Anemia among Apparently Healthy Senegalese Children Aged 9-15 Months

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Abstract: In Senegal, despite its high frequency, there is no real program to fight against anemia among infants. This work was carried out in the Dakar suburb from 1st September, 2009 to 27th January, 2010 among apparently healthy children aged 9-15 months at the time of their immunization against yellow fever and measles. They showed no known chronic condition or acute infection at the time of the survey. The objectives were to study the diet, prevalence, type and risk factors of anemia. The questionnaire was about whether the father and the mother were working and about the children's diet during the first six months of their life. All the children underwent anthropometric measurements (weight and height) and a complete blood count. We considered children as anemic if the hemoglobin rate was below 11g/dl. Of the 245 children, 212 were anemic, which was a prevalence of 86.5%. This anemia, frequently of the microcytic hypochromic type (68. 86%) was significantly ($p < 0.0003$) observed among the children of housewives compared with those whose mothers were employed. Among anemic children, 60.8% were only taking breast milk with or without cereal porridge as a food supplement. The absence of consumption of protein, vegetables, fruits and dairy products was a risk factor for the occurrence of anemia ($p <0.0001$). In total, at the time immunization is stopped, almost all Senegalese children, while apparently healthy, still face nutritional anemia. The adverse consequences of anemia on child health require the implementation in developing countries of a specific program of struggle against anemia. The activity of vaccination might be the best opportunity to provide the nutritional education these mothers need.

Keywords: Anemia, Risk Factors, Healthy Children.

I. INTRODUCTION

In Senegal, like in most developing countries, anemia, which is one of the most important public health problems, is unfortunately ignored or overlooked. The last demographic and health survey revealed a prevalence of 76% among children under 5 years of age [1]. Anemia leads to increased susceptibility to infections [2, 3], and causes delayed physical and cognitive development [4, 5]. Diouf. S *et al*. had showed that the treatment of anemia had a positive impact on the growth of Senegalese children [6]. Among the many causes of anemia, the origin due to deficiency, particularly iron deficiency, is the most common [7, 8]. In our country, despite its high incidence and its devastating effects on children's health, there is no program in the Ministry of Health that addresses anemia. The expanded immunization program was an opportunity for us to study anemia among children at the time of their immunization against yellow fever and measles. The objectives were to study among apparently healthy children the diet at the time of the study and the diet during the first months of life as well as the prevalence, type and risk factors of anemia.

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II. PATIENTS AND METHODS

This work was conducted at the Institute of Social Pediatrics of Cheikh Anta Diop University located in Dakar suburb over a 5-month period from 1stSeptember, 2009 to 27th January, 2010. We conducted a cross-sectional study on 245 children aged 9-15 months, who came only to get vaccinated against yellow fever and measles. They showed no known chronic condition or acute infection at the time of the survey. We obtained the consent of the parents of all the children included in the study. The survey team consisted of a physician, for clinical examination, assisted by a nurse for anthropometric measurements and for completing the questionnaire that concerned the socioeconomic profile of parents and the nutrition of children.

The protein and iron contents of the main food consumed by Senegalese children aged 9-15 months are thus constituted [9].

The anthropometric parameters considered were Age, Weight and Height. Weight/Age, Height/Age and weight/Height indicators expressed in Z-score were used as the basis for the assessment of the nutritional status. For all these three indicators, the value of - 2 Z scores was used as the critical point below which to define malnutrition. All children underwent a complete blood count at the Institut Pasteur in Dakar on an automated counter of the Counter cell-dyn 3700 type. To pose the biological diagnosis of anemia we selected

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Table 1: Protein and Iron Content of 8 Foods Frequently Consumed by Children in Senegal

Food (100 g)	Proteins (g)	Iron (mg)
Meat Beef, boiled	29	14.7
Fish African, carp, boiled	16.9	0.8
Egg Egg, boiled	13.3	2.5
Vegetable Beans, white, boiled	8.2	1.8
Fruit Mango, ripe, raw	0.6	1.1
Diary products Yoghurt, whole milk, nature	3.4	0.1
Milk Breast milk	1.1	0.2
Cereal Rice, white, polished, boiled	2.6	0.3

a rate of hemoglobin (Hb) < 11g/dl. Anemia was considered severe if the rate of Hb was <7g/dl, moderate if 7 g/dl ≤ Hb < 9 g/dl, mild if 9 g/dl ≤ Hb < 11 g/d. According to the Mean Corpuscular Volume (MCV), anemia was classified as macrocytic (MCV> 90 FL), normocytic (80FL ≤ MCV ≤90FL) or microcytic (MCV <80FL). Epi Info 2000 was used to calculate anthropometric indicators by applying "NUTSTAT" and comparison tests (X^2 and p) by applying "STATCALC," the difference being considered significant if p <0.05.

III. RESULTS

Of the 245 children who underwent a complete blood count, 212 were anemic, which was a prevalence of 86. 5%.

III.1. Socioeconomic Characteristics of Anemic Children's Parents

Only 46 mothers (21.7%) were illiterate. Among the 166 (78.3%) educated mothers, 70.7% had a low level of education because they left school at the primary cycle, while 7.6% had a secondary education level. The education of mothers was not significantly (p = 0.64) associated with children's anemia. The majority of mothers (80.2%) consisted of housewives who were thus unemployed. Yet, almost all fathers (93.4%) were employed.

III.2. Characteristics of Anemic Children

III.2.1. Gender and Age

Of the 212 children, 107 (50.5%) were male and 105 (49.5%) female, the gender ratio was 1.01. The vast majority of children, or 184 (86.8%), were aged 9 months and 28 (13.2%) were aged 10-15 months. The average age was 9.2 ± 0.68 months.

III.2.2. Diet

During the first 6 months of life, 60.4% of mothers had opted for exclusive breastfeeding. In terms of food diversification, 39.6% of children had started it prematurely before the age 6 of months, while 1.9% had started it late.

Table 2: Distribution of Children by Diet at the Time of the Study

Diet	Number	%
Exclusive breastfeeding	3	1.4
Breastfeeding and cereal porridge	126	59.4
Breastfeeding and family dishes	21	9.9
Breastfeeding with cereal porridge and family dishes	51	24.1
Cereal porridge and family dishes	11	5.2

The average age of diversification was 5.41 ± 1 months.

Regarding diet at the time of the study, over half of children (59.4%) were receiving only cereal porridge as supplementary food, 5.2% had already been weaned, while 1.4% were still under exclusive breastfeeding.

III.2.3.Nutritional Status

Parents' anthropometric constants taken during the investigation did not explain the nutritional status of children. The average of the Weight/Age, Height/Age and weight/Height indicators of the children were respectively -0.28± 1, -0.53± 0.99 and -0.91±1.23. The prevalence of underweight, stunting and emaciation were respectively 5.2%, 8% and 1.4%.

III.2.4. Hematologic Data

III.2.4.1. Parameters of the Hemogram

Table 3: Values of Hemogram Parameters

Parameters	Minimum	Maximum	Mean	Standard Deviation
Hb (g/dl)	5.90	10.90	9.50	1.05
Ht (%)	11.7	33.2	29.03	2.89
Plq (G/l)	19.00	931.00	445	156.67
MCV (fl)	48	80	65.67	7.03
MCH (pg)	13	48	21.68	3.82

Hb= Hemoglobin, Ht=Hematocrite, Plq= Platelets, MCV= Mean Corpuscular Volume MCH= Mean Corpuscular Hemoglobin. The mean hemoglobin was 9.50±1.05g/dL.

The mean values of MCV and MCH were 65.67±7.03 fl and 21.68±3.82 pg, respectively.

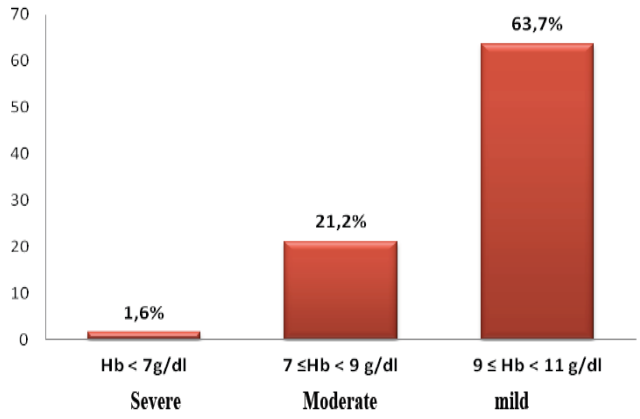

Figure 1: Classification of anemia cases by severity.
A classification by MCV and MCH showed that hypochromic microcytic anemia cases were the most frequent with a rate of 68.86%, followed by hypochromic normocytic anemia cases (30.18%).

III.2.4.2. Characteristics of Anemia

Of the 212 anemic children, 156 (63.7%) had mild anemia and 1.6% had severe anemia.

Microcytic anemia cases were the most frequent (68.86%) followed by normocytic anemia cases (30.18%). Almost all anemia cases (99%) were of the hypochromic type.

Table 4: Distribution of Anemia by Mean Corpuscular Volume and Mean Corpuscular Hemoglobin

Anémia	Number	%
hypochromic microcytic	146	68.86
hypochromic normocytic	64	30.18
normochromic macrocytic	1	0.48
normochromic normocytic	1	0.48
Total	212	100

III.3. Risk Factors for Anemia

III.3.1. Anemia and Socioeconomic Parameters

Among the 193 children of educated mothers, 166 (86%) were anemic, against 46 (88.5%) among non educated mothers. Anemia among children was not significantly ($p = 0.64$) associated with the education of mothers. Yet, anemia was significantly ($p < 0.0003$) observed among children of housewives (90.9%) compared with those whose mothers were employed (72.4%).

III.3.2. Anemia and Diet

Among the children who had received exclusive breastfeeding for the first 6 months of life, 128 (83.7%) were anemic, against 84 (91.3%) among non exclusively breastfed children.

Exclusive breastfeeding was not a risk factor for anemia ($p = 0.08$).

The analysis of the diet at the time of the study showed that children who were not taking animal protein from meat, fish or egg were significantly ($p <0.0001$) more anemic than those who were consuming it. Furthermore, the absence of consumption of vegetables, fruits and dairy products was also a risk factor for the occurrence of anemia.

Table 5: Risk Factors of Anemia

Factors	Anemia		No Anemia		RR (CI à 95 %)	P
	n	%	n	%		
Meat						
No	205	91.5	19	8.5	2.75 (1.5 -5)	0.0001
Yes	7	33.3	14	66.7	1	
Fish						
No	127	100	0	0	1.39 (1.24 – 1.55)	0.0001
Yes	85	72	33	28	1	
Egg						
No	196	92.5	16	7.5	1.91 (1.34 -2.72)	0.0001
Yes	16	48.5	17	51.5	1	
Vegetable						
No	103	100	0	0	1.3 (1.19 – 1.43)	0.0001
Yes	109	76.8	33	23.2	1	
Fruit						
No	163	93.1	12	6.9	1.33 (1.14 – 1.56)	0.0001
Yes	49	70	21	30	1	
Diary products						
No	176	100	0	0	1.92 (1.53 – 2.4)	0.0001
Yes	36	52.2	33	47.8	1	
Breast milk						
No	17	100	0	0	1.17 (1.11 – 1.23)	0.07
Yes	195	85.5	33	154.	1	
Cereal porridge						
No	25	92.6	2	7.4	1.08 (0.96 – 1.22)	0.25
Yes	187	85.8	31	14.2	1	
Mother Profession						
No	170	90.9	17	9.1	1.26 (1.06 – 1.48)	0.0003
Yes	42	72.4	16	27.6	1	

RR: relative risk.
CI: confidence interval.

IV. DISCUSSION

The prevalence of anemia was very high and estimated at 86.5% including 21.2% of moderate forms and 1.6% of severe forms. At country level, the fifth Demographic and Health Survey [1] conducted in 2010 had showed that 76% of Senegalese children of less than 5 years of age had anemia: 23% were suffering from mild anemia, 48% from moderate anemia and 5% from severe anemia. The highest frequency of mild anemia (63.7%) in our series was probably related to the age of our children. In fact, it's all about apparently healthy infants aged between 9 to 15 months most often corresponding to the beginning of deficiency anemia. The overall prevalence (86.5%) largely exceeded the 40% threshold defined by the WHO [2] defining the severe endemic proportions of anemia in a population, but was near the rate of 80% of the anemic infants found in the Ninh *et al*. [10] study in Vietnam.

The distribution by type of anemia showed that hypochromic microcytic cases were accounting for 68.86 % of anemia cases.

In Senegal, Diagne I *et al*. [11] in a study published in 2010, had found a rate of 79.6% of hypochromic microcytic anemia among children followed–up on an ambulatory basis, which confirms the prevalence of this type of anemia among Senegalese children.

In developing countries, anemia is mainly caused by iron deficiency [12-14].

Many authors [15, 16] have indeed demonstrated that hypochromia and microcytosis are reliable parameters of iron deficiency.

The prevalence of hypochromic microcytic anemia was at the rate of 30.18%. This type of anemia could result in a combined deficiency in iron, Vitamin B12 and Folic Acid.

We found no significant difference as regards the prevalence of anemia among children according to the mother's education. Generally, mothers' illiteracy and low levels of education have a negative impact on children's health. Consumption of iron-dense foods particularly meat and fish depend, among other things, on the household income and its purchasing power. Child anemia was not correlated with the existence of the father's profession. However, we noticed that that the absence the mother's profession was a risk factor for anemia ($p<0.0003$). In Senegal, the existence of the mother's income may positively impact on food quality and therefore on child nutrition.Children were under exclusive breastfeeding in 60.4 % of cases during the first six months of life against 39% [1] at country level without significant correlation ($p=0.08$) between exclusive breastfeeding and anemia. In spite of the relative low iron content of breast milk, the child nutritional needs can be covered in the first months of life. The breast milk's bioavailability of iron combined with the iron stock achieved in the last months during the intra-uterine life as well as the breakdown of red blood cells in the first weeks of life also help improve the total body iron in the first months of life.After 6 months, it is recommended [17] to introduced new foods particularly those high in proteins and vitamins which will help prevent anemia through iron deficiency. In our series, 58.5% of children had started diversifying their diet at 6 months. In 2010 [1], 29% of Senegalese children aged between 6 to 9 months did not receive any supplementary food which thus favored the occurrence of malnutrition and deficiency of micronutrients such as iron.

In Senegal, diet diversification is made of semi-solid food substantially carbohydrate-containing (millet or rice porridge), which are not enough to cover the whole nutritional needs particularly in proteins and iron. In France, S. Hercberg found that 80 to 85 % of children and adolescents have iron intakes lower than the recommended nutritional supply and are in the range of 5 and 10 mg [18]. In this survey 60.8% of children aged between 9 to 15 months were exclusively breastfed this combined or not with cereal porridge. Children who did not consume meat, fish eggs nor dairy products were significantly ($p<0.0001$) more anemic. The absence of animal protein consumption (meat, fish and eggs) and Vitamin C is a risk factor for iron deficiency anemia [16]. Food financially more affordable such as dairy products, beans and groundnuts are often used by mothers as supplementary food, which contributes to slightly improve the protein intake. In order to compensate for this relative child food's low iron content, food iron fortification, particularly flours, is an interesting alternative. But often, the child iron deficiency anemia also becomes subject to other causes such as geophagy and intestinal parasites that need to be managed as shown by Diouf S. *et al*. [6] in the Senegal rural area.

V. CONCLUSION

At the time the extended immunization program was stopped, nearly all the Senegalese children even though apparently healthy still faced anemia. The mothers' economic situation was one of the major factors associated with the occurrence of anemia due to poverty. There is a major need to develop a specific anemia control program. The activity of vaccination might be the best opportunity to provide the nutritional education these mothers need. However, the most sustainable solution would also consist in improving the families socio-economic level by creating income-generating activities.

REFERENCES

[1] SENEGAL. Agence Nationale de la Statistique et de la Démographie, ICF International. Enquête Démographique et de Santé à Indicateurs Multiples au Sénégal (EDS-MICS) 2010-2011. USA: Calverton, Maryland 2012; pp. 183-5.

[2] World Health Organization. Iron deficiency anemia: assessment, prevention and control: a guide for programme managers. Geneva: WHO 2001.

[3] Lukens JN. Iron deficiency and infection. Am J Dis Child 1975; 129: 160-2.

[4] Sachdev H, Gera T, Nested P. Effect of iron supplementation on mental and motor development in children: systematic review of randomized controlled trials. Public Health Nutr 2005; 8(2): 117-32. http://dx.doi.org/10.1079/PHN2004677

[5] Hurtado EK, Claussen AH, Scott KG. Early childhood anemia and mild or moderate mental retardation. Am J Clin Nutr 1999; 69(1): 115-19.

[6] Diouf S, Diagne I, Moreira C, Signaté Sy H, Faye O, Ndiaye O, *et al*. Traitement intégré de la carence enfer, de l'avitaminose A et des parasitoses intestinales: impact sur la croissance des enfants sénégalais. Arch Pediatr 2002; 9: 3-4. http://dx.doi.org/10.1016/S0929-693X(01)00704-7

[7] Balarajan Y, Ramakrisnan U, Ozaltin E. Anaemia in low-income and middle-income countries. Lancet 2012; 378(9809): 2123-35. http://dx.doi.org/10.1016/S0140-6736(10)62304-5

[8] Pasricha SR, Black J, Muthayya S, Shet A, Bhat V, Nagarai S, *et al*. Determinants of anemia among young children in rural India. Pediatrics 2010; 126: 140-49. http://dx.doi.org/10.1542/peds.2009-3108

[9] Stadlmayr B, N Enujiugha V, Bayili RG, Fagbohoun EG, Samb B, Addy P, *et al*. Table de composition des aliments d'Afrique de l'Ouest. Rome: OUN, Food and Agriculture 2011; p. 166.

[10] Ninh NX, Berger J, Dao TQ, Nguyen CK, Traissac P, Ha HK. Efficacité de la supplémentation en fer quotidienne et hebdomadaire pour le contrôle de l'anémie chez le nourrisson en milieu rural au Vietnam. Cahiers Santé 2002; 12: 31-37.

[11] Diagne I, Fall AL, Diagne-Gueye NR, Dème Ly I, Lopez Sall P, Faye CE, *et al*. Anémies hypochromes microcytaires en pédiatrie : fréquence et réponse au traitement martial. Étude chez les enfants suivis en ambulatoire au centre hospitalier national d'enfants Albert Royer de Dakar au Sénégal. J Pédiatr Puériculture 2010; 23: 119-24.

[12] Atanda HL, Bon JC, Force-Barge P, Porte J, Rodier J. Contribution à l'étude de la prévalence de l'anémie chez l'enfant en milieu tropical. Med Afr Noire 1997; 44: 1-5.

[13] Nutrition for health and development. A global agenda for combating malnutrition. Geneva: WHO 2000; pp. 16-17.

[14] Berger J, Dillon JC. Stratégies de contrôle de la carence en fer dans les pays en développement. Cahiers Santé 2000; 12: 22-30.

[15] Archambeaud-Breton MP, Dommergues JP, Ducot B, Rossignol C, Yvart J, Tchernia G. Reevaluation of the utility of mean cell haemoglobin (MCH) screening of infants for iron deficiency. Nouv Rev Fr Hematol 989; 31: 307-9.

[16] Navarro JF, Macia ML. Hypochromie red cells as an indicator of iron deficiency. J Rheumatol 1997; 24: 804-5.

[17] Dupont C. Protein Requirements during the first year of life. Am J Clin Nutr 2003; 77(6): 1544s-9s.

[18] Hercberg S. La carence en fer chez l'enfant. J Pédiatr Puériculture 1992; (7): 393-7.

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