

# Analysis of the Effect of Dietary Diversity on Anemia in Women of Reproductive Age in Senegal

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## Abstract

**Introduction:** Anemia in women of reproductive age is a common health problem in Senegal. The objective of this research was to study the contribution of dietary diversity in the fight against anemia in women of reproductive age in two regions of Senegal using the propensity score method. **Methodology:** An observational, cross-sectional and analytical study of women of reproductive age and their households was conducted in the Kolda and Kedougou regions in 2015. This was a three-stage random sample survey. The data was collected during an individual interview. Conditional logistic regression was used to identify the risk factor for this anemia. **Results:** In this study, 1926 women of reproductive age were surveyed. The average age of women of reproductive age surveyed was 27.2 years with a standard deviation of 7.6 years. The median age was 26 years old. Married women were in the majority. Pregnant and lactating women were 43.8%. The percentage of women with adequate diets was 31.5%. The proportion of women with anemia was 51.8%, or 998 women of reproductive age. Adequate dietary diversity is the main factor associated with anemia in these women (OR = 0.75 (0.59 - 0.96)). **Conclusion:** The prevalence of anemia in women of reproductive age is still high in the southern regions of Senegal. To combat this phenomenon, it is therefore necessary to intensify interventions on the balance of diet, iron and folic acid supplementation in pregnant and lactating women and to strengthen the empowerment of women.

## Keywords

Anemia, Dietary Diversity, Woman, Senegal

## 1. Introduction

According to WHO, in 2014, an estimated 1.62 billion people worldwide suffer

from anemia. Children and women of childbearing age are, unfortunately, most at risk, with a global anemia prevalence of 43% in children under five, 38% in pregnant women and 29% in non-pregnant women aged 15 years. at 49 years old. Food consumption has an influence on the occurrence of anemia. The higher a region at a high level of food insecurity, the higher the prevalence of nutritional disorders [1] [2]. In Senegal, according to the EDS-MICS 2010-2011, the prevalence of anemia among women is 54% against 31% among men [3].

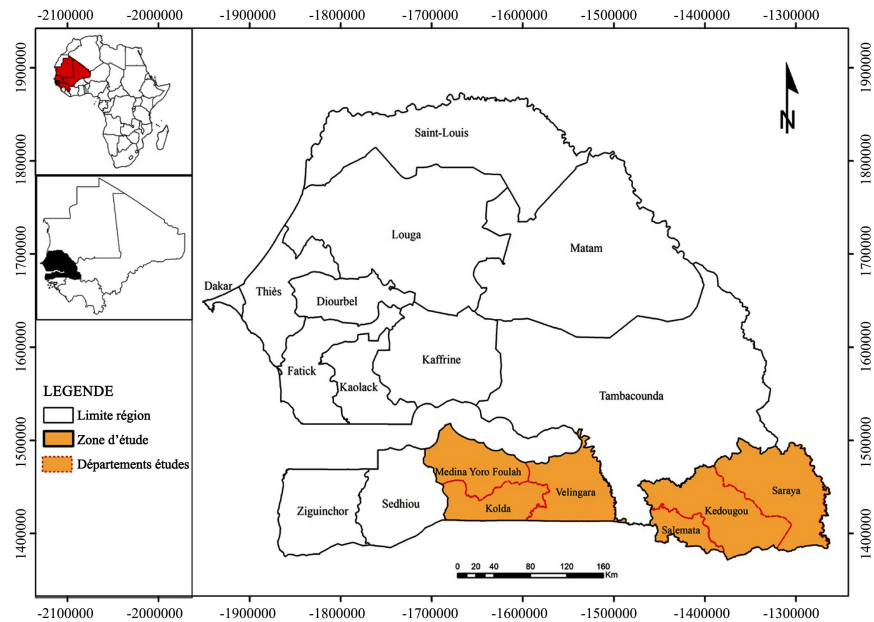
The health consequences of anemia are multiple. Anemia decreases physical capacity, causes a state of weakness, fatigue, affects the feeling of well-being. It reduces intellectual performance and work capacity thus slowing down productivity. In addition, it reduces the resistance to infections and increases the risk of death during the gravid-puerperal period, resulting in health care costs that could have been avoided. In short, it has major negative consequences for human health and social and economic development [4] [5] [6] [7].

The agriculture and livestock sectors are a priority for the State of Senegal. According to the Ministry of Agriculture and Rural Equipment, cereal production increased by 57% between 2014 and 2015 [8]. In the Kolda region, production amounted to 5795 tonnes of groundnuts and 105 tonnes of maize seed, 60 tonnes of sorghum seed and 15 tonnes of fonio seed [9]. But despite all these efforts, anemia remains a public health problem more for women and children [3]. The Kolda and Kedougou regions are among the most affected regions. Improving food production does not improve the fight against anemia. To better understand the phenomenon of anemia, we made a hypothesis on the use of food. The hypothesis of this study is that a woman's diet is the main risk factor for the onset of anemia in women of reproductive age. The objective of this study is to analyze the effect of dietary diversity in the fight against anemia in women of childbearing age in southern regions of Senegal using conditional logistic regression with the propensity score matching method on the woman's diet.

## 2. Framework of the Study

This study was conducted in southern Senegal in the Kolda and Kedougou regions. These two regions are among the most disadvantaged regions of Senegal. The Kolda region is composed of three departments: Kolda, Velingara and Medina Yoro Foulah (MYF). The Kedougou region is also composed of three departments: Kedougou, Saraya and Salemata. **Figure 1** shows the map of Senegal.

In 2014, 16% of Senegalese households were food insecure, including 2% in a severe situation and 14% in a moderate situation. 42% of households were in a food security situation and 42% of households were food secure. For the Kolda region, 42% were moderately or severely food insecure, 40% were food insecure and 18% food secure. In Kédougou, 33% of households were food insecure, 42% of households were food security limit and 25% food security [10].



**Figure 1.** Geographical position of Kolda and Kedougou in Senegal.

In 2013, the percentage of households that practiced agriculture was 79% in Kolda and 75.5% in Kedougou. Among them, those who had a stock available in June 2013 were 38.1% in Kolda and 45.3% in Kedougou. The practice of breeding was also more frequent in Kolda with 78.2% of households than in Kedougou with 65.3% [11].

According to the results by region of EDS-MICS 2010-2011, there is a difficult access to social and health services (only 36.6% of the population in Kolda and 30.1% in Kedougou) and the lack of the resources available to supervise the most vulnerable groups, particularly women, are factors contributing to this situation and to the deterioration of the living conditions of the poorest [3].

### 3. Materials and Methods

It is an observational, transversal and analytical study with propensity score matching. It was made between October and December 2015.

This study concerned all women aged between 15 and 45 years in the regions of Kolda and Kedougou and having freely accepted to participate in the study.

The sample size was calculated from the Hsieh formula [12]. It was assessed from a risk  $\alpha$  of 5%, a power of 90%, an anemia prevalence of 54% and a coefficient  $\beta$  expected of 0.2. With a non-response rate estimated at 10%. The sample size that maximizes the estimates is 1900 households for the six health districts.

A two-stage random survey was conducted. The first degree consisted of the census districts (CD) drawn by villages or neighborhoods and the second degree by households. In total, the study was conducted at the level of sixteen CDs per health district. In each CD, twenty households were selected. At the CD level, the first grant was drawn, and the others were selected consecutively. A systematic

draw was made according to the number of households in the CD. In each household a woman was chosen by lottery to be surveyed.

Data collection was based on electronic questionnaires. The investigators were responsible for collecting the data directly on the tablets. They were organized in eighteen teams each of which was guided by a team leader. In each region there was a supervisor. After four days of training, the investigators conducted a pilot survey to test the questionnaires and collectors before starting the actual collection.

Anemia was measured by hemoglobin, which was determined using the HemoCue® device. It is a portable haemoglobinometer to quantify the hemoglobin level of the person in less than a minute, from a drop of capillary blood.

As in the EDS-MICS 2010-2011, the woman is considered anemic if the hemoglobin is less than 11 g/dl. For pregnant women, anemia will be considered mild if the hemoglobin level is between 10.0 and 10.9 g/dl [3]. The anemia levels were set at the following intervals [13]:

- Severe anemia = hemoglobinemia < 7 g/dl,
- Moderate anemia = 7 g/dl ≤ hemoglobinemia < 10 g/dl,
- Light anemia = 10 g/dl ≤ hemoglobinemia < 11 g/dl.

The CARI Questionnaire from the World Food Program (WFP) assessed the level of food security [14].

The diet has been evaluated through the diversity of foods consumed by the woman. Dietary diversity was appreciated through the number of food groups that women consumed in the 24 hours prior to the survey. In line with the recommendations of the WFP and the Food and Agriculture Organization of the United Nations (FAO) for measuring the Women's Dietary Diversity Score (WDDS), nine food groups were searched. Those who had consumed more than four different food groups a day had a good diet [15]. The woman's diet was considered adequate if the WDDS was four or more.

The data was analyzed with Rstudio. At first, the probability of having an adequate diet was sought. The variables used to construct the propensity score are the main individual characteristics of the woman and the factors related to her household. The propensity scores thus obtained, that is, the conditional probability of having one type of diet, allowed for the match between women in both groups, with a 1:1 ratio. Balance was sought by observing the distribution of these variables between the group having an adequate diet and the group having an inadequate diet. Finally, a conditional logistic regression identified the factors related to anemia in women of reproductive age. Associations were measured by odds ratios (OR) with their confidence intervals.

The approval of the Senegal National Committee for Ethics for Health Research (CNERS) was obtained before the start of field activities. Participation in this study was free. Free and informed consent was obtained from all women aged 18 and over. For women under 18 years of age a consent of their legal guardian was obtained before their own consent. A fact sheet was administered to

each woman and the legal guardian for minors, before signing the consent form. No compensation was given to the people surveyed. The data collected was confidential. The identity of the individuals who consented to participate was not mentioned on the collection tools. In all uses of the results, anonymity has been respected.

## 4. Results

### 4.1. Characteristics of Women and Households

The average age of women of reproductive age surveyed was 27.2 years with a standard deviation of 7.6 years. The median age was 26 years old. Married women were in the majority. Pregnant and lactating women accounted for 43.8%. The percentage of women with adequate diets was 31.5%. The proportion of women with anemia was 51.8%, or 998 women of reproductive age.

Most households had between seven and twelve people (39.9%). Poor households were the majority at 34%. The majority of the households surveyed lived in rural areas (76.2%). Of all the households surveyed, 50.3% were from the Kolda region. Households with food insecurity were 36.3%.

Before matching, the distribution of the variables between the group of women with an adequate diet and those with an inadequate diet shows an imbalance. Indeed, on several characteristics, we have statistically significant differences between the two groups of the diet (as shown in **Table 1**).

After pairing by propensity score construction, it shows a perfect balance between the adequate diet group and the inadequate diet group. Matching with a 0.02 caliper resulted in two groups of 536 matched women. No difference is statistically significant (as shown in **Table 2**). The biggest difference is noted for the income-generating activity (34.1% vs. 29.9%).

### 4.2. Risk Factors Associated with Anemia in Women of Reproductive Age in Kolda

The conditional logistic regression made with the paired base allowed to have an explanatory model with all the adjustment variables (logistic model 1). The stepwise method allowed for the most parsimonious model (logistic model 2). Thus, the factors associated with anemia of the woman found are the adequate diet (OR = 0.75 (0.59 - 0.96)), pregnancy or breastfeeding (OR = 1.69 (1.31 - 2.17)). Women living in the Kolda region are less exposed to anemia than women in the Kedougou region. **Table 3** shows the two models of conditional logistic regression of anemia among women of reproductive age.

## 5. Discussion

This study allowed us to estimate the prevalence of anemia of women in Kolda and Kedougou regions through the use of hemoglobinometers. The proportion of women with anemia was 51.8%, or 998 women of reproductive age. According to the ongoing EDS 2010-2011, in Senegal, the prevalence of anemia among

women is 54%, of which 61% among pregnant women 49% among those who are breastfeeding [3]. In Guinea Conakry globally 49% of women suffer from anemia. In Côte d'Ivoire, the EDS-MICS 2011-2012, recorded 54% of anemic women [16].

Indeed, the Vitamin and Mineral Nutrition Information System (VMNIS) classifies the prevalence of anemia greater than or equal to 40% as severe [17].

This study found women who had an adequate diet were women who ate at least four food groups a day. These women were less likely to be anemic than women who had a poor diet with an odds ratio of 0.75 with a confidence interval between 0.59 and 0.96.

The inadequate dietary diversity is an important risk factors for anemia in women of reproductive age in southern Senegal.

**Table 1.** Characteristics of women and households according to diet before matching.

Characteristics	Adequate diet (N = 606)	Inadequate diet (N = 1320)	P value
	n (%)	n (%)	
Women characteristics			
<b>Instruction</b> (Yes VS. No)	231 (38.1)	346 (26.2)	<0.001
<b>Maternal situation of women</b> (Pregnant or lactating VS. Not pregnant or not lactating)	261 (43.1)	582 (44.1)	0.711
<b>Income generating activity of women</b> (Yes VS. No)	208 (34.3)	305 (23.1)	<0.001
<b>Folic acid iron supplementation</b> (Yes VS. No)	568 (93.7)	1215 (92.0)	0.224
<b>Micronutrient supplementation</b> (Yes VS. No)	103 (17.0)	247 (18.7)	0.399
Households characteristics			
<b>Marital status of the household</b> (Married VS. Not married)	589 (97.2)	1286 (97.4)	0.890
<b>Geographical area</b> (Urban VS. Rural)	167 (27.6)	272 (20.6)	0.001
<b>Region</b> (Kolda VS. Kedougou)	349 (57.6)	619 (46.9)	<0.001
<b>Economic situation of the household</b> (≤Poverty threshold VS. >poverty threshold)	268 (44.2)	910 (68.9)	<0.001
<b>Household size</b> (≤12 people VS. >12 people)	324 (53.5)	887 (67.2)	<0.001
<b>Household food security</b> (Security VS. Insecurity)	479 (79.0)	747 (56.6)	<0.001
<b>Propensity score</b>	0.38 ± 0.15	0.28 ± 0.14	<0.001

**Table 2.** Characteristics of women and households according to diet after matching.

Characteristics	Adequate diet (N = 536)	Inadequate diet (N = 536)	P value
	n (%)	n (%)	
Women characteristics			
<b>Instruction</b> (Yes VS. No)	179 (33.4)	191 (35.6)	0.480
<b>Maternal situation of women</b> (Pregnant or lactating VS. Not pregnant or not lactating)	229 (42.7)	223 (41.6)	0.757
<b>Income generating activity of women</b> (Yes VS. No)	160 (29.9)	183 (34.1)	0.150
<b>Folic acid iron supplementation</b> (Yes VS. No)	501 (93.5)	502 (93.7)	1.000
<b>Micronutrient supplementation</b> (Yes VS. No)	97 (18.1)	112 (20.9)	0.280
Households characteristics			
<b>Marital status of the household</b> (Married VS. Not married)	522 (97.4)	521 (97.2)	1.000
<b>Geographical area</b> (Urban VS. Rural)	148 (27.6)	149 (27.8)	1.000
<b>Region</b> (Kolda VS. Kedougou)	310 (57.8)	315 (58.8)	0.804
<b>Economic situation of the household</b> (≤Poverty threshold VS. >poverty threshold)	262 (48.9)	266 (49.6)	0.855
<b>Household size</b> (≤12 people VS. >12 people)	295 (55.0)	302 (56.3)	0.712
<b>Household food security</b> (Security VS. Insecurity)	410 (76.5)	403 (75.2)	0.669
<b>Propensity score</b>	0.36 ± 0.13	0.36 ± 0.13	>0.999

**Table 3.** Factors associated with anemia in women of reproductive age (by conditional logistic regression).

Covariates	Univariate	Logistic model 1		Logistic model 2	
	Crude OR (95% CI)	Adj OR (95% CI)	pvalue	Adj OR (95% CI)	P value
Women characteristics					
<b>Woman's diet</b> (adequate VS. inadequate)	0.74 (0.58 - 0.95)	0.75 (0.59 - 0.96)	0.023	0.75 (0.59 - 0.96)	0.022
<b>Instruction</b> (Yes VS. No)	0.77 (0.6 - 0.99)	0.82 (0.63 - 1.07)	0.142	0.82 (0.63 - 1.06)	0.137
<b>Maternal situation of women</b> (Pregnant or lactating VS. Not pregnant or not lactating)	1.73 (1.36 - 2.22)	1.7 (1.32 - 2.19)	<0.001	1.69 (1.31 - 2.17)	<0.001
<b>Income generating activity of women</b> (Yes VS. No)	0.73 (0.56 - 0.94)	0.78 (0.6 - 1.03)	0.075	0.78 (0.6 - 1.02)	0.07
<b>Folic acid iron supplementation</b> (Yes VS. No)	0.67 (0.41 - 1.11)	0.69 (0.41 - 1.16)	0.163		
<b>Micronutrient supplementation</b> (Yes VS. No)	0.84 (0.62 - 1.14)	0.83 (0.61 - 1.14)	0.256		

## Continued

	Households characteristics				
<b>Region</b> (Kolda VS. Kedougou)	1.56 (1.22 - 1.99)	1.54 (1.19,2)	0.001	1.55 (1.2 - 2)	<0.001
<b>Geographical area</b> (Urban VS. Rural)	0.77 (0.59 - 1)	0.78 (0.59 - 1.04)	0.088	0.79 (0.59 - 1.04)	0.097
<b>Economic situation of the household</b> (≤poverty threshold VS. >poverty threshold)	1.01 (0.79 - 1.28)	1.19 (0.91 - 1.56)	0.192	1.2 (0.93 - 1.55)	0.15
<b>Household size</b> (≤12 people VS. >12 people)	0.91 (0.72 - 1.16)	1.06 (0.81 - 1.39)	0.66		
<b>Household food security</b> (Security VS. Insecurity)	0.84 (0.63 - 1.11)	0.88 (0.66 - 1.18)	0.39		
<b>Marital status of the household</b> (Married VS. Not married)	1.45 (0.68 - 3.06)	1.45 (0.67 - 3.12)	0.348		

Most anemic women are pregnant or breastfeeding. Our study showed that the risk of anemia is multiplied by 1.69 in pregnant or lactating women. EDS-MICS 2010-2011 states that Senegalese pregnant women are more often anemic (61%) than those who are breastfeeding (49%) or those who are neither pregnant nor breastfeeding (56%) [3]. According to the Bayébié study, 66.1% of pregnant women in the Dakar region have anemia [18]. WHO estimated in 2015 worldwide that 43% of pregnant women were anemic compared to 33% of non-pregnant women [19]. Leke and Kremp noted that in Africa, 66.6% of pregnant women were anemic [20]. Miguel found that in Costa Rica, 60% of pregnant women are anemic [21]. The prevalence of anemia was twice as high among pregnant women as among other women [22].

This high prevalence of anemia in pregnant or breastfeeding women may have several explanations: the iron and folic acid deficiency deficit, the needs of which are increased with a diet that is not very diversified, the low rate of women's participation in prenatal consultation and supplementation programs, the lack of access to health facilities and the low decision-making power of women. Khadim et al have shown that among pregnant women who are on iron and folic acid supplementation, only 56% are adherent to iron and folic acid for 90 days. The level of education and accessibility of prenatal consultation services were key determinants of iron and folic acid intake [23]. A good level of education of the woman would also protect against the occurrence of anemia in women. In Côte d'Ivoire, anemia is more common among women with no education (55.3%) than among those with primary (54.3%) and secondary (48.8%) [16].

This study showed that women with an income-generating activity (IGA) have fewer cases of anemia than those without an IGA. The income generating activity seems to protect against anemia. The financial autonomy of women increases their decision-making power over their medical follow-up.

Anorlu had found in Nigeria that socio-economic status was significantly associated with anemia ( $p < 0.001$ ) with higher prevalence among women of low



socioeconomic status [24]. The survey in Mauritania revealed that the percentage of anemic subjects is slightly higher among women who do not work (50.2%) than among women who work (46.8%) [25]. In 2013, Bayébié found in Dakar that economic activity reduced the risk of anemia [18]. A good level of socio-economic well-being is a protective factor against anemia. According to EDS 2010-2011, the prevalence of anemia is 58% for women in the poorest households against 53% for those of the richest households [3].

Food diversity and anemia are therefore a health problem related to the socio-economic level of the countries. A good socio-economic level would be a protective factor against anemia through a better nutritional status [26] [27] [28].

The implementation of food fortification and diversification strategies is necessary to successfully cover the micronutrient intake of vulnerable populations.

## 6. Conclusions

Anemia is the most common abnormality in hematology. It is a major public health problem particularly in developing countries and frequently affects women of reproductive age. The proportion of women with anemia was 51.8%, or 998 women. The study showed that a good diet in women could protect against anemia especially during pregnancy and breastfeeding.

Interventions integrating food diversification and economic development must be implemented in Senegal at all levels of the health pyramid to combat anemia among women.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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