ANALYSIS OF THE RELATIONSHIP BETWEEN CHILD MALNUTRITION AND FOOD INSECURITY IN A RURAL AREA OF THE DEMOCRATIC REPUBLIC OF CONGO

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Abstract

According to the UNICEF's General Framework for Malnutrition, Household Food Security is one of the three underlying causes of maternal and child undernutrition. In order to verify whether this relation also applies in rural areas of the province of Central Kasai, in the Democratic Republic of Congo, we performed a cross-sectional study which included 300 randomly selected households of eight rural districts. The research revealed that child malnutrition – measured as wasting and stunting – was not correlated with Food Consumption Score (FCS).

1. Introduction

Child undernutrition is one of the major causes of mortality and morbidity throughout the world and is responsible every year for at least 3.1 million of child deaths (Victora et al., 2008). In fact, at least one third of total child deaths in the world are linked to malnutrition due to the increased risk of dying of malaria, measles and pneumonia. From a socio-economic perspective, malnutrition is correlated with limited life expectancy, disabilities, reduced workers' productivity and higher health-care costs (Frongillo, de Onis, & Hanson, 1997). Malnutrition has also a very high social and economic impact since it is responsible for the 6.7% of DALYs (Disability Adjusted Life Years) in the world (Lim et al., 2012).

This burden affects poor countries at a greater extent as almost 90% of undernourished children live in low-income and low-middle income countries (UNICEF, 2013).

The Democratic Republic of Congo is one of the poorest countries of the world. During the past two decades its development was halted by two civil wars which costed at least 3.4 million casualties, and left the country struggling in a deeply unstable political configuration, to this day.

Not surprisingly Child Malnutrition in the Democratic Republic of Congo is a serious health and socio-economic issue, with chronic and acute malnutrition rates standing respectively at 43 and 8% (WHO, 2015a). Compared to other regions

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constantly affected by civil wars, like the Great Lakes Region, Central Kasai has not been affected by war in the last 30 years; nonetheless, indicators regarding mother and child malnutrition are among the worst in the country. The under-five mortality rate in Central Kasai is of 135 children every 1,000 births, and the underweight prevalence stands at around 30% (USAID, 2014).

According to UNICEF General Framework for Malnutrition, there are three layers of causal determinants of child malnutrition – basic, underlying and immediate causes. The basic causes are those related to the political, economic, legal and ideological context since they determine the effective state of resources distribution and utilization in the population.

Among the underlying causes that directly influence the nutritional status at the household level there are food security, inadequate care, unhealthy households and poor health services.

Many authors have highlighted the clear relationship that links poor caring practices and poor hygienic environments to the onset of child malnutrition (Campbell, Benova, Gon, Afsana, & Cumming, 2015; Dangour, Watson, Cumming, Boisson, & Che, 2013; Ngure et al., 2014). However, the association between household food security and child undernutrition is still unclear, especially in rural Sub-Saharan regions where hunger hits poor households the most.

The aim of this paper is to verify the association between household food security (measured through the Food Consumption Score) and child malnutrition in a rural context in the Democratic Republic of Congo.

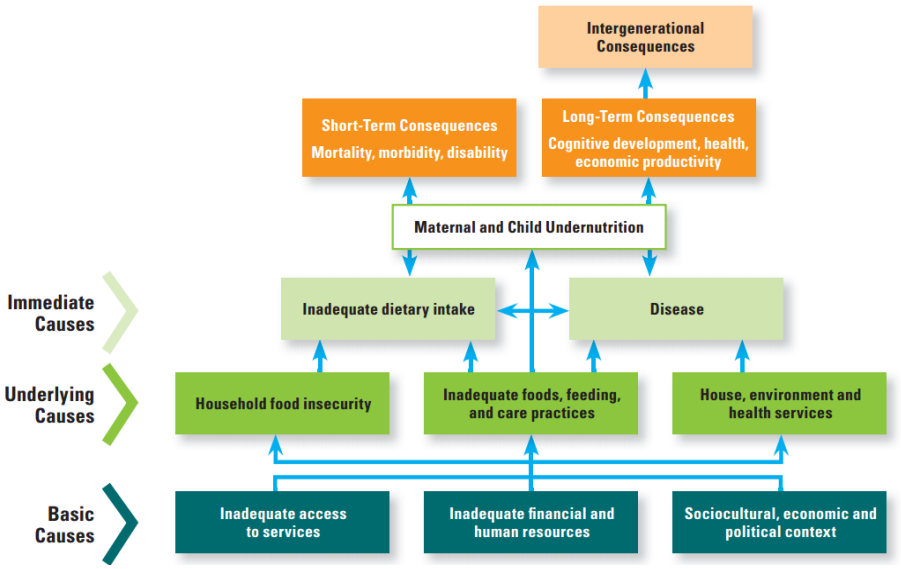

Figure 1: UNICEF General Framework for malnutrition

7. Material and Methods

7.1 Study area and population

The study was conducted in the region of Luiza, in the Central Kasai province.

Total population at the time of data collection was estimated at 174,000 people (Bureau Central de la Zone de Santé de Luiza, 2015).

7.2 Study design

This is a cross-sectional sub-study of a multi-sectorial project funded by the UNDP[23] and carried out by the INGO COOPI (Cooperazione Internazionale). The main objective of the research was to assess whether child malnutrition significantly correlated with poor food consumption patterns. Three hundred children aged between 6 and 59 months were anthropometrically measured and their household's responsible was asked to answer questions regarding food access, diet and consumption, as contemplated in the Food Consumption Score.

7.3 Sampling methodology and sample size

Following a three-steps sampling methodology, eight Health Districts (Zones de Santé - ZS) were selected as primary sampling units (total population estimated at 70,022 inhabitants); the eight areas selected were the most affected by child malnutrition according to a Screening survey conducted in the same region. Within the eight ZS, twenty-five clusters – 22 villages and 3 quarters of the small city of Luiza – were randomly selected as the sampling pool. Finally, following the criteria of selecting 12 households per cluster, 300 households were randomly included in the investigation,

Sample size calculation was based on results of the Screening survey on the prevalence of malnutrition in the target area, and estimates of under-five mortality rate from the demographic archives of the Health-Zone Central Office of Luiza (Bureau Centrale de la Zone de Santé). We estimated a design effect of 1.5 according to the "Sampling Methods and Sample Size Calculation for the SMART Methodology" that sets DEFF at 1.5 when expected prevalence is around 10% or no previous information about DEFF is available or the number of households per cluster is lower or equal to 15 (Humanitarian Response, 2012). Table 1 summarizes the sampling procedure.

Parameter	**Value**
Under-five children percentage	17.1%
Expected malnutrition prevalence[24]	11,9%
Desired precision (d)	5%
Design effect (DEFF)	1.5
Average household size	6
Percentage of non-response households	5%
Children to be included	263
Households to be included	300
Household per cluster	12
Number of clusters	25

Table 1: Sampling procedure

[23] UNITED NATIONS DEVELOPMENT PROGRAM
[24] Screening Survey conducted in August 2015

$$n = \left(t^2 \times \frac{p \times q}{d^2}\right) \times DEFF$$

Figure 2: Sample size calculation formula n = sample size ; t = linked to 95% confidence interval for cluster sampling; p = expected prevalence; q = 1-p ;d = relative desired precision ; DEFF = Design Effect (Action Contre la Faim International, 2012)

7.3.1 Sampling pool

The sampling pool was created from the list of villages and neighbourhoods of the eight ZS of the region of Luiza which resulted as malnutrition hot spots by a Screening Survey carried out during the month of August.

District	**Village**	**Pop.**	**Cluster**	**District**	**Village**	**Pop.**	**Cluster**
Mukungu	MUKUNGU	1732	1	Kamushilu	KANEMA	352	14
	ISUKU	376	2		NTUNGU	1741	15
	NGUEJANSANDJI	714	3		KAMUSHILU	1701	16
	KATANDA	516	4	Kakamba	KABUANKAMUTONGA	978	17
Mubinza	NTUMBA	1709	5		QUARTIER KANO	2692	18
	KABULUKU	1439	6		UPUTU	84	19
	MUYOWU	532	7	Kandakanda	QUARTIER KAKAMBA	2478	20
	MUKENGE	1518	8		LUYAMBI	3279	21
Mpikambuji	MPIKAMBUJI	1063	9		ILUNGA 2	2015	22
	KANTU	554	10	Kakala	NSAKANSAKA	1101	23
Kapanga	KAPANGA	1199	11		MULUNDA	805	24
	DIABA	772	12		NGUEJAMBUTA	924	25
	KANDEBA	277	13				

Table 2: List of randomly selected villages/neighbourhoods including total population according to

7.4 Indicators

7.4.1 Food Consumption Score (FCS)

The Food Consumption Score (FSC) is a reliable indicator of food security status of households, which focuses primarily on “food access”. The score is calculated by taking in consideration the frequency of consumption of several food groups (staple foods, animal-derived protein sources, milk, tubers, oils and fat, fruits, vegetables, pulses, spices, etc.), each one weighted with a different coefficient corresponding to its nutritional value.

FCS cut-offs and weights are summarized in table number 2 and 3.

Value	**Food Consumption Score**
0-28	Poor
29-41	Limit
>42	Acceptable

Table 3: FCS cut-offs

Food group	**Weight**
Cereals, tubers and root crops	2
Meat and fish	4
Milk	4
Oil/fats	0.5
Fruit	1
Vegetables	1
Pulses	3
Sugar	0.5

Table 4: FCS food groups and weights

7.4.2 Child malnutrition

Child malnutrition was measured using Weight-for-Height (acute malnutrition) and Height-for-Age (chronic malnutrition) Standard Deviations (Z-scores). A child whose Z-score is lower than -2.00 was considered malnourished (World Health Organization, 2009).

7.5 Data collection and analysis

Participant's privacy and dignity were maintained during visits and throughout the study period. Verbal informed consent was considered sufficient, as written signature was not culturally suitable. All data collected were kept confidential and questionnaires anonymous.

7.5.1 Measurements

Anthropometric measurements included weight, height and level of oedema. Height was measured to the nearest millimetre with a measuring board, and weight with a paediatric balance scale. Length and height cut-offs were 65 and 110 cm. Children less than 24 months of age (or up to 87 cm in height) were measured lying down while children aged 24–59 months (or 87 cm and above) were measured standing up. Oedema presence was determined by applying gentle thumb pressure for 3 seconds on the topside of each foot. The investigators were required to specify the level of oedema according to three degrees of severity (+, ++, +++). In case of oedema, the child was classified as severely malnourished (de Onis et al., 2012).

7.5.2 Data verification and cleaning

All data collection sheets were verified by the study supervisors and sent daily to the survey coordinator in order to eliminate/rectify errors and inconsistencies. Length/height measurements were also checked for consistency with inclusion criteria.

7.5.3 Sheets preparation

Two input masks for the Wash/Food Security data were prepared at the beginning of the survey using Epi Info software (version 6.04d). Nutritional data were entered in the Nutrisurvey.ena software. After the first data insertion, a second one was performed in order to compare the files and eventually correct any possible mismatch. Beforehand, the input masks were tested regarding internal and external consistency. All data were transferred to SPSS (version 20) to perform data cleaning and statistical analysis.

7.5.4 Statistical analyses

All analyses were conducted using SPSS (version 20). Proportions were compared using a Chi-Square Test with a significance level of 95% ($P < 0.05$), and correlations were tested using Pearson's r correlation coefficient. Food groups consumption were analysed across both FCS and malnutrition groups performing an Independent-Samples Kruskall-Wallis Test.

8. Results

8.1 Socio-demographic characteristics

Among the 286 surveyed households, agriculture was the main source of income with a prevalence of 78%, followed by small-scale trading (11.9%) and salaried employment (5.6%).

All twenty-five clusters were located in rural areas at least 50 km away from the nearest populated area (Luiza).

Included households			**Main source of income**		
Included	286	95,33%	Agriculture	223	78,00%
Excluded*	14	4,67%	Small-scale trade	34	11,90%
Child's sex			Salaried work	16	5,60%
Male	143	50,00%	Other	8	2,80%
Female	143	50,00%	Fishing	4	1,40%
Child's age			Herding	1	0,30%
6-23	100	35,00%			
24-59	186	65,00%			

Table 5: Socio-demographic characteristics of the sampled households

8.2 Child nutritional status and Food Consumption Score results

Male and female ratio was perfectly balanced with 143 boys and 143 girls. Sixty-five percent of children were between 24 and 59 months old and 35% of them were between 6 and 23 months old. Acute malnutrition prevalence was 21% while chronic malnutrition rate was 53.5%. Regarding food security, 46.5% of households had an Acceptable FCS, 42.7% had a Borderline FCS and 10.8% had a Poor FCS.

Weight-for-Height		
Severe Wasted	11	3,80%
Moderate Wasted	49	17,20%
Not Wasted	226	79,00%
Height-for-Age		
Severe Stunted	71	24,80%
Moderate Stunted	82	28,70%
Not Stunted	133	46,50%
Food Consumption Score		
Poor	31	10,80%
Limit	122	42,70%
Acceptable	133	46,50%

Table 6: Prevalence of malnutrition – wasting and stunting – and Food Consumption Score

* Height higher than 110cm or length lower than 65cm

8.3 Statistical analysis

8.3.1 Chi-Square Test

As outlined in table 7,8 and 9 the analyses evidence no significant differences regarding the prevalence of malnutrition among the households grouped into the three food security groups. The absence of correlation was also true when the analyses focused on different age groups – from 6 to 23 month and from 24 to 59 months.

FCS and Wasting Prevalence 6-23 months			**Weight-for-Height (Wasting)**		**Tot**	**FCS and Wasting Prevalence 24-59 months**			**Weight-for-Height (Wasting)**		**Tot**
			Wasted children	**Non-wasted children**					**Wasted children**	**Non-wasted children**	
FCS	Acceptable	counting	57	76	133	FCS	Acceptable	counting	32	101	133
		% in FCS	42,90%	57,10%	100%			% in FCS	24,10%	75,90%	100%
	Borderline	counting	50	72	122		Borderline	counting	21	101	122
		% in FCS	41,00%	59,00%	100%			% in FCS	17,20%	82,80%	100%
	Poor	counting	13	18	31		Poor	counting	9	22	31
		% in FCS	41,90%	58,10%	100%			% in FCS	29,00%	71,00%	100%
	Total	counting	120	166	286		Total	counting	62	224	286
		% in FCS	42,00%	58,00%	100%			% in FCS	21,70%	78,30%	100%

Table 7: Crosstab between FCS and Wasting

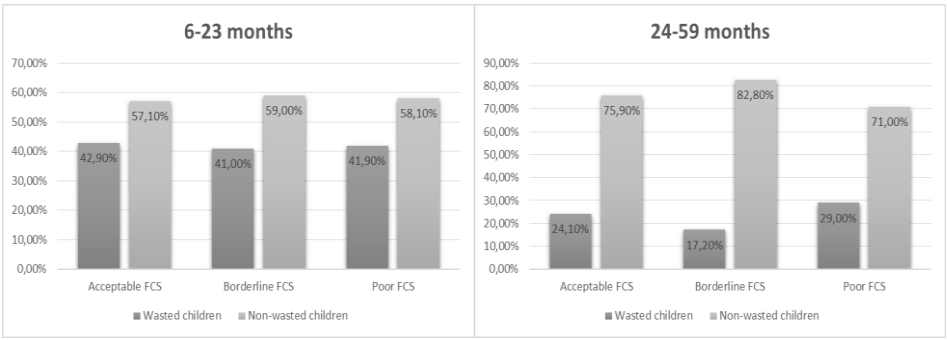

Figure 3: Wasting prevalence across FCS groups. No significative difference emerged among different FCS Groups (Acceptable, Borderline, Poor) regarding Wasting Prevalence

6-23 months				**24-59 months**				**TOTAL**	
Indicator	Value	df	Asymptotic Significance (2-sided)	Value	df	Asymptotic Significance (2-sided)	**TOTAL**	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,575[b]	2	,750	1,782[c]	2	,410	Pearson Chi-Square	2	,490
Likelihood Ratio	,578	2	,749	1,794	2	,408	Likelihood Ratio	2	,491
Linear-by-Linear Association	,415	1	,519	,180	1	,671	Linear-by-Linear Association	1	,988
N of Valid Cases	100	b. 1 cells (16, 7%) have expected count less than 5. The minimum expected count is 4, 90.		186	c. 0 cells (0, 0%) have expected count less than 5. The minimum expected count is 7, 79.		N of Valid Cases	a. 0 cells (0, 0%) have expected count less than 5. The minimum expected count is 12, 79.	

Table 8: Statistical significativity between FCS and Wasting. Limit value for significance ≤ 0,05

FCS and Stunting Prevalence 6-23 months			Height-for-Age		Total	FCS and Stunting Prevalence 24-59 months			Height-for-Age		Total
			Stunted children	Non-stunted children					Stunted children	No n-stunted children	
CS F	Acceptable	counting	25	22	47	FCS	Acceptable	counting	47	39	86
		% in FCS	53,19%	46,81%	100%			% in FCS	54,65%	45,35%	100%
	Borderline	counting	20	23	43		Borderline	counting	45	34	79
		% in FCS	46,50%	53,50%	100%			% in FCS	56,96%	43,04%	100%
	poor	counting	6	4	10		poor	counting	10	11	21
		% in FCS	60,00%	40,00%	100%			% in FCS	47,62%	52,38%	100%
	Total	counting	51	49	100		Total	counting	102	84	186
		% in FCS	51,00%	49,00%	100%			% in FCS	54,84%	45,16%	100%

Table 9: Crosstab between FCS and Stunting

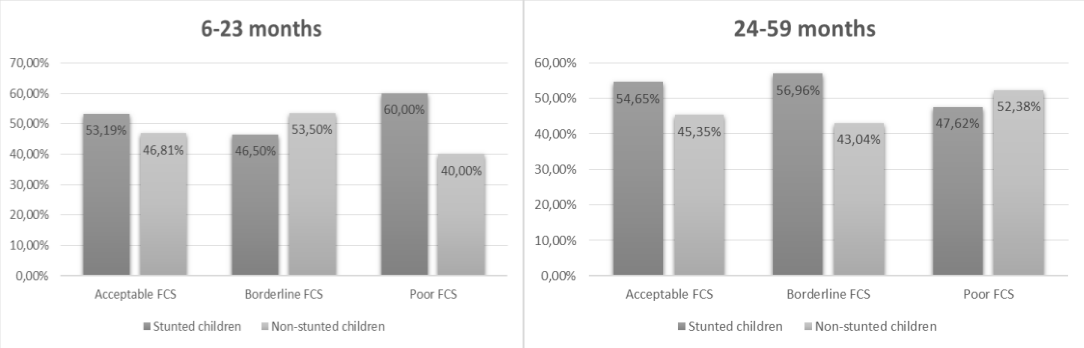

Figure 4: Stunting prevalence across FCS groups. No significative difference emerged among different FCS Groups (Acceptable, Borderline, Poor) regarding Wasting Prevalence

6-23 months				24-59 months			Total		
Indicator	Value	df	Asymptotic Significance (2-sided)	Value	df	Asymptotic Significance (2-sided)	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,761[b]	2	0,683	,587[c]	2	0,746	,068[a]	2	0,966
Likelihood Ratio	0,764	2	0,683	0,585	2	0,746	0,068	2	0,966
Linear-by-Linear Association	0,002	1	0,969	0,087	1	0,767	0,065	1	0,800
N of Valid Cases	100	b. 1 cells (16,7%) have expected count less than 5. The minimum expected count is 4,90.		186	c. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 9,48.		286	a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 14,42	

Table 10: Statistical significativity between FCS and Stunting. Limit value for significance ≤ 0,05

8.3.2 Independent-Samples Kruskall-Wallis test

No differences were found when considering the average household consumption of single food groups among households with malnourished children and those with no malnourished children (see tables 10 and 11).

Household FCS	Children's nutritional status	Cereals	Pulses	Vegetables	Fruits	Meat/fish	Milk and dairy products	Sugar	Oils
ACCEPTABLE	Non-stunted children	6,99	4,20	6,79	3,07	3,37	1,28	2,24	6,76
	Stunted children	7,00	3,72	6,92	2,31	3,18	1,11	1,51	6,75
BORDERLINE	Non-stunted children	7,00	0,62	7,00	1,94	1,34	0,03	1,37	6,56
	Stunted children	7,00	0,95	6,91	2,02	1,26	0,02	1,23	6,18
POOR	Non-stunted children	7,00	0,00	7,00	1,47	0,06	0,00	0,88	6,41
	Stunted children	7,00	0,07	7,00	0,93	0,00	0,00	0,60	5,80
Equal distribution across the categories STUNTING – NON STUNTING		Yes 0,243	Yes 0,477	Yes 0,505	Yes 0,545	Yes 0,496	Yes 0,575	Yes 0,386	Yes 0,353
Equal distribution across the categories ACCEPTABLE, BORDERLINE, POOR		Yes 0,550	**No 0,000**	Yes 0,550	**No 0,044**	**No 0,000**	**No 0,000**	Yes 0,281	**No 0,004**

Table 21: Independent sample test for stunting and FCS. Average consumption per household is used in the food groups' columns

Household FCS	Children's nutritional status	Cereals	Pulses	Vegetables	Fruits	Meat/fish/	Milk and dairy products	Sugar	Oils
ACCEPTABLE	Non-Wasted Children	6,99	3,75	6,83	2,66	3,42	1,31	1,83	6,73
	Wasted Children	7,00	4,77	6,89	3,03	2,86	0,97	2,14	6,83
Borderline	Non-Wasted Children	7,00	0,77	6,95	1,99	1,33	0,03	1,23	6,43
	Wasted Children	7,00	0,78	7,00	1,96	1,22	0,00	1,61	6,30
Poor	Non-Wasted Children	7,00	0,05	7,00	1,00	0,05	0,00	0,68	5,73
	Wasted Children	7,00	0,00	7,00	1,70	0,00	0,00	0,90	7,00
Equal distribution across the categories WASTING – NON WASTING		Yes 0,372	Yes 0,617	Yes 0,274	Yes 0,154	Yes 0,308	Yes 0,915	Yes 0,430	Yes 0,141
Equal distribution across the categories ACCEPTABLE, BORDERLINE, POOR		Yes 0,550	**No 0,000**	Yes 0,550	**No 0,044**	**No 0,000**	**No 0,000**	Yes 0,281	**No 0,004**

Table 12: Independent sample test for wasting and FCS. Average consumption per household is used in the food groups' columns

9. Discussion

Rates of child malnutrition in this sample of households of the province of Central Kasai were found to be very high. According to the WHO cut-offs, wasting prevalence higher than 15% is considered "critical" (de Onis et al., 2012), and in our sample the prevalence was definitely above the cut-off percentage. The results are coherent with

the latest Demographic and Health Survey conducted in 2014 where malnutrition rates in Central Kasai were among the highest in the Democratic Republic of Congo (USAID, 2014).Besides malnutrition rates, the survey also highlighted other key development indicators which are poorly applied in Central Kasai, such as mosquito-nets utilization, presence of WASH facilities (covered latrines, protected sources of water) and public health access (USAID, 2014).

The absence of correlation between household food security and child malnutrition could be accounted for by other underlying variables, which, nonetheless can potentially influence results. Although poor households food security is among the three underlying causes of malnutrition, its association with child malnutrition is often blunted by coping strategies aimed to protect the youngest elements of the family (Leonard, 1991), so that FCS does not always reliably reflects a child nutrition status. Moreover, studies have also shown that FCS does not always appropriately reflects individual nutrient intakes levels, notably because of its universal food-weights that are hardly applicable in every context of analysis (Jones, Ngure, Pelto, & Young, 2013). For example, we found fruit consumption to be very low in all the three FCS subgroups – possibly hiding some chronic micronutrient deficiencies that could lead to malnutrition (Lock, Pomerleau, Causer, Altmann, & McKee, n.d.). In fact, FCS does not discriminate between which category of fruits and vegetables are being consumed – rich in Vitamin A, iron, folic acid – but it simply "counts" the household consumption frequency.

On the other hand, WASH environment (WHO, 2015b) and breastfeeding and/or complementary feeding practices (Setegn et al., 2012; WHO, 2009) have a more direct impact on child nutritional status, and, according to the 1,000 Days paradigm, the child's nutritional status is also significantly affected by the quality of feeding during the first 1,000 days of his life, which include the nine months spent in the mother's womb (Duggan, 2014). Further analyses are required to confirm the findings.

10. Study limitations

Our study sample – 300 households – was big enough to provide statistical significance, yet a higher number of households could be required to underline the cause-effect relation between malnutrition and household food security. The number of households included was within our logistic and financial means.

Another limitation was the utilization of self-reported date of birth in months referred by the household's caregiver as birth certificate was not always present at the moment of the interview.

11. Conclusion

Food Consumption Score alone was not able to provide sufficient correlation with both acute and chronic child malnutrition when applied in a rural context in the Democratic Republic of Congo (Kasai Central). Yet, average consumption for some food group categories was significantly different across Food Consumption Score

categories. Further researches are required, focusing on a qualitative and semi-qualitative approach throughout Focus Groups and KAP Surveys.

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