

# Relationship between nutritional status and mortality in hospitalized children aged 1-59 months in the pediatric department of the CHU of Parakou (CHU-P) from 2018 to 2020

## Abstract

**Introduction:** Malnutrition is directly or indirectly associated with the death of children under 5 years of age in half of the cases. The objective of this study was to establish the relationship between pathological nutritional status and mortality in hospitalized children aged 1 to 59 months in the pediatric department of the CHU-P in Benin from 2018 to 2020.

**Framework and method:** This was a descriptive and analytical study with retrospective data collection. Data were collected from the medical records of children aged 1 to 59 months, admitted to the pediatric department of the CHU-P from January 1, 2018 to December 31, 2020.

**Results:** A total of 6789 children met the inclusion criteria out of 9285 children admitted from 2018 to 2020, including 693 children dying during their hospital stays. Among these children, 2174 suffered from acute malnutrition with a death rate of 13.7%. Chronic malnutrition and underweight accounted for a size of 1,694 and 2,241, respectively with a death rate of 13.4% and 14.1%, respectively. Acute malnutrition ( $p=0.005$ ), chronic malnutrition ( $p=0.018$ ), and underweight ( $p=0.000$ ) were associated with hospital mortality.

**Conclusion:** Pathological nutritional status, especially the different types of undernutrition are associated with hospital mortality. Reducing intra-hospital mortality requires community actions to improve the nutritional status of children.

**Keywords:** pathological nutritional status, hospital infant and child mortality, Benin

## Introduction

Infant and child mortality remains high in sub-Saharan Africa despite the efforts made by States in the context of Sustainable Development Goals (SDGs).<sup>1</sup>

According to the fifth Demographic and Health Survey in Benin (DHSB-V),<sup>2</sup> this mortality is 9.6%.

The main causes of infant and child mortality in Benin are represented by malaria, acute respiratory tract infections, diarrhea, measles and malnutrition.<sup>2</sup>

According to Doumbia et al<sup>3</sup> in Mali, the three main causes of child death were: malnutrition (47%), malaria (32%) and acute respiratory tract infections (19%).

In developing countries, malnutrition is directly or indirectly associated with the death of children under 5 in 45% of cases,<sup>4</sup> underlining its importance in infant-child morbidity and mortality.

Every minute, about 10 children suffering from severe acute malnutrition die, nearly 5 million every year.<sup>5</sup> The objective of this work was to establish the relationship between intra-hospital mortality and the nutritional status of hospitalized children aged 1 to 59 months in the pediatric department of the CHU-P from 2018 to 2020.

## Framework and study methods

### Framework, type and period of study

This was a descriptive and analytical study with retrospective data collection conducted in the pediatric department of the Teaching

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Hospital of Parakou (CHU-P) in Benin Republic. Data were collected using the medical records of the children admitted from January 1, 2018 to December 31, 2020.

### Study population

The source population consisted of hospitalized children aged 1 to 59 months during the study period. The target population is all hospitalized children of the same age group in the department.

### Inclusion criteria

The inclusion criteria were as follows:

- Children aged 1-59 months,
- Children hospitalized in the department from January 1, 2018 to December 31, 2020,
- Children having specified anthropometric parameters with documented age and type of hospital discharge.

### Exclusion criteria

Information that could interfere with the diagnosis (cases of nephropathy, heart disease or other situations with symmetrical edemas).

### Sampling

This was an exhaustive and consecutive census of the medical records of children meeting the inclusion criteria.

## Study variables

The main variable was the nutritional status which has three sub-classes, namely a good nutritional status, a poor nutritional status (undernutrition) and an excess of nutritional status (over nutrition).

The nutritional status is good when the following anthropometric parameters and indices are all normal:<sup>6</sup>

- a) Weight-for-Height (WH) Index;
- b) Body Mass Index for Age (BMI/Age);
- c) Mid-Upper Arm Circumference (MUAC);
- d) Height-for-Age (HA) Index;
- e) Weight-for-Age (WA) Index

Malnutrition includes acute malnutrition, chronic malnutrition and underweight:<sup>6</sup>

- 1) Acute malnutrition was defined by a WH index and/or a BMI/Age lower than -2 standard deviation (SD) and/or a MUAC under 125 mm;
- 2) Chronic malnutrition was defined by a HA index less than -2 SD;
- 3) Underweight was defined by a WA index less than -2 SD;

Over nutrition is composed of overweight and obesity:<sup>6</sup>

- 1) Overweight was defined by a WH index and/or a BMI/Age between 2 and 3 SD;
- 2) Obesity was defined by a WH index and/or a BMI/Age greater than or equal to 3 SD.

The secondary variables were socio-demographic (age of the child, sex, ethnicity of the children's parents); clinical (anthropometric parameters on admission, diagnosis); nutritional (exclusive breastfeeding, food diversification) and evolutionary (vital status at hospital discharge).

The age of the children is expressed in months. The age groups considered were as follows:

1; 6, 6; 12, 12; 24 and 24; 59.

## Food diversification

Food diversification was the qualitative nominal variable and has three categories (Good, Bad and not specified). Food diversification is of good quality if and only if these seven (07) conditions are met:

- 1) Type of feeding adapted to the age (exclusive breastfeeding up to 6 months of life, complementary feeding from 6 months);
- 2) Complementary feeding is adequate if the composition is respected (food containing proteins, carbohydrates, lipids, fruits, variety);
- 3) In good consistency (thick porridge, solid foods in paste form)
- 4) Meal frequency (3 meals, 2 snacks);
- 5) Quantity of food at each meal (required quantity regulated by the child, food given by reaction);
- 6) Feeding technique (breast or cup, food in a separate bowl);
- 7) Micronutrient supplementation (iron, folic acid at 6 months and 18 months, vitamin A at 6 months and every 6 months, deworming at 9 months and every 3 months).

## Diagnosis

Qualitative nominal variable; it is the health problem posed by the child. The most common diagnoses among children into five groups were: severe malaria, sepsis, acute respiratory tract infections, Gastro-intestinal tract infections with diarrhea and other diagnoses. The diagnoses were retained as registered in the medical records.

## Vital status at hospital discharge

Qualitative dichotomous variable corresponding to the state of the child's health at discharge and has two categories (Alive and Deceased).

## Data collection method

### Collection Tool

Data collection was carried out using the survey form, the medical record of each child, and hospitalization registers.

### Collection process

All medical records of children aged 1 to 59 months that met the inclusion criteria were identified and the survey forms were filled.

### Data processing

The data collected were entered into Epi Data 3.1fr software. After the entry, the consistency of data and eventual entry errors were checked. Then these data were exported into Microsoft Excel 2016 software for analysis. The analysis was also done with Epi Info version 7.2 and IBM SPSS statistics 26. The parameters of central tendencies (Mode, Mean, and Median) and dispersions (Standard deviation) were used for the description of the quantitative variables. Proportions with confidence intervals were used for qualitative variables.

Pearson's Khi2 test was used to cross the vital status of the subjects included with their nutritional status.

The statistical significance level was set at 0.05. The ranking of explanatory variables was carried out according to the value of the adjusted Odds-Ratio (aOR) and their confidence interval at 95% (95% CI).

## Ethical considerations

- d) The opinion of the local ethics committee of the University of Parakou has been obtained (Ref: 0540/CLERB-UP/P/SP/R/SA).
- e) Authorization from the Head of the pediatric department has been obtained.
- f) Moreover, data have been collected and processed with respect of anonymity and confidentiality

## Results

The general number of children admitted to the pediatric department of the CHU-P from 2018 to 2020 was 9285. Of them, 7204, 6789 and 415 were included, studied and excluded, respectively.

Among the 415 (4.47%) children excluded, 99 (1.07%) were aged 1 to 5 months and 316 (3.40%) aged 6 to 59 months. The diagnoses made in the children excluded from the study were: heart failure (126 cases), nephrotic syndrome (96 cases), acute renal failure (75 cases), acute glomerulonephritis (58 cases) and hepatic failure (29 cases).

The sample for this study was therefore 6789, i.e. a coverage of 73.11%, with 549 (8.09%) children aged 1 to 5 months and 6240

(91.91%) children aged 6 to 59 months. In these children studied, 693 died (10.20%) and 6096 children (89.80%) were discharged alive.

### Sociodemographic and nutritional characteristics

The children identified included 54.4% of boys and 45.6% of girls during the period from 2018 to 2020. The sex ratio was 1.2.

The average age of the children was  $21.5 \pm 13.4$  months with the extremes of 1 and 59 months. The children were aged between 24 and 59 months in 44.7% of cases (Table 1).

**Table 1** Distribution by age group of hospitalized children aged 1 to 59 months in the pediatric department of CHUD-B/A from 2018 to 2020

Age	Size	%	95% CI
[1 ; 6]	549	8.1	[7.0- 9.2]
[6 ; 12]	1400	20.6	[19.9- 21.3]
[12 ; 24]	1806	26.6	[25.9- 27.2]
[24 ; 59]	3034	44.7	[44.2- 45.2]
<b>Total</b>	<b>6789</b>	<b>100</b>	

Exclusive breastfeeding up to 6 months was specified for 3452 children. The children's mothers had declared having practiced exclusive breastfeeding up to 6 months in 54.4% of cases.

The quality of complementary feeding had been specified for 2881 children (42.4%). All of these 2881 children had a poor food diversification.

The diagnosis most represented was severe malaria, made in 4386 children, i.e. a proportion of 64.6% (Table 2).

**Table 3** Relationship between nutritional status in hospitalized children aged 1 to 59 months in the pediatric department of the CHU-P from 2018 to 2020 and their vital status

		Vital status at discharge		Total	Odds-ratio	CI (95%)	P-value
		Alive	Deceased				
<b>Acute malnutrition</b>	No	n 4220	395	<b>4615</b>			<b>0.005</b>
	Yes	n 1876	298	<b>2174</b>			
<b>Chronic malnutrition</b>	No	n 4629	466	<b>5095</b>			<b>0.018</b>
	Yes	n 1467	227	<b>1694</b>			
<b>Underweight</b>	No	n 4170	378	<b>4548</b>			<b>0</b>
	Yes	n 1926	315	<b>2241</b>			
<b>Over nutrition</b>	No	n 5941	671	<b>6612</b>			<b>0.972</b>
	Yes	n 155	22	<b>177</b>			

**Table 2** Distribution according to the diagnosis of the hospitalized children aged 1 to 59 months in the pediatric department of the CHU-P from 2018 to 2020 (n = 6789)

	Size	%	95% CI
Severe malaria	4386	64.6	[64.2- 65.0]
Sepsis	1005	14.8	[13.9- 15.6]
Acute respiratory tract infections	706	10.4	[9.4- 11.4]
Gastro-intestinal tract infections with diarrhea	495	7.3	[6.1- 8.5]
Others	197	2.9	[1.0- 4.8]
<b>Total</b>	<b>6789</b>	<b>100</b>	

Others: epileptic seizure (37 cases), encephalitis (27 cases), meningitis (88 cases), urinary tract infection (31 cases), nutritional rickets (5 cases), measles (17 cases), acute renal failure (22 cases).

### Relationship between nutritional status and evolution

Acute malnutrition was significantly associated with hospital mortality ( $p= 0.005$ ). The child death rate related to acute malnutrition was 13.7% (Table 3).

Chronic malnutrition was significantly associated with hospital mortality ( $p= 0.018$ ). The child death rate related to chronic malnutrition was 13.4% (Table 3).

Underweight was significantly associated with hospital mortality ( $p= 0.000$ ). The child death rate due to underweight was 14.1% (Table 3).

Mortality was not significantly associated with overnutrition ( $p= 0.972$ ) (Table 3).

In multivariate analysis, among the different types of malnutrition, acute malnutrition had a higher risk of intra-hospital mortality in children (Odds-ratio=1.376) (Table 4).

**Table 4** Types of malnutrition associated with intra-hospital mortality in hospitalized aged 1 to 59 months in the pediatric department of the CHU-P from 2018 to 2020

		Odds-ratio	CI (95%)	P-value
<b>Acute malnutrition</b>	No	1		
	Yes	1.376	[1.12-1.69]	<b>0.002</b>
<b>Chronic malnutrition</b>	No	1		
	Yes	1.246	[1.02-1.52]	<b>0.031</b>
<b>Underweight</b>	No	1		
	Yes	1.353	[1.08-1.70]	<b>0.01</b>

## Discussion

### Validity of the study

A descriptive study was carried out with retrospective data collection from January 1, 2018 to December 31, 2020, i.e. a period of 03 years.

An exhaustive and consecutive census of the medical records of children from one month to 59 months hospitalized during the above-mentioned period was carried out. The data collection was done rigorously on the survey form developed for this purpose, by ourselves in respect of confidentiality, anonymity and using the reference standards of WHO.

However, the retrospective nature of this study could lead to biases related to the non-documentation of certain information in children's medical records. Since information that may have been collected but has not been documented is considered not done, it is important to redo this study with a prospective data collection.

In fact:

1. The imprecise age of children could lead to selection and information biases;
2. The anthropometric parameters (weight, height, mid-upper arm circumference) in the medical records may not be correct, leading to information bias. However, these data were taken by qualified and trained health workers with robust and reliable tools in a usual exercise context.

Despite these inherent limitations of this type of study (retrospective), this work has the merit of approaching a very large sample of hospitalized children in the pediatric department over three years, with a rigorous method respecting ethical standards. In addition, the diagnosis of pathological nutritional status was made using several complementary anthropometric parameters (MUAC, WH index, BMI/age especially for acute malnutrition) making our results more objective.

### Analysis, interpretation and comparison of results

#### Acute malnutrition

Acute malnutrition was significantly associated with hospital mortality ( $p= 0.005$ ). The child death rate from acute malnutrition was 13.7%. This high mortality rate could be explained by the high frequency of severe acute malnutrition cases with complications in the pediatric department of the CHU-P which is a therapeutic nutritional recovery center.

According to Sinanduku et al,<sup>7</sup> in DRC in 2017, the frequency of mortality among children with acute malnutrition was 9.83%.

This rate was even lower according to Traoré et al,<sup>8</sup> in Mali in 2016 who reported 5%. Diall et al,<sup>9</sup> in Mali in 2011, reported a mortality rate of 3.1% in children with acute malnutrition.

#### Chronic malnutrition

Chronic malnutrition was significantly associated with hospital mortality ( $p= 0.018$ ). The death rate of children related to chronic malnutrition was 13.4%. This high mortality rate could be explained by the association with comorbidities such as life-threatening chronic diseases in children.

Ngirabega et al,<sup>10</sup> in Rwanda in 2008, noted that intra-hospital mortality was associated with chronic malnutrition (OR= 4.6 [2.5-8.4] 95% CI). This mortality affected 6.9% of children.

According to Diall et al,<sup>9</sup> in Mali in 2011, the mortality rate of children with chronic malnutrition and underweight was 27%.

#### Underweight

Underweight was significantly associated with hospital mortality ( $p = 0.000$ ). The child death rate related to underweight was 14.1%. The high mortality rate could be explained by the composite nature of this parameter, which takes into account both emaciation and growth retardation which are significantly associated with death in these children.

According to Ngirabega et al,<sup>10</sup> in Rwanda in 2008, intra-hospital mortality was associated with underweight (OR= 4.0 [2.0-8.2] 95% CI).

### Conclusion

This study noted that more than one in ten children died in the pediatric department of the CHU-P from 2018 to 2020. Poor nutritional status is directly or indirectly responsible. Acute malnutrition ( $p=0.005$ ), chronic malnutrition ( $p=0.018$ ) and underweight ( $p=0.000$ ) were associated with hospital mortality. Reducing intra-hospital mortality will require community actions to improve the nutritional status of children.

Considering the retrospective nature of this study which could potentially lead to selection and information biases, a prospective study is desirable in order to better establish the relationship between the pathological nutritional status in the pediatric department and the vital status at discharge.

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### Conflicts of interest

The authors declare that there are no conflicts of interest.

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