



Multidimensional Poverty and Acute Malnutrition of Children in Households of Mayo-danay Division, Cameroon

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Abstract: *Introduction:* The SMART survey (2017) in the Far North region, Cameroon presents high prevalence of malnutrition: 4.5% of global acute malnutrition (GAM) and 40.9% of chronic malnutrition (CM). *Objectives:* To examine the relationship between multidimensional poverty and malnutrition among children under-five in the Mayo-Danay Division. Specifically, assess the nutritional status of children, describe the living conditions of children in households and measure the association between multidimensional poverty and nutritional status of children. *Methods:* A cross-sectional, descriptive and analytical study was conducted on a cluster sample at two levels. Anthropometric measurements were used to assess the nutritional status of children. The non-monetary, simplified approach, based on the search for deprivation indices of the well-being of children in the household was used. *Results:* Out of 433 children surveyed, we observed: 4.4% GAM; 13.9% of underweight and 23.3% MC. Out of the 65,82% poor children, 13,59% had chronic malnutrition; 2.09% GAM and 15.00% underweight. Multidimensional poverty among children was associated with the CM (OR = 4, 436; (CI = 2, 767 - 7,111) and GAM (OR = 4, 194; (CI = 1, 514 - 11,416). *Conclusion:* The study highlights the interaction between the living conditions of children in households and the impact on their nutritional status. Multidimensional poverty is associated with malnutrition in children. We recommend to initiate a simulation and comparison study, of poverty reduction scenarios, in the study area.

Keywords: Multidimensional Poverty, Malnutrition, Cameroon, Children-under-five, Nutrition

1. Introduction

Health is an important indicator of well-being. In particular, the health of children is an indicator of the standard of living of households. Indeed, it is influenced by the environmental, economical, sociocultural and biological characteristics of parents [1]. In Cameroon, Mayo-Danay is the poorest Division in the far North region, with an incidence of poverty of 87.5% [2]. This Division is often a

victim of repeated floods, undermining the stability of its economy. The Division is bordered with Chad on three of its sub-Divisions. It is a cross-border trade area for agricultural products, with the majority of products exported to Chad, and to a lesser extent to Nigeria. Most of the products imported into the region come from Nigeria, among others: yams, wheat flour, potato, sorghum, orange fruit, cowpea, bean, garlic, pasta, soft drink, sugar, peanut seed, goats, rice... [3].

Data from the Standardized Monitoring and Assessment of Relief and Transitions (SMART) surveys of 2017 showed a high prevalence of malnutrition in the far North regions, with a prevalence of 4.5% global acute malnutrition (GAM). Of these, 1.1% children with severe acute malnutrition (SAM); 40.1% chronic malnutrition (CM) and 19.2% underweight [4]. Several studies have studied the determinants of malnutrition. According to OSORIO, Ana María et al [5], the context in which the children live affects their health, regardless of the characteristics of the children, their mother, and their household. Communities share physical, social, and economic attributes that may be fundamental to improve the health condition of individuals. The sanitary conditions, education, social networks, and socioeconomic status of communities are factors that are associated with the nutritional status of children. Therefore, the nutritional status of children is associated with the family's standard of living. The demographic and health surveys with multiple indicators of Cameroon (DHS) in 2011 showed that children under the age of five from rural areas are more likely to be victims of malnutrition than those from the urban environment with 40.5% and 21.9% respectively for chronic malnutrition, 7.6% and 3.0% for acute malnutrition, 20.2% and 7.2% for underweight [6].

According to the "summary of humanitarian needs", lack of food, environmental conditions, limited access to health and water, recurrent epidemics (cholera, measles, acute respiratory infection, malaria) associated with low vaccination coverage, and inadequate feeding and hygiene practices are important determinants of malnutrition in the northern part of Cameroon [7]. However, there has been no study on the role of multidimensional poverty on the onset of malnutrition in children under five years of age. The multidimensional poverty index, is a new composite statistical indicator developed in 2010 by a laboratory of the University of Oxford and used by the United Nations Development Program [8]. This index aims to account for the phenomenon of poverty in three of its dimensions: deprivation in education, health and standard of living. This will help to provide scientific evidence of the weight of child poverty in households on malnutrition. The objective of this study was to illustrate the link between multidimensional poverty and malnutrition among children under five in the Division of Mayo Danay. The purpose was specifically to assess the nutritional status of children, describe the living conditions of children in households, and measure the association between multidimensional poverty and the nutritional status of children.

2. Methods

We conducted a cross-sectional, descriptive and analytical study of a sample of children, irrespective of gender, from randomly drawn households in the Division of Mayo-Danay. Data were collected during the post-harvest period, in the dry season, from February 26, 2015 to March 8, 2015.

2.1. Study Population

The Division of Mayo-Danay grouped in 2014, five health districts including, Maga, Velé, Kar-Hay, Yagoua and Guéré, and 41 health areas and 714 villages/neighbourhoods. The population of this Division was 739268 inhabitants in 2014, of which 124936 children from 0 to 59 months or 16.9% of the general population of the Division [9]. Several ethnicities lived and shared the Department, among others, the Massas, the Toupouris, the Musgums, the Mousey, the Peuls, the Kanuris, the Kéras etc. The study population consisted of children under the age of five from households in the Department of Mayo-Danay. Only children between 6 and 59 months of age whose parents or care takers of children who have stayed in the study area for at least one month and who have freely consented were included in the study. Children not belonging to the selected households were excluded from the study.

2.2. Sampling

This was a two-degree cluster survey. The cluster (village/neighborhood) was the first level of sampling and the household was the second level or unit of investigation. In a household, all target children meeting the inclusion criteria were included in the sample for the measurement of anthropometric parameters. Only one parent or caretaker was interviewed in the household. This procedure was done randomly, from the selection of clusters to the households to be investigated, optimizing representability and limiting selection bias.

The sample size (n) was calculated from the ENA software version 2012, used in SMART nutritional surveys. For an estimated prevalence of 12%, which corresponded to the prevalence of global acute malnutrition among under-5 in the far North region [6], a desired precision of 5% and a cluster effect of 1.5, the minimum sample size was 265 Children. Considering an average household size (in the far North) of 5.7 persons [10], 5% of possible refusal (and absence) of participation and a proportion of 19.6% of children under 5 years of age in 2015 [10], the ENA software calculated a minimum size $m = 277$ households at investigate in the Division of Mayo Danay. The number of households per village (u) was the number of households to be investigated in total on the number of clusters ($u = m/30$), or 9.23 households (10 households were surveyed per cluster). The eleven districts of the Department constituted a single stratum and each village/district constituted a cluster. An exhaustive list of 714 villages/quarters (clusters) of the Division had been introduced into the ENA software entry mask allowing a random draw of thirty clusters. The households were randomly drawn by systematic random sampling by applying a survey step calculated by the teams of trained investigators and according to the pre-established applied procedures.

2.3. Data Collect Process

The interview of the participants took place during the day

or in the evening according to the availability of the households. After obtaining the consent of the head of the family or his legal representative, a questionnaire was administered in a face-to-face interview with the child's mother or caretaker.

Anthropometric Measurements

The calmest children (usually the eldest) were first measured, in chronological order:

(i). Age

Age: it was collected through an official document containing the date of birth of the child or estimated using the local calendar of events or compared to a child whose age or date of birth was known.

(ii). Weight

Weight: the weighing was done using the electronic scale SECA 415, France, with a maximum capacity of 150kg. The children were weighed naked, either by direct weighing for the children (13-59 months), or by double weighing for the small children (6 – 12 months) or not being able to stand on the scale. The weight was read and carried in kilograms with a precision of 0, 1kg.

(iii). Brachial Perimeter

Brachial perimeter (BP): the BP measurement was performed in all children on the left arm using a special Ribbon called Shakir band, halfway between the shoulder and the elbow. The arm should hang, be relaxed and loose along the body at the time of reading. The PB measurement was read and recorded to the nearest cm and millimeter.

(iv). Bilateral Edema

Bilateral edema: the presence of edema was evaluated by a two-inch pressure exerted simultaneously on the back of the child's two feet for 3 seconds. When the thumbprint remained marked on the back of both feet (bucket sign), there was a presence of bilateral edema in the child.

(v). Height/Length

Height/length: it was measured using a Shor measuring tape graduated in cm and the measure read and recorded in cm with a precision of 0,1cm. Children under 2 years of age were measured in the reclining position (length), and those aged 2 years and older in standing position (height).

The thresholds used for classifying children according to their nutritional status from anthropometric indices were classified into three main classes and two subclasses (moderate and severe) per class defined in the following manner:

2.4. Class One. Acute Malnutrition

- a) Severe acute malnourished (SAM): weight-for-size index less than-3 Z-scores, and/or presence of bilateral edema or brachial perimeter < 115 mm.
- b) Moderate acute malnourished: weight-for-size index between-2 and-3 Z-scores or brachial perimeter \geq 115 mm and < 125 mm.

2.4.1. Class Two. Stunting

- a) Severe growth retardation: size-for-age index less than-3 Z-scores.

- b) Moderate growth retardation: size-for-age index between-2 and-3 Z-scores.

2.4.2. Class Three. Underweight

- a) Severe underweight: weights-for-age index less than-3 Z-scores.
- b) Moderate underweight: weights-for-age index between-2 and-3 Z-.

2.5. Measuring Child Poverty in Households

The deprivation approach (non-monetary approach) used in our study to measure poverty [8] is an approach in which poverty is defined as the lack or mismatch in food fields, equipment, standards and common or customary services or activities in a company. We looked for a set of variables to collect in order to identify the deprivations of children in households and build a poverty score. The search for deprivations covered four dimensions. The poverty level of the children here was expressed as a percentage of the deprivations that children faced in the household. For each dimension of well-being, an indicator of poverty reflecting the critical level below which a child (as a person) was considered deprived or poor was defined. In a first step, it was defined for each dimension as a relevant deprivation indicator and a critical level (absolute or relative) considered as a poverty line. We used five dimensions of Matchinidé et al., [11]. These dimensions were measured with indicators made dichotomic for multidimensional poverty and the calculation of poverty index among children under 5 years of age.

Nutritional dimension: searches for deprivation of the babies from exclusive breast feeding at least six months after birth.

Drinking water dimension: search for deprivations on access to an improved water source according to the classification of the World Health Organization [12]. It was a water under pipeline supplying the home; public fountain/fountain Terminal; tubed well /drilled well; dug wells protected; protected source; drilling. The time spent by someone in the household walking to access an improved or non-improved water source.

Sanitary dimension: research of deprivation on improved toilets, it consisted of flush toilets (towards a sewer system with drains or a septic tank, or a pit latrine); improved ventilated pit latrine (VIP); slab-covered pit latrine; composting latrine [13].

Health dimension: research of deprivations on childcare through the vaccination of children according to their age on the one hand and on the other hand by vitamin A supplementation (100IU), at least six months after birth.

Living environment dimension: search for deprivations on the normal population index (INSEE standards), either less than or equal to two children per room (dormitory). The nature of the walls, normal or standard wall, hard walls or mud brick walls. The nature of the soil was improved if its material was made of cement/mud brick, tiled/marble. The nature of the roof was said to be improved when the material

was plate, cement, mud brick.

A second step was to calculate the incidence of poverty of each child, i.e. the number of deprivations in each area of which the child was a victim and to calculate the number of children who had multiple deprivations for the entire possible combinations. Children in the same household could have the same deprivations, in which case information on deprivation was generalized among all children in the household.

To aggregate these dichotomous indicators into a simple composite indicator that has the property to be a good summary of the information provided by the initial indicators, we used the factorial method (multiple correspondence analysis or MCA) used by Asselin [14]. All the indicators used had the same weight. The analytical expression of the composite indicator for a child (I) is written:

$$C_i = \frac{1}{K} \sum_{k=1}^K \sum_{J_K=1}^J W_{J_K^k}^{i,j_k}$$

Where $W_{j_i}^k$ denotes the normalized score of the category J_k of the variable K on the first axis of the MCA of X and J_{i,j_i}^k a binary variable 0/1 equal to 1 if (i) to category J_k and 0 if no. K is the number of primary variable retained. The C_i index of an individual (child) was simply the average of the weights of the binary variables I_{k_i} , j_k .

The child poverty index (%) was equal to $100 - CI \times 100$. The poverty index here thus expressed the percentage of deprivation that the child faced in the household. A child was then considered to be poor multidimensional when deprived in at least 3 of the 10 (30%) areas covered by the indicators. The weight of all scores being "1", so "poor multi dimensionally" had a maximum score of $\leq 30\%$ and children with a score $\geq 40\%$ were considered "non-poor multi dimensionally" [8].

2.6. Ethical Standards Disclosure

Our study targeted particularly children aged 6-59 months, vulnerable to malnutrition. The selection of the participants for the study was made without distinction of gender, race or ethnicity. The adults selected to answer the questionnaires had given their free verbal consent and the children whose parameters were measured were those whose parent or legal guardian had given verbal consent. Children screened with severe acute malnutrition were referred to the nearest acute malnourished ambulatory nutritional center. In order to ensure confidentiality and secure the information collected during the investigation, the questionnaires were anonymous, the raw data were only accessible to some people and the digital databases were coded. The protection of the participants in our study was based on international regulatory texts such as the Helsinki Declaration, the Nuremberg Code, the Belmont report, the international ethical guide for epidemiological studies developed by CIOMS (Council for international organizations of medical sciences).

2.7. Statistical Analysis

The data collected was analyzed by the ENA software version 2012 to classify children according to their nutritional status and to assess the severity of malnutrition. Epi-Info 7 allowed us to perform the various statistical tests at a confidence interval of 95% and a random error of 5%. The graphs and tables were designed from Excel 2010. It is assumed that the normal range of growth is between -2 and +2 standard deviations, which includes 95% of the reference population. Z-scores were expressed in standard deviation multiples (ET): A Z-score of 0 was equivalent to the median while it was a Z-score of -2 occurring below the median. Prevalence of malnutrition in under-five children was measured separately for wasting, stunting and underweight. Influence of various socio-economies factors on under-nutrition was measured using bivariate analysis. The association between the nutrition status and the standard of living was measured by the Chi 2 test according to whether the value of Odd ration was significant or name, calculated from the software Epi Infos 7.1.40 version.

3. Results

3.1. Socio-demographic Data

The study was conducted with 433 children, including 220 females (50.8%) and 213 male males (49.2%). The average age of the children was 30 months, the standard age difference between the children in the sample was 14.70 months. With 27.0%, children aged 6-17 months were the most represented in the sample and 54-59 months at least (4.8%). Male sex was more represented by the 18-29-month age bracket (58.0%) and females by the 30-41-month age group (53.3%). The age of mothers or children in the household (294 women) ranged from 15 to 87 years, with an average age of 30 years. Among heads of households (278), age ranged from 18 to 85 years, the average age of heads of households was 40 years. The most recurrent age in both types of parents was 30 years. The majority of children's households (92.59%) were in united homes (marriage, concubine), 5.05% were widowers/widows, others separated (1.35%) or singles (1.01%).

3.2. Nutritional Status of Children

Overall acute malnutrition (GAM) in children was 4.4% (% CI = 2.7; 7.1), underweight at 13.9% (% CI = 10.0; 19.0) and chronic malnutrition at 23.3% (% CI = 19.0; 28.3). There was no significant difference in gender for the different forms of malnutrition.

3.3. Living Conditions of Children in Households

Only 29.67% of children were exclusively breastfed for the first six months of life. However, 82.64% of children had received vitamin A supplementation after their first six months of life (Table 1). More than 67.3% of children under the age of five lived in households with an improved water

source. Regarding the distance between households and the water point, 89.12% of children were from households whose water source (improved and/or not improved) was less than

15 minutes' walk. Finally, children from households with no access to improved sanitation were 87.44%.

Table 1. Distribution of child welfare indices.

Well-being indices	Number	%	CI (95%)
Exclusive breastfeeding			
yes	127	29,67	25,43; 34,29
no	301	70,33	65,71; 74,57
Vitamin A			
received	357	82,64	78,66; 86,02
Not received	75	17,36	13,98; 21,34
Water source			
improved	287	67,37	62,66; 71,76
Not improved	139	32,63	28,24; 37,34
Access time to the water source			
≤ 15 minutes	385	89,12	85,70; 91,82
> 15 minutes	47	10,88	8,18; 14,30
Type of toilet			
improved	376	12,56	83,85; 90,35
Not improved	54	87,44	9,65; 16,15
Vaccination/age			
Completed vaccine	353	81,52	77,47; 85,00
Not completed vaccine	80	18,48	15,00; 22,53
Living environment			
Adequate roof	101	23,33	19,48; 27,65
Inadequate roof	332	76,67	72,35; 80,58
Adequate soil	47	10,88	8,18; 14,30
Inadequate soil	385	89,12	85,70; 91,82
Adequate wall	67	15,47	12,27; 19,31
Wall not suitable	366	84,53	80,63; 87,73
Adequate population index	128	29,56	25,35; 34,14
Inadequate population index	305	70,44	65,86; 74,65
Poverty status			
Poor	285	65,82	61,11; 70,24
No poor	148	34,18	29,76; 38,89

Concerning the vaccination status of children, 18.48% had not received the vaccines recommended for their age (table 1). The distribution of deprivations related to the living environment of children in households is shown in table 1. Of the children, 70.44% are deprived of an adequate population index (1 or 2 children for a household room), 84.53% are deprived of a household with adequate walls,

89.12% are deprived of adequate soil and 76.67% of a household with an adequate roof for their well-being. The living environment, sanitation and exclusive breastfeeding are the main deprivations that children face in the Mayo-Danay. The majority of children in households had a score between 3 and 5 (figure 1), with 23.56% for the score of 3; 24.02% for the score of 4 and 23.56% for the score of 5.

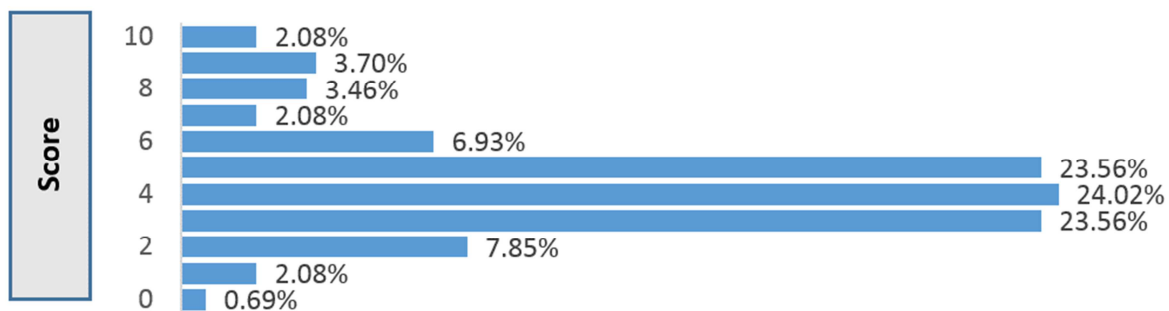


Figure 1. Proportion of children according to deprivation scores (0 to 10).

The proportion of the poorest children with no access to any welfare dimension was 0.69% and 2.55% had access to all dimensions. Of the 433 children surveyed, 65.82% did not have access to more than 30% (score ≤ 3) of the indicators of well-being in the household.

3.4. Poverty and Nutritional Status

The comparison between the nutritional status of children and the status of child poverty (table 2) showed that 60,61% of chronically malnourished children were poor multi-

dimensionally (OR = 4,436; CI = 2,767; 7.111 P-value = 0,000); and 66.67% of acute malnourished children were poor multi-dimensionally (OR = 4,178; CI = 1,548; 12.298); and 70.97% child with underweight were poor multi-

dimensionally (OR = 0,497 CI = 0,5158; 1.7877; P-value = 0,000). The multi-dimensionally poor children are therefore four times more at risk of chronic malnutrition or acute malnutrition than non-poor children.

Table 2. Crossing of nutritional status and child poverty status in households.

Status poverty	malnourished	non-malnourished	Odd Ratio	CI (95%)
	N (%)	N (%)		
Chronic malnutrition				
Poor	60 (60,61)	86 (25,75)	4,436	2,76; 7,11
Not poor	39 (39,39)	248 (74,25)		
Total	99 (100)	334 (100)		
Acute malnutrition				
Poor	12 (66,67)	134 (32,29)	4,178	1,54; 12,29
Not poor	6 (33,33)	281 (67,71)		
Total	18 (100)	415 (100)		
Underweight				
Poor	44 (70,97)	260 (72,51)	0,497	0,51; 1,78
Not poor	18 (29,3)	102 (27,49)		
Total	60 (100)	371 (100)		

5. Discussion

The results of our study showed malnutrition prevalence (4.4%) close to those published by UNICEF in SMART surveys of 2017 (4.5%) in the far North region [4]. This similarity of results confirms the impact of malnutrition in the Far North region and Mayo-Danay division in particular. Exclusive breastfeeding was 29.67% in the Mayo-Danay Division, this proportion is not very far from that found by DHS of 2011 [6] in Cameroon (20%), However, the recent surveys show an improvement in the proportion of exclusively breastfed children at national level that is, 40% according to DHS (2017) [15]. Access to drinking water (improved water source) remains low in the study area, i.e. 67.37%, slightly below the proportion at national level (71%) regional level in 2011 according to the DHS (2011). The same source had found a higher proportion (41%) people with access to improved sanitation against 12.7% found in our survey. The high proportions of households using inadequate shelters (76.67% roof; 89.12% soil; 84.53% walls and 70.44% stand index) were predictable because the housing characteristics already reported by the DHS (2011) were nationwide, with 46.3% of the shelters without electricity; 43.2% of the shelters with soil or sand covering material, 41.3% of the shelters, of which more than three people used a sleeping room. These indices of living standards below the national level could be explained by the level of development below other parts of the country and the arid climatic and environmental conditions in the far north zone. These results confirm the classification of the area as one of the poorest divisions of the region, with a poverty index of 71.5% [2].

The incidence of multidimensional poverty here (65.82%) was below that found by Lekeumo [11] with 88.9%. This difference could be explained by the fact that the zone went through a minimum of development between the two periods of study (2007-2015), in addition, several NGOs work in the area to improve access to sanitation, drinking water and

infant and young child feeding. On the other hand, the deprivation indices used in our study were adapted to the age group of children under five, whereas those used by Lekeumo [11] assessed multidimensional poverty among children aged 5-17 in the household. The association between the level of poverty and the child's health was already studied by several authors before.

The work of Ahoey and Vodounou [1] in Benin had shown that the standard of living in the household is one of the factors that contribute strongly to reducing the risk for a child to have a stunted growth. According to the authors, an increase of one unit of wealth would reduce the risk of stunting by 0.2%, which is 10 times greater than the effect of the one-year increase in the number of years of study. There is a significant association between "poor multi-dimensionally" and chronic malnutrition and acute malnutrition. These results confirm those found by Ambapour and Moussana H [16] according to which the impact of the wealth index is positive and very significant, showing that an increase in household wealth by 10%, would reduce chronic malnutrition 6.3%. According to the same source, the fact that the child belongs to a very poor household exacerbates malnutrition. The work of Ouedraogo (2008) showed specificity in the weight of indices of wealth on chronic malnutrition in children aged five years. In fact, according to the author, wealth improves the health of boys in rural areas. On the other hand, for girls, their nutritional status deteriorates in electrified households and those with a bicycle, and improves with the possession of means of communication (TV, radio) [17]. Mayor *et al.* (2001), already confirmed the link between the growth retardation and the economic situation in the country. According to the authors, the values are widely dispersed but the prevalence of stunting that spreads between 30 and 50% for GNP values of < \$300, drops to 20-30% for values of \$600-800. According to the same study, this type of relationship was not observed with the indicator of young children's thinness. This confirms that the indicator of stunting reflects fairly well the overall

economic status of countries [18]. A more recent study by Khanna et al., (2017) shows an association between all types of malnutrition and socio-economic factors [19].

Our study confirms these results in a more specific way, illustrating the association between poverty and stunting in children under five in households. In the Central African Republic, the probability for a child from a household living in a low-weight lifestyle is 23.2% higher than that of a child from a household with a high standard of living at the national level. The probability is 63.7% when the child belongs to a household with a low standard of living, all other things being equal [20]. More recent work by Ossorio et al., (2018), has confirmed the association between standard of living in the household and malnutrition, according to the author, at the level of individuals and households, the probability of malnutrition [5].

In General, nutritional surveys to assess malnutrition in children are conducted during periods of wedding. This study was carried out in the post-harvest period, which could lead to a misconception of a decline in the prevalence of child malnutrition in the far North region, compared to the previous years.

6. Conclusion

The study showed a high proportion of malnourished children in Mayo-Danay households with 4.4% of acute malnourished child; underweight: 13.9% and 23.3% chronic malnourished. The living conditions of children in households remain precarious, particularly with very limited access to improved sanitation, an inadequate environment and a small proportion of infants who have benefited from exclusive breastfeeding (29.67%). The study highlighted the interaction between the living conditions of children in households and the impact on their nutritional status of children. In short, children in poor households are more vulnerable to chronic malnutrition and underweight than those with a higher standard of living. The high prevalence of malnutrition in the study area and in the far North region in general requires particular attention both to early diagnosis and to the economy and environment of the household. We recommend conducting a feasibility study for early detection of maternal malnutrition at home (MAMA MUAC). Initiate a simulation and comparison study of poverty reduction scenarios in the study area aimed at improving the living environment of households and promoting care for children to reduce malnutrition-related morbidity among.

Conflicts of Interest

The authors do not declare any conflict of interest.

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