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Factors Associated with Acute Malnutrition in Children from 0 To 5 Years in 8 Regions of Senegal

Alioune Badara TALL[1], Abdoul Aziz NDIAYE[1]
Boubacar GUEYE[1], Ndeye Fatou NGOM[1], Adama FAYE[2], Anta AGNE[1], Papa Gallo SOW[1], Martial Coly BOP[1], Awa GAYE[1], Ousseynou KA[1], Anta TAL-DIA[2]

[1](UFR SDD/ University Alioune Diop of Bambey, Senegal)
[2](ISED/ University Cheikh Anta Diop of Dakar, Senegal)

Summary: *Acute malnutrition is both a medical problem and a social problem. The child's medical problems are partly the result of social problems of the home in which he lives. The successful management of acute malnutrition passes through the recognition and solution of problems, both medical and social. Therefore, this study aimed to assess factors associated with emaciation of children 0 - 59 months in eight regions of Senegal where the nutritionalsituation haddeteriorated.*

A quick survey, standardized and simplified, conducted by the SMART methodology was performed from November 3 to December 19, 2014. This was a cross-sectional survey in two-stage clusters, featuring a collection of individual anthropometric and health data and the household data. Data were entered in the ENA software where a first analysis was performed using the new WHO standards and those of NCHS. After this first phase a bivariate analysis with Epi Info software was conducted. Then all variables with p <0.25 were included in the multiple logistic regression analysis to study the relative importance of factors associated with the dependent variable that is of acute malnutrition of the child in its two phases (moderate and severe). The adequacy of the model was made by the Hosmer-Lemeshow test.

A total of 8755 children were interviewed in 8628 households. The sex ratio was equal to 1.01. The average age of children was 27 months with a standard deviation of 16. The risk of MAM was higher among male children (ORa = 1.30), the 24-59 age group (ORa = 1.21), having experienced at least one episode of diarrhea during the last 15 days (ORa = 1.32) and being supplemented with vitamin A (ORa = 1.71).

The risk of SAM was higher among male children (ORa = 1.65), having experienced at least one episode of diarrhea during the last 15 days preceding the survey (ORa = 2.52) and not having benefited from the anti measles vaccination (ORa = 2.04).

The analysis conducted in this study has allowed to identify factors that are associated with different degrees of acute malnutrition. Methods of analysis of acute malnutrition among children surveyed showed the importance of action at the immediate and underlying factors. It will be therefore to improve care practices in order to reduce morbidity, to promote key behaviors within households.

Keywords: *Acute Malnutrition-SMART - associated factors – Senegal*

I. Introduction

Good nutrition is essential for maintaining good health and optimum human performance. But malnutrition causes real problems, especially for the survival and growth of children on the one hand and for the health of pregnant and lactating women on the other hand. Malnutrition is a "pathological condition resulting from the deficiency or excess, relative or absolute, of one or more essential nutrients, that this state is clinically manifest or not is detectable as biochemical analyzes, anthropometric and physiological "[1]

According to the Global Hunger Index (GHI) 2012, the world hunger has declined somewhat since 1990 but remains "serious". The global average masks significant differences between regions and countries. Regionally, they are South Asia and sub-Saharan Africa that get the highest GHI scores. [2]

Different experts have shown that malnutrition contributed significantly to child mortality. First Evaluated at 53% of all deaths under five in the previous decade [3], this contribution was reviewed to 35% by more recent studies [4]. Nearly one million deaths are directly related to severe acute malnutrition without counting those who die in a state of moderate malnutrition.

In 2008, soaring food prices and the two successive poor rainy seasons have raised fears of a deterioration of the nutritional situation in Senegal as was the case in other countries in the sub-region. In response to this concern, a monitoring committee has been established and a number of contingency measures have been taken. The lack of recent data on the nutritional status (EDS 2005) pushed conducting a nutritional survey based on the SMART methodology (Standardized Monitoring and Assessment of Relief and Transition) in order to assess the extent of

the nutritional situation in the different departments of the country. The survey was conducted in 3 departments representing 3 of 7 agro-ecological zones of Senegal but also food insecure areas at risk and / or with already recognized nutritional problems. At each of these departments, only some health districts were surveyed: Matam (Matam region), Gossas and Guinguinéo (Fatick region), Sédhiou and Goudomp (Kolda region). The results showed global acute malnutrition prevalence of 17.3% for the district of Matam, 12.8% for the District of Goudomp, 10.3% for the District of Guinguinéo, 9.4% for district of Sédhiou and 8.4% for the district of Gossas [5].

In 2009, following the findings and recommendations of the 2008 report, a nutrition component was added to the Early Warning System (EWS) of the country. Also, always aiming to improve the nutritional surveillance system, UNICEF has supported the Ministry of Health and the Nutrition Enhancement Program (NEP) for the decentralization of the SMART methodology at each of the 14 regions of the country in order to obtain reliable data and of high quality in the regions but also in the health districts within these different regions. The results showed global acute malnutrition prevalence below 10% for the regions of Tambacounda, Kédougou, Kolda and Sédhiou. However, the prevalence of global acute malnutrition was 19.2% for the Matam region. [6]

In 2010, AGVSAN survey (Global Analysis of Vulnerability, Food Security and Nutrition) of the World Food Program reported the acute malnutrition rate of over 15% for all departments of Matam and Tambacounda . Prevalence was between 10 and 15% for the departments of Louga and Diourbel and within the departments of Kolda and Kedougou. The nutritional situation seemed so alarming to the southeast of the country. [7]

An EDS-MICS survey was conducted during the period from October 2010 to April 2011. The survey which is representative at the regional level reveals global acute malnutrition prevalence above the threshold of 10% for the regions of St. Louis (17.6%), Tambacounda (12.3%), Thies (14.3%), Matam (17.3%) and Louga (15.6%). This suggests that the nutritional situation has deteriorated in the North of the country [8]. The objective of this study is to investigate the factors associated with acute malnutrition in children aged 0 to 59 months in Thies, Diourbel, Louga, Saint Louis, Matam, Tambacounda, Kédougou and Kolda which showed the highest prevalence of acute malnutrition according to the EDS-MICS 2010, in order to contribute to a better management of nutritional problems.

II. Material and Method

I.1. Conceptual framework of the study

the nutritional status is directly related to food and infectious diseases such as diarrhea, acute respiratory infections, malaria and measles. Both elements reflect the socioeconomic conditions underlying the household, community and country, resulting themselves, from national political, economic and ideological structures. The following diagram (fig. 1) shows the conceptual framework of the nutritional status adapted of UNICEF analysis. It reflects the relationship between different factors of malnutrition and their impact on the nutritional status of children. Although the political, socio-economic, environmental and cultural (local and national) and poverty (household level) have an effect on the nutritional status of women and children, the only variables considered in this study were those that could be assessed during the survey. Factors selected are highlighted in the diagram.

These factors are:

- Immediate, such as diet factors (micronutrient status and micronutrient supplement) and infectious diseases (diarrhea and respiratory infections). The vitamin A supplementation in children 6 to 59 months would reduce the overall risk of death by 24% [9]. A diet rich in iodine also avoid the child disorders due to iodine deficiency (IDD), which can cause significant stunting in the population.
- Underlying biological and behavioral factors, such as vaccination against measles and feeding practices of children less than two years. In Senegal there is a network of community stakeholders conducting nutrition education. These enable women to better adhere to monitoring strategies / growth promotion (SPC). These IEC activities within the community would allow it to be favorable to vaccination and de-worming of children.
- Underlying socioeconomic factors, such as household size and income can affect food security.
- Basic factors such as place of residence because of certain social inequalities can have an impact on all the above-mentioned factors.

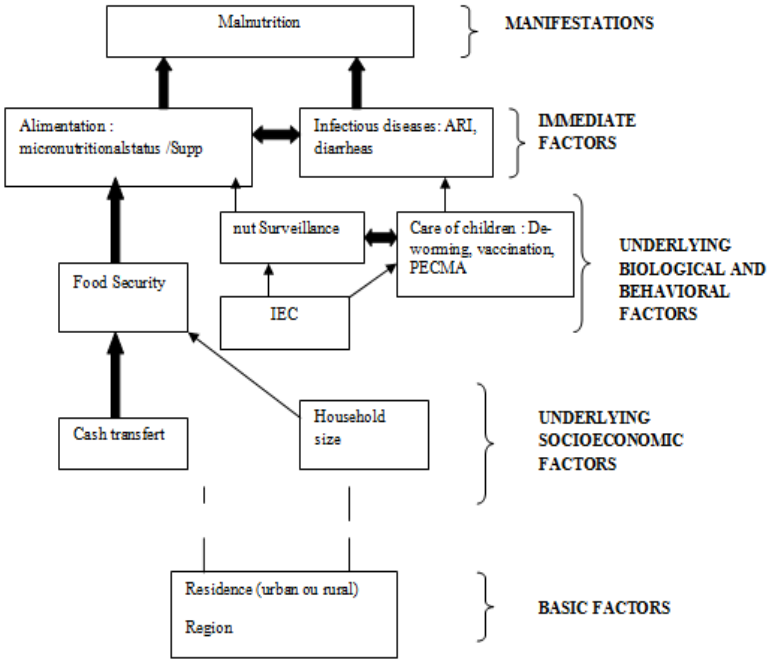

Figure 1: Conceptual framework of the study

Acute malnutrition is both a medical problem and a social problem. The child's medical problems are partly the result of social problems of the home in which he lives. Malnutrition is the result of chronic nutritional deprivation and often emotional: ignorance, poverty and family difficulties prevent parents to provide to the malnourished child care and required nutrition. The successful care of acute malnutrition passes through the recognition and solution of problems, both medical and social. If the disease is considered to be purely medical, the child may relapse on his return home and other family children remain exposed to the same risk.

I.2. Type and period of study

All data collection was held from November 3 to December 19, 2014.This is a cross-sectional survey in two-stage clusters, featuring a collection of individual anthropometric and health data and those relating to households.It was conducted by the SMART methodology, a method of quick survey, standardized and simplified with daily data entry in the field to ensure their quality.

I.3. The Population of Study

The population of study consisted of children aged 0-59 months in all 8 regions defined as survey areas.

• Inclusion Criteria

It was any child aged 0 to 59 months member of the selected household

• Exclusion criteria

It was :

Any child resident for less than a month in the household

Any child whose parents refused the survey

I.4. Sampling

The sampling method used was a random drawing to two degrees. Each region was considered one stratum.

Selecting clusters

The sampling technique at the first stage was to determine the list of clusters to survey for each stratum. The draw was done using the ENA software independently for each stratum in proportion to the population size. According to stratum, between 32 and 44 clusters were selected; each cluster containing from 12 to 23 households

Selection of households and children

This second stage of sampling was carried out by systematic random sampling. This was done from a list of updated households for the selected clusters in this survey or on site using a sampling step.

The definition used for the household is "all the members who share the same roof, which put all or part of their resources and who eat the meal prepared in the same pot."
Within each household visited, all children aged 0-59 months were included in the sample, whether present or absent.

Special cases
If a concession selected by the sampling step included more than one household, the numbering of households of the concession was always done in the direction of clockwise to determine the household to survey. In households, all children 0 to 59 months were surveyed. Every missing child or whose parents refused to participate in the survey and meeting the inclusion criteria is on the anthropometric questionnaire. The team returned to visit the household at the end of the day (by appointment) to take anthropometric measurements of absents. If the child still was not present, he was not replaced.
If the occupants of a household selected were missing, investigators returned to visit the household before the end of the day. If at the end of the day the household is still empty, it was noted as absent.
If a child was hospitalized during the survey, it was measured on site by the team of investigators at the end of the day, if the place of hospitalization was less than 15 km.
Children with disabilities were included in the survey and a maximum of data were collected. If physical deformity prevented a measurement to be performed, these data were considered missing.

I.5. Data collection
Collection Method: Data were collected during individual interviews with the mother / guardian of a child. This interview was done at the same time as taking anthropometric measurements.
Collection Tools : An individual household questionnaire was developed for this purpose and allowed to collect in the household all data concerning the eligible child.

Variables collected:
Data collection focused on the variables described below:
Sex: it was codified "M" for male or "F" for female.
Age: Date of birth was collected from a formal document (civil-status document, health card) bearing the child's name. However, if there is no document, the investigator estimated the age with the help of the parent, or by referring to the age of a child whose age is known (and confirmed by the events calendar) or the calendar of events developed for the purposes of this survey.
Weight: Children were weighed naked, close to 100 grams using an electronic scale SECA mothers-child. In each cluster, before the measures, scales were checked and calibrated at using a sample weight.
Size: The size was measured using a measuring board Shorr at three graduated shelves in centimeters, with an accuracy of 0.1 cm, for all children except those with a lower limb disability. Children less than 87 cm were measured in supine position while children of 87 cm or more were measured while standing. A wooden stick of 110 cm was used in every morning of the collect to calibrate the board.
Diarrhea and acute respiratory infection (ARI): The occurrence of these two diseases in the past 15 days was asked for each investigated child. The answer was coded 0 = No, 1 = Yes. Clinical definitions were:
Diarrhea: liquid bowel movement three or more times a day.
ARI: Fever with at least two of the following symptoms: rhinitis, cough, redness or pain in the throat OR fever with rapid breathing (> 50 breath per minute) accompanied by at least one of the following symptoms: cough, difficulty breathing.
Vitamin A supplementation and de-worming: questions were raised as to whether the child has been supplemented with vitamin A and de-wormed. The answer was coded: 0 = No, 1 = Yes 3 = Do not know.
Vaccination against measles: Questions were asked to determine if children 9 to 59 months were vaccinated against measles. The codification of the response was different according to the answer of the accompanying person and the presence of the certificate (vaccination card / health book): 0 = No, 1 = Yes / card, 2 = Yes / mother and 3 = Do not know.
Salt iodization: A test to determine if the salt consumed by the households surveyed was iodized or not was made by investigators. The result of this test was noted 0 = No, 1 = Yes 3 = salt not available.
Nutritional surveillance: Questions were asked to determine if the children had received nutritional monitoring activities during the three (3) months preceding the survey (weighing and taking the monthly size).
Communication activities as behavioral change communication (BCC): (interpersonal communication, chats, social mobilization) were evaluated during the three (3) months preceding the survey.

Threshold values used for classification of acute malnutrition [10]
Acute malnutrition encompasses moderate acute malnutrition (MAM) and severe acute malnutrition (SAM). It

is a deficiency situation due to multiple nutrient deficiencies. It is defined by the weight / size index or Mid Upper Arm Circumference (MUAC) and / or presence of bilateral edema.

1. The moderate acute malnutrition (MAM) is determined by a Weight / Height index between -3 and - 2 Z scores (WHO reference) in children aged 0 to 18 years or a MUAC between 115 and 125 mm in children 6 to 59 months. There are no clinical signs or shapes.

2. Severe acute malnutrition (SAM) is determined by an index weight / height <- 3 Z scores (WHO reference) in children aged 0 to 18 years or MUAC <115 mm in children 6 to 59 months and / or presence of bilateral edema. It can be with or without other complications.

The index weight for height (P / T, expressed in z-score) was therefore used for each child and / or the presence of bilateral edema was noted to estimate acute malnutrition..

I.6. Seizure and data analysis

Data were entered in the ENA software where a first analysis was performed; it has allowed identifying the different phases of acute malnutrition using the new WHO standards and of NCHS. After this first phase all the data were analyzed using the Epi Info software.

I.6.1. descriptive part

The descriptive part concerned the calculation of the average and standard deviations for quantitative variables. Quantitative variables were described by their frequencies and their confidence intervals at 95%.

***I.6.2. Analytical* part**

I.6.2.1. Bivariate analysis

The relationship between the dependent variable that is to say the nutritional status (presence of malnutrition, lack of malnutrition) and other explanatory variables transformed into qualitative variables was studied using the test khi2; A difference was considered significant if $p < 0.05$. This analysis has allowed to sort variables with a p lower than 0.25 for the multivariate analysis.

I.6.2.2. multivariate analysis

All variables with p lower than 0.25 were included in the multiple logistic regression analysis to study the relative importance of factors associated with the dependent variable that is the acute malnutrition of the child in its two phases (moderate and severe).

At each step, the variable associated with the largest p-value was eliminated from the model at the 5% threshold.

The adequacy of the model was made by the Hosmer-Lemeshow test [11]

II. Results

A total of 8755 children were interviewed in 8628 households.

II.1. Descriptive study

II.1.1. Socio-demographic characteristics of respondents

Table I: Distribution of respondents according to the socio-demographic characteristics

Variables	Nomber (n)	Frequence (%)
Sex (N=8755)		
F	4350	49,7
M	4405	50,3
Residence (N=8755)		
Urban	1866	21,3
Rural	6889	78,7
Age Group (N=8755)		
0 – 23	3770	43,1
24 – 59	4985	56,9
Household size (N=8628)		
1 – 9	2186	25,3
10 – 107	6442	74,7

Of the 8755 children surveyed, the sex ratio was equal to 1.01. The average age of children was 27 months with a standard deviation of 16. The average size of 8628 households was 16.5 with a standard deviation of 10.7.

Table II: Distribution of respondents by region

Regions (N=8755)	Nomber (n)	Frequence (%)
Diourbel	1165	13,3
Kédougou	516	5,9
Kolda	891	10,2
Louga	1082	12,3
Matam	1571	17,9

Saint-Louis	1196	13,7
Tambacounda	1286	14,7
Thiès	1048	12
Total	**8755**	**100**

II.1.2. Health characteristics of respondents

Table III: Distribution of respondents according to the existence of disease during the 15 days preceding the survey

Variables(N=8755)	**Nomber (n)**	**Frequence (%)**
Diarrhea		
Yes	2068	23,6
No	6687	76,4
ARI		
Yes	5041	57,6
No	3714	42,4

II.1.3. Distribution of respondents according to consumption in some micronutrients

Table IV: Distribution of respondents according to iodized salt and vitamin A

Variables	**Nomber (n)**	**Frequence (%)**
Iodized salt (N=8755)		
yes	6215	71
No	2540	29
Vit A (N=7692)		
Yes	6588	85,6
No	1104	14,4

II.1.4.Distribution of respondents according to the preventive and promotional care received

Table V: Distribution of respondents according to the preventive and promotionalCare received

Variables	**Nomber (n)**	**Frequence (%)**
Measles Vaccination (N=7279)		
Yes	6280	86,3
No	999	13,7
De-worming (N=6832)		
Yes	5728	83,8
No	1104	16,2
Nutritional monitoring (N=8755)		
Yes	2538	29
No	6217	71
IEC (N=8755)		
Yes	2574	29,4
No	6181	70,6

II.1.5. Distribution of respondents according to the degree of acute malnutrition by the standards of references used

Table VI: Acute malnutrition rate according to WHO standards and NCHS

Degree of acute malnutrition (N=8755)	**OMS Standards**		**NCHS Standards**	
	Nomber (n)	**Frequence(%) [IC]$^{95\%}$**	**Nomber (n)**	**Frequence (%) [IC]$^{95\%}$**
Global acute Malnutrition (GAM)	753	8,6 [8 – 9,2]	719	8,2 [7,6 – 8,8]
Moderate acute Malnutrition (MAM)	638	7,3 [6,8 – 7,9]	663	7,6 [7 – 8,2]
Severe acute Malnutrition (SAM)	115	1,3 [1,1 – 1,6]	56	0,6 [0,5 – 0,8]

The difference of frequencies of GAM and MAM depending on whether one uses the WHO standards or NCHS is not significant. However, as regards the SAM, this difference is significant. This study found twice as many cases of SAM with the WHO standard in comparison with that of NCHS.

II.2. Analytical Study

II.2.1. Bivariate analysis

II.2.1.1. Factors associated with moderate acute malnutrition

Table VII: Factors associated with moderate acute malnutrition

Factorsstudied	**Modalities**	**MAM**		
		Yes n (%)	**No n (%)**	**P**
Sex	F	277 (6,4)	4073 (93,6)	
	M	361 (8,2)	4044 (91,8)	<0,01
Residence	Urban	118 (6,3)	1748 (93,7)	
	Rural	520 (7,5)	6369 (92,5)	0,04
Age Group	0 – 23	245 (6,5)	3525 (93,5)	
	24 – 59	393 (7,9)	4592 (92,1)	0,007
Household size	1 – 9	158 (7,2)	2028 (92,8)	
	10+	473 (7,3)	5969 (92,7)	0,45
Vit A	Yes	525 (8)	6063 (92)	
	No	61 (5,5)	1043 (94,5)	0,002
iodized Salt	Yes	441 (7,1)	5774 (92,9)	
	No	197 (7,8)	2343 (92,2)	0,15
De-worming	Yes	465 (7,4)	5777 (92,6)	
	No	173 (6,9)	2340 (93,1)	0,19
ARI	Yes	403 (8)	4638 (92)	
	No	235 (6,3)	3479 (93,7)	0,001
Diarrhea	Yes	190 (9,2)	1878 (90,8)	
	No	448 (6,7)	6239 (93,3)	<0,01
Measles Vaccination	Yes	480 (7,6)	5800 (92,4)	
	No	88 (8,8)	911 (91,2)	0,11
Nutritional monitoring	Yes	160 (6,3)	2378 (93,7)	
	No	478 (7,7)	5739 (92,3)	0,01
BCC	Yes	191 (7,4)	2383 (92,6)	
	No	447 (7,2)	5734 (92,8)	0,39

II.2.1.2. Factors associated with severe acute malnutrition

Table VII: Factors associated with severe acute malnutrition

Factorsstudied	**Modalities**	**SAM**		
		Yes n (%)	**No n (%)**	**P**
Sex	F	43 (1)	4307 (99)	
	M	72 (1,6)	4333 (98,4)	<0,01
Residence	Urban	21 (1,1)	1845 (98,9)	
	Rural	94 (1,4)	6795 (98,6)	0,2
Age Group	0 – 23	64 (1,7)	3706 (98,3)	
	24 – 59	51 (1)	4934 (99)	0,004
Household size	1 – 9	31 (1,4)	2155 (98,6)	
	10+	82 (1,3)	6360 (98,7)	0,34
Vit A	Yes	85 (1,3)	6503 (98,7)	
	No	14 (1,3)	1090 (98,7)	0,5
iodizedsalt	Yes	90 (1,4)	6125 (98,6)	
	No	25 (1)	2515 (99)	0,05
De-worming	Yes	78 (1,2)	6164 (98,8)	
	No	37 (1,5)	2476 (98,5)	0,23
ARI	Yes	72 (1,4)	4969 (98,6)	
	No	43 (1,2)	3671 (98,8)	0,16
Diarrhea	Yes	51 (2,5)	2017 (97,5)	
	No	64 (1)	6623 (99)	<0,01
Measles Vaccination	Yes	70 (1,1)	6210 (98,9)	
	No	24 (2,4)	975 (97,6)	0,002
Nutritional monitoring	Yes	39 (1,5)	2499 (98,5)	
	No	76 (1,2)	6141 (98,8)	0,14
BCC	Yes	31 (1,2)	2543 (98,8)	
	No	84 (1,4)	6097 (98,6)	0,32

II.2. Multivariate Analysis

Table VIII: Factors associated to moderate acute malnutrition

Factorsstudied	Modalities	OR raw (IC 95%)	OR adjusted (IC 95%)	P(LR-test)
Sex	M F	1,31 (1,12-1,54) 1	1,3 (1,1-1,53) 1	0,002
Residence	Urban Rural	1 1,21 (0,98-1,49)	1 1,2 (0,97-1,48)	0,084
Nutritional monitoring	Yes No	0,81 (0,67-0,97) 1	0,89 (0,73-1,07) 1	0,203
Diarrhea	Yes No	1,41 (1,18-1,68) 1	1,32 (1,1-1,59) 1	0,004
ARI	Yes No	1,29 (1,09-1,52) 1	1,12 (0,94-1,34) 1	0,187
Vitamine A	Yes No	1,58 (1,27-1,96) 1	1,71 (1,29-2,26) 1	<0,001
Age Group	6-23 24-59	1 1,23 (1,04-1,45)	1 1,21 (1,01-1,45)	0,033
De-worming	Yes No	1,09 (0,91-1,3) 1	0,77 (0,6-1,1) 1	0,032

Table IX: Factors associated to severe acute malnutrition

Factorsstudied	Modalities	OR raw (IC 95%)	OR adjusted (IC 95%)	P(LR-test)
Sex	M F	1,66 (1,14-2,43) 1	1,65 (1,13-2,42) 1	0.009
Residence	Urban Rural	1 1,22 (0,76-1,96)	1 1,13 (0,7-1,82)	0,619
Diarrhea	Yes No	2,62 (1,81-3,79) 1	2,52 (1,73-3,67) 1	<0,001
Age Group	0-23 24-59	1 0,6 (0,41-0,87)	1 0,74 (0,49-1,11)	0,147
De-worming	Yes No	1 0,85 (0,57-1,26)	1 1,45 (0,87-2,43)	0,148
Measles Vaccination	Yes No	0,58 (0,39-0,84) 1	0,49 (0,3-0,81) 1	0,007

III. Discussion

III.1. Limitations and strengths of the study

This study has some limitations that should be emphasized. Indeed determining the vaccination status of vitamin A supplementation and de-worming of children if the related documents were not available could determine the memory bias. However thanks to the importance of sample size, statistical tests were reliable.

III. 2. Prevalence of acute malnutrition

The situation of malnutrition is precarious in view of the importance of the level of global acute malnutrition found in the sample. It is 8.6% according to WHO standards. This type of malnutrition is the result of insufficient food during the period preceding the survey; it can also be the result of recent illness, especially diarrhea or rapid deterioration of feeding conditions. However, we note that the prevalence is lower compared to the results of EDS V where the level of global acute malnutrition was 10%. [8] Only the methods used were not the same and part of the EDS V took place during the pre-transition period. The comparison of degrees of emaciation between the WHO standards and NCHS revealed a significant difference in the SAM. The proportion of children severely emaciated according to WHO standards (1.3% [1.1-1.6]) double that of NCHS standards (0.6% [0.5-0.8]). This comparison corroborates the joint WHO / UNICEF statement which says that when the WHO standards are used the threshold of -3 z-score for the index P / T classifies two to four times more severely malnourished children than the NCHS [12].

III.3. Factors associated with acute malnutrition

III.3.1. *Association acute malnutrition and child sex*

It appears that in bivariate analysis there was a statistically significant link between MAM and sex ($p < 0.01$). In fact more cases of MAM were noted in male children. The same trend is observed for cases of SAM. A 2008 study in the Democratic Republic of Congo had revealed similar results. [13] In Mali, the SMART survey conducted in July 2011 showed that malnutrition rates were higher among boys in the same age group. [14] Multivariate analysis shows that male children were at risk of 1.3 times to a MAM than female. This risk is equal to 1.7 times for the SAM. Advanced research is needed to scientifically explain these differences between the sexes. This greater vulnerability of boys to malnutrition has been identified elsewhere in Africa, but the mechanisms remain unclear. Wamani and Al analyzed sixteen Demographic and Health Surveys of sub-Saharan countries that show a high risk of malnutrition for boys and even more so that the socioeconomic status of their

families is low. These authors hypothesized that boys are more vulnerable than their sisters in the same age groups. Sociocultural or genetic sequence factors could explain this phenomenon. [15] The observation of the respondents and other anthropological techniques could confirm these assumptions and provide essential contextual information.

III.3.2. Association acute malnutrition and area of residence

Children from rural areas were more exposed to the MAM (p = 0.04). However, this effect of the place of residence was mitigated by logistic regression. Regarding the SAM, the prevalence is higher in rural areas but the difference was not significant.

III.3.3.Association acute malnutrition and age of the child

The results of the bivariate analysis show that the age group from 24 to 59 months was more impacted by the MAM. In logistic regression, the risk was 1.21. Compared to the SAM the difference is significant in bivariate analysis but this is attenuated when going to logistic regression. Most studies have shown that acute malnutrition rates were highest in the age group 6 - 23 months. [14] This corresponds to the complementary feeding period. During this period an additional supply in quantity and quality must be available in addition to breast milk. However the observed practices are not always adequate: late introduction of complementary foods, unbalanced diet (low energy density, poor balance in macro and micronutrients), insufficient number of meals, etc. The difference in prevalence observed in our study may be explained by the policy of the State of Senegal in nutrition. Indeed the PRN, the armed wing of the CLM is implementing the Community strategy to fight against malnutrition and covers the entire territory; its main target is the age group 0-23 months. This may explain the lower prevalence of MAM in this age group.

III.3.4. Association acute malnutrition and vitamin A supplementation

Children who received the vitamin A supplementation seem more affected by the MAM. The risk was 1.7 ($p < 0.001$). This can be paradoxical when we know the important role of this micronutrient in the body. Vitamin A is a powerful antioxidant and helps to strengthen the child's defenses against infection. The explanation which can be given for this is that the administration of vitamin A is part of the package of services provided in support of children with MAM. She is given routinely on admission of MAM children in PECMA program

III.3.5. Associationacute malnutrition and infectious morbidity

The prevalence of ARI and diarrhea was quite high in the sample. It was 57.6% and 23.6% respectively thus higher than the national average. [8] The occurrence of infectious diseases during the two weeks preceding the study exposed more children to the MAM. However only in logistic regression with diarrhea children had a risk of 1.3 to MAM. Regarding the SAM, only the association with diarrhea is significant. The risk was 2.5 times. It is often said, diarrhea is the main boulevard leading to malnutrition. Diseases deteriorate nutritional status, which in turn promotes the occurrence of diseases by depletion of the immune system. The result is a vicious cycle "malnutrition-infectious diseases."

Thus, the impact of malnutrition on disease had been estimated by the World Bank, in its 1993 report "Investing in Health" that malnutrition is responsible for 20 to 25% of all diseases occurring among children in poor countries. [16]

III.3.6. Associationacute malnutrition and preventive and promotional care

Nutritional monitoring activities and IEC have interested than the third of children surveyed (29% and 29.4%). The prevalence of MAM was less important in the age group who received nutritional monitoring with a significant difference. However, this factor is mitigated by logistic regression. As regards the MAS, the link is statistically significant between vaccination against measles and its occurrence. Children who were not vaccinated against this disease ran 2 times the risk of severe emaciation.

III.3.7. Risk factors for acute malnutrition

The prevalence of MAM was higher in children:

- Male (ORa = 1.30)
- The 24-59 age group (ORa = 1.21)
- Having experienced at least one episode of diarrhea during the last 15 days (ORa = 1.32)
- And being supplemented with vitamin A (ORa = 1.71).

The prevalence of SAM was higher in children

- Male (ORa = 1.65)
- Having experienced at least one episode of diarrhea during the last 15 days preceding the survey (ORa = 2.52)
- And who have not benefited from the anti measles vaccination (ORa = 2.04).

IV. Conclusion

This nutrition survey conducted using the SMART methodology, enabled the Government and its partners to provide reliable and timely data on the nutritional status of children aged 0-59 months.

The analysis conducted in this study permitted to identify factors that are associated with different degrees of acute malnutrition. Methods of analysis of acute malnutrition among children surveyed showed the importance of action at the immediate and underlying factors. It will therefore improve care practices to reduce morbidity, to promote key behaviors within households.

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