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Epidemio-Clinical Profile and Factors Associated with Performance Indicators of Integrated Management of Severe Acute Malnutrition in Children Aged 6 - 59 Months Hospitalized at the Kalaban Coro Reference Health Center

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Abstract

Introduction: Malnutrition is an important reason for consultation in Mali's health facilities and remains a major public health problem. The aim of this study was to describe the epidemioclinical profile and associated factors with performance indicators of integrated management of severe acute malnutrition in children aged 06 to 59 months. **Methodology**: this was a cross-sectional study with retrospective data collection (January 2021 to December 2022). All children hospitalized for severe acute malnutrition in the pediatric department

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and whose medical records were usable were included. Data collected using a standardized questionnaire was analyzed with SPSS Version 20 software. **Results:** A total of 534 children were included. The 12 to 23 months age group (49.1%) and the female sex (53.18%) were the most affected. Fully vaccinated children by age represented 49.4%. The predominant form of malnutrition was marasmus (77.7%). Diarrhea/vomiting (30.3%), fever (18.4%) and cough (15.5%) were the main reasons for consultations. Cure, discontinuation and death rates were 78.5%, 2.1% and 9.2%, respectively. On univariate analysis, the factors statistically associated with performance indicators (cure, dropout, death) were gastroenteritis (P-value < 0.01), malaria (P-value < 0.01) and acute respiratory infections (P < 0.01). **Conclusion:** This study reveals that the frequency of severe acute malnutrition remains high at the Kalaban Coro reference health center. Better prevention of illnesses such as malaria, gastroenteritis, and respiratory infections, as well as timely referral, could help facilitate its management.

Keywords

Children Aged 6 - 59 Months, Severe Acute Malnutrition, Associated Factors, Performance Indicators

1. Introduction

According to the World Health Organization (WHO), malnutrition is a pathological state resulting from the relative or absolute deficiency or excess of one or more essential nutrients, whether manifested clinically, or detectable only by biological, anthropometric or physiological analyses [1]. Acute malnutrition is a devastating public health problem of epidemic proportions [2].

In 2022, WHO estimated that 149 million children under the age of 5 were stunted (too small for their age), 45 million were emaciated (too thin for their height) and 37 million were overweight or obese. Undernutrition is thought to play a role in around 45% of deaths among children under 5. These deaths occur mainly in low- and middle-income countries. At the same time, in these same countries, rates of overweight and obese children are rising [3].

According to a report by FAO *et al.*, some 256.1 million people (20% of the total population) in Africa are undernourished; of these, 239.1 million live in sub-Saharan Africa. Within the sub-Saharan African region, Southern African countries continue to have the lowest burden of undernourishment (5.3 million), while East Africa has the highest burden in terms of numbers (133.1 million) [4]-[8].

In Mali, according to EDSM-VI, the prevalence of global acute malnutrition (GAM) varied by region, with 18.9% in Segou, 13.8% in Mopti and 9.2% in Sikasso, compared with 10.9% in Bamako, 11.4% in Kayes and 9.9% in Koulikoro. The most critical rates were noted in conflict-affected regions such as Kidal, Timbuktu and Gao, where the GAM rate reached 26.7%, 18.9% and 13.3% respectively, but also in some unaffected regions with population growth due to the

migration of refugees from conflict zones, notably the Segou region, where the rate rose from 18.4% to 18.9% between 2013 and 2018 [9].

Reports from the local health information system (LHIS), reported that, 678 children had been treated at the Kalaban Coro Intensive Nutritional Recovery and Education Unit (URENI) against 2810 in the severe ambulatory nutritional recovery and education units (URENAS) between June 2019 and November 2020 with an average of 37 children per month and peaks observed after mass screening campaigns and periods of childhood illnesses such as diarrhea and malaria. From June to December 2019 the proportion of severely acutely malnourished children (SAM) admitted to URENI for medical complications stood at 18.5% against 28.22% recorded between January and November 2020. This disproportion of children admitted to URENI compared to URENAS may demonstrate worsening cases of malnutrition, delayed referrals or unjustified referrals (misdiagnosis).

This state of affairs prompted our study, the aim of which was to describe the epidemioclinical profile of severe acute malnutrition in children aged 06-59 months hospitalized in the pediatric unit of the Kalaban Referral Health Center (RHC). It also aims to determine the factors associated with performance indicators of integrated management of severe acute malnutrition.

2. Methodology

2.1. Type of Study

This was a descriptive cross-sectional study on children aged between 6 and 59 months hospitalized in the pediatric ward of the Kalaban Coro Reference Health Center for severe acute malnutrition.

2.2. Study Location and Period

The Koulikoro region, Mali's 2nd administrative region, comprises 08 health districts. The Kalaban Coro health district, which is the 3rd, had a reference health center, which is the 2nd level of contact for local populations, and 27 community health centers (CHC), which are the first level of contact for communities in Mali's health pyramid.

This study took place from January 1, 2020 to December 31, 2021, in the pediatrics department of the Kalaban Coro Reference Health Center.

2.3. Study Population

The source population consisted of malnourished children aged 6-59 months from the Kalaban Coro health district. The target population consisted of malnourished children of the same age admitted to the Kalaban Coro referral health center for severe acute malnutrition during the study period.

2.4. Inclusion and Exclusion Criteria

All children aged 6 to 59 months admitted to the pediatric unit with a weight/height ratio < −3 Zscore or MUAC < 115 mm with or without nutritional edema were

included in this study. Not included in this study, children whose files could not be used, those whose names did not appear in the hospitalization register, children aged over 5 years; children with chronic malnutrition and children with moderate acute malnutrition.

2.5. Sampling Method

Given the objective of the study, we carried out an exhaustive sampling of all eligible cases registered during the study period.

2.6. Data Collection Procedure and Tools Used

Data were collected from medical records and hospital registers, using a questionnaire designed for this purpose. In addition to the questionnaires, the other tools used were:

- The reference table of the new WHO curves (WHO growth curve from 2006, Z-score P2 table for children aged 6 - 59 months).
- For premature and low birth weight babies, we used the Fenton growth charts which are specifically designed for this. These curves take into account the differences in growth between full-term and premature babies. They are used to assess the weight, length and head circumference of premature babies from birth until 50 weeks postmenstrual age (corrected gestational age).
- Individual follow-up sheets for malnourished people at URENI.
- Copies of the national protocol for the integrated management of acute malnutrition.
- The district nutrition report highlights performance indicators.
- Integrated malnutrition management plan (IMPAM) for community health centers (CHC).
- Growth indices used in this study include height-for-age, weight-for-age, and height-for-age. These indices allow a comprehensive assessment of children's growth and development.
- Z SCORE was used to assess children's growth relative to a reference population. Z SCORES for weight-for-age, height-for-age, and weight-for-height were calculated for each child.

2.7. Data Collected

The variables collected were:

- Socio-demographic characteristics of children and their anthropometric measurements (age, sex, weight, height, brachial perimeter),
- Socio-demographic characteristics of the children's parents or guardians
- Children's clinical data (reason for consultation, dietary history, presence of oedema, associated pathologies, state of dehydration, etc.),
- Nutritional data (admission criteria, forms of malnutrition, type of breastfeeding, type of weaning and causes).

2.8. Data Collection and Analysis

After manual processing, checking and correction of outliers, the data were entered into Microsoft Excel and analyzed using SPSS version 20.

The analysis plan comprised two stages. First, we carried out a descriptive analysis of the study sample. Quantitative variables were described in terms of mean and extremes, and qualitative variables in terms of percentage. Secondly, an association was sought between the indicators of care performance (cure, death, abandonment and referral) and certain potential explanatory variables. The analysis was limited to univariate analysis, and the Chi-Squared Test was used for this purpose. The significance level was set at 5%.

2.9. Ethical Considerations

The purpose of the study was explained to the parents (father, guardian or mother) of each child, and their verbal agreement to the use of their children's medical data to help enrich the scientific data was obtained. Anonymity and confidentiality were respected throughout the study process.

2.10. Operational Definition of Some Variables According to Mali's Protocol of Integrated Management for Acute Malnutrition (10)

- SAM in children aged 6 to 59 months: any patient (child aged 6 to 59 months) who meets at least one of the following criteria is suffering from severe acute malnutrition:
  - P/T (weight/height index) <−3 z-score (WHO 2006 unisex table) or,
  - BP (Brachial Perimeter) < 115 mm,
  - Presence of bilateral edema (+ admission to URENAS; ++ or +++ admission to URENI).
- Cured: who have completed treatment in the Acute and Transition phases and whose condition does not require transfer to URENAS.
- Reference: a reference is defined as a patient who arrives at an URENI from an URENAS, or who arrives from an URENAS in anticipation of an URENAM.
- Abandoned: is defined as a patient absent for two consecutive URENAS weigh-ins, 2 URENAM appointments and 2 URENI days.
- Deceased or death: is defined as a patient who dies during his/her stay in the URENI/URENAS/URENAM program after registration.
- Length of stay: is defined as the time elapsing from the date of admission to the date on which the patient successfully achieves "cured" status (in URENAS) or is successfully treated in URENI; it does not refer to the physical time of discharge from the program or facility.

2.11. Description of Integrated Management of Acute Malnutrition in Mali

According to the IMAM (Integrated Management of Acute Malnutrition) approach

in Mali, there are three malnutrition management units (Figure 1):

- URENI: Intensive nutritional recovery and education unit in the Reference Health Centers (RHC).
- URENAS: Severe Ambulatory Nutritional Recovery and Education Unit in the Community Health Centers (CHC).

URENAM: Moderate Outpatient Nutritional Recovery and Education Unit in Community Health Worker Sites (CWS).

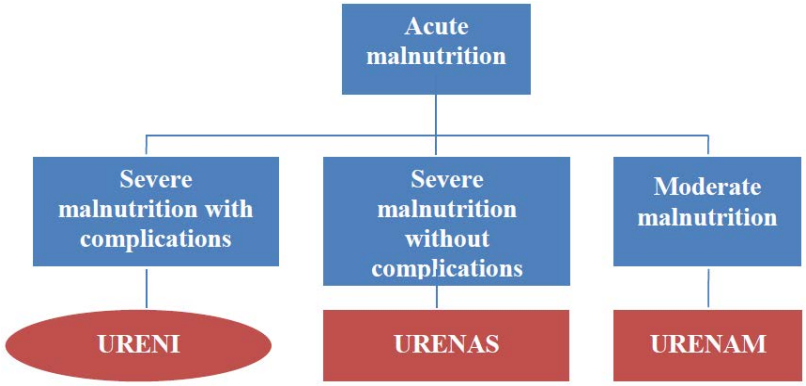

Figure 1. Distribution of acute malnutrition according to care units.

3. Results

During our study period, we collected data on 534 severely acutely malnourished children out of 2836 hospitalized in the department, i.e., a frequency of 18.8%.

3.1. Socio-Demographic Characteristics

3.1.1. Socio-Demographic Characteristics of Children

A total of 534 children aged 6 to 59 months meeting the inclusion criteria were enrolled. The mean age was 25.75 ± 48 months, with extremes of 9 and 48 months. The age range most represented was 12 to 23 months, and females were most affected. In terms of vaccination status, almost half (49.4%) of the children had received all the vaccines according to their age, 35.6% incompletely vaccinated and 15% were never vaccinated (Table 1).

Table 1. Sociodemographic characteristics of children aged 6-59 months admitted to the pediatrics department of Kalaban Coro HRC, January 2020-December 2021.

Variables	Number (N)	Percentage (%)	M ± SD*
Age range (months) n = 534			25.75 ± 48
[06 - 11]	172	32.2	
[12 - 23]	262	49.1	
[24 - 35]	77	14.4	
[36 - 59]	23	4.3	
Gender (n = 534)			
Female	284	53.18	
Male	250	46.82	
Parents' residence (n = 534)			

Continued

Kalaban Coro district	364	68.16
Outside Kalaban Coro district	170	31.83
Vaccination status		
Correctly vaccinated (full vaccination)	264	49.4
Incorrectly vaccinated (incomplete vaccination))	190	35.6
Never vaccinated	80	15.0

M ± SD*: Means Standard deviation.

3.1.2. Parents' Socio-Demographic Characteristics

The most represented age group was 20 - 40, with 77.5% (n = 414) of fathers and 63.1% (n = 337) of mothers. The majority of parents (31.8%; n = 170) of fathers and 38.6% (n = 206) of mothers were illiterate. The majority of fathers were married (95.9%; n = 512), with polygamy the most common matrimonial regime (89.0%; n = 475).

Approximately 96.1% (n = 513) mothers were married, 71.7% (n = 383) were housewives and 43.3% (n = 231) were primiparous, 41.4% (n = 221) were multiparous and 15.5% (n = 82) were large multiparous. The majority of the children's parents (83.18%) came from the urban commune of Kalaban Coro.

The average income of children's mothers was respectively 2.500 FCFA (less than 10 US Dollars) per month for housewives and 85.000 FCFA (less than 200 US Dollars) for civil servant mothers and those with income-generating activities. The average income of fathers was 45,000 FCFA (approximately 76.5 US Dollars) for workers and 150.000 FCFA (approximately 255 US Dollars) for state employees.

3.2. Children's Clinical and Nutritional Profiles

The clinical and nutritional profile of the children are described in Table 2. With regard to clinical data, diarrhea/vomiting (30.3%; n = 162), fever (18.4%; n = 98), cough (15.5%; n = 83) and anorexia (15%; n = 80) were the main reasons for consultation; 68.5% (n = 365) of children were admitted spontaneously. Thirty-five patients (6.5%) had a history of malnutrition. The main clinical signs included hypothermia in 60.9% (n = 325) of case, hypoglycemia in 56.2% (n = 300) of case, candidiasis (49.1%; n = 262), bilateral oedema (22.1%; n = 118), dehydration folds /denutrition folds (12.5%; n = 76), conjunctival pallor (6.7%; n = 36) and a prominent abdomen (5.4%; n = 29).

Nutritional inclusion criteria included weight/height ratio < −3 Z-Score in 38.9% (n = 208), brachial perimeter (BP < 115mm) in 38.6% (n = 206) and bilateral oedema in 22.5% (n = 120). Marasmus was the most frequent form of malnutrition with 77.9% (n = 416) of cases, followed by Kwashiorkor (17%; n = 91) and the mixed form (5.1%; n = 27).

Breastfeeding was not exclusive in 82.2% (n = 439), artificial in 3.7% (n = 20) and mixed in 8.2% (n = 44). Supplementary feeding had been introduced before the 6th month of life in 44.4% (n = 237), between 6 and 12 months in 43.4% (n =

232) and beyond 12 months in 12.2% (n = 65). The weaning age was less than 6 months in 3.6% (n = 19), between 6 to 12 months in 8.2% (n = 44), between 13 to 18 months in 9.6% (n = 51) and more than 18 months in 31.6% (n = 166). The type of withdrawal was gradual in 37.8% (n = 202) and abrupt in 15.2% (n = 81). The causes of weaning were the required age according to the mothers (65%; n = 184), close pregnancy (20.5%; n = 58) and illnesses of the child and/or the mother (7.5 %; n = 20).

The length of hospital stay was between 8 and 14 days in 49.8% of cases, with an average of 8.5 ± 10.1 days.

Table 2. Clinical and nutritional data for children aged 6-59 months admitted to the pediatric ward of Kalaban Coro HRC, January 2020-December 2021.

Variables	Number	Percentage (%)	M ± SD*
***Children's clinical data* (*n* = 534)**			
Reason for consultation			
Fever	98	18.4	
Cough	83	15.5	
Diarrheas/Vomiting	162	30.3	
Weight loss	53	9.9	
Anorexia	80	15	
Other (altered consciousness, convulsion, bloating)	58	10.9	
Type of admission			
Spontaneous	365	68.4	
Referral	169	31.6	
Family history of malnutrition			
Yes	35	**6.5**	
Non	499	**93.5**	
Physical examination signs			
Hypothermia	325	60.9	
Edema	118	22.1	
Candidiasis	262	49.1	
Pallor	36	6.7	
Dehydration/ malnutrition	67	12.5	
Prominent belly	29	5.4	
Visible ribs	15	2.8	
Other (dry skin, fine hair, stunted growth)	7	1.3	
Hypoglycemia	300	56.2	
***Nutritional data for children* (*n* = 534)**			
Admission criteria			
P/T < −3 Z-Score	208	38.9	
PB < 115mm	206	38.6	
Bilateral edema	120	22.5	
Type of malnutrition			
Marasmus	416	77.9	
Kwashiorkor	91	17	
Mixed	27	5.1	

Continued

Type of feeding before 6 months			
Breast-feeding	439	82.2	
Formula feeding	20	3.7	
Mixed breastfeeding	44	8.2	
Supplementary feeding	31	5.8	
Age of introduction of complementary food (months)			
Under 6	237	44.4	
[6 - 12]	232	43.4	
Over 12	65	12.2	
Weaning age (months)			
Below 6	19	3.6	
[6 - 12]	44	8.2	
[13 - 18]	51	9.6	
Greater than 18	169	31.6	
Type of weaning			
Progressive	202	37.8	
Abrupt	81	15.2	
Not weaned	251	47	
Reason for weaning			
Pregnancy	58	20.5	
Weaning age according to mother	184	65	
Illness (mother and/or child)	21	7.4	
Other (refusal to breastfeed; abandonment by mother; mother's death)	20	7.1	
Length of hospitalization			8.5 ± 10.1

3.3. Period of Admission of Children Aged 6 to 59 Months to the Pediatric Ward of the Kalaban Coro Referral Health Center

The highest admission frequencies were observed in September (15%), July (14.4%) and October (14.2%), with extremes in August and September (4.5%-15%). These periods are known as the hunger gap in Mali **(**Figure 2**).**

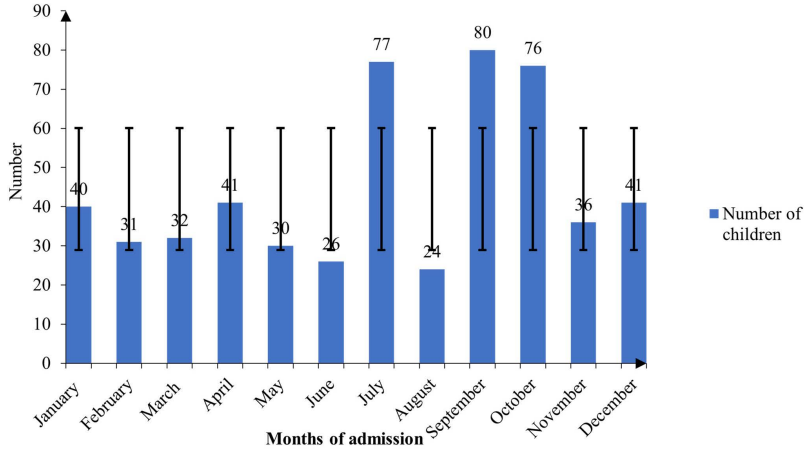

Figure 2. Admission of children depending on month.

3.4. Associated Pathologies

Digestive disorders (39.3%; n = 210), malaria (35.4%; n = 189), acute respiratory infections (14.2%; n = 76), measles (3.6%; n = 19), HIV/AIDS (2.4%; n = 13) and meningitis (1.9%; n = 10) were the associated pathologies encountered (Table 3).

Table 3. Distribution of patients according to the underlying diseases encountered.

Comorbidities	Number (n)	Percentage (%)
Gastroenteritis	210	39.3
Malaria	189	35.4
Acute respiratory infections	76	14.2
Measles	19	3.6
HIV/AIDS	13	2.4
Meningitis	10	1.9
Others (cutaneous staphylococcal disease, motor and cerebral palsy…)	17	3.2

3.5. Performance Indicators for the Management of Severe Acute Malnutrition

Indicator performance was marked by recovery (82.3%), drop-out (2.1%), transfer (6.4%) and death (9.2%). Monitoring was done once a week during the first month and once every two weeks during the 2nd and 3rd months. The causes of death were severe dehydration (42.9%; n = 21), malaria (34.7%; n = 17) and respiratory conditions (18.4%; n = 9) (Figure 3).

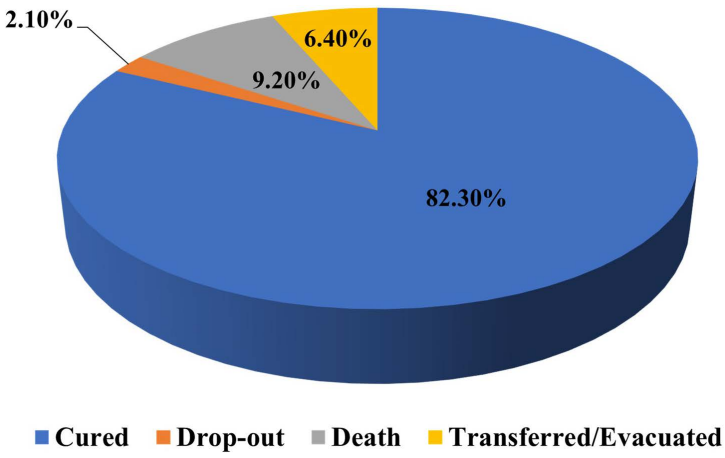

Figure 3. Performance indicators for the management of severe acute malnutrition.

3.6. Analysis of Associated Factors with Performance Indicators of the Management of Severe Acute Malnutrition in Children Aged 6 - 59 Months

In univariate analysis, the factors statistically associated with performance indicators (cure, drop-out, death) were gastroenteritis (P-value < 0.01), malaria (P-value < 0.01) and acute respiratory infections (P < 0.01). Type of admission and length of hospital stay were not statistically associated with child outcome (p > 0.05) (Table 4).

Table 4. Factors associated with performance indicators for the management of severe acute malnutrition in children aged 0 - 59 months hospitalized in the pediatric ward of Kalaban Coro RHC, January 2020-December 2021.

Variables	Outcome of hospitalized children (performance indicators)			
	Cured (%)	Deaths (%)	Drop-out (%)	*p-value*
Pathologies				
Malaria (n = 534)	153(34.8)	24(59.2)	02(18.2)	P < 0.01
ARI* (n = 534)	54(12.3)	10(20.4)	02(18.2)	P < 0.01
Gastroenteritis (n = 534)	184(41.8)	09(18.4)	07(63.6)	P< 0.01
Type of admission				
Spontaneous admission	311(70.7)	30(61.2)	04(36.4)	
Referred to CSRéf	129(29.3)	19(38.8)	07(63.3)	P > 0.05
Length of hospital stay (days)				
[1 - 7]	178(40.5)	20(40.8)	02(18.2)	
[8 - 14]	221(50.2)	20(40.8)	07(63.6)	P > 0.05
>=* 15	41(9.3)	09(18.4)	02(18.2)	

>=*: greater than or equal to; ARI*: Acute Respiratory Infections.

4. Discussions

4.1. Socio-Demographic Characteristics

The aim of this study was to describe the epidemioclinical profile and determinants of performance indicators for the management of severe acute malnutrition in children aged 06-59 months in the pediatric ward of the Kalaban Coro referral health center in the Koulikoro region.

The 12 - 23 months age bracket and the female sex were the most affected, as in several studies reported in the literature [4] [10]-[14]. From a sociological point of view, this predominance of females is a major advantage in terms of the quality of care given to children and the quality of nutritional advice given. The predominance of the 12 - 24 months age group has been reported by several other authors [11] [13]-[15]. Malnutrition at this age could be explained by inadequate dietary diversification, done early or late or with unsuitable complementary foods, or early ablactation following the onset of a new pregnancy. It could also be the result of insufficient food consumption, poor practice of food hygiene rules and/or poor attendance at health services. In our context, one of the root causes of the occurrence of malnutrition in the 12 - 23 months age group is the poor knowledge of populations about good nutritional practices.

Vaccination is an intervention that protects children against many diseases and strengthens their immune systems in the face of numerous aggressions. Despite these facts, many African children do not benefit from this intervention, which is one of their fundamental rights. In our study, less than half (49.4%) of the children included had the correct immunization status for their age. However, the proportion of fully vaccinated children in our study considered low is higher than the

44% reported by Bire and Shifeta in a study carried out in Ethiopia. The low proportion of vaccination coverage observed in our series could be explained on the one hand, by the non-compliance with the vaccination schedule by the parents of children and on the other hand, by the low effectiveness of advanced and mobile strategies which were largely impacted. by the security crisis. This unfortunate observation requires the implementation of local strategies to achieve vaccination targets in a context of insecurity.

As for the parents' characteristics, most of them were illiterate and had no stable source of income. Indeed, the average income of children's mothers was respectively 2.500 FCFA (less than 10 US Dollars) per month for housewives and 85.000 FCFA (less than 200 US Dollars) for civil servant mothers and those with income-generating activities. The average income of fathers was 45,000 FCFA (approximately 76.5 US Dollars) for workers and 150.000 FCFA (approximately 255 US Dollars) for state employees. In addition to this, there are in our context, demographic factors that influence the nutrition and health of children in particular. In fact, 89.0% of fathers were polygamous and 15.5% of mothers were multiparous. Our data corroborate those reported in the literature series [15] [16]. As a result, families with low or unstable incomes and large families are more exposed to malnutrition. This exposure manifests itself at the family level in chronic undernourishment, which in turn leads to malnutrition.

4.2. Epidemiological-Clinical and Nutritional Profiles of Children

Five hundred and thirty-four severely acutely malnourished children out of two thousand eight hundred and thirty-six hospitalized in the department were enrolled, representing a frequency of 18.8%. Although this frequency is lower than that reported by some authors [17] [18], it remains very high for a pathology considered avoidable through the adoption of simple measures such as exclusive breastfeeding, vaccination and good nutritional practice. The root cause of the non-application of these measures is the illiteracy or low level of education of the population in general. The highest admission frequencies were observed in September (15%), July (14.4%), and October (14.2%). These periods are known as lean times in Mali, when many households are unable to provide the three meals of the day. These periods are also times of high frequency of certain pathologies such as malaria and gastroenteritis which are part of the immediate causes of malnutrition.

In terms of clinical features, diarrhea/vomiting, fever, cough and anorexia were, in order of frequency, the main reasons for consultation. Thirty-five patients (6.5%) had a history of malnutrition. This situation would reflect a system problem due to the poverty of families in terms of their monthly income and the low level of knowledge of the populations. The main signs on physical examination included candidiasis (49.1%), bilateral oedema (22.1%), dehydration/denutrition folds (12.5%), conjunctival pallor (6.7%) and a prominent abdomen (5.4%). A similar trend was reported in work by SANOGO M Y [19]. These signs are fairly

frequent in malnourished children, and can be explained by the fact that their immune system is weakened, making them more vulnerable than others to comorbidities. Poor individual and collective hygiene practices, combined with incomplete immunization status according to age, encourage the recrudescence of these signs in malnourished children.

From a nutritional point of view, admission or hospitalization criteria were based on the results of anthropometric measurements such as weight/height ratio, brachial perimeter (BP) and the search for edema of the lower limbs. Weight/height ratio < −3 Z-Score and brachial perimeter (BP) < 115 mm accounted for 38.9% and 38.6% respectively. These data were lower than the 56.1% reported by Nguefack *et al.* [20] and the 58.8% reported by Kahinda *et al.* [21].

Marasmus was the most frequent form of malnutrition with 77.9% of cases, followed by Kwashiorkor (17%) and the mixed form (5.1%). Our results are clearly inferior to those reported in studies conducted by Coulibaly AT [15], but close to those of this author [22]. The predominance of the slump in our study could partly be explained by the deterioration of the food situation and poverty which are aggravated by the multidimensional crisis that our populations are experiencing.

Despite sufficient advice being given during antenatal and postnatal consultations on the benefits of early breastfeeding, exclusive breastfeeding and nutrition plans during pregnancy, breastfeeding and infant and young child feeding, beliefs cultural, low level of education of parents and poverty prevent them from correctly following all the advice received and remains a challenge in our communities, as confirmed by our study. Indeed 82.2% of children were not exclusively breastfed until the 6th month of life and weaning was abrupt in 15.2% of cases. As for weaning, it is not carried out under the right conditions. Weaning is usually decided abruptly, without taking the minimum food diversification measures necessary for the child. According to the standards, diversification must take place from 6 months. In our context, the common fact is that this weaning is generally done suddenly without diversification beforehand. It occurs during a new pregnancy or an illness, which makes it difficult for the child to overcome, thus leading to a breakdown in nutritional balance and an immune deficiency. In addition, illiteracy promotes traditional beliefs about food taboos. According to these beliefs, children's consumption of certain foods such as fish, meat and eggs would lead them to theft. In our contexts, children were essentially given family dishes as a substitute food, and even if the opposite occurred, mothers were generally unaware of when and how to diversify or ablactate.

As in the study conducted by Maïga M *et al.* [23], the main causes of withdrawal cited in the study were age as defined by the mothers (65.0%), close pregnancy (20.5%) and illness of mother and/or child (7.4%). This reflects a problem with the adoption of modern contraceptive methods by parents which remains a very sensitive phenomenon in many environments.

4.3. Underlying Diseases

The diagnosis of underlying pathologies was made after screening for severe acute

malnutrition in subjects aged 6-59 months admitted to the Kalaban Coro reference health center for various reasons. Gastroenteritis followed by malaria, acute respiratory infections and HIV/AIDS were the main pathologies associated with malnutrition in our study. This same trend was reported in a study carried out in Mali in 2019 [23] but different from that reported in the studies conducted by Bire and Shifeta where anemia followed by pneumonia and gastroenteritis predominated [24]. The proportion of patients infected with HIV (2.4%) observed in our study was close to that (2.2%) reported in a study carried out in Uganda in 2021 [25] but much lower than those reported in the work of several other series in the literature [20] [21] [26] [27]. This difference could be explained by the non-systematization of HIV screening in our malnutrition treatment units, even though they can be the gateway to entry. Malaria represented 35.4% in our study and was the second comorbidity. This could be explained by the endemicity of this pathology and the inadequacy of non-compliance with preventive measures. This proportion is lower than 39.1% reported by Odikro *et al.* [23] but higher than the 19% and 20% reported in work carried out respectively in Cameroon [24] and Niger [28].

In this study, we did not look for the pathologies causing malnutrition in our hospitalized children. However, the high frequency of underlying diseases strongly directs us towards causality or the contribution of these pathologies in the occurrence of malnutrition in our patients given that these underlying pathologies are considered as immediate causes of malnutrition according to the literature [29].

4.4. Performance of Indicators

The evolution of patients was marked by cure (82.3%) for a reference threshold above 75%, death (9.2%) versus a reference below 10% in URNAS and URENI, and abandonment (2.1%) for a reference value below 15% in URENAS and URENI. We recorded 6.4% referrals to a higher structure, including 1.9% for lack of space and 4.5% for medical transfer. All these performance indicators are acceptable according to IMAM standards in Mali [30]. This performance could be explained by the very low frequency of input shortages, the capacity-building of IMAM providers and the close follow-up of patients.

The drop-out rate observed in our series could be explained mainly by the parents' lack of financial means for the management of associated pathologies, or their desire to return home for other family problems. As for the deaths that did occur, they could be caused, on the one hand, by an alteration in the immune system associated with malnutrition, making the children highly vulnerable, and on the other hand, by a late consultation and/or referral of malnourished patients, which usually takes place after the onset of complications.

The length of hospitalization generally depends on the course of the disease. In our study, the majority of patients (49.8%) had a hospital stay of between 8 and 14 days, which is lower than the reference value (< 4 weeks) indicated in the integrated management of acute malnutrition, but close to the WHO standards, which

indicate a length of stay of 7 - 10 days at the URENI [14].

In view of these findings, strengthening communication for development (C4D) activities is one of the communication approaches needed to help reduce this rate. This communication, focused on behavioral change, is an "interactive process for the development of specific messages and approaches using various communication channels with the aim of encouraging and supporting appropriate positive behaviors". These desired behaviors include adherence to treatment, and respect for therapeutic follow-up. Other approaches, such as the use of community relays and community platforms, could play an important role in raising community awareness.

4.5. Factors Associated with SAM Management Performance Indicators

Associated pathologies can be either a direct cause of the occurrence of malnutrition, or a consequence of malnutrition due to the vulnerability of the state of health of persons in case of malnutrition or vice versa. In our study, the factors statistically associated with performance indicators (cure, abandonment, death) were gastroenteritis (P-value < 0.01), malaria (P-value < 0.01) and acute respiratory infections (P < 0.01). These results confirm data from the literature, where these pathologies have been identified as independent factors associated with the occurrence of death in children under five years of age [31]-[34].

Contrary to the literature, type of admission and length of hospital stay were not statistically associated with outcome in our study (p > 0.05).

5. Conclusions

This study shows that the frequency of severe acute malnutrition remains high at the Kalaban Coro CSRéf. Factors associated with patient outcome were gastroenteritis, malaria and acute respiratory infections.

Better prevention of comorbidities and timely referral could help improve management performance indicators.

Study Limitations

The main limitation of this study concerned data collection from medical records and hospitalization registers. Some information, such as the three delays in patient referral/evacuation (delay in parents' decision to use the health service, delay linked to geographical accessibility and delay in care linked to the health facility) was not available. It was also difficult to make use of these data because of the quality of the archiving.

Data analysis was also limited to a univariate analysis, which did not allow confounding factors to be identified.

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Conflicts of Interest

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

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