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Infant and Young Child Feeding Practices and Nutritional Status of Children (0-24 Months) in Households of Ndjamena State, Chad

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Abstract: Malnutrition is a well-known public health problem in children under 5 in developing countries. It is in this sense that a study was carried out among children aged 0 to 24 months in households in the Ndjamena region. This study therefore sought to assess the relationships that could exist between the anthropometric status of children from 0 to 24 months and their feeding practices as well as the nutritional and health status of mothers. This is a descriptive and cross-sectional study using a multistage stratified cluster sampling technique in which the household was the basic sampling unit. In fact, out of 1000 households surveyed, 396 mother / child couples were interviewed. A questionnaire comprising the variables (feeding practices of infants and young children, dietary diversity of the mother, socio-demographic and professional parameters of the mother and anthropometric parameters) made it possible to collect information on the children and their mothers. Anthropometric data were collected in order to calculate the indices (Weight / Height; Height / Age; Weight / Age; BP and bilateral edemas), and for the classification of children, we used the WHO references. The prevalence of acute malnutrition was 28.34% where 3.70% presented the severe form. Similarly, 24.20% of children surveyed were affected by stunting with 10.20% of them presenting the severe form. In addition, 18.41% were underweight with 9.93% having the severe form. However, 88.80% of the mothers didn't attended school, 46.60% of them were housewives, 55.90% were under 25.5 years old and mostly having at least one child (81.50%). Most of the infants (83.60%) received colostrum, where 33.60% of mothers breastfed the infants immediately after birth. Then, 55.90% of the mothers surveyed continued to breastfeed until the age of over one year (≥ 14 months). In addition, 33.60% of the mothers introduced the complementary food early. Overall malnutrition was significantly more common among children of mothers who did not attend school, as well as those who reportedly did not practice any economic activity. Finally, the prevalence of the three forms of malnutrition decreased when the mother's education level increased, the mother's health and nutritional conditions were good, and the feeding practices were appropriate. This study allowed us to identify the factors that impact the life of this vulnerable social layer and for which it would be important to further improve strategies to reduce and limit the spread of malnutrition in children.

Keywords: Households, Ndjamena, Infant, Young Child, Feeding Practices, Nutritional Status, Chad

1. Introduction

Most deaths in the world, at an early age among children, result from the problem of malnutrition following health disorders or their nutritional status. According to the World Food Program (WFP) in 2013 [1], about 842 million peoples suffer from malnutrition in the world, and every day 17,000 children die, which is equivalent to the rate of a child every five seconds [2]. In developing countries, more than 50% of deaths of children under five is linked to malnutrition [3]. Indeed, 90% of people with malnutrition live in developing countries and more than 60% of people are women and children [4-6]. Africa, which represents about 10% of the world population, has a very large number of undernourished people [7], sub-Saharan Africa with 30% of the population, or 239 million inhabitants being particularly affected [8].

In sub-Saharan Africa, feeding practices are often inadequate and incompatible with the recommendations of the World Health Organization and therefore constitute the main factors hindering the physical and mental development of the 'child. Breast milk therefore remains the ideal food for infants, providing the necessary nutrients in addition to other non-nutritional benefits, health benefits, for infants and mothers [9-11]. Recent nutritional survey in Chad revealed difference in breast milk feeding and quality of complementary foods with urbanization [12]. Prevalence of malnutrition was alarming and associated to poor quality of food intake and practices in infants [13]. It has been recommended that after the breastfeeding of the first six months of birth, infant must be supply of with foods of good nutritional and hygienic quality to cover the energy needs of the latter. Fundamentally, growth and development of children depend on several factors where food practice remains the primordial element in the child's life. Food practice largely depends to sociodemographic characteristics of the family as well as the diversity of foods in the community. In this respect, balanced, healthy and diversified food is recommended to child under 24 months, while malnutrition at this stage is disastrous, as it is very detrimental to growth and behavior [14]. Dietary diversity is a qualitative measure of food consumption that reflects the diversity of foods to which children can access. In addition, it helps to meet nutritional needs [15]. However, in the Ndjamena town, complementary food often starts too early or too late, and foods are often nutritionally insufficient or the quality is bad for the child [9, 14].

The improvement of the nutritional status of children from 0 to 24 months requires a better assessment at the community level and the establishment of a nutritional education system. In order to improve the food practices strategy in the Ndjamena region, this study has been initiated aimed at assessing the Nutritional status of children from 0 to 24 months in this region, the food practices of infants and the maternal characteristics. The study makes use of multiple linear and logistic regression analyses to assess the correlation between the nutritional status and the other variables.

2. Methods

2.1. Types and Subjects of Study

This was a descriptive and cross-sectional survey that was carried out on children from 0 to 24 months in the region of Ndjamena, (Chad). The different forms of malnutrition have been determined in households.

2.2. Sampling

Sample size: The minimum sample size (n) was determined using Bernoulli's formula:

$$n = \frac{(1{,}96)^2 \times N}{(1{,}96)^2 + I^2 N - 1}$$

In this equation n is the minimum sample size, N is the number of households in the city of N'Djamena which was about 951,418 households, I is the acceptable error on the prevalence fixed at 10%, and 1.96 represents the Z value for 95% confidence level. Applying this formula, the minimum size was approximately 384 households. In this study, the sample size used was set at 1000 households.

The sampling procedure used in this study consisted of a multi-stage stratified cluster sampling design in which the household was the basic sampling unit.

2.2.1. Selection of Clusters

The selection of the clusters was made by a systematic draw based on the probability proportional to the size of the population of the primary units (ZD). This is how each stratum (district) has had its survey base, composed of a list of all enumeration areas (ZD) belonging to it. This procedure ensures the representativeness of the sample at each of the district neighborhoods. For this, the ENA for Smart version of 09 July 2015 was used for this selection.

2.2.2. Selection of Households

The household has been defined as "a collective unit or social group, consisting of related individuals or not, living under the same roof, under the authority of a head of the household, sharing their resources and expenses and eating the same meal [16]. Beforehand, an exhaustive enumeration of households in each selected cluster made it possible to obtain an updated list of households. In each cluster, the selection of households was made by a systematic survey. The survey step was calculated by dividing the approximatively total number of households (N) in a cluster by the number of households to investigate (n). Then, the selection of the following households was made in a systematic way by applying the survey step.

2.3. Study Population or Target

The study population was composed of households with at least one child under the age of 24 months. Were included in these study households in the Ndjamena region that have at least one child from 0 to 24 months and whose chiefs gave their consent.

2.4. Conduct of the Investigation and Data Collections

The surveyed populations have been encountered in households. Within each household visited, the mothers of children were interviewed. A structured questionnaire administered by the investigators was used to request information on socio-demographic data, assessments of infant and young child feeding practices (ANJE), through seven (7) basic indicators according to the WHO recommendation [17]; which are: early breastfeeding, exclusive breastfeeding, continued breastfeeding at the age of one year, the introduction of complementary foods, dietary diversity, according to the 24 hour reminders of the eight (8) food groups used to benefit children, the minimum frequency of meals, and minimum acceptable diet. The anthropometric measurements of the children were carried out: The weight of each child was measured using a UNISCALE scale or electronic personal weighing machine with SECA type battery, with an accuracy of 100g. All the children were weighed naked. The weight was recorded in kilograms to the nearest 0.1 kilogram. Size: The length was taken using a SHORR measuring rod graduated in centimeters and precise to the millimeter. Children <87 cm tall were measured lying down and those ≥ 87 cm tall when standing. MUAC (MUAC): MUAC was measured using the Shakir strip midway between the shoulder and the elbow [18, 19]. The BP reading was done in millimeters and to the nearest millimeter. The strip was renewed according to use. MUAC was also measured in women of reproductive age (15 - 49 years) with an adapted Shakir band. And then the edemas were checked by exerting with two thumbs, three seconds pressure on the backs of both feet of the children. Edema was considered present if the fingerprint (shape of the cup) persisted on the backs of both feet for a few seconds. Those of the SIMBA type (Symmetrical, Painless, Soft, Bilateral, Ascending) were considered as nutritional edemas according to the SMART method.

The age of the child was determined from the date of birth in his vaccination book, or given by the parents. In case the mother did not know the age of the child, a schedule of events has been established including important, religious, political and environmental events in order to be able to estimate the age in months. Particular attention has been paid to events that can be used to estimate age around the threshold of 6 months to 5 years.

Data collection was carried out by 10 teams made up of two investigators each and under the supervision of three experts. All were previously trained and subjected to a 2-day pilot survey.

2.4.1. Calculation of Nutritional Indices

The anthropometric measurements of the child were used to calculate the nutritional indices that define the three forms of malnutrition: emaciation (acute malnutrition) is weight-for-height (W/H), the growth retardation (stunting) (chronic malnutrition) is height-for-age (H/A) and the underweight is weight-for-age (W/A). The Z-scores were calculated according to the new standards of distribution [20] published in April 2006 to assess the growth and development of children from birth until the age of 5 [20-24]. A z-score <-2 standard deviation indicates moderate and a Z-score <-3 indicates severe malnutrition.

2.4.2. Score Diversity

The dietary diversity score (DDS) of children and mother was assessed by counting the number of food groups (more than 7 for the child and 9 for the mother that exist) consumed by the child or the mother the day before the survey. When five or more food groups were counted, the DDS was classified as "meeting" the Minimum Diversity Score (MDD) and when it was less than four, the DDS was classified as "not meeting" the private label.

2.5. Ethical Considerations

The investigation was carried out following the authorization of the competent authorities under the memo N° 035 of January 2020 of the sanitary delegation, Chad. The investigation was only conducted after obtaining consent in preamble to the investigation sheet. The confidentiality of the data has been guaranteed, the identity of the child has not been unveiled and during the passage of investigators in households, all children meeting the admission criteria (MUAC <115 mm) were oriented to the nearest health center.

2.6. Confidentiality

All data collected have been treated confidentially. Numbers (codes) were used to identify each participant, and anonymity was therefore respected. Only the head of the study has access to individual data. In any case, the individual results of the participants were not communicated to other people. The data of the study were retained until the end of the survey.

2.7. Statistical Analysis

The Software Sphinx Plus²-Edition Lexica-V5 was used for the development of the questionnaire sheet and collection of responses. Data were exported to the Excel sheet to purify the data and calculate the nutritional indices using the standards based on WHO (2006) and the ENA software (July 2015 version). And we also served in sampling the drawing of the clusters surveyed. Descriptive analyzes, simple and multiple linear or logistic regression analysis were performed using SPSS Software 16.0. The significant level was fixed at α=0.05.

3. Results

3.1. Maternal and Children Characteristics

Table 1 presents the main characteristics of mothers and children. In all the households surveyed, more than half of the mothers had the age in between 21-30 years with an average age of 25.5 years. Nearly half (48.8%) of the mothers have never gone to school and 7.1% studied Koran, the majority (81.5%) had only one child under 2 years.

Table 1. *Some sociodemographic and professional characteristics of the mothers and children.*

Variables	modalities	N	Frequencies (%)
Age of the mother	≥ 20	88	15.7
	21 – 30	314	55.9
	31 – 40	145	25.8
	41 – 50	14	2.7
Occupation of the mother	household	262	46.6
	Official p / v	94	16.7
	Merchant	90	16.7
	Breeder/Agriculture	9	1.6
	Student	31	5.5
	Other	76	13.5
Level of Instruction	out of school	274	48.8
	Primary	59	10.5
	Secondary	114	20.3
	Superior	75	13.3
	Literate (Koranic School)	40	7.1
Number of children < 2 years in charge	1	458	81.5
	2	96	17.1
	≥ 3	8	1.5
Child Age	[1 - 6]	115	20.5
	[7 - 12]	133	23.7
	[13 - 18]	164	29.2
	[19 - 24]	150	26.7
Sex of the child	Female	271	48.3
	Male	291	51.7
Vaccination against measles	Yes	368	65.5
	No	163	29.0
	Do not know	31	5.5
Supplementation in vit-A	Yes	368	45.5
	No	157	27.9
	Do not know	37	6.6
Worm the child	Yes	336	59.8
	Non	184	32.7
	Do not know	42	7.2

All age groups of children from 0 to 24 months were represented with almost similar proportions (20.5 to 29.2%). Similarly, the proportions of boys and girls were quite similar with 51.7% and 48.3% frequencies, respectively. Regarding the vaccination coverage against measles, deworming and vitamin A supplementation, we find that 65.5% of children from 6 to 23 months have been vaccinated against measles, 45.5% have been supplemented with vitamin A, and 59.8% of them were dewormed in the past six months.

3.2. Prevalence of Malnutrition in Children

Figure 1 presents the Z score distribution polygon frequency of our sample children as compared to reference distribution. The figure gives a general picture of the acute, chronic and underweight status of children under 24 months in the population of Ndjamena. Globally the distributions of our sample were shifted left for the 3 types of malnutrition, either in general or in the girls and boy's substrata. The means of these distributions were respectively -0.48±1.08; -0,96±1,27 and -0,83±1,16. It appears from the figure that Z score distribution of chronic malnutrition is more shifted while that of acute malnutrition is less shifted. In addition, the distribution polygon of girls is more shifted for acute malnutrition, while that of boys is more shifted for chronic malnutrition. Chronic malnutrition manifests itself in a height-for-age (H/A) deficit, it represents a measure of the long-term effects of malnutrition, in other word it reflects stunted growth. The underweight is the weight for age deficit (W/A) which determines the existence of a weight inadequate for a given age. Underweight has been revealing of both chronic and acute malnutrition. The shift of the sample curve to the left indicates that there are more cases of children suffering from malnutrition in the surveyed population than in the reference population. The prevalence of malnutrition along with the 95% confidence limit associated to these distributions are shown in table 2. It shows that 13.10% of children suffered from overall acute malnutrition, with 3.70% presenting the severe form, whereas 24.20% of children were chronic malnourished among which 10.20% of them presented the stern form. For the underweight, 18.18% of investigated children had a weight inadequate of which 5.20% had the stern form.

Table 2. *Prevalence (95% confidence limit) of gender-based malnutrition in children 0-24 months in the Ndjamena region, January 2020.*

Types de la malnutrition	Boys		Girls		Children aged 0-24 months		
	Moderate	Severe	Moderate	Severe	Moderate	Severe	Overall
Acute	13.8 (9.6 -19.5)	1.4 (0.5-4.30)	4.9 (2.7 -8.8)	1.5 (0.5-4.4)	9.1 (6.7 – 12.4)	3.7 (2.1 – 6.6)	13.1 (9.8-16.8)
Chronic	15.9 (11.0 -22.5)	8.2 (5.0 -13.1)	15. 3 (10.7 -21.2)	3.7 (1.6 -8.2)	14.2 (10.9 – 18.2)	10.2 (7.1 – 14.1)	24.2 (19.7 – 29.4)
Underweight	15.4 (11.2-20.7)	3.8 (2.0 – 7.3)	10.1 (6.8 – 14.7)	3.80 (1.8 – 8.0)	12.5 (9.7- 16.0)	5.20 (3.4 – 7.8)	18.2 (14.1 –22.0)
MUAC Edema	2.6 (0.5-4.2)	2.5 (1.6 – 6.7)	1.8 (2.5-9.2)	3.6 (1.0 – 5.6)	3.1 (1.8-5.3)	2.9 (1.7- 4.9)	5.9 (3.9- 9.0)

Values under bracket are 95% confidence limit.

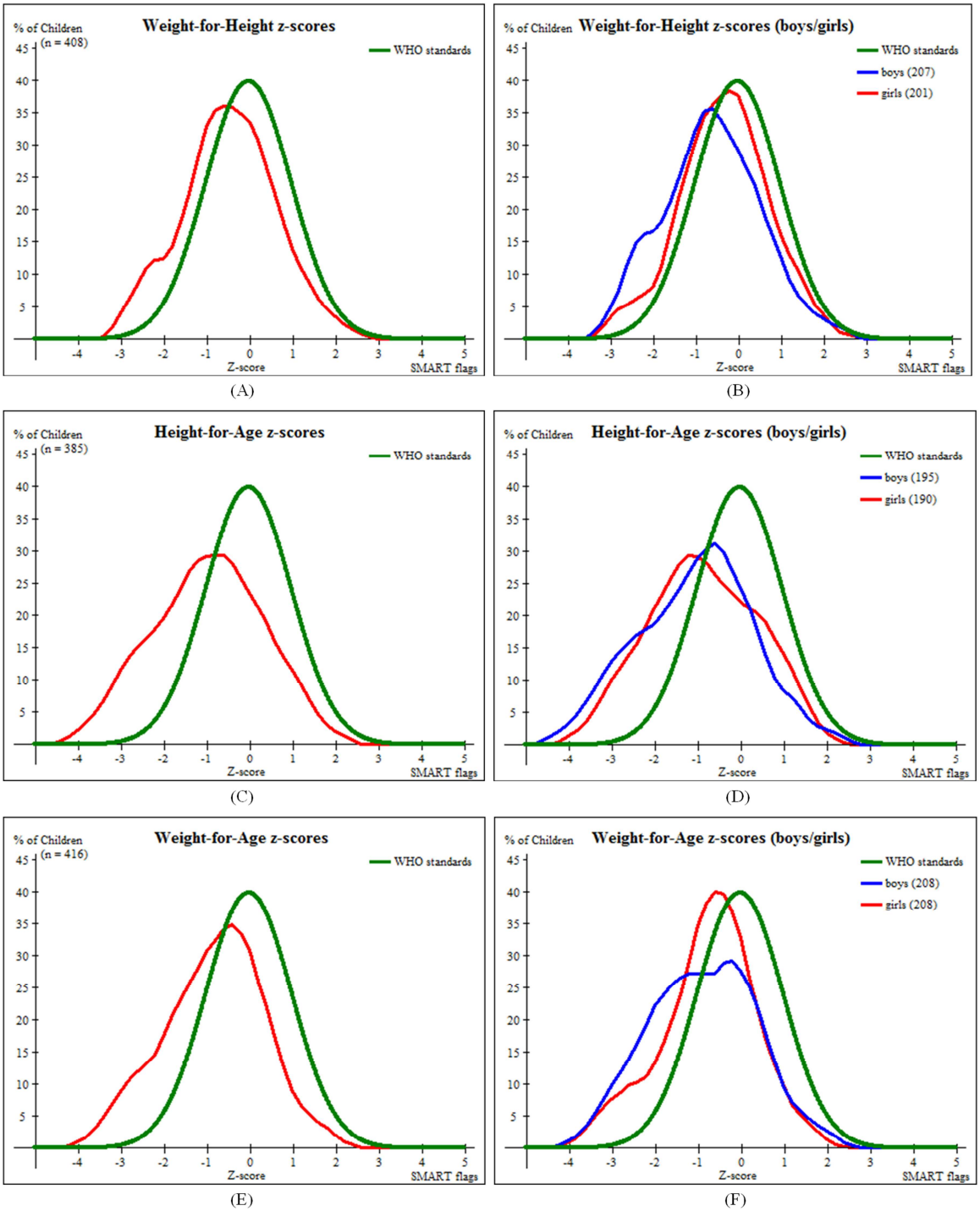


Figure 1. *Polygon of frequency distribution of Z score for the different form of malnutrition (acute, chronic, and underweight) in children under 24 months in the Region of Ndjamena, January 2020.*

3.3. Dietary Diversity Score and Feeding Characteristics of Children

Table 3. *Score of Food Diversity of children under 24 months in Ndjamena city.*

Groups	Terms	N	Frequencies (%)
Mothers	Meeting MDD	303	53.9
	Not meeting MDD	259	46.1
Children	Meeting MDD	171	30.4
	Not meeting MDD	391	69.6

MDD is minimum Dietary Diversity.

Table 3 gives the score diversity of children under 24 months and mothers having at least one child under 24 months in Ndjamena town in 2020. It appears from the table that respondents who have received at least 5 food groups out of 9, the day preceding the investigation represented 53.9% while those not meeting the MDD represented 46.1%. the DDS of the child reflects that of the mother.

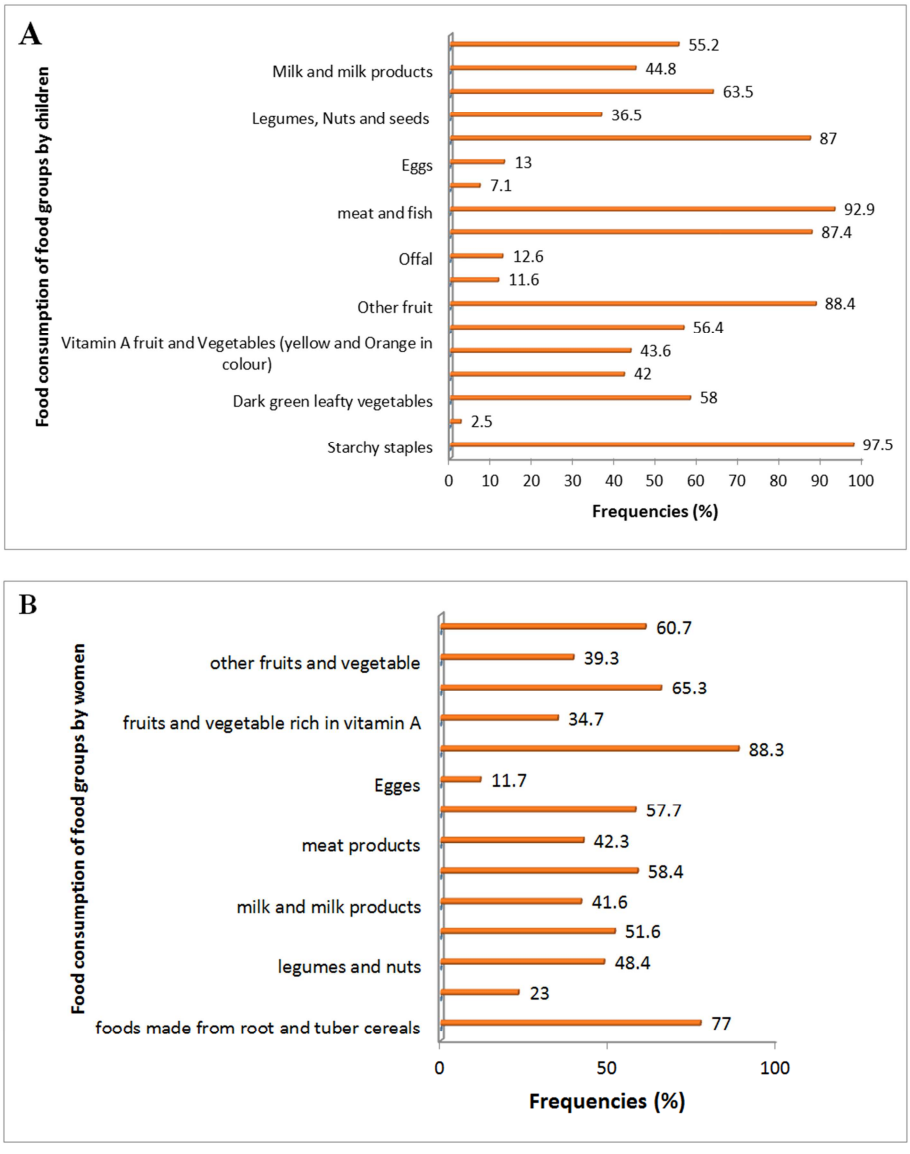


Figure 2. *Dietary diversity of mothers and children in households at Ndjamena city.*

Figure 2A presents the different food groups consumed by the mothers on the day preceding the investigation. It clearly appears that the regimes were predominantly made of starchy food (97.5%), meat and fish (92.9%). Vegetables (58.0%), fruits (43.6%). and milk/dairy products (44.8%) were fairly represented while eggs (13.0%), nuts (36.5%), giblets (12.6%) were poorly consumed by the population.

While the DDS of the mother was globally fairly

acceptable, that of the children was very poor. Out of the 7 food groups, the frequency of children from 6 to 23 months who received at least 4 groups the day before the investigation was 30.4%, about half that of the mothers. The diversity of foods consumed presented in figure 2B revealed that the children from 6 to 24 months were feed essentially on cereals (77.0%). Meat (42.3%), nut (48.4%) and milk/dairy products (41.6%) were fairly represented while fruits vegetables (34.7%) and egg (11.7%) were poorly represented.

Table 4. *Feeding characteristics of children.*

Variables	Modalities	Effective (N)	Frequencies (%)
Colostrum	yes	470	83,6
	No	92	16,4
Time of bossed after birth immediately	Less	189	33,6
	than an hour	69	12,3
	Between 1h to 24h	187	33,3
	More than 24h	117	20,8
Continued breastfeeding	yes	385	68,8
	No	175	31,3
Moment of breastfeeding	the availability	106	30,2
	Precise moments	21	6,0
	On request	221	63,0
	Qd the breast weighs	3	0,9
Feed Numbers	<3	16	3,4
	4 to 7 times	225	53,2
	8 times and over	108	37,9
	Do not know	38	5,5
Types of sudden weaning	Brusque	85	54,5
	Progressive	71	45,5
Age of withdrawal	≥ 6 months	114	10,6
	7 – 13 months	135	26,5
	≤ 14 months	183	62,9
Reason for weaning	Drops the breast quicky	2	0,8
	crevice at breast	9	6,5
	Child disease	19	13,7
	Pregnancy	47	36,3
	Resumption of mother's work	5	1,6
	Refusal to tete	26	18,5
	No milk	13	8,9
	Prefers artificial milk	5	2,4
	Hurts nipples	17	11,3
Place of delivery at home	At hospital	121	22,4
	Health or Center	413	76,3
	In a private clinic	1	0,2
	Other	6	1,1
Health Assistance	Personal Health	453	83,7
	Traditional attendant	62	11,5
	Unqualified staff	26	4,8
Prenatal consultation	not visit	60	13,9
	1-3 visit	251	49,7
	≤ 4 visit	184	36,4
Excavation of children	Yes	48	8,9
	No	493	91,1
Food Introduction Age	> 6month	410	76,2
	6 month	127	23,6
	≤ 6 month	1	0,2

Table 4 presents the children feeding practices (ANJE). Most of the children from 0 to 24 months had benefited from a beavering in the early hours after their birth. Indeed, 83.6% of them had received the colostrum. In the meantime, 68.8% of respondent mothers pursued breastfeeding while 63.0% of mothers were breastfeeding at the request of their child. In addition, the results revealed that 53.2% of children were feed between 4 to 7 times. On the other hand, 54.5% of the mothers suddenly ceased to breastfeed their children while more than half (62.2%) of them continued to breastfeed until the age of greater than or equal to 14 months and 76.2% of children were introduced to early supplement food at the

lower age of six (> 6) months. In addition, 36.3% of mothers had sealed their children because of pregnancy. With regard to the place of delivery, the results showed that 76.3% of mothers were giving birth to the hospital or at the health center and 83.0% were assisted by health personnel at the time of delivery. In general, 49.3% of women followed the prenatal visit between 1 to 3 times the whole period of pregnancy.

3.4. Predictors in Reducing the Malnutrition

Health care and food diversity:

Table 5. *Multivariate logistic regression predicting malnutrition indicators by food diversity and health care utilization.*

Variables	Modalities	Acute Malnutrition		Acute malnutrition		Underweight	
		OR (CL 95%)	P	OR (CL 95%)	P	OR (IC 95%)	P
Prenatal visit	≤ 4 Visit	1		1		1	
	Not Visit	9.88 (0.85 114.73)	0.067	5.39 (0.62 46.76)	0.127	0.361 (0.01 0.268)	0.612
	1-3 Visit	0.001 (0.00)	0.078	0.40 (0.08 1.95)	0.257	0.028 (0.08 0.66)	0.027
Place of delivery	at hospital or health center	1		1		1	
	Other	35.4 (0.57 213.01)	0.091	0.25 (0.03 2.31)	0.220	1.01 (0.39 2.82)	0.113
Sex of the child	M	1		1		1	
	F	1.02 (0.68 1.52)	0.943	1.042 (0.69 1.57)	0.846	0.60 (0.39 0.93)	0.601
Vaccination against measles	yes	1		1		1	
	No	0.84 (0.49 1.47)	0.546	1.71 (0.93 2.99)	0.063	2.10 (1.17 3.76)	0.013
Vitamin A supplementation	yes	1		1		1	
	No	1.20 (0.50 2.91)	0.685	1.38 (0.57 3.38)	0.478	0.49 (0.20-1.21)	0.120
Virmoxi	yes	1		1		1	
	No	0.75 (0.34-1.17)	0.480	0.79 (0.35 1.77)	0.561	1.56 (0.61 3.47)	0.279
Milk maternal	yes	1		1		1	
	No	0.76 (0.48-1.20)	0.237	0.61 (0.39-0.96)	0.031	1.00 (0.61-1.63)	0.993
Cereals	yes	1		1		1	
	No	2.47 (1.35-4.53)	0.003	1.737 (0.966-3.065)	0.065	0.839 (0.451-1.559)	0.578
Legumes and nuts	yes	1		1		1	
	No	1.31 (0.79-2.18)	0.300	1.252 (0.759-2.067)	0.379	0.582 (0.336-1.010)	0.054
Milk and dairy product	yes	1		1		1	
	No	0.59 (0.37-0.94)	0.027	0.81 (0.51-1.28)	0.367	1.09 (0.67-1.76)	0.733
Meat and fish	yes	1		1		1	
	No	0.43 (0.27-0.69)	0.001	0.58 (0.36-0.92)	0.021	1.95 (1.16-3.17)	0.011
Eggs	yes	1		1		1	
	No	0.43 (0.32-1.39)	0.276	0.74 (0.36-1.51)	0.410	2.01 (0.90-4.47)	0.088
Fruits and vegetables	yes	1		1		1	
	No	1.03 (0.48-2.22)	0.937	0.78 (0.36-1.68)	0.523	0.77 (0.35-1.72)	0.526
Other fruits and vegetables	yes	1		1		1	
	No	0.77 (0.41-1.46)	0.427	0.27 (0.14-0.52)	0.001	1.20 (0.61-2.36)	0.608
Mothers	Meeting MDD	1		1		1	
	Not meeting MDD	0.88 (0.60 1.27)	0.483	0.89 (0.62 1.28)	0.525	1.08 (0.72 1.59)	0.723
Children	Meeting MDD	1		1		1	
	Not meeting MDD	1.03 (0.67 1.55)	0.881	0.97 (0.65 1.45)	0.897	1.35 (0.89 2.05)	0.160

Analysis of factors associated with nutritional status in children showed that among health care of the child, only 1-3 prenatal visit ($p<0.027$) and vaccination against measles ($p<0.03$) were significantly associated with malnutrition indicators, in particular underweight (Table 5). Specifically, 1 to 3 antenatal visits reduced the risk (OR 0.028) of developing underweight compared to those who are used to having antenatal visits more than 4 times. In addition, not vaccinating the child increases the risk (OR 2.1) to develop underweight as compared to vaccinated child. The work also revealed that food diversity affected all the form of malnutrition (Table 5). In this respect, we found that cereals (p=0.003), milk and dairy products (p=0.027), and meat and fish (p=0.001) were significantly associated with acute malnutrition; chronic malnutrition was significantly associated with maternal milk (p=0.031), meat and fish (p=0.021), other fruits and vegetables (p=0.001); underweight was only associated with consumption of meat and fish (p=0.011). Precisely, non-consumption of maternal milk protected (OR = 0.61) the child against chronic malnutrition while non consumption of cereals protect (OR = 2.47) the child from acute malnutrition; not consuming milk and dairy product reduced the risk (OR=0.57) to develop acute malnutrition while not consuming meat and meat products protects from acute (OR=0.43) and chronic (OR=0.58) malnutrition, while it increases the risk of underweight (OR=1.95). No consuming other fruits and vegetable protects from chronic malnutrition (OR=0.27).

3.5. Sociodemographic Characteristic of the Mother and Child

Table 6. *Multivariate logistic regression predicting malnutrition indicators by sociodemographic parameters.*

Variables	Modalities	Acute malnutrition		Chronic malnutrition		Underweight	
		OR (IC 95%)	P	OR (IC 95%)	P	OR (IC 95%)	P
Mother's education level	Out of school	1		1		1	
	Primary	0.69 (0.34 1.39)	0.296	0.50 (0.25 1.01)	0.050	0.75 (0.38 1.50)	0.417
	Secondary	1.09 (0.65 1.84)	0.740	0.76 (0.45 1.09)	0.296	0.92 (0.54 1.56)	0.754
	Tertiary	1.05 (0.54 2.04)	0.892	0.54 (0.27 1.09)	0.538	0.85 (0.04 1.77)	0.663
	Literate (Koranic school)	2.59 (1.27 5.30)	0.009	0.38 (0.16 0.90)	0.029	0.90 (0.41 1.97)	0.795
Mother's profession	Housewife	1		1		1	
	Official P / V	0.46 (0.25 0.87)	0.016	0.58 (0.31 1.07)	0.079	0.73 (0.39 1.36)	0.317
	Trader	1.07 (0.62 1.84)	0.805	1.324 (0.76 2.30)	0.324	1.80 (1.06 3.07)	0.031
	Breeder / Agriculture	2.28 (0.57 9.10)	0.243	1.11 (0.28 4.49)	0.857	0.47 (0.057 3.93)	0.489
	Pupil / Student	1.03 (0.42 2.53)	0.942	4.43 (1.71 11.49	0.002	0.11 (0.01 0.84)	0.034
	Others	0.61 (0.32 1.16)	0.129	1.06 (0.57 1.96)	0.857	1.18 (0.65 2.15)	0.588
Mother's age	≥ 20	1		1		1	
	21 - 30	0.82 (0.47 1.42)	0.482	1.35 (0.75 2.42)	0.311	1.00 (0.57 1.77)	0.988
	31 - 40	0.91 (0.49 1.68)	0.761	1.16 (0.60 2.24)	0.656	0.86 (0.45 1.64)	0.642
	41 - 50	1.30 (0.34 4.21)	0.668	0.84 (0.22 3.28)	0.803	0.66 (0.17-2.64)	0.561
Number of children <5 years	1	1		1		1	
	2	1.65 (1.01 2.70)	0.857	1.71 (1.01 2.87)	0.045	1.14 (0.66 1.96)	0.650
	≤3	2.70 (0.56 12.97)	0.034	0.37 (0.04 2.87)	3.441	1.33 (0.24 7.50)	0.745
Child's age	< 6	1		1		1	
	7 - 12	1.02 (0.54 1.93)	0.962	0.66 (0.33 1.33)	0.244	1.24 (0.70-2.21)	0.466
	13 - 18	1.63 (0.91 2.94)	0.104	2.48 (1.37 4.48)	0.003	0.77 (0.43 1.37)	0.372
	19 - 24	2.45 (1.36 4.41)	0.003	3.58 (1.98 6.49)	0.000	0.68 (0.37-1.25)	0.215

Table 6 describes adjusted odds ratios (ORs), confidence interval (CI) and level of significance of association between the malnutrition indicators and some mother's sociodemographic characteristics. It was demonstrated with logistic regression that children from mothers with primary education were less prompt to chronic malnutrition (OR=0.50, p=0.05) while children from women who attaint koranic school were more prompt to acute malnutrition (OR=2.59, p=0.009), and protected from chronic malnutrition (R=0.38, p=0.029) compared to women without education. In regard to mother's profession, children from mothers with Official P/V occupation were protected from acute malnutrition (OR=0.46, p=0.016), traders had child at risk of underweight (OR=1.80, p=0.031), pupil/student had child at risk of chronic malnutrition (OR=4.43, p=0.002) but protected against underweight (OR=0.11, p=0.034). mother's age was not associated to any form of malnutrition while family's with 2 or 3 children were at risk of acute (OR =1.65-2.70, p<0.05) and chronic (OR=0.71, p=0.045) malnutrition. The child age was equally associated with acute and chronic malnutrition. Children with age 13-18 months were at risk of chronic malnutrition (OR=2.48, p=0.003) while those of 19-24 months were at risk of acute (OR=2.45, p=0.003) and chronic (OR=3.58, p<0.001) malnutrition.

4. Discussion

Our data significantly confirms the association between socio-professional parameters, dietary practices and the nutritional status of children aged 0 to 24 months surveyed in the Ndjamena region.

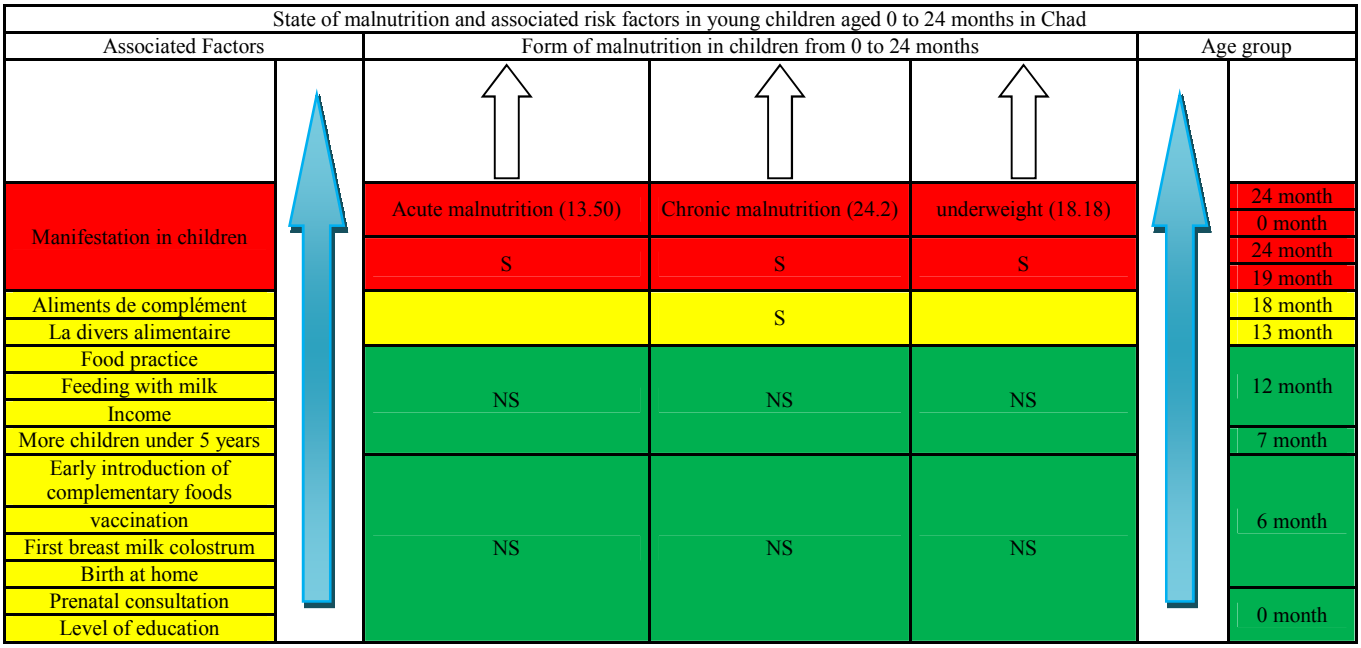
It is evident from our observations that addressable factors such as health care and food diversity of the child have an impact on nutritional status of the child. Furthermore, the mothers educational level and profession, number of children in the family and the child age are important factors influencing nutritional status of the child. Overall malnutrition in children aged 0-24 months. The overall prevalence of malnutrition in the study site varied from on type to another, 13.10, 24.20 and 5.90, for acute, chronic and underweight, respectively. The prevalence was observed to be significantly higher for boys than for girls. The high risk of boys compared to girls is consistent with other reports in Nigeria [25] and Ethiopia [26]. The prevalence of acute malnutrition in our study site has exceeded the threshold of 10% (serious situation) according to the criteria defined by the WHO. This result is in line with previous data one year ago in the same area [12], revealing that if any action was done, no significant change has resulted. Our results are in line with prevalence 11-18% reported in previous studies conducted in other regions of sub-Saharan Africa [27, 28]. The prevalence of global chronic malnutrition (24.20%) is at a worrying state according to WHO, lower than 18.6% reported in 2020 [12] in the same population. The prevalence of underweight was 15% quite high than 11.4% reported elsewhere in Kenya [29], but significantly lower than 23-33% [30, 31] reported in Cross River State, Nigeria.

The present study showed that the child age was a relevant factor associated to malnutrition. Although initiating breastfeeding within the first hour after birth in general did not meet the WHO guidelines, we found that children of less than 6 months were not associated to any form of malnutrition. Only 45.9% of mothers breastfed their infants immediately following childbirth. This frequency was higher as compared to 32.0% and 35.6% reported respectively in 2019 and 2020 in the same population, probably as a consequence of corrective actions made towards improving the care of children in Chad. Similarly, the rate of children who received colostrum was 83.6% is our study, but 79.4% and 75.6% respectively in 2019 and 2020 in the same population [12, 32]. First hour breastfeeding frequency was similar to 44.5% reported at EDO region of NIGERIA [11], but much lower than 87% and 62.6% reported at northwest and Debre-Berhan in Ethiopia, respectively [33, 34]. These differences have been associated in earlier studies to the level of awareness of the feeding conditions of the children in the study area, the level of education of mothers and the socio-cultural education of population.

While all the children received breastfeed for at least 6 months, it appeared that 68.0% of the surveyed mothers pursued breastfeeding up to more than one year (≥14 months). Previous studies have shown that a long life breastfeeding leads to a reduction in neonatal mortality specifically to infection [2, 4]. In addition, the continuation of breastfeeding up to two years or more, has beneficial effects, for the mother and child couple, to reduce the consequence of diseases, then corrects the social accumulation of the child, and contributes to the limitation of breast cancer in the mother [35]. The rate of 68.0% observed in this work revealed a progression in the studied area, were 28.6% was reported in 2020, with a national rate of 53.8% [32]. Six months is a critical period in the life of child where the milk become insufficient to meet the daily dietary needs. In our 49.9% of our sample population, complementary foods have been introduced early at age than 6 months. This proportion is comparable to that obtained in many other countries such as Nigeria with 48.4% [36], Ethiopia with 52% [37]. Our work revealed significant association of chronic malnutrition with children at 13-18 months and 19-24 months probably as a consequence of feeding inadequacy at the 6th month. In addition, acute malnutrition was associated with children aged 19-24 months. In fact, only 30.4% children received the minimum number of supplementary groups of foods required the day before the investigation. Similar low rates were reported in our sample population one (48.0%) and two years (32.1%) ago before our investigation in 2020 and 2019, respectively [12, 32].

While complementary food is essential in reducing malnutrition in infant, it is generally agreeing that the diversity of the dietary is an important parameter associated to malnutrition [38]. However, we did not found a significant relation between meeting the dietary diversity and the malnutrition status. Ouedraogo [39] reported dietary diversity has little influence on the anthropometric status of children, showing that the high dietary diversity does not reassure the achievement of the coverage of nutrient requirements if the quality of food taken is low. The average frequency of mothers and children who meet the dietary diversity the day before the survey were quite low, 53.9% and 30.4%, respectively. It is admitted that the child must have a balanced and diversified diet to cover the necessary nutrient requirements for proper functioning, hence reduce the risk of malnutrition. From the above, it appears that the food must comprise the different groups in equilibrated form to avoid malnutrition. Generally, the dietary regime of mothers (99%) and children (77%) was made of cereals roots and tubers, while meat and fish were less represented, 7.1% for mothers and 57.5% for children. On the other hand, egg consumption was low (11.7%). Many factors may have influenced the eating habits of the population such as their religion or ancestral believed, the availability in the area, and the poverty. According to social belief, the low consumption of eggs by children has the consequence of slowing down the expression or articulation of words during their growth. The results of the logistic regression revealed the negative effect of feeding children with maize on the development of acute (OR=2.47) and chronic (OR=1.74) malnutrition, while less consumption of meat and fish was associated (OR=1.95) with underweight. This result was in agreement with those of Ousman [40] who found that high consumption of grains alone did not meet micronutrient needs, regardless of how much of the food groups you eat properly [41]. The increasing risk of consumption of cereals may also be due to the treatments applied to the cereals. In fact, cereals in their native form absorbed much water, leading to less dense energy porridge with accepted viscosity (120 mm/s). Treatments such as fermentation and germination, or enzymatic action of amylase are well known to improve on the energy density of porridge, but their use in household of our sample population is under investigation to ascertain their role in the malnutrition.

The child malnutrition greatly depends on the mother's behavior, which are also link to their sociodemographic characteristics. Mothers with no prenatal visit, who deliver out of hospital, who do not vaccinate their child against measles exposed their child to risk of malnutrition. In addition, mother with koranic school education, with profession traders, pupils/students or possessing 2 or more children of less than 5 years were at risk to develop at least one of the 3 forms of malnutrition. Our finding is in line with Amsalu [36], Tessema in Kenya [29] and Anthony in Nigeria [11] who reported that mother's illiteracy, mother's profession helped to increase the risk of child malnutrition under five. These observations are essential for the intervention point of view, since it would help not only to select target population. The hypothesized scheme of malnutrition in Chad is presented in figure 3.



S. significant; NS. not significant

Figure 3. *The hypothesized scheme of malnutrition in Chad.*

5. Conclusions

This study determines the malnutrition status of children 0-24 months in Ndjamena. The state of acute malnutrition is serious, chronic malnutrition is worrying while underweight is children less than 6 months were not affected by any of the 3 forms of malnutrition while those 9-18 month were highly affected by chronic malnutrition and those 19-24 months by acute and chronic malnutrition. The chronic malnutrition seems to have started at the pregnancy with less prenatal visit, at the birth with delivering out of hospital, and not breastfeeding the baby and not given the colostrum, non-vaccination against measles. At 6 months, the complementary food is not given to child, and when it is, the dietary diversity score is very low characterized by about 2-3 groups of food only. I addition the food is made essentially of cereals and tubers with less fish, meat and egg. At 13 months the child starts expressing chronic malnutrition which lead at 19 months to acute malnutrition characterized. Many mother's sociodemographic characters factors associated to the development of malnutrition at the different growing stage of the child: koranic school education and illiterate, traders and student occupation, having 2 or more children under 5 years. These are target population for nutritional interventions that are urgent in this case. As perspective investigation of the nutritional quality of complementary porridge of children is envisaged to elucidate its role in the malnutrition.

6. The Study Limit

The limits of this study is that most of the risk factor details have been obtained from the mother because there was no other way to get the information; There may therefore be information biased or erroneous. We also noted a weakness in the 24-hour recall method that was used for the collection of food data, and this weakness lies in the fact that because of cognitive problems, mothers may not be able to recall or accurately report the food consumption of their child. Cognitive challenges may include lack of knowledge and memory (oblivion) and the situation of maintenance. In addition, the 24-hour reminder method tends to underestimate the dietary intake of about 10% compared to the observed intake. However, it does not take into account the prospective measure to quantify the consumption of parent / child couple.

Abbreviations

ANJE: assessments of infant and young child feeding practices;
CI: Confidence Interval;
DDS: dietary diversity score;
ENA: Emergence Nutrition Assessment;
H/A: Height-for-Age;
MDD: Minimum Diversity Score;
MUAC: Mid-Upper Arm Circumference;
n: number of households to investigate;
N: total number of households;
OR: Odds Ratio;
SIMBA: Symmetrical, Painless, Soft, Bilateral, Ascending;
W/A: Weight-for-Age;
W/H: Weight-for-Height;
WFP: World Food Program;
ZD: enumeration areas.

Declarations

Ethical Statement

Written consent was obtained from the parents/guardians of the children for their participation in the study, which was approved by the provincial health delegation of Ndjamena from the Ministry of Public Health on December 10, 2019 (Ref: N°878/PR/ MSP/DSPN/SAF/2019).

Ethical Approval and Consent to Participate

The investigation was carried out following the authorization of the competent authorities according to the memorandum N ° 035 of January 2020 from the Health Delegation. The investigation was only conducted after obtaining consent as a preamble to the investigation form. The confidentiality of the data was guaranteed, the identity of the child was not revealed and when the interviewers visited the households, all the children meeting the admission criteria (MUAC <115 mm) were referred to the nearest health center.

Voluntary Participation and Withdrawal from the Study

The head of household has the right not to take part in the survey or to refuse the further use of data concerning him. Any withdrawal from the investigation will not be prejudicial.

Confidentiality

All data collected has been treated confidentially. Numbers (codes) were used to identify each participant, and anonymity was therefore respected. Only the study manager has access to individual data. In any case, the individual results of the participants were not communicated to other persons. Study data was retained until the end of the investigation.

Declaration of Data Availability

The datasets generated for this study are available on request from the corresponding authors.

Competing Interests

The authors declare that they have no competing interests.

Author Contributions

ABDG conceptualized, developed the theoretical ideas and oversaw the project. AHC performed analysis and wrote the manuscript. AGEC contributed to the analysis and helped to draft the manuscript. CEF contributed in theoretical ideas and presentation of the manuscript. All authors read and approved the final manuscript.

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