koranic schools.

**Keywords:** Anemia, iron deficiency, fatigue

**Materials and methods:** We led a retrospective, cross-sectional study, from January 2018 to October 2018, conducted in some Koranic schools of Dakar (Capital of Senegal) and at Hematology and Biochemistry departments of Aristide Le Dantec Hospital. Statistical analysis of the data was performed using SPSS software (version 20).

**Results:** Our sample contained 833 boarders from Koranic schools in the urban and semi-urban areas of Dakar, aged between 3 and 15 years and predominantly male. Asthenia was the most common sign found in 44.7% followed by perleche and pruritus in respectively 37.8% and 20.8% of cases. Out of 833 Koranic school residents, 98 had a hemoglobin level below the WHO threshold, accounting for a prevalence of anemia at 11.76%. The anemia was mild in the majority of cases (60.2%) and severe in only 2.04% of cases. The risk of anemia did not depend on the age or sex of the child, but its severity was significantly associated with the female sex ( $p = 0.019$ ). The anemia found in the children was predominantly hypochromic microcytic (67.3%). Serum iron and Ferritinemia performed in 54 of the 66 cases of microcytic anemia showed iron deficiency anemia in 59.26% of cases and inflammatory anemia or hemoglobinopathy in the other cases of microcytic anemia.

**Conclusion:** At the end of this study, we found a prevalence of anemia of about 11.76% among children in Koranic schools in the Dakar region. This shows that anemia is still a public health concern.

## Introduction

Anemia and iron deficiency are public health concerns worldwide, with important socio-economic consequences [1]. They cause a reduction in well-being; fatigue, lethargy, impair performance and work capacity [2]. It is well known that the average loss of physical efficiency due to martial deficiency is significant [3] and that approximately two billion people are affected worldwide. Developing countries pay the highest price with a prevalence accounting for

about 50% of cases in children under 4 years of age and 45% in school-age children [4-7]. In Senegal, the Demographic and Health Survey (DHS) conducted in 2017 showed that 70.9% of Senegalese children under 5 years of age suffered from anemia: 23% underwent mild anemia, 48% from moderate anemia, and 5% from severe anemia. However, Diouf et al. found in their study a prevalence of 86.5% with 63.7% of mild anemia and 1.6% of severe anemia [8]. Untreated anemia in children can have serious consequences on their mental faculties, growth and

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development, leading to attention problems, learning delays, and poor school performance [8-10]. This anemia is multifactorial and usually a consequence of nutritional deficiencies (iron and/or vitamin B12) and may also be related to digestive parasitosis. Growth and physical performance are also affected as well as immune defenses [11,12]. Despite the high prevalence and adverse health consequences reported, there are few representative findings in Senegal on the prevalence and predictors of anemia in school-aged children, particularly those in Koranic schools. Thus, we considered it relevant to conduct the present study to determine the anemia profile of children attending Koranic schools. Our specific objectives were: to determine the prevalence of anemia, to set anemia patterns, and to correlate the abnormalities observed with the underlying condition found in these children.

### Patients And Methods

#### Study setting

This study was conducted in boarding schools in Dakar areas and the Hematology and Biochemistry departments of Aristide Le DANTEC Hospital in collaboration with dermatologists and parasitologists. Our study population consisted of children over 3 years of age living in the Dakar region. Fifteen schools located in the departments of Dakar and Pikine were included.

#### Type, period, and study population

This descriptive, cross-sectional study was conducted from January to October 2018 in selected Koranic schools, and all children living there were included in this study. A simple random sampling method was conducted before the inclusion of the Koranic schools.

#### Study procedure

Each child was given a code after informed consent from their legal representative. All children were examined by a physician before a biological assessment including venous blood samples. The children were interviewed directly about symptoms as well as sociodemographic characteristics using a standard questionnaire. Data obtained from the physical examination and interviews with legal representatives were entered on a case report form (CRF).

#### Parameters studied

Socio-demographic parameters (age, sex, ethnicity, parent's occupation, and the number of residents per room), clinical signs of anemia, and biological parameters for the exploration of anemia (blood count, martial assessment, blood smear).

#### Biological assessment

To make the biological diagnosis of anemia we considered a Hb level according to age group. Anemia was defined with Hb 11 for children aged 6 years, Hb 11.5 g/dl for children aged 6 to 11 years, and Hb 12 g/dl for children aged 12 to 15 years. Anemia was classified as mild (Hb between 9 and 10.9 for children aged 6 years, Hb between 10 and 11.4 g/dl for children aged 6 to 11 years, and between 10 and 11.9 g/dl for children aged 12 to 15 years), moderate (Hb between 7 and 9.9 g/dl), and severe (Hb 7 g/dl) for children aged 6 to 15 years, based on the WHO-recommended adjusted Hb concentration. According to the Mean Globular Volume (MGV), the anemia was classified as macrocytic (MGV 90 fl), normocytic (MGV between 80 and 90 fl), or microcytic (MGV 80 fl).

#### Statistical analysis

The data were entered with the Epi-info software (7.2.2.2) and then transferred to the SPSS software (Statistical Package for Social Sciences) version 20 for statistical analysis.

We proceeded to the descriptive study with the calculation of frequencies and proportions for the qualitative variables and the calculation of means and standard deviations for the quantitative variables.

The analytical study was done with cross-tabulations. To compare the frequencies, we used the Pearson Chi-square test or the two-tailed Fisher exact test, depending on their applicability, with a significance threshold of  $p < 0.05$ .

#### Control Quality

Data reliability was verified by control quality (CQ) of the SYSMEX XT2000iä (Japan) automated hematology analyzer, the blood count determination device. A 3-level control batch was run 3 times during the day (pre-shift and post-shift).

The ARCHITECTci4100™ (Abbot Diagnostics, Chicago, Illinois, USA) automated immuno-biochemistry system was checked daily.

#### Ethical considerations

The study was conducted after authorization from the ethics committee of the Cheikh Anta Diop University of Dakar. It was financed by the mother-child center of excellence (CEA-SAMEF). For each institution, a visit was made to the site to obtain the consent of the person in charge, followed by an inclusion visit for dermatological consultations and sampling (whole blood and fresh stool).

Inclusions were made after informed consent from the heads of the different schools involved. During the

study, the confidentiality of information was guaranteed. Consultations, sampling, and analysis were done free of charge. A specified analysis was performed after each visit to detect urgent cases requiring management. Post-inclusion visits were made for treatment and possible monitoring. Patients with iron deficiency were treated and the others were followed up.

**Results**

We included a total of 833 boarders from Koranic schools in the urban and semi-urban areas of Dakar. The mean age was 9.97 +/- 2.78 years, ranged from 4 to 15 years. The most represented age group (530 children) was the one from 6 to 11 years old. Among these residents, we noted a clear male predominance of 714 (85.7%) and a sex ratio estimated at 6.0 (Table I).

Asthenia was the most frequent sign (44.7%), followed by perleche and pruritus in 37.8% and 20.8% respectively (Table I).

Father's incomes were often not regular because their informal (63,7% of them) or lack activities (26%).

As well as mothers, about 92% were either without occupation (housewives 57.3%) or working in the informal sector (traders' 34.7%). And only 8% were in the formal sector (Medicine, Pharmacy, Police, etc.) (Table I).

As for the number of children per room, we noted at least five students per room and that most of them (55,2%) are more than ten per room.

The current stool analysis showed at least one parasite in 103 residents and the dermatological consultation found an affection in more than 65% of them (Table I).

**Table 1:** Distribution of sociodemographic and clinical characteristics of children in Koranic schools in Dakar

Variable	Catégories	Frequency	Percentage %
<b>Gender</b>	Male	714	85,7
	Female	119	14,3
	Total	833	100
<b>Sex ratio = 6</b>			
<b>Age</b>	≤ 05 years	46	5,5
	06-11 years	530	63,6
	12-15 years	257	30,9
	Total	833	100
<b>Mean age = 9,97+/- 2,78</b>			
<b>Clinical signs</b>	Asthenia	372	44,65
	Perlechia	315	37,81
	Pruritis	173	20,77
	Palor	155	18,61
	Abdominal	53	6,36
	Hematuria	141	16,9
	Jaundice	10	1,2
	Geophagie	242	29,1
<b>Occupational status of themother</b>	Housewife	477	57,3
	Informal sector	289	34,7
	Formal	67	8,0
	Total	833	100
<b>Occupational Status of the father</b>	Unemployed	218	26,2
	Informal sector	531	63,7
	Formal sector	84	10,1
	Total	833	100
<b>Number of children per bedroom</b>	5-10 enfants	373	44,78
	>10 enfants	460	55,22
<b>Current stool examination</b>	Parasite seen in stool	103	12,37
	No parasite seen	730	87,63
	Total	833	100
<b>Diagnosed dermatosis</b>	Yes	548	65,8
	No	285	34,2
	<b>Total</b>	<b>833</b>	<b>100</b>

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A whole blood count was performed for all included children. We found 98 children with hemoglobin levels below the threshold values set by the WHO, so the prevalence of anemia was 11.76% of the study population. The prevalence depended on age group was 17.39% in children aged under 6 years and 12.64% and 8.95% in children between 6 and 11 years and in older ones, respectively. The mean hemoglobin level was 12.67+/- 1.22 g/dl in the study population and 10.64+/-0.79g/dl in anemic children. Among the anemic children 60.2%, 37.8%, and 2.0% had mild, moderate, and severe anemia respectively.

In our series, anemia was mild in the majority of cases, accounting for 60.2%, and it was severe in only 2 children, representing 2.04% of cases.

The anemia found was mostly hypochromic microcytic (67.3%). Apart from this type of anemia, normocytic hypochromic or normochromic anemia was found in 32.7% of anemic children. Any macrocytic type was noted.

We then performed iron metabolism test (sideremia an ferritin level) in children with microcytic anemia. Thirty-two of them have had an iron deficiency anemia (Table II).

**Table II:** Distribution of hematological parameters of children in Koranic schools in Dakar

Variable	Categories	Frequency	Percentage %
<b>Hémoglobine</b>	Low	98	11,76
	Normal	735	88,24
	<b>Mean = 12,68+/-1,25</b>		
	Low	561	67,3
	Normal	272	32,7
	<b>Mean = 79,7+/-6,14</b>		
<b>VGM</b>	Low	379	45,50
	Normal	454	54,50
	<b>Mean = 26,87+/-2,32</b>		
<b>TCMH</b>	Mild	59	60,2
	Moderate	37	37,8
	Severe	2	2
	Normal	10	20,83
<b>VS</b>	Accelerate	38	79,17
	<b>Total</b>	48	100
<b>Ferserique</b>	Low	44	81,48
	Normal	10	18,52
	<b>Total</b>	54	100
<b>Feritinémie</b>	Low	32	52,3
	Normal	22	40,7
	<b>Total</b>	54	100

The prevalence of anemia decreased with age and was significantly higher in the younger age group with a prevalence of 17.39% (Table III). The degree of severity of anemia was significantly not dependent of age ( $p=0.45$ ). But we noted that mostly, anemia was mild in children under 11 years and moderate (52.2%) in children aged 12 years or older.

**Table III:** Distribution of anemic children according to age group and sex.

Age group	Total number of children	Total number of children with anemia					
		Female		Male		Total	
		N	%	N	%	N	%
≤ 5 years	46	03	37,5	05	62,5	08	17,39
06-11 years	530	10	14,9	57	85,1	67	12,64
12-15 years	257	01	4,3	22	95,7	23	08,95
<b>Total</b>	<b>833</b>	14	14,3	84	85,7	98	117,6

The risk of occurrence of anemia was independent of gender ( $p=0.99$ ), but its severity was significantly

associated with gender ( $p=0.019$ ). Mild anemia was more common in both sex with a higher frequency

(85.7%) among girls. Moderate anemia was more common in boys. On the other hand, girls are at greater risk of being affected by severe anemia (Table IV).

**Table IV:** Degree of anemia by gender and age group

GROUP PATIENT	SEVERITY OF ANEMIA			TOTAL N (%)	p-value	
	MILD N (%)	MODERATE N (%)	SEVERE N (%)			
GENDER	F	12 (85,72)	1 (7,14)	1 (7,14)	84	0,019
	M	47 (56,0)	36 (42,9)	1 (1,1)		
AGE GROUP	< 6	6 (75)	2 (25,0)	0 (0,0)	8	0,45
	06-11	42 (62,7)	23 (34,3)	2 (3,0)	67	
	12-15	11 (47,8)	12 (52,2)	0 (0,0)	23	

We then perform a bivariate logistic regression and that have shown any significant association between sociodemographic data and the notion of anemia in children in Koranic schools in Dakar (Table V).

**Table V:** Distribution of bivariate logistic regression about sociodemographic factors of children with or without anemia in Koranic schools in Dakar

Variables	Categories	Hemoglobin status			p-value
		Anemic N (%)	Normal N (%)	Total N (%)	
Age of the child	≤ 5 years	08 (17,39)	38 (82,61)	46 (100)	0,151
	06-11 years	67 (12,64)	463(87,36)	530 (100)	
	12-15 years	23 (8,95)	234(91,05)	257 (100)	
	Total	98 (11,76)	735(88,24)	833 (100)	
Sex of the child	Female	14 (11,76)	105(88,24)	119 (100)	0,067
	Male	84 (11,76)	630(88,24)	714 (100)	
	Total	98 (11,76)	735(88,24)	833 (100)	
Occupation of the mother	House wife	52 (11,90)	425 (89,10)	477 (100)	0,067
	Informal sector	33 (11,42)	256(88,58)	289 (100)	
	Formal sector	13 (19,40)	54 (80,60)	67 (100)	
	Total	98 (11,76)	735(88,24)	833 (100)	
Occupation of the father	Unemployed	30 (13,76)	188(86,24)	218 (100)	0,396
	Informal sector	60 (11,30)	471(88,70)	531 (100)	
	Formal sector	8 (9,52)	76 (90,48)	84 (100)	
	Total	98 (11,76)	735(88,24)	833 (100)	
Number of Children per bedroom	5-10 children	51 (11,09)	409(88,91)	460 (100)	0,865
>10 children	47 (12,60)	326(87,40)	373 (100)		
Current stool examination	Parasite seen in stool	11 (10,68)	92 (89,32)	103 (100)	0,72
	No parasite seen	87 (11,92)	643(88,08)	730 (100)	
Diagnosed dermatosis	Yes	60 (10,95)	488(89,05)	548 (100)	0,31
	No	38 (13,33)	247(86,67)	285 (100)	

**Discussion**

Anemia is one of the major public health concerns globally, and in the sub-Saharan area in particular. In developing countries, the prevalence of anemia is 50% in children, especially those of school age and living in poor conditions [13]. Nutritional deficiency and intestinal parasitosis may be responsible for the high prevalence of anemia.

In sub-Saharan Africa, parasitic diseases and low bioavailable iron intake are the major causes of anemia [14]. Iron deficiency is the most common cause of childhood anemia, which may reflect an imbalance between iron intake (consumed and

absorbed) and iron reserve losses, resulting in inadequate hemoglobin synthesis [15-18]. Indeed, iron homeostasis is very important, because iron is necessary for the complete myelination of sensory neurons, which is correlated with behavior and learning [19-21]. Thus, the physiological damage observed during iron deficiency includes, among others, a delay in cognitive development, a decrease in psychomotor abilities, and a decrease in immunity leading to an increased susceptibility to infections [18,20]. WHO has proposed a classification based on an estimate of the prevalence of anemia and its public

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health importance: a nil, mild, moderate, and severe public health problem when the prevalence is  $\leq 4.9\%$ , 5.0%-19.9%, 20.0%-39.9%, and  $\geq 40\%$ , respectively [15]. Accordingly, the 11.76% prevalence of anemia among Koranic school children is still a real public health problem in the study area. This indicates that a considerable number of children in the community suffer from anemia.

In the present study, intending to determine the prevalence, characteristics, and predictors of anemia in children aged 3 to 15 years, boarders of Koranic schools, we worked on a sample of 833 children in boarding schools in 15 Koranic schools in urban and semi-urban areas of the Dakar region.

Our study population was predominantly male (85.71%), with a sex ratio equal to 6, which does not corroborate the results of Salama et al. who had a predominantly female sex in their study with 87

### Conclusion

In this current study, anemia was found to be a mild public health concern among Koranic School Children. Hence, focused policies and strategies of government towards school children should be designed to reduce anemia among low-income & low-education groups. Moreover, health education that enhances the knowledge of women about child-feeding practices should be given regularly. On top of that, further studies using a larger sample size and including the assessment of all anemia diagnostics tests and subclinical infections are required to be conducted to identify the cause-effect relationships of anemia with its contributing factors.

The strengths of our study are the size of our sample and the measurement of serum iron and ferritin. However, this study was constrained by certain limitations, namely: failure to perform hemoglobin electrophoresis, the lack of dosage of vitamins B12 and folate, and failure to perform the inflammatory assessment. These tests could potentially be of great help to us in identifying some specific causes of anemia in children.

And unfortunately, there are no local previous studies on the same subject in Koranic schools in Senegal.

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