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Original Research Article

Nutritional Status of Children in the PROFISEM Intervention Zone: Logone Occidental and Wadi-Fira in Chad

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Abstract: In Chad, as in most sub-Saharan African countries, the nutritional situation remains a major concern, and is an underlying cause of many other health problems. The aim of this study is to assess the nutritional status of children aged 6 to 59 months in the provinces of Logone Occidental and Wadi-Fira, in order to contribute to a better management of nutritional problems. The study was carried out between August 16 and October 10, 2022, and involved 207 children aged 6 to 59 months in Wadi-Fira, and 63 aged 6 to 59 months in Logone Occidental. Data collection was carried out using a questionnaire and measurements to collect data on the children's socio-demographic characteristics and anthropometry. Analysis of the children's nutritional status was based on the z-score of nutritional indices and edema according to 2006 WHO references. Analysis of the results showed that the prevalence of global acute malnutrition is 18.84%, chronic malnutrition affects 30.9% and underweight affects 32.9% of children in Wadi Fira. In Logone Occidental, about 1/10 child (9.20%) suffers from acute malnutrition, 33.6% from chronic malnutrition and 22.8% from underweight. In Wadi-Fira, the nutritional situation is considered critical, with more than one child on 15 suffering from global or moderate acute malnutrition. In Logone Occidental, the nutritional situation is precarious for both forms of acute malnutrition. The nutritional situation in both provinces needs a reinforcement of current actions in the fight against malnutrition.

Keywords: Nutritional status, anthropometry, malnutrition, Chad, PROFISEM.

INTRODUCTION

Malnutrition due to the lack of one or more essential nutrients, is a public health problem in developing countries. It affects children in particularly because of the importance of the quality and quantity of the nutrients they need for rapid growth [1]. On a global scale, the burden of malnutrition in all its forms remains a challenge. According to current estimates, 144 million children under the age of 5 are stunted, 47 million are suffering from wasting, and 38.3 million are overweight [2]. In Chad, as in most sub-Saharan African countries, the food and nutrition situation remains a concern, and is an underlying cause of many other health problems. It is strongly linked to the general context and socio-economic reality of the country. Malnutrition has become an endemic problem, characterized by high morbidity and mortality linked to various communicable and non-communicable diseases and to malnutrition.

Those most affected are children aged between 6 and 59 months. According to the results of the 2021 SMART survey, at national level, the prevalence of all forms of malnutrition is higher than the thresholds set by the WHO. Analysis of the results showed a national prevalence of global acute malnutrition of 10.9%, with a proportion of 2.0% in the severe form [3].

Analysis of the food and nutrition situation using the Harmonized Framework tool indicates that 20% of the population suffers from recurrent food and nutrition insecurity [4]. The prevalence of global acute malnutrition (GAM) is 10%, giving rise to a worrying nutritional situation according to the WHO classification. At sub-national level, sixteen (16) provinces are in a situation of concern (GAM ≥10%). Considering the prevalence of severe acute malnutrition, the nutritional situation is urgent according to the

threshold defined for humanitarian emergencies. According to the IPC 2021 analysis, the high prevalence of acute and chronic malnutrition in the country in general corresponds to a structural situation generated and maintained by the combined effect of several factors. However, some of the country's provinces have persistently high prevalence of malnutrition in all its forms. These provinces must therefore be addressed individually, in order to bring their nutritional situation under control. The aim of this study is to assess the nutritional status of children aged between 6 and 59 months in the intervention zones of the PROFISEM program (Programme d'Opérationnalisation de la Filière Semencière), in order to contribute to a better understanding of the food and nutritional situation and to inform actors working in the field to better orient their intervention strategies, as well as to contribute to a better management of nutritional issues.

The specific objective of this study is to assess the nutritional status of children aged 6 to 59 months in the provinces of Logone Occidental and Wadi-Fira (Chad), PROFISEM's intervention zone, in order to contribute to better management of nutritional problems.

MATERIAL AND METHODS

Presentation of the study area

The study took place in two (2) provinces of Chad: Wadi-Fira (Figure 1) and Logone Occidental (Figure 2). For practical reasons, each province was considered as a stratum.

Located in the east of the country, at the very heart of the Sahelo-Saharan domain, Wadi-Fira has a short rainy season (July to September) and a long dry season, as well as relatively wide temperature variations [5]. According to Guibert and Lagnaba [6], average annual rainfall is between 200 and 400 mm. Water resources are essentially limited to rivers, all of which are temporary, and alluvial aquifers. There are no large underground water tables. Like the rest of the country, agriculture accounts for over 80% of the region's working population [7].

Logone Occidental is located in the south-west of the country, in the Sudanian zone. Average annual rainfall is between 1,000 and 1,127 mm/year, with two seasons: a rainy season covering the period from May to October and characterized by heavy rainfall, and a dry season lasting approximately five (05) months and covering the period from November to the end of March, but whose limits are variable today. Temperatures are moderately high, ranging from 10°C to 31°C, with an annual average of 27°C.
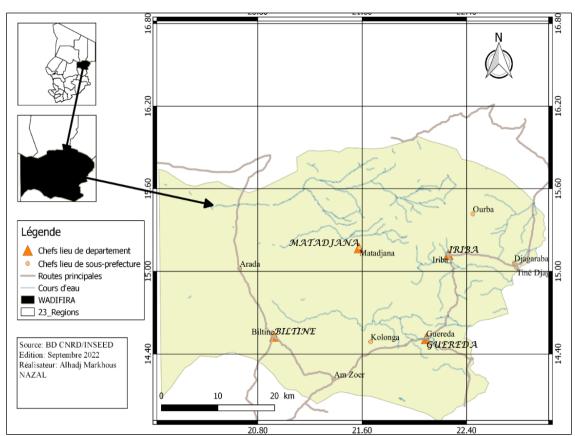

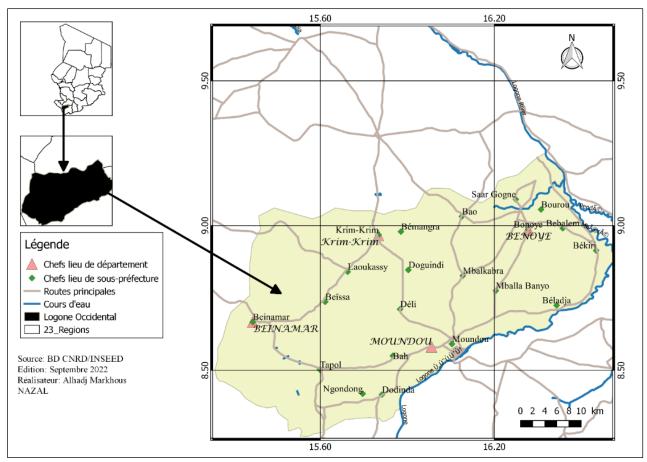**Figure 1 : Localisation de la Province de Wadi Fira**

Figure 2 : Localisation de la Province du Logone Occidental

Type and period of study

This is a cross-sectional survey based on a standardized methodology, involving data collection by anthropometric measurements and individual surveys. Data collection took place between August 16 and October 10, 2022.

Target population

The study's target population was children aged 6 to 59 months residing in the 2 provinces at the time of the survey.

Sample size

The sample size was determined independently for each stratum. The sample size was calculated using ENA 2020 software.

Table 1: Below gives the sample size by stratum (province).

Strata	Number of children surveyed	Number of households surveyed	TOTAL
Wadi-Fira	207	237	444
Logone Occidental	163	187	350
TOTAL	**370**	**424**	**794**

Sampling technique

To ensure the representativeness of the sample at the level of each stratum, the two-stage cluster random sampling technique was adopted. The first stage consisted in the systemic random selection of clusters, while the second stage involved the random selection of households within the clusters selected at random by applying a sampling step.

Data collection techniques and tools

In order to gain a better understanding of the nutritional situation in the provinces to be surveyed,

primary data collection was carried out using a structured questionnaire and measurements to collect data on children's socio-demographic characteristics and anthropometry.

Data processing and statistical analysis

ENA 2020 software was used to capture anthropometric data. However, to complete the analysis and calculation of weighted indicators for the two provinces, Epi info 23.0 software was used. The same software was used to compare and reconcile the databases. Finally, for statistical analysis, all data were

exported and analyzed using SPSS software Nutritional indices were calculated using the new WHO standards [8] and ENA software [9]. Analyses were then carried out using the "Complex Sampling Analysis" module of the Epi info software, to take into account the cluster sampling design. The Pearson chi-square test is used to test associations between different variables. The significance level for statistical tests is set at 5%. Table 2 shows the thresholds used to classify the different types of malnutrition into Z-scores.

Table 2: Thresholds used to classify different types of malnutrition in Z-score

	Acute malnutrition	Chronic malnutrition	Weight insufficiency
Severe	P/T <-3 SD and/or bilateral nutritional edema	T/A <-3 ET	P/A <-3 ET
Moderate	-3 ET ≤ P/T < -2	-3 ET ≤ T/A < -2	-3 ET ≤ P/A < -2
Global	P/T < -2 SD and/or bilateral nutritional edema	T/A < -2 ET	P/A < -2 ET

Assessment of nutritional status was based on the WHO classification of nutritional status within a population according to the prevalence of global acute malnutrition (% of children with P/T<-2z-score and/or edema) [10].

Table 3: Classification of public health importance for children under 5 years of age

Prevalence (%)	Critical	Serious	Precarious	Acceptable
Weight-for-height	≥ 15	10 – 14	5 – 9	< 5
Height-for-age	≥ 40	30 – 39	20 – 29	< 20
Weight-for-age	≥ 30	20 – 29	10 – 19	< 10

RESULTS

Sociodemographic characteristics of surveyed children

In Wadi-Fira, a total of 207 children were surveyed, 93 of them were male and 114 female, with a sex ratio (boy/girl) of 0.82. In Logone Occidental, 163 children were surveyed, including 84 boys and 79 girls, giving a boy/girl ratio of 1.06. In both provinces, children in the range of 6-12 month age represented the highest proportion (27.5%) in Wadi-Fira and 34.9% in Logone Occidental, while the lowest proportion was for those aged 36 to 48 months (10.1% and 0% respectively), as shown in Table 6. The sex ratio is 0.92. The sample is therefore representative to both sexes (Table 4).

Table 4: Distribution of children surveyed by age group and gender

	Sexe	Male		Female		Total		Ratio
	Age	n	%	n	%	n	%	Boy : Girl
Wadi-Fira	6-12 months	15	7.2%	42	20.3%	57	27.5%	0.36
	12-24 months	22	10.6%	33	15.9%	55	26.6%	0,67
	24-36 months	29	14.0%	10	4.8%	39	18.8%	2.90
	36-48 months	07	3.4%	14	6.8%	21	10.1%	0.50
	48-59 months	20	9.7%	15	7.2%	35	16.9%	1.33
	TOTAL	**93**	**44.9%**	**114**	**55.1%**	**207**	**100%**	**0.82**
Logone Occidental	6-12 months	42	25.8%	15	26.3%	57	34.9%	2.8
	12-24 months	33	20.2%	22	40.0%	55	33.8%	1.5
	24-36 months	9	5.5%	29	76.3%	38	23.4%	0.31
	36-48 months	00	0.0%	00	0.0%	00	0.0%	0
	48-59 months	00	0.0%	13	100%	13	7.9%	0
	TOTAL	**84**	**51.5%**	**79**	**48,5%**	**163**	**100%**	**1.06**
Both	6-12 months	57	15.41%	57	15.41%	114	30.81%	1
	12-24 months	55	14.86%	55	14.86%	110	29.73%	1
	24-36 months	38	10.27%	39	10.54%	77	20.81%	0.97
	36-48 months	7	1.89%	14	3.78%	21	5.68%	0.50
	48-59 months	20	5.41%	28	7.57%	48	12.97%	0.71
	TOTAL	**177**	**47.84%**	**193**	**52.16%**	**370**	**100.00%**	**0.92**

Prevalence of acute malnutrition

The prevalence of the different forms of acute malnutrition (global, moderate and severe) based on the z-scores of the P/T index and/or edema in children aged 6 to 59 months by stratum are detailed in table 5 below.

Table 5: Prevalence of acute malnutrition by province

Province / Prevalence	Wadi Fira		Logone Occidental	
	n	%	n	%
Chronic Global Malnutrition	39	18.84%	15	9.20%
Moderate Chronic Malnutrition	35	16.9%	13	7.97%
Severe Chronic Malnutrition	26	12.56%	7	4.29%
Normal status	**107**	**51.69%**	**128**	**78.52%**

The prevalence of global acute malnutrition according to the z-scores of the P/T index in children aged 6-59 months is 18.84% in Wadi-Fira, and 9.20% in Logone Occidental. In contrast to the global form, the moderate acute malnutrition has a prevalence of 16.9% and 7.97% in Wadi-Fira and Logone Occidental respectively. The severe acute malnutrition has a prevalence of 12.56% in Wadi-Fira and 4.29% in Logone Occidental. 51.69% of children aged 6-59 months in Wadi-Fira Province have normal status. This percentage rises to 78.52% in Logone Occidental. Figures 3 and 4 below illustrate the results of the proportions of children suffering from malnutrition, expressed in z-score, and or nutritional edema by gender.
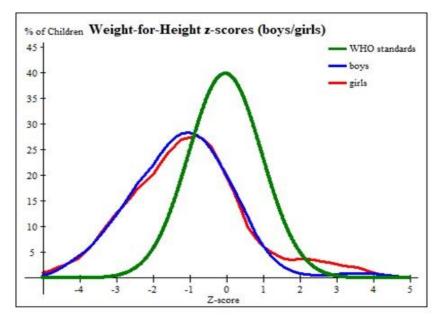

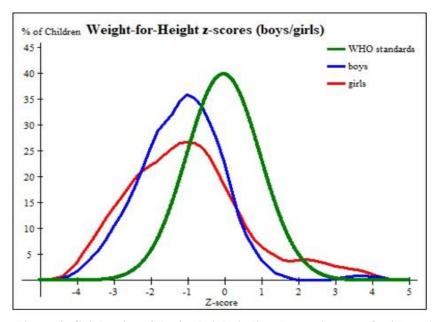**Figure 3: Child weight-for-height indices by gender (Wadi-Fira)**

Figure 4: Children's weight-for-height indices by sex (Logone Occidental)

The blue and red curves illustrate the z-score distribution of the weight-for-height (W/H) index for the sample of children aged 6 to 59 months surveyed in all provinces, while the green curve represents the z-score distribution of the weight-for-height (W/H) index for children in the same age group in the WHO 2006 reference population. Comparison of these two curves with the reference shows a shift to the left of the red and blue curves in relation to the green curve. This shift reflects the difference between the nutritional status, in terms of the magnitude of acute malnutrition, of children surveyed in two provinces, and that of children in the reference population. Indeed, observation shows that there are more malnourished children in the population of two provinces than in the WHO 2006 reference population.

Prevalence of chronic malnutrition

Chronic malnutrition or stunting is assessed using the T/A index, and the results obtained by province are shown in Table 6.

Table 6: Prevalence of chronic malnutrition by province

Province / Prévalence	Wadi-Fira		Logone Occidental	
	n	%	n	%
Chronic Global Malnutrition	64	30.9%	56	33.6%
Moderate Chronic Malnutrition	30	14.5%	32	19.2%
Severe Chronic Malnutrition	34	16.4%	24	14.4%
Normal status	**79**	**38.2%**	**55**	**32.8%**

These results show that chronic global malnutrition affects more than a third of children. The lowest prevalence observed is that of severe chronic malnutrition, at 14.4% among children in Logone Occidental province. Figures 5 and 6 illustrate the comparison of the z-score curve of the height-for-age index (T/A) for the sample of children aged 6 to 59 months surveyed in each province, according to gender (blue curve for boys and red curve for girls) with that of the z-score of the same index for the WHO 2006 reference population (green curve). Examination of this figure reveals a significant shift to the left of the red curve in relation to the green curve. This shift demonstrates the extent of stunting in the under-5 population of the provinces surveyed, compared with the reference population [8]. The magnitude of chronic malnutrition (stunting) in this population is also illustrated by a very high average (-1.59) Z-score for the height-for-age index of the under-5 population surveyed.
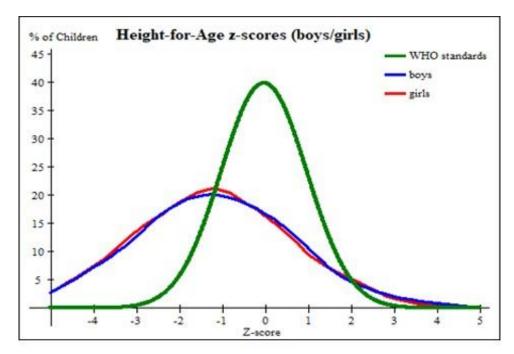

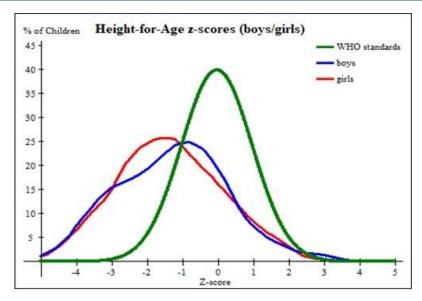**Figure 5: Indices taille-âge des enfants selon le sexe (Wadi – Fira)**

Figure 6: Child height-age indices by sex (Logone Occidental)

Underweight prevalence

Underweight in children aged 6 to 59 months is assessed using the z-scores of the P/A index. The results are shown in Table 7.

Table 7: Prevalence of underweight by province

Province / Prevalence	Wadi Fira		Logone Occidental	
	n	%	n	%
Global Underweight	66	32,9%	36	22,08%
Moderate Underweight	46	22,9%	26	15,95%
Severe Underweight	20	10,0%	12	7,36%
Normal status	**75**	**36,2%**	**89**	**54,60%**

Like chronic global malnutrition, underweight also affects more than a third of children in Wadi-Fira. In Logone Occidental, it affects 22.08% of children under 5. The blue and red curves in figures 7 and 8 represent the z-score distribution of the weight-for-age (WFA) index for the sample of children aged 6 to 59 months surveyed in all strata of the administrative regions, compared with the WHO 2006 reference population (green curve). The mean z-score of the W/A index is -1.42 with a standard deviation of 1.08, and the leftward shift of the red curve shows that there are more underweight children in the under-5 study area than in the WHO 2006 reference population (green curve), see figure below.
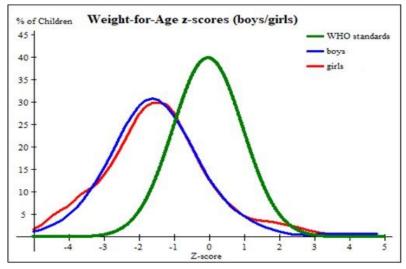

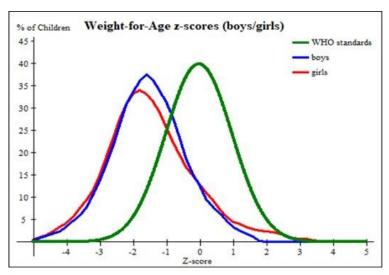**Figure 7: Child weight-age indices by gender (Wadi Fira)**

Figure 8: Child weight-age indices by gender (Logone Occidental)

DISCUSSION

This study assessed the nutritional status of children under 5 years of age in the provinces of Wadi-Fira and Logone Occidental in Chad, using the WHO classification scale. In Wadi-Fira, in the Sahelian zone, the nutritional situation is considered critical, with more than one child in 15 suffering from global or moderate acute malnutrition. In the province of Logone Occidental, in the Sudanian zone, the nutritional situation is precarious for both forms of acute malnutrition. This situation calls for a reinforcement of current actions in the fight against malnutrition. Despite the predominance of the global and moderate forms of malnutrition in both provinces, the severe form is not negligible, with a prevalence of 12.56% in Wadi-Fira and 4.29% in Logone Occidental. Although the situation in Logone Occidental is acceptable, Wadi-Fira is in a serious situation with regard to severe acute malnutrition. Indeed, its prevalence exceeds the 10% alert threshold and is between 10 and 14%, a range considered to be that of an emergency and requiring the implementation of coordinated interventions to mitigate the consequences of this acute malnutrition on the population in general and children in particular. Given that the latter is often fatal, it deserves even greater attention from the Chadian government and its partners. At national level, the results of the SMART 2021 survey reveal a prevalence of global acute malnutrition of 10.9%, with 2.0% of children suffering from the severe form, and a prevalence of moderate acute malnutrition of 8.9% [3].

With stunting prevalence in Wadi-Fira and Logone Occidental at 30.9% and 33.6% respectively, the situation is considered severe in terms of chronic global malnutrition in children under 5. This situation is almost identical to the national situation in Chad in recent years. Indeed, according to Chad's SMART 2021 report, the prevalence of chronic malnutrition at national level in 2021 is 30.4%. This is virtually unchanged from 2020. Although in Wadi-Fira we observed a slightly better state

of this indicator compared to acute malnutrition, the high prevalence of chronic malnutrition in both provinces corresponds to a structural situation generated and maintained by the combined effect of several factors. Indeed, stunting is thought to be linked to the mother's poor health and nutritional status, inadequate infant and young child feeding practices, and infections [11]. More specifically, the mother's nutritional status and health before, during and after pregnancy influence fetal and infant growth and development [12]. A recent study in the Masken district of Ethiopia reported that the number of children under 5, household size, mother's occupation, duration of breastfeeding, particularly exclusive breastfeeding, and method of breastfeeding were factors independently associated with stunted growth in children aged 24-59 months [13]. Given that chronic malnutrition could have serious long-term consequences such as intellectual deficits and reduced productivity, the current situation would therefore constitute a heavy burden that could compromise the future of future generations. The role of chronic malnutrition is well known as a risk marker for inappropriate development in children [14]. It also has significant economic consequences at individual, household and community levels [15, 16]. Prevalence levels of underweight correspond to a critical situation in Wadi-Fira and serious in Logone Occidental according to the WHO classification scale. Given that underweight is a condition that depends on both acute and chronic malnutrition, improving this state will necessarily involve effectively combating these two determinants (acute malnutrition and stunting). Compared with this study, the results of the national survey revealed a national prevalence of underweight of 21.6% (20.6 - 22.6), with 6.2% (5.6 - 6.8) in the severe form [3].

CONCLUSION

The study provided a picture of the nutritional status of the provinces of Wadi-Fira and Logone Occidental in Chad. As a cross-sectional survey, the

results provide a snapshot of the nutritional situation at the time of data collection in the field. Analysis of the situation showed that Wadi-Fira, in the Sahelian zone, is the most affected by acute malnutrition in terms of the proportion of children affected by this phenomenon. Analysis of the prevalence of global acute malnutrition revealed that the nutritional situation is critical in this province, while it remains precarious in Logone Occidental in the Sudanian zone. As well as acute malnutrition, chronic malnutrition and underweight are also present in these provinces in their various forms. One third of children suffer from severe stunting. The malnutrition situation remains worrying in these two provinces, according to the WHO classification. Given that a child's nutritional status is dynamic and can change over time, the situation reported by the survey could change at any time if living conditions deteriorate in the communities concerned. To tackle the problem of malnutrition, actions to be taken should include promoting essential family practices and strengthening the multi-sectoral response by investing in nutrition-sensitive sectors at the same time.

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