



## Impact of Therapeutic Foods on Hematological Parameters of Malnourished Children Admitted at the Intensive Nutritional Recovery Center of Tessaoua, Maradi, Niger Republic

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### Authors' contributions

This work was carried out in collaboration among all authors. Author MML did the conceptualization, methodology and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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### ABSTRACT

**Aims:** To evaluate the impact of the therapeutic foods on the hematological parameters of malnourished children below 5 years of age.

**Study Design:** This is a Prospective cross-sectional study.

**Place and Duration of Study:** Intensive Nutritional Recovery Center of Tessaoua, Maradi, Niger republic, from June 15 to September 10, 2022.

**Methodology:** We included 60 malnourished children (36 males, 24 females; age range 6-59 months) who are severely acutely malnourished. Standard survey forms that were developed for the purpose have permitted to obtain sociodemographic and hematological data (hemoglobin level and leukocyte count) concerning malnourished children.

**Results:** The results showed that among the 60 children that were surveyed, at entry, 50 (83.33%) were recorded to have a low hemoglobin level and 36 (60%) with highly elevated leucocyte count. At the end of treatment with therapeutic foods, it was observed an overall normalization of these parameters during an average duration of hospitalization.

**Conclusion:** Therapeutic foods have shown a significant positive influence on hematological parameters of malnourished children. Their use should therefore be encouraged in line with other strategies in order to ensure good and rapid recovery in malnourished children under five years of age.

*Keywords: Children; hematological parameters; malnourished; therapeutic foods.*

## 1. INTRODUCTION

Food insufficiency can lead to the onset of severe acute malnutrition which is currently one of the most concerning public health issues worldwide, especially in least developed countries [1-3]. For years, sub-Saharan regions have faced chronic food insecurity and high levels of malnutrition among mothers and children [4]. The Niger republic, a Sahelian outland country of the west Africa, is subjected to frequent climatic shocks, to insecurity and to humanitarian emergencies [5-7]. The burden of acute malnutrition among children is persistent and remain one of the highest globally, with a prevalence which continues to oscillate in the range of 10 to 15% corresponding to a serious situation according to the World Health Organization (WHO) classification scale [8,9]. As part of the follow-up and monitoring of the nutritional condition for children under 5 years of age, the Ministry of Public Health, in collaboration with its technical and financial partners, in particular United Nations Children's Fund (UNICEF) and World Food Program (WFP), have proposed periodic national surveys which is an opportunity for the Niger republic to have up-to-date and valid data not only for all regions but also for the whole country at the same time [10].

Inadequate food intake in a child will lead to an immediate effect which could contribute for growth to slow or stop. Micronutrient deficiencies are a major public health problem. Severe acute malnutrition is reported to be due to deficiency of type II nutrients (i.e., protein, zinc, magnesium, phosphorus and potassium) which in response could lead to growth failure [11]. Currently, in addition to basic medical care, children with severe acute malnutrition are treated with specialized foods, most often F75 or F100 milk diets and ready-to-use therapeutic foods (RUTF) [12-15]. The government of Niger republic through the Ministry of Public Health has integrated the Community Management of Acute Malnutrition (CNAM) approach as part of the national nutrition strategy to treating severely acutely malnourished children [6]. The national

protocol was first developed in 2005 [16], followed by updates in 2006 and 2009, ultimately leading to the final version which was titled as "Protocole Nationale de prise en Charge de la Malnutrition". Concerning the geographic coverage of CNAM at national level, in each district, regional or national hospital, there is a specialized unit dedicated for the management of severely acutely malnourished hospitalized patients with medical complications. A total of 50 of such units are available across the country. Affected children are treated as hospitalized patients in these facilities known as Intensive Nutritional Recovery Centre (CRENI) [9]. The assessment of the nutritional status is based on a number of clinical, biochemical, anthropometric and biophysical examinations. Nutritional recovery of malnourished children is achieved through therapeutic management with the aid of various foods which would not only have positive effects on the growth of children, but also on the regulation of biological parameters. The present study was proposed with the aim to evaluate the impact of therapeutic foods on the hematological parameters of malnourished children treated in the Intensive Nutritional Recovery Centre of Tessaoua.

## 2. METHODOLOGY

### 2.1 Study Setting

This study was carried out at the Intensive Nutritional Recovery Centre (CRENI), which is a specialized unit included in the provincial hospital (Hopital de District, HD) of Tessaoua. The HD hospital is the main healthcare facility in Tessaoua, a city of more than 445 584 inhabitants with an average density of 81.41 inhabitants per km<sup>2</sup>, a rate of increase of 3.7% and an average number of children per housework of 7.56.

The CRENI is specialized in the management of patients hospitalized with severe acute malnutrition under two phases: (i) initial stabilization during which life-threatening complications are treated, and (ii) rapid nutritional recovery during which catch-up growth

occurs. The diet includes the use of therapeutic milk formula which consists of F-75 milk (used at initial stage of severer acute malnutrition), F-100 milk (used during rehabilitation stage of severer acute malnutrition) and Ready-to-Use Therapeutic Foods (RUTF) (associated with F-100 milk for rapid gain of weight).

## 2.2 Study Design, Period and Population

This is a prospective cross-sectional study aimed at evaluating the impact of therapeutic foods on hematological parameters of malnourished children experiencing recovery at the Intensive Nutritional Recovery Centre. It took place from June 15 to September 10, 2022. During this period, 60 children from 6 to 59 months of age who are severely acutely malnourished were admitted at the Centre.

## 2.3 Inclusion and Exclusion Criteria

They will be included in the study people who meet the following criteria: (i) severely acutely malnourished child in the age group of 6 to 59 months and who benefit of therapeutic foods for their recovery and (ii) malnourished children whose blood has been taken and analyzed in the laboratory. Children with age limit not falling within the interval of 6 to 59 months.

## 2.4 Data Collection and Processing

The data were collected using a standard survey form during the interviews with the mothers of the children, followed by the recording of the sociodemographic characteristics and biological data of the severely acutely malnourished children. The data collected were further entered, cleaned and tabulated.

## 3. RESULTS AND DISCUSSION

### 3.1 Sociodemographic Characteristics of Children and Their Mothers

Of the 60 children enrolled, thirty-six (60%) were males. Children with age falling within the range of 6 to 11 months were predominant (22; 36.6%), followed by those falling within the range of 12 to 23 months (20; 33.3%). This was in line with studies done in Ethiopia [17,18], Niger [19], and Ghana [20].

The majority of mothers were recorded with age falling within the range of 30 to 39 years (45%), followed by those falling within the range of 20 to

29 years (36.6%). Amadou et al. (2021) in his study which was aimed to evaluate the nutritional status of malnourished children in two healthcare centers of Tessaoua (Niger) found that the majority of the mothers of malnourished children were aged between 20 to 30 years (56%) [21].

56(93%) among them are married. Majority of them had no formal education (63.3%). Fifty-four (90%) mothers are housewife (Table 1).

In term of marital status, almost all the women who were the subject of our study are married (93.33%), only 6.67% are divorced. About 63% of mothers who participated in the interview were illiterate and the rest were literate with very low level of education. This higher proportion of illiterate mothers could be a contributing factor in increasing the prevalence of malnourished children in this area. In addition, Tessaoua is a province where the majority of inhabitants are merchants or farmers. This could explain the absence or the low level of maternal education. Maternal literacy is an essential factor for proper infant feeding practices [22-28]. Particularly because, mothers who are literate and with better education are more likely to be empowered financially [29-32]. For instance, Noshaba et al (2013) in his study reported a maternal literacy of 62.5% and further demonstrated the existence of a strong association between child's nutritional status with the literacy of mothers [33]. Sphiwe et al (2019) in his study found that 41.8% of the underweight children and 44.2% of children categorized as wasted belonged to mothers with low maternal education status [32]. Alderman and Luc (2004) in their study reported that mothers with secondary education and above had a positively significant effect on the anthropometric scores of their children when compared with uneducated mothers [34]. Menalu et al. (2021) in his study formulated a statement on the basis of his findings, that children born into families unable to read or write and informally educated had a 4.2- and 2.5-fold increased risk of stunting and malnutrition, respectively, compared to children born into university or college-educated families [18]. Adeyomu et al (2022) in his study which focused on what determines the malnutrition of under-five children among rural households in the southwest of Nigeria, found that a unit increase in the mother's level of education will decrease the probability of the child being malnourished by 3.1% [35]. Though, for a good fight against malnutrition in most developing countries, policy makers, humanitarians and

other interested parties should consider among other strategies to promote better maternal education.

### 3.2 Magnitude of Hematological Abnormalities among Malnourished Children

Regarding the hematological parameters and before the beginning of treatment of severely malnourished children, we found that all the recruited children suffered of considerable depletions of certain important hematological parameters: 50(83.3%) out of 60 were recorded with moderate (16.6%) and severe anemia

(66.6%); 36(60%) with leucocyte count greater than the normal.

However, at the end of treatment, it was observed a significant normalization of the hemoglobin level and leucocyte count among the treated children. None of the recovered malnourished children was recorded suffering from severe anemia. Only 3(5%) out of 60 were found with moderate anemia. At discharge, a normalization of leucocytes count was observed in 53(88.3%) recovered children. Only 7(11.6%) were recorded with leucocytes less than the normal count (Table 2).

**Table 1. Sociodemographic characteristics of malnourished children and their parents**

Variables	Frequency (n=60)	Percentage
<b>Age group (in months) of the child</b>		
6 – 11	22	36.6
12 – 23	20	33.3
24 – 35	10	16.6
36 – 59	8	13.3
<b>Sex of the child</b>		
Female	24	40
Male	36	60
<b>Age group (in years) of the mothers</b>		
< 20	6	10
20 – 29	22	36.6
30 – 39	27	45
≥ 40	5	8.3
<b>Marital status of the mother</b>		
Married	58	93.3
Divorced	2	6.7
<b>Educational status of the mother</b>		
No formal education	38	63.3
Primary education	18	30
Secondary education	4	6.7
<b>Occupational status of the mother</b>		
Housewife	54	90
Petty trader	6	10

**Table 2. Magnitude of hematological abnormalities among severely acutely malnourished children before and after treatment with therapeutic foods**

Hematological parameters		Before treatment n (%)	After treatment n (%)
Hemoglobin level	Normal	10(16.6)	57(95)
	Moderate anemia	10(16.6)	3(5)
	Severe anemia	40(66.6)	0(0)
Leucocyte count	Normal	24(40)	53(88.3)
	Less than normal	0(0)	7(11.6)
	Greater than normal	36(60)	0(0)

Hematopoietic tissues which are essential for cell renewal and proliferation are extremely influenced by the availability of nutrients [36]. Thus, a deficiency of nutrients in the system could lead to impaired production of cellular blood components [37] and further development of pathological conditions such as anemia, changes in leucocytes count, changes in reticulocyte count, and changes in the hematopoietic microenvironment of the bone marrow [38-41]. In the present study, 83.3% children with severe acute malnutrition were found to be anemic, out of which 66.6% were severely anemic and 16.6% were at moderate stage. This study shows increased burden of anemia in severely acutely malnourished children as compared to other studies done in Ethiopia (53.4%) [41], Sri Lanka (55.5%) [42], Bangladesh (56.5%) [43], Guinea-Bissau (80.2%) [44]. Arya et al (2017) in his study conducted in a tertiary care Centre of Kampur in India, found that 95% of the children with severe acute malnutrition had anemia, out of which 52% were severely anemic and 28% were moderately anemic [45]. Thakur et al (2014) reported 81.1% of severely malnourished children to be anemic, out of which 67.3% as severely anemic and 13.8% as moderately anemic [46]. However, our result concerning the prevalence of anemia among the studied population was lower than that obtained by Gohain et al (2016) (91%) [40]. The sociodemographic characteristics of malnourished children partly contribute the high prevalence of anemia in this study. The other common hematological abnormalities found in the present study were the elevated leucocyte count or leukocytosis, which was observed in 36(60%) children. Leukocytosis was reported by many researchers to be a common feature in malnourished children [41,45]. Getawa et al (2020) in his study conducted in Ethiopia reported a prevalence of leukocytosis of 26.7% among malnourished children [41]. Leukocytosis in these children may be as a result of opportunistic infections which appear due to compromised immune system. The association of infection with malnutrition has long been highlighted in many published studies [40,45,47,48]. After the different phases of treatments of malnourished children with therapeutic foods (F75 and F100 milks, and Plumpy nuts), we have constated a significant normalization of hemoglobin level and leucocyte count in 57(95%) and 53(88.3%) children respectively. Though, this study indicates that therapeutic foods are effective in improving developmental potential among children aged

under five and also helped in the reduction of the anemia burden and other gastrointestinal infectious diseases. For instance, the nutrient density of most of these therapeutic foods ensures rapid recovery among children that were supervised [49,50]. In malnourished children, deficiencies of essential nutrients are the main cause of delayed development. Many studies have reported the positive impact of therapeutic foods on various parameters or variables which characterized normal body development [51-55].

Important limitations of the present study were first associated with the sample size and secondly the difficulty to establish relationship between hematological abnormalities and associated factors.

#### 4. CONCLUSION

Globally, we have noticed the positive impact of the therapeutic foods on hematological parameters of malnourished children. In fact, of the 60 children who have experienced treatment against malnutrition, only 10(16.6%) did not reach normalization of their hemoglobin level (5%) or leucocyte count (11.6%). This situation should draw the attention of healthcare personals to accompany those who have not reach normalization through outpatient monitoring strategy (such as ambulatory follow up) after their discharge. This study encourages policymakers, Non-Government Organizations, researchers and other interesting parties to undergo more frequent studies with the aim to best describe the trend of hematological changes in severely acutely malnourished children.

#### ETHICAL APPROVAL

The protocol of this study was approved by the department of Nutrition and Diet of the "Institut Universitaire de Technologie Agroalimentaire et Nutritionnel (IUT)" of the University of Boubakar Ba de Tillabéri. All data were fully anonymized before we exploited them.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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