Contribution of Dehydration and Malnutrition to the Mortality of Children 0-59 Month of Age in a Senegalese Pediatric Hospital

Assane Sylla*, Younoussa Keita, Cheikh Sidate Diouf, Modou Guéye, Falilou Mbow, Ousmane Ndiaye, Saliou Diouf and Mohamadou Guélaye Sall

Pediatric Service of Cheikh Anta Diop University of Dakar, Senegal

Abstract: In-hospital mortality is an indicator of the quality of care. We analyzed the mortality of under five years children of Pediatric ward of Aristide Le Dantec teaching hospital to update our data, after an previous study conducted ten years earlier.

Methods: This was a retrospective study involving children 0-59 months of age, hospitalized from January 1, 2012 to December 31, 2012.

For each child, nutritional status was assessed according to 2006 World Health Organization growth standards; clinical and biological data were recorded. The outcome of the disease was specified. Bivariate and multivariable were used to identify risk factors for death.

Results: 393 children were included. Overall mortality rate was 10% (39/393). Factors associated with death were severe wasting [OR = 8.27, 95% CI [3.79-18], male gender (OR = 2.98, 95% CI [1.25-7.1]), dehydration (OR = 5.4, 95% CI [2.54-13.43]) in the model using the weight-for- height z score, male gender (OR = 2.5, 95% CI [1.11-5.63]), dehydration (OR = 8.43, 95% CI [3.83-18.5]) in using the height- for- age z score, male gender (OR = 2.7, 95% CI [1.19-6.24]), dehydration (OR = 7.5, 95% CI [3.39-16.76]), severe underweight (OR = 2.4, 95% CI [1.11-5.63]), in the model using the weight-for- age z score, and male gender (OR = 2.5, 95% CI [1.11-5.63]), dehydration (OR = 8.43, 95% CI [3.83-18.5]) in that using MUAC.

Dehydration and malnutrition are two independent factors of mortality. Our management protocols of dehydration and malnutrition have to be updated. Screening malnutrition has to be done systematically for each child by anthropometric measurements using WHO growth standards.

Keywords: Mortality, child malnutrition, dehydration, Senegal.

I. INTRODUCTION

The child mortality is a major public health problem in developing countries. It is a good indicator for the main programs for children and targeted by the integrated management of childhood illness [1] and also for an evaluation of the quality of care in health facilities. Objective number four of the Millennium Development Goals aims to reduce the rate of 2/3 in 2015. In Senegal, the rate decreased from 139 ‰ in 2005 [2] to 72 ‰ [3] in 2010. The main causes of death in children 0-59 month of age are the neonatal diseases, diarrhea, pneumonia, malaria and malnutrition as an underlying cause. However, in the developing countries hospitals, the leading causes of death are various.

In a study conducted in the pediatric ward of Le Dantec hospital in 2002, the mortality was dominated by malnutrition and diarrhea [4].

Ten years after this first study, we undertook this work to update our data and analyzed the contribution of malnutrition on the mortality of children 0-59 months aged, hospitalized in the pediatric ward of the Aristide Le Dantec hospital.

II. PATIENTS AND METHODS

II.1 Study Setting

Aristide Le Dantec pediatric hospital is located in Dakar, capital city of Senegal. It counts 25% of pediatric beds in Dakar. The hospital counts about 700 inpatients per year and 3,000 outpatients. It is frequented mainly by a poor population from the suburbs of Dakar and regional health facilities. The hospital has a 72-bed inpatients.

II.2. Study Design, Population and Period

This was a retrospective study involving children 0-59 months of age, hospitalized from January 1, 2012 to December 31, 2012.

II.3. Data Collection

For each child we collected age, sex, reasons for consultation and / or hospitalization. Clinical evaluation was done until discharge and findings recorded. We measured the nutritional status of the children. Weight was measured to the nearest 100g. An infant length

*Address correspondence to this author at BP 18 119 Pikine-Dakar, Senegal; Tel: (00221) 77 6-57-70-97; E-mail: drassanesylla@gmail.com

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board with a sliding foot board to the nearest 0.1 cm was used to measure the recumbent length of children aged less than 24 months, and a wooden scale with a sliding head piece was used to measure the standing height of children aged 24 months and older. Mid-upper arm circumference (MUAC) was also measured.

Wasting was defined severe as weight-for-height Z score (WHZ) < -3 wasting and moderate as WHZ between [-3, -2]. Underweight was defined severe as weight-for-age Z score (WAZ) < -3, moderate as WAZ between [-3, -2]. Stunting was defined severe as height - for age Z score (HAZ) < -3 and moderate as HAZ between [-3, -2]. All these indices were calculated using 2006 WHO growth standards. Hemoglobin concentrations, C-reactive protein, rapid diagnostic test for malaria (RDT), serum protein were measured. The outcome of disease was notified.

II.4. Data Analysis

SPSS (Statistical Package for Social Sciences) software Version 18 was used for data entry and analysis. Categorical variables were compared with chi-square test or Fisher's exact test. The significance level was used for p-values less than 0.05, in the bivariate analysis. Associated factors were assessed by calculating the relative risk (RR) with confidence intervals at 95%. Logistic regression models were used for multivariate analysis. Each model included an anthropometric indicator separately. All the variables associated to child deaths in bivariate analysis were included in each model. Adjusted Odds ratio (OR) with confidence intervals (CI) at 95% were derived from the final models and the P value of the Wald chi-square for each variable was presented in the tables.

III. RESULTS

III.1. Morbidity

A total of 393 children under five years of 650 (60%) were admitted to the general pediatric ward (Table **1**).

Of 393 children enrolled 114 (29%) were newborns, 72 (18.3%) children 29 days- 11 month of age, 60 (15.3%) children 12- 29 month of age, and 147 (37.4%) children 30-59 month of age, 255 (64.9%) were male.

The reasons for the visit or hospitalization were dominated by fever (80.2%), vomiting (44.3%), diarrhea (29%) and cough (19%).

A total of 138 (35.1%) had dehydration. The children 30-59 months of age suffered predominantly from dehydration, followed by those 12 - 29 months of age.

Table 1: Clinical and Biological Characteristics of Patients

	N (%)
Age	
0-28 days	114(29.0)
29days- 11 month	72 (18.3)
12 - 29 month	60 (15.3)
30- 59 month	147 (37.4)
Gender	
Male	255 (64.9)
Female	138 (35.1)
Reasons for visit and or for hospitalization	
Fever	315 (80.2)
Vomiting	174 (44.3)
Diarrhea	114 (29.0)
Cough	75 (19.0)
Dehydration	138 (35.1)
Other	93 (23.7)
Diseases	
Neonatal disease	114 (29.0)
Malaria	99 (25.2)
gastroenteritis	60 (15,3)
Acute lower respiratory infection	51 (13.0)
Other	69 (17.5)
Outcome of disease	
Death	39 (10.0)

Neonatal diseases were the most common group of diagnosis found in 114 of 393 (29%). Of the 114 newborns, 108 C-reactive protein (CRP) were made, and 60 was positive (55.6%).

However, 99 of 393 (25.2%) had confirmed RDT malaria, severe in 48 patients (24 anemic malaria, 24 cerebral malaria). The prevalence was highest among children 30 to 59 months of age. Of the 393 children 60 (15.3%) had gastro - enteritis. The children 29 days -59 months of age were predominantly affected.

Acute lower respiratory infections were found in 51 patients (13%). The children 30-59 months of age were more affected.

III.2. Nutritional Status

A total of 90 children of 393 (22.9%) had severe acute malnutrition for WHZ as shown in Table **2**.

Severe underweight was observed in 84 patients of 393 (21.3%) and severe stunting in 30 (7.7%).

Of the 393 children 219 (55.7%) had anemia, 54 among them had severe anemia. Of the 219 patients 21 were neonates, 60 children 1 to 11 months of age, 51 children 12-29 months of age and 87 children 30-59 months of age.

III.3. Co - Morbidity

The proportion of dehydrated children was higher in children with severe underweight (52% vs 31.1% p = 0.001) and in children with severe wasting (56.7% vs 28.7% P = 0.000001).

The acute gastroenteritis was more common in children with severe underweight (28% vs 12.3% p = 0.001) and those with a severe wasting (26.7% vs 11% p = 0.001).

The proportion of children with anemia was higher in children with wasting (23.3% vs 10.9%) (P = 0.003).

III.4. Analysis of Factors Associated with Mortality

The overall mortality was 10% (39 deaths of 393 patients). In bivariate analysis following factors were significantly associated with mortality: severe wasting, severe underweight, moderate anemia, dehydration and the following diagnosis: neonatal disease, malaria and acute gastroenteritis (Tables **2** and **3**).

In logistic regression analysis, severe malnutrition diagnosed by WHZ or WAZ, dehydration status, male gender were the independent factors constantly

Table 2: Bivariate Analysis of Association between Nutritional Status and Mortality

	Morbidité n(%)	Mortalité n(%)	RR CI 95%	P
Weight – for - height (z score)				
< -3	90 (22.9)	27(30.0)	6.8 (3.33-13.8)	0.000001
[-2, -3]	99 (25.2)	3(3.0)	0.69 (0.19 -2.48)	NS
> -2	204 (51.9)	9 (4.4)	1	
Weight – for -age (z score)				
< -3	84 (21.3)	15(17.8)	3.04 (1.48-6.21)	0.001
[-2, -3]	105 (26.7)	12(11.4)	1.94 (0.9- 4.17)	0.08
> -2	204 (51.9)	12(5.9)	1	
Taille/âge (z score)				
< -3	30 (7.7)	3 (10.0)	1.01 (0.33- 3.08)	NS
≥ -3	363(92.3)	36 (9.9)	1	
MUAC (mm)				
< 115	171 (43.5)	15(8.8)	0.81 (0.44-1.5)	NS
≥ 115	222 (56.5)	24(10.8)	1	
Hemoglobin concentration (g/dl)				
< 9	96 (24.4)	6 (6.25)	0.91 (0.35-2.34)	NS
[9- 11[	123(31.3)	21(17.1)	2.48 (1.27 - 4.84)	0.01
≥ 11	174(44.3)	12(6.9)	1	
Serum Protein (g/l) (n=336)				
< 60	261 (77.7)	24(9.2)	2.3 (0.71 – 7.43)	NS
≥ 60	75 (22.3)	3 (4.0)	1	

MUAC: Mid upper arm circumference; RR: relative risk; CI 95%: Confidence interval 95%; NS: no significative.

Table 3: Bivariate Analysis of Factors Associated with Mortality

	Deaths n(%)	RR CI 95%	P
Age			
0-28 days	9 (7.9)	0.55 (0.26 -1.16)	NS
29days- 29 month	9 (6.8)	0.48 (0.23 – 1.01)	NS
30-59 month	21 (14.3)	1	
Gender			
Male	30 (11.8)	1.80 (0.88-3.7)	NS
Female	9 (6.5)	1	
Dehydration			
Yes	30 (21.7)	6.16 (3.01-12.6)	0.000001
No	9 (3.5)	1	
Diagnosis at discharge			
Neonatal disease	12(10.5)	4.21 (1.22 – 14.53)	0.025
Malaria	15(15.2)	6.06 (1.80 – 20.3)	0.001
Acute lower respiratory infection	0 (0%)	-	
Acute gastroenteritis	9(15)	6 (1.69 – 21.3)	0.002
Other	3 (2.5)	1	

RR: relative risk; CI 95%: Confidence Interval at 95%; NS: No significative.

Table 4: Adjusted Odds Ratio (OR) and Confidence Interval (CI) at 95% Derived from Logistic Regression Models for Death

Variables	OR	CI 95%	P
Model 1 with weight-for-height z score (WHZ)			
WHZ< -3/≥ -3	8.27	3.79 - 18	0.000001
male/female	2.98	1.25 – 7.1	0.014
Deshydration yes/no	5.4	2.54 – 13.43	0.000001
Model 2 with height-for-age z score (HAZ)			
Deshydration yes/no	8.43	3.83 – 18.5	0.000001
male/female	2.5	1.11 – 5.63	0.026
Model 3 with weight – for - age (WAZ)			
WAZ< -3/ ≥ -3	2.4	1.11 – 5.63	0.019
Deshydration yes /no	7.5	3.39 – 16.76	0.000001
male/female	2.7	1.19 – 6.24	0.017
Model 4 with MUAC			
Deshydration yes/no	8.43	3.83 – 18.5	0.000001
male/female	2.5	1.11 – 5.63	0.026

MUAC: Mid-upper arm circumference.

associated with the death, in the different models (Table **4**).

IV. DISCUSSION

Nutritional status is an important factor of morbidity; it is not always included in the initial evaluation of patients because the anthropometric measurement is not systematic. Malnutrition is a major public health problem in developing countries; despite its prevalence decreased, nutritional emergencies are recurrent in sub-Saharan area.

A previous study showed the link between the child survival and nutritional status [4].

Dehydration is known to the main complication of diarrhea. The results highlighted that 35% of our patients had dehydration. In a previous study [4], diarrhea appeared as a factor associated with death. However, this study did not show the specific role of dehydration in the occurrence of these deaths. The results showed that, the children 30-59 months of age suffered predominantly from dehydration, followed by those 12 - 29 months of age. However in few studies, majority of patients had less than 12 months [5].

Anemia is a public health problem and is a target of various health programs of the child because of its impact on growth and cognitive development. The anemia is found in more 55.7% of our patients. In a population –based study [6] the prevalence is higher (86.5%) among apparently healthy children. In a hospitalized –based study the frequency of anemia is lower (4.5%).

It is well demonstrated that malnutrition is linked with infectious diseases because of immunodeficiency. In a previous study [7], malnutrition was associated with infectious diseases as follows: diarrhea (51.4%), pneumonia (30.1%) and malaria (6.9%).

In this study, overall mortality is 10%. It is less than that recorded in few studies [4, 8-10].

The risk of death in our patients is associated with severe malnutrition diagnosed by WHZ and WAZ. Malnutrition assessed by HAZ and MUAC were not associated with mortality. Dehydration was also independently associated with the occurrence of death. This result is different from a previous study made in 2002 [4] where the link is established between mortality and nutritional status assessed by MUAC. In this study diarrhea was other independent factor of death but the responsibility of the dehydration status was not well established although it was known that dehydration was the main complication of diarrheal episode. Two Kenyan studies demonstrated that the presence of the risk of death from diarrhea was multiplied by 2.5 [11] or 2 [12], in children with severe acute malnutrition. A study in Zambia [13] showed that dehydration status multiplied by 2.5 the risk of death in hospitalized children.

Regarding the prognostic value of MUAC, this anthropometric indicator is not associated with mortality in this study. However two studies [14, 15] highlighted an association between low MUAC and death.

In our study, WHZ and WAZ were only to be associated with death. However, malnutrition defined as WHZ, WAZ or HAZ less than -2, multiplied by 4.2 the risk of death in a Kenyan study [11]. Also in our study, the HAZ was not associated with death. In contrast, in a study conducted both in Africa, Asia and Latin America [16], the risk of death was 12.3 fold in stunted children. In Rwanda [17], only the WAZ and HAZ indices were significantly associated with death.

CONCLUSION

Dehydration and severe malnutrition status were two independent factors associated with in- hospital mortality. It is therefore necessary to adjust our dehydration and malnutrition management. Also we recommend assessing nutritional status by anthropometric measurements in all under five years hospitalized children.

CONFLICT OF INTEREST

None.

REFERENCES

[1] World Health Organisation. Handbook IMCI-integrated management of childhood illness. Geneva: UNICEF/WHO, 2000: 173p.

[2] Ndiaye S, Mohamed A. Demographic health survey in Sénégal 2005. Calverton, Maryland, USA: Centre de Recherche pour le Développement Humain [Sénégal] et ORC Macro.

[3] National agency of statistics and demography (NASD)[Senegal], et ICF International. Demographic health survey 2010-2011. Calverton, Maryland, USA: NASD et ICF International.

[4] Sylla A, Diouf S, Sall MG, Ndiaye O, Moreira C, Kuakuvi N. Predictive factors of death in a pediatric service from Dakar: diarrhea and brachial perimeter. Arch Pediatr 2002; 9: 557-58. http://dx.doi.org/10.1016/S0929-693X(01)00841-7

[5] Mabiala-Babela JR, Pandzou N, Nkanza Kaluwako ST, Senga P. Epidemiological aspects of severe dehydration in infants at CHU of Brazzaville (Congo). Arch Pediatr 2007; 14: 1366-73.

[6] Diouf S, Sylla A, Diop F, Diallo A, Sarr M. Anemia among apparently healthy senegalese children. Arch Pediatr 2013; 20: 311-16.

[7] Sylla A, Diouf S, Sall MG, Ndiaye O, Moreira C, Kuakuvi N. Epidemiology and management of malnutrition in hospitalized children 0-5 years of age in Dakar. Arch Pediatr 2002; 9: 101-102. http://dx.doi.org/10.1016/S0929-693X(01)00703-5

[8] Camara B, Diouf S, Faye PM, Ba A, Ba M, Sow D, *et al.* Morbidity and mortality in a pediatric hospital at Dakar (Senegal). Arch Pediatr 2005; 12: 1772-78. http://dx.doi.org/10.1016/j.arcped.2005.09.022

[9] Koffi KS, Guédéhoussou T, Djadou KE, Gbadoe JAD, Gnamey DK, Atakouma DY. Morbidity and mortality of children 0-15 years old hospitalized in pediatric unit at the hospital of Be (Togo) in 2005. Arch Pediatr 2010; 17: 1107-13.

[10] Okechukwu AA, Nwalozie C. Morbidity and mortality pattern of admissions into the Emergency Paediatric Unit of University of Abuja Teaching Hospital, Gwagwalada. Niger J Med 2011; 20: 109-13.

[11] O'Reilly CE, Jaron P, Ochieng B, Nyagara A, Tate JE, Parsons MB, *et al*. Risk factors for death among children less 5 years old hospitalized with diarrhea in Western rural Kenya 2005-2007: a cohort study. Plos Med 2012; 9: e1001256. http://dx.doi.org/10.1371/journal.pmed.1001256

[12] Talbert A, Thuo N, Karisa J, Chesaro C, Ohuma E, Ignas J, *et al*. Diarrhoea complicating severe acute malnutrition in Kenyan children: a prospective descriptive study of risk factors and outcome. PLoS One 2012; 7: e38321. http://dx.doi.org/10.1371/journal.pone.0038321

[13] Irena AH, Mwambasi M, Mulenga V. Diarrhea is a major killer of children with severe acute malnutrition admitted to inpatient set-up in Lusaka, Zambie. Nutr J 2011; 10: 110. http://dx.doi.org/10.1186/1475-2891-10-110

[14] Bejon P, Mohammed S, Mwangi I, Atkinson SH, Osier F, Peshu N, *et al*. Fraction of all hospital admissions and deaths attributable to malnutrition among children in rural Kenya. Am J Clin Nutr 2008; 88: 1626-31. http://dx.doi.org/10.3945/ajcn.2008.26510

[15] Briend A, Maire B, Fontaine O, Garenne M. Mid-upper arm circumference and weight-for-height to identify high-risk malnourished under-five children. Matern Child Nutr 2012; 8: 130-3. http://dx.doi.org/10.1111/j.1740-8709.2011.00340.x

[16] McDonald CM, Olofin I, Flaxman S, Fawzi WW, Spiegelman D, Caulfield LE, *et al*. Nutrition Impact Model Study. The effect of multiple anthropometric deficits on child mortality: meta-analysis of individual data in 10 prospective studies from developing countries. Am J Clin Nutr 2013; 97: 896-901. http://dx.doi.org/10.3945/ajcn.112.047639

[17] Ngirabega JDD, Munyanshongore C, Donnen P, Dramaix M. Influence of malnutrition on childhood mortality in a rural hospital in Rwanda. Rev Epidemiol Sante Publique 2011; 59: 313-18. http://dx.doi.org/10.1016/j.respe.2011.05.002

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