


Biological Abnormalities in Severe Acute Malnutrition in Children Aged 1 to 59 Months at the National Hospital of Niamey in 2024

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Abstract

Introduction: Severe Acute Malnutrition remains a major public health problem among children under 5 years in Niger. The objective of this work was to study biological abnormalities in Severe Acute Malnutrition at the National Hospital of Niamey. **Materials and Methods:** This was a descriptive and analytical cross-sectional study conducted from January 2023 to December 2024 at the National Hospital of Niamey. The study covered children aged 1 to 59 months admitted for Severe Acute Malnutrition. The variables studied were related to blood count abnormalities, blood ionogram disturbances, and microbiological abnormalities. Data analysis was performed using Sphinx Plus Version 5.0 software. **Results:** Of 5439 children hospitalized, 300 children (5.5%) with Severe Acute Malnutrition were recorded. The mean age of patients was 14.48 months \pm 9.08 [1 - 59 months]. Fever (79.3%) and diarrhea (72.7%) were observed. Blood count analysis showed anemia in 97.3% of patients. Moderate anemia was present in 51.4% of cases and severe anemia in 29.8% of patients. In white blood cell count, hyperleukocytosis was found in 63.7%. Thrombocytosis was found in 25.7%. Blood ionogram abnormalities included hyponatremia (62.9%) and hypokalemia (50.6%). Hypoglycemia was present in 66% of patients. Urinalysis was positive in 36% of cases. The main germ found was *Escherichia coli* in 5.3%. Stool culture was positive in two (2) patients. **Conclusion:** Blood count abnormalities such as anemia, hyperleuko-

cytosis, and thrombocytosis are frequent. Hypoglycemia, hyponatremia, and hypokalemia are also common. Biological disturbances must be systematically screened for the adequate management of the patients.

Keywords

Severe Acute Malnutrition, Anemia, Hypoglycemia, Hyponatremia, Niger

1. Introduction

Severe Acute Malnutrition remains a major public health problem among children under 5 years of age worldwide [1] [2]. In Niger, it was one of the causes of morbidity and mortality in children [3] [4]. It is responsible for several clinical and paraclinical abnormalities. Indeed, metabolic disorders and secondary hematological abnormalities have been reported as a result of nutritional deficiency or associated complications. These abnormalities are a major cause of morbidity and often worsen the child's prognosis [5] [6]. In our context, few studies have been conducted on these morbid entities. The objective of this work was to study biological abnormalities in Severe Acute Malnutrition at the National Hospital of Niamey.

2. Materials and Methods

2.1. Type and Period of Study

This was a descriptive and analytical cross-sectional study conducted over a one-year period, from January to December 2024.

2.2. Study Population

The study covered children aged 1 to 59 months admitted for Severe Acute Malnutrition to the Internal Nutritional Recovery Center (INRC) at the National Hospital of Niamey.

2.2.1. Inclusion Criteria

Children admitted for whom biological tests were performed, including at least a complete blood count, blood ionogram (sodium and potassium levels), bacteriological cultures (cytobacteriological examination of urine [CBEU] and stool culture), and thick smear, were included.

2.2.2. Exclusion Criteria

Children transferred to other departments before the end of treatment and those who left the hospital were excluded from the study.

2.2.3. Sampling Method and Sample Size

The minimum sample size was calculated using the SCHWARTZ formula:

$$n = \varepsilon \hat{\alpha}^2 \times pq \div x^2$$

where p is the prevalence of acute malnutrition, $q = 1 - p$; α = the accepted risk of error (5%), \mathcal{E} = reduced deviation at alpha risk (α) = 1.96 and 95% precision, i = desired precision (0.01). With a prevalence of 51.2% according to a hospital study in Niger [7], an error risk α of 5%, a reduced deviation at risk α of 1.96 and the desired precision i of 0.01, the minimum sample size was approximately 240 cases. For convenience, 300 patients meeting the inclusion criteria were studied.

2.3. Variables Studied

The variables studied were related to the general characteristics of the children (age, sex, clinical signs, treatment). Next, blood count abnormalities (presence of anemia, leukocytosis, and platelets) and ionogram disturbances (hyponatremia, hypokalemia) were explored. Finally, microbiological abnormalities (urinalysis, stool culture), variables related to associated diagnoses, and evolutionary aspects were studied.

2.4. Diagnostic Criteria and Operational Definition of Variables

Severe Acute Malnutrition was diagnosed according to WHO methods [8]. Anemia was defined as a hemoglobin level below 10 g/dL (moderate between 10 g/dL and 5 g/dL, and severe if <5 g/dL). Hyperleukocytosis was defined as a white blood cell count $> 10,000$ cells/mm³, and leukopenia as <5000 cells/mm³. For platelets, thrombocytosis was defined as a platelet count $> 450,000$ cells/mm³, and thrombocytopenia as $< 150,000$ cells/mm³. Hypoglycemia was defined as a venous blood glucose level below 3.3 mmol/L, hyponatremia as a serum sodium level < 130 mmol/L, and hypokalemia as a serum potassium level < 3 mmol/L.

2.5. Data Collection and Analysis

Data were collected from patient medical records and patient monitoring forms. Data entry and analysis were performed using Sphinx Plus Version 5.0 software. Data were expressed as numbers and proportions for the descriptive part. Pearson's chi-square test or Fisher's exact test was used to investigate the relationship between qualitative variables. The test was non-significant if the p -value (p) was less than 0.05.

3. Results

3.1. Characteristics of the Study Population

A total of 300 children (5.5%) were included out of the 5439 children hospitalized in the department during the study period. The 12- to 24-month age group was the most represented (46.3%). The mean age of patients was 14.48 months \pm 9.08 [1 - 59 months]. The sex ratio was 1.41. Fever, diarrhea, and vomiting were the main reasons for consultation, with 79.3%, 72.7%, and 66.7% respectively. Physical examination revealed severe weight loss, moderate skin and mucosal pallor, and dehydration in 85.3%, 48.7%, and 11.4%, respectively. Lethargy was also found in 70% of patients. Marasmus was the most common clinical form (77.3%).

Nutritional treatment based on therapeutic milk was instituted in all patients. Antibiotic therapy, antimalarial treatment, and oral rehydration were administered in 96.7%, 40.7%, and 33.7% of cases, respectively.

3.2. Blood Count and Biochemical Abnormalities

Blood count data are shown in **Table 1**. Blood count analysis showed anemia in 97.3% of patients. It was moderate anemia in 51.4% of cases and severe in 29.8% of patients. In the white blood cell count, hyperleukocytosis was found in 63.7%. Thrombocytosis and thrombocytopenia were the abnormalities found in platelets, with 25.7% and 7.7% respectively. Blood ionogram abnormalities (**Table 2**) included hyponatremia (62.9%) and hypokalemia (50.6%). Hypoglycemia was present in 66% of patients.

Table 1. Blood count results.

Blood count	Number (N)	Percent (%)
Hemoglobin level (N = 300)		
Normal	8	2.7
Anemia	292	97.3
Severity of anemia (N = 292)		
Mild	55	18.8
Moderate	150	51.4
Severe	87	29.8
Leukocytosis (N = 300)		
Normal	80	26.7
Leucopenia	29	9.6
Hyperleukocytosis	191	63.7
Platelet level (N = 300)		
Normal	200	66.6
Thrombopenia	23	7.7
Thrombocytosis	77	25.7

Table 2. Blood ionogram and sugar level.

Variables	Number (N)	Percent (%)
Ionogram (N = 178)		
Sodium level		
Normal	58	32.6
Hyponatremia	112	62.9
Hypernatremia	8	4.5

Continued

Potassium level		
Normal	84	47.2
Hypokaliemia	90	50.6
Hyperkaliemia	4	2.2
Blood sugar level (N = 300)		
Normal	68	22.7
Hypoglycemia	198	66.0
Hyperglycemia	34	11.3

3.3. Microbiological Abnormalities

Table 3 shows the results of microbiological and serological tests (urinalysis, stool culture, thick smear, and human immunodeficiency virus [HIV] serology). Stool culture was performed in 34.7% of cases (N = 104), with only two (2) positive results (*Escherichia coli*). Urinalysis was performed in 43.3% of patients, with a positive culture in 7.8% of cases. The main germ found was *Escherichia coli* in 5.3% of the samples tested. HIV serology was requested for all patients, with only one (1) positive result (0.3%).

Table 3. Microbiological results.

Bacterial analysis	Number (N)	Percent (%)
Stool culture (N = 104)		
<i>Escherichia coli</i>	2	1.9
Absence of pathogenic germs	102	98.1
Cyto-bacteriological examination of urine (N = 130)		
<i>Escherichia coli</i>	7	5.3
<i>Staphylococcus aureus</i>	1	0.8
<i>Klebsiella oxytoca</i>	1	0.8
<i>Serratia odorifera</i>	1	0.8
Absence of pathogenic germs	120	92.3
HIV serology (N = 300)		
Positive	1	0.3
Negative	299	99.7

3.4. Associated Pathologies and Evolutionary Aspects

The main associated pathologies were malaria (38.7%), and suspected urinary tract infection (34.6%) or digestive tract infection (43.3%). Seven (7) deaths were reported (2.3%). No links were found between blood count abnormalities (ane-

mia, leukocytosis, and platelet abnormalities), ionogram disturbances (hyponatremia, hypokalemia), hypoglycemia, and deaths ($p > 0.05$).

4. Discussion

Based on the results obtained, this study found a high frequency of biological disturbances associated with Severe Acute Malnutrition. The limitations of this study were mainly related to the non-exhaustiveness of the biological tests, in particular the exploration of micronutrients such as iron, vitamins, and other nutritional markers. In addition, antibiotic therapy, which is almost systematic in children suffering from Severe Acute Malnutrition, also probably limited the positivity of microbiological tests. Another limitation of the study is the relatively small sample size, which may affect the power of the statistical tests used to detect significant associations between biological abnormalities and mortality.

Blood count abnormalities such as anemia have been reported by other authors, with varying proportions [8]-[12]. The data found in this study regarding anemia differed from those reported by Traore *et al.* in Mali [13], where the authors found a higher proportion of severe anemia, with 19% of cases. Mikolele-Bilombo *et al.* [10] in Congo Brazzaville also reported a different profile, with varying degrees of anemia in all patients. Anemia during Severe Acute Malnutrition has multiple causes [5] [6] [14]. On the one hand, it is a deficiency anemia. In severe acute malnutrition, there is a quantitative deficiency of micronutrients in the body, some of which are essential for hematopoiesis. These include iron, folic acid, and vitamin B12. Unlike the present study, some authors have been able to measure the levels of these micronutrients. Panda *et al.* reported a frequency of hypoferritinemia, indicating iron deficiency, in 31.6% of malnourished children [15]. Another study on microcytic anemia, conducted by Malam-Abdou *et al.*, found that 32% of children were malnourished and 9% had iron deficiency anemia [16]. On the other hand, malnourished children have compromised immune systems, which predisposes them to infections and therefore to inflammatory anemia [14]. To combat anemia and micronutrient deficiencies in general, the WHO has developed enriched milk formulas for the treatment of nutritional deficiencies [17]. Furthermore, these observations suggest regular monitoring of the status of the micronutrients concerned in order to implement a supplementation strategy with a view to reducing the associated morbidity.

The hyperleukocytosis or leukopenia found in this study has also been reported by other authors [15] [18]. The leukocytosis observed during severe acute malnutrition is thought to be secondary to micronutrient deficiencies responsible for immune system dysfunction [18] [19]. These disorders expose children to repeated bacterial, viral, or parasitic infections, complicating the clinical picture. These infectious diseases are sometimes obvious, but more often than not, active investigation is required, as recommended by the management protocol [17]. Infections are screened for by performing bacterial cultures (blood cultures, stool cultures, and urine cultures).

In this study, bacterial cultures performed on patients were mostly negative, raising the issue of routine antibiotic therapy in children suffering from severe acute malnutrition. HIV screening is also routine according to the national protocol for the prevention and management of acute malnutrition in Niger [20]. This was found in one case in the present study. This result differs from those of Traore *et al.* and Nkumisongo *et al.*, who reported 12.90% and 19.3% of cases positive for HIV [13] [21]. The increased susceptibility to infection in children suffering from severe acute malnutrition also explains the high frequency of malaria found in this study. Malaria infection was also reported in a study in the Democratic Republic of Congo with a lower frequency (16.1%) [21].

Glycemic regulation disorders, particularly hypoglycemia, were present in about one-third of patients. This result is similar to that of Traore *et al.* [13], who found hypoglycemia in 45% of cases. This frequency of hypoglycemia is probably correlated with the frequency of lethargy found in the majority of patients on admission. Hypoglycemia is quite common in malnourished children due to oxidative stress [22]. This predisposition to hypoglycemia has led the national protocol for the prevention and management of acute malnutrition to systematically recommend a glucose bolus, either through hypertonic glucose serum or therapeutic milk [20]. Ionic disorders such as hyponatremia and hypokalemia reported could be explained by the high frequency of fluid loss, particularly diarrhea and vomiting. This leads to dehydration, which has been reported in other studies with varying frequencies [7] [23]. These abnormalities must be actively screened for and adequately managed, as they are a source of morbidity and mortality.

5. Conclusion

Biological abnormalities are common in cases of Severe Acute Malnutrition in our context. The main blood count abnormalities were anemia, hyperleukocytosis, and thrombocytosis, suggesting systematic screening in malnourished children. The ionogram revealed hyponatremia and hypokalemia in patients that are often secondary to dehydration. Hypoglycemia, a feared complication, was also common. Bacterial infections were weakly positive, with *Escherichia coli* being the most commonly found germ. These biological disturbances must be systematically screened for and lead to a rigorous diagnostic approach and adequate management.

Conflicts of Interest

There are no conflicts of interest.

References

- [1] United Nations Children's Fund (UNICEF) (2025) Un enfant sur quatre dans le monde est en situation de pauvreté alimentaire sévère en raison des inégalités, des conflits et des crises climatiques. <https://www.unicef.org/fr/communiqués-de-presse/un-enfant-sur-quatre-dans-le-monde-est-en-situation-de-pauvrete-alimentaire>

- [2] Wambua, J., Ali, A., Ukwizabigira, J.B. and Kuodi, P. (2025) Prevalence and Risk Factors of Under-Five Mortality Due to Severe Acute Malnutrition in Africa: A Systematic Review and Meta-Analysis. *Systematic Reviews*, **14**, 29. <https://doi.org/10.1186/s13643-024-02740-9>
- [3] Ministère du Plan and Institut National de la Statistique du Niger (2025) Annuaire statistiques du Niger 2024. MP, INS. <https://snis.ne/annuaire-statistiques/>
- [4] Ministère du Plan and Institut National de la Statistique du Niger (2022) Rapport final de l'enquête nationale de nutrition réalisée en 2020 par la méthodologie SMART. MP, INS. <https://snis.ne/annuaire-statistiques/>
- [5] Roulet, M., Cheseaux, M. and Coti, P. (2005) Conséquences de la dénutrition chez l'enfant et l'adolescent. Mortalité, morbidité, conséquences médicoéconomiques. *Nutrition Clinique et Métabolisme*, **19**, 207-213. <https://doi.org/10.1016/j.nupar.2005.09.011>
- [6] Noel, A., Morel, F.B. and Marion-Letellier, R. (2024) La malnutrition aiguë sévère: De la physiopathologie à la prise en charge. *Nutrition Clinique et Métabolisme*, **38**, 2-10. <https://doi.org/10.1016/j.nupar.2023.11.003>
- [7] Soumana, A., Kamaye, M., Assoumane, M. and Hamsatou, D. (2014) Contribution à l'étude prospective de la malnutrition sévère chez les enfants de 6 à 59 mois au Niger: Cas du District Sanitaire de Madaoua, dans la Région de Tahoua. *Annales de l'Université Abdou Moumouni*, **16**, 118-125.
- [8] Organisation mondiale de la santé (OMS) and Fonds des Nations Unies pour l'Enfance (UNICEF) (2009) Normes de croissance OMS et identification de la malnutrition aiguë sévère chez l'enfant. OMS, UNICEF. <https://iris.who.int/>
- [9] Labo, Z.A., Issa, A.A., Attinine, A.S., Daouda, S. and Labo, B.S. (2023) Factors Associated with Chronic Malnutrition among Children Aged 0-59 Months in Niger. *Health Research in Africa*, **1**, 54-59.
- [10] Mikolele-Bilombo, C., Atipo-Ibara Ollandzobo, L., Ahoui-Apendi, C., Ocko Gokaba, L.T., Mabilia Babela, J.R. and Ibara, J.R. (2019) Anomalies de l'hémogramme au cours de la dénutrition sévère chez l'enfant au CHU de Brazzaville. *Journal africain de pédiatrie et de génétique médicale*, **9**, 51-56.
- [11] Ndokain, J.G., Mbaihodji, J., Yandäi, F.H., El Kari, K. and Soudy, I.D. (2025) Etude de l'anémie associée à la sous-nutrition chez les enfants de 6 à 59 mois, au Centre Hospitalier Universitaire de la Mère et de l'Enfant à N'Djaména, Tchad. *International Journal of Biological and Chemical Sciences*, **19**, 100-113. <https://doi.org/10.4314/ijbcs.v19i1.8>
- [12] Tshitadi Makangu, A., Mbulu Lukadi, C., Munanga Kabasele, A., Mbadila Kisina, H. and Basilua Kanza, J.P. (2023) Etude de l'anémie chez les enfants de 0 à 5 ans fréquentant l'hôpital général de référence de Matete à Kinshasa: Profil, prévalence et causes associées en 2014. *Revue des Sciences de la Santé*, **2**, 54-57. <https://doi.org/10.71004/rss.023.v2.i1.20>
- [13] Traore, F., Maiga, B., Diall, H., Sissoko, S., Sacko, K., Konaté, D., *et al.* (2020) Prise en charge de la malnutrition aiguë chez l'enfant dans un hôpital secondaire sahélien. *Mali Medical*, **35**, 32-37. <https://malimedical.org/>
- [14] Khan, L. (2018) Anemia in Childhood. *Pediatric Annals*, **47**, e42-e47. <https://doi.org/10.3928/19382359-20180129-01>
- [15] Panda, S., Barik, R.R., Bharaj, D. and Ranjan, J. (2023) Clinico-Biochemical Profile of Severe Acute Malnutrition with Special Reference to Infection. *International Journal of Academic Medicine and Pharmacy*, **5**, 382-386.
- [16] Malam-Abdou, B., Djibrilla-Almoustapha, A., Amadou-Hamadou, S., Elhadj-Chefou,

- M., Maman-Brah, M., *et al.* (2025) Pediatric Microcytic Anemias in Niamey: A 6-Month Prospective Descriptive Study on Epidemiology and Etiologies. *Health Sciences and Disease*, **26**, 1-5.
- [17] World Health Organization (WHO) (2023) Guideline on the Prevention and Management of Wasting and Nutritional Oedema. WHO. <https://www.who.int/publications/i/item/9789240082830>
- [18] Morales, F., Montserrat-de la Paz, S., Leon, M.J. and Rivero-Pino, F. (2023) Effects of Malnutrition on the Immune System and Infection and the Role of Nutritional Strategies Regarding Improvements in Children's Health Status: A Literature Review. *Nutrients*, **16**, Article 1. <https://doi.org/10.3390/nu16010001>
- [19] Soliman, A.T., Alaaraj, N.M. and Rogol, A.D. (2022) The Link between Malnutrition, Immunity, Infection, Inflammation and Growth: New Pathological Mechanisms. *World Journal of Advanced Research and Reviews*, **15**, 157-167. <https://doi.org/10.30574/wjarr.2022.15.1.0673>
- [20] Direction de la Nutrition (DN) Niger (2025) Protocole National de Prévention et de Prise en charge de la Malnutrition aiguë.
- [21] Nkumisongo, S., Ntanga, M.N., Lutumba, O.M., Lubo, D.L., Kashila, F.M., Nkombo, M.N., *et al.* (2022) Réadmission chez l'enfant de moins de 5 ans ayant été traité pour malnutrition aiguë sévère à Lubumbashi, République Démocratique du Congo. *Revue de l'Infirmier Congolais*, **6**, 33-39. <https://doi.org/10.62126/zqrx.2022616>
- [22] Bandsma, R.H.J., Mendel, M., Spoelstra, M., Reijngoud, D., Boer, T., Stellaard, F., *et al.* (2010) Mechanisms behind Decreased Endogenous Glucose Production in Malnourished Children. *Pediatric Research*, **68**, 423-428. <https://doi.org/10.1203/pdr.0b013e3181f2b959>
- [23] Camara, E., Diop, M.M., Barry, I. K., Conde, I., Barry, A. and Bah, M. (2021) Malnutrition Aigüe Sévère avec Complications chez les Enfants de 0 à 59 Mois: Aspects Épidémiologiques, Cliniques et Thérapeutiques au Service de Pédiatrie de Labé (Cotakry). *Health Sciences and Disease*, **22**, 6-10.