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## **Establishment of an Epidemiological Survey Model, for the Under Five-Year Old Children's Nutrition, at the Health Districts in the Democratic Republic of Congo (DRC)**

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# Establishment of an Epidemiological Survey Model, for the Under Five-Year Old Children's Nutrition, at the Health Districts in the Democratic Republic of Congo (DRC)

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## ABSTRACT

### Background

From pediatricians' and public health experts' point of view, early delayed growth of children affects their physical and mental development. This delay in growing may be due to perinatal infection but, most frequently, it is secondary to nutritional causes and infection, while lack of nutrients aggravates the infectious process

Despite several efforts undertaken par the DR Congo's Government and its partners in the fight for the children's nutritional improvement, the prevalence of acute malnutrition has not reduced and still affects two millions children between 6 and 59 months in its severe form

This study aims at examining the fundamental reasons for this controversial situation. It was initiated in order to propose an epidemiological survey based system, standard, simple and cost effective approach that could quickly detect changes in the children and environment and provoke early alarm leading to appropriate actions.

### Methods

We engaged a descriptive and transversal epidemiological survey targeting the nutritional status of under-five year old children and their breastfeeding mothers in relation to food security in the randomized sanitary districts of the Southern Austrian former Katanga province in the DR of Congo, between 1st September 2012 and 31st March 2013 . Nutritional data related to children, mothers and environmental food availability were collected using pre-established questionnaires during three precise periods of the year. We sourced for data through three types of exercises and at three precise periods; then the data was analyzed to determine changes in children and families that lead to nutritional status classification and to specific actions

The study followed laid down criteria for inclusion and exclusion, and encompassed subjects sampled in rural and urban sites. Twelve health centers sites were identified: three urban (25%): two in Katuba commune: namely Katuba, Kisanga health centers, one in Kamalondo, kamalondo Health centre) and nine rural centres (75%): four in Malemba Nkulu Zone : Lwamba, Malemba Nkulu, Mulongo, Mukanga; three in Mutshatsha Zone: Lualaba, Kanzeze, Mutshatsha and two in Dilolo zone: Kasaji and Dilolo

### Results

Findings from the study were as follows.

- A weak input of exclusive breastfeeding both in rural and in urban sites. The exclusive breastfeeding has a mean breastfeeding duration of  $6,898 \pm 5,334$  or a duration of one month and three weeks
- There was no relationship between breastfed child malnutrition and mother's age
- Furthermore the results distribution allowed different classifications of sanitary sites as "acceptable, limited or poor"
- With reference to food safety calculated with two scores the CSA (family alimentary consumption score) and the CSI (Coping strategy index) the classification of sites as "under control", "to follow closely" and "red alert".
- This provided a regional food safety map useful to families, sanitary zones and districts in charge, including all task forces and decision making bodies.

### Conclusion

The developed epidemiological survey system allows a simple, cost- effective and efficient follow up of "risky" sanitary areas and provide bases for decisions taking in favour of children in general and under five- year old in particular

Keywords: Epidemiological survey; nutritional status; food safety; sanitary zones and districts; Democratic Republic of Congo

## INTRODUCTION

An early delayed growth of a child affects his or her physical and mental development [1]. The delay in growing is sometimes due to perinatal infection but, most frequently, it is secondary to nutritional causes and infection, while lack of nutrients aggravates the infectious process [2]. This is particularly severe in an under five-year old child [3]. In fact, during this fast growing period, a well balanced nutritional status should secure child's harmonious development and increase of his or her potential means of self-defense against infectious diseases among others. A well balanced nutritional status contributes to the morbidity and mortality reduction of the neonate, the baby and the child. It is of the common knowledge that the morbidity-mortality of a child suffering from acute malnutrition is 4 to 9 times higher than that of a well nourished one.

Multiple efforts had been made by the Government of Democratic Republic of Congo (DRC) and its partners in the fight against malnutrition. The National Policy on Nutrition adopted in 2000 led into the creation of "PRONUT"(Programme for Nutrition) with the sectarian support of numerous partners and non-governmental organizations (NGOs) such as Food and Agricultural Organization (FAO) and United Nations International Children's Emergency Funds (UNICEF). The 2013-2014 Demographic Survey and Health pointed out that the DRC still face nutritional challenges [4]. Prevalence of acute malnutrition in the country did not show any significant change, with severe malnutrition still affecting about two millions of children of 6 to 59 months. The situation was almost the same in the ex-province of Katanga. Recently, Mukalay [5], described the nutritional status in the ex-province of Katanga by determining the under five years children's malnutrition living in a semi urban area of Lubumbashi city. The author noted that there was almost no change between the 2002 and 2008 nutritional situation.

Among advocated reasons for the feeble improvement of the under five aged children's nutritional situation in the country are the following: sectarian projects (instead of integrated) and absence of preventive projects (purely curative projects) targeting only immediate causes and not malnutrition- These attitudes were described by certain experts as absence of common currency, absence of integrated, durable and credible system, being unable to describe and compare the nature and severity of food crisis to determine alarmingly high levels that require quick response.[ 6,7 ]

This current study aims at organizing an integrated, simple and reproducible response measure, based on observations from epidemiological survey of nutrition and food security for under five aged children in the sanitary districts under study between 1st September 2011 and 31st March 2014.

Its specific objectives are to: determine the average duration of exclusive mother breastfeeding; evaluate the breastfeeding mothers' nutritional status; analyze nutritional indicators with regard to integrated phases classification or IPC; determine the " alert point" or point 0 that shall declare the alarm; propose a nutritional epidemiological survey model for under five aged children and produce a Nutritional and Food security map for this study area

## METHODS

A prospective descriptive cross-sectional study was engaged. Its target population was of children less than 5years old and their breastfeeding mothers. The study population included also families food providers and food security in the assessed area. Because of the nature of the work, the convenience sampling was adopted with regard to the number of children and mothers to include.

The study sites (also designed as sentinel sites) were determined as follows. First the stratification of sanitary districts of the former Katanga province sanitary zones was done in: Zones (1<sup>st</sup> degree zones), health areas (2<sup>nd</sup> degree) and habitation units or families' residences (3<sup>rd</sup> degree). Then the systematic randomization was applied. However it was only performed on the settings responding to the criteria of satisfactory physical access, satisfactory operating of the pre scholar medical consultations (PSMC) and significant malnutrition indicators of which AGM (acute global malnutrition,) values below 10 % with phase III food security witnessed an acute alimentary crisis that threatened existence.

The twelve selected sites were as follows: three urban (25%) : two in Katuba commune: namely Katuba, Kisanga health centers, one in Kamalondo, kamalondo Health centre) and nine rural centres (75%): four in Malemba Nkulu Zone : Lwamba, Malemba Nkulu, Mulongo, Mukanga; three in Mutshatsha Zone: Lualaba, Kanzeze, Mutshatsha and two in Dilolo zone: Kasaji and Dilolo Malemba Nkulu, Mutshatsha and Dilolo and as urban sites : Kamalondo and Katuba in Lubumbashi city.

Pre-established questionnaires including various chosen parameters were made available: child nutritional variables, exclusive breastfeeding, food product at the market. Children and their mothers were observed during pre scholar medical consultations (PSMC) with the pre-established questionnaire of parameters , and administered at

least four times a year between 1st September 2011 and 31st March 2014 (per trimester) to note intervening changes. In addition, families' provision food security in the area was assessed.

In each site were determined the frequency and the distribution of exclusively breastfeeding children by a cross sectional approach, while indicators of nutrition and food safety were noted as follows during the study period as follows:

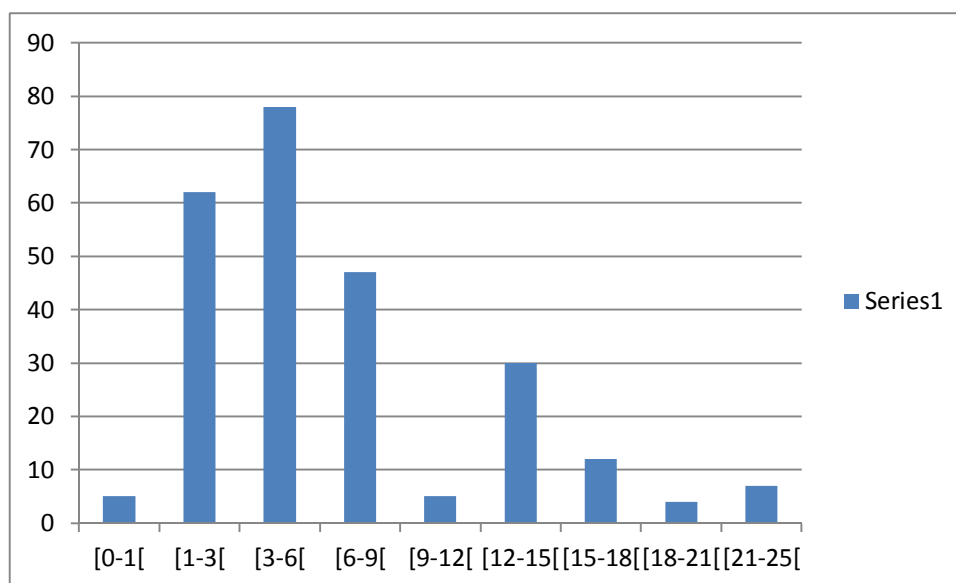
- ✓ Every week: establishment of list price of six most utilized basic food products at each site market
- ✓ Once a month: routine data collection at each structure: proportion of under 5 aged children with weight deficiency at the PSMC; the number of malnourished children registered at the structure; the number of neonates born with a weight below 2.5kg and the number of under 5 aged infants mortality.
- ✓ Every trimester: Programme for enquiries for data about the 6-59 months children with an arm perimeter (PB: brachial perimeter) below or equal to 12.5cm; the proportion nutritional oedemas; the family alimentary consumption score.

Data analysis was done to compared results, which should show tendencies with regard to nutritional status and food security for the year. The following tools were: mean and median for dispersion as well as percentages for descriptive statistical analysis and interpretation; Chi square : to analyze relationship or compare two observed percentages; Univariate or multivariate analysis to appreciate and weigh risky factors and use of logistic regression

## RESULTS

### 1. The exclusive breastfeeding duration.

As indicated on Figure1 (Exclusive breastfeeding frequency duration), the highest exclusive breastfeeding frequency was 78% for the duration of 3 to 6 months. The mean breastfeeding duration was  $6.898 \pm 5.334$ . This gives duration of one month and three weeks. With  $X^2=150.33 > X^2 = 1.64$  ( $p<0.05<0.01$ ), the null hypothesis suggesting that the exclusive breastfeeding follows the normal distribution was rejected. So the chances for a child to be breastfed up to six months were 0.028 (or 2.8%) in the study area and within the period of study. The chance for a child to be breastfed up to 1 month and two weeks was 0.312(or 31.2%)



**Figure 1: The exclusive breastfeeding duration during the study**

The mean breastfeeding duration was  $6.898 \pm 5.334$ . ( $X^2 = 150,33 > X^2 = 1,64$  ( $p<0,05<0,01$ ))

### 2. The nutritional prevalence of breastfed babies with regard to breastfeeding mothers' ages

The nutritional status of babies was assessed using the W/H score (with W as weight and H as height) in reduced deviation/median weight of reference over the standard deviation of reference.

As shown on Table 1 (Malnutrition of breastfed babies and breastfeeding mothers' ages), calculated  $X^2=3.415763324$  corresponding read values were, for 0.05: 3.841 and 0.01 and 6.635. Calculated  $X^2$  was inferior to 3.841 and 6.635 ( $p<0.01>0.05$ ); so the null hypothesis was accepted between the exposition of breastfeeding mothers' age : inferior or equal to 18 years and the breastfed babies' malnutrition level. Thus, as shown on the contingency Table 2, there was no statistically significant relationship between breastfed babies' malnutrition level and their breastfeeding mothers' age (or the fact that their breastfeeding mothers are younger than 18 years or live in precarious conditions).

**Table 1: The relationship breastfeeding babies' nutrition and the mothers' age or condition.**

	malnutrition	absence of malnutrition	Total
Age < or =18-year old	4	41	45
> 18 years old	6	199	205
	<b>10</b>	<b>240</b>	<b>250</b>

Legend: Malnutrition of breastfed babies and mothers' ages): Calculated  $X^2=3, 415763324$ . Corresponding read values were for 0.05: 3.841 and 0.01 and 6.635. Calculated  $X^2$  inferior to 3,841 and 6,635 ( $p<0.01>0,05$ ); so the null hypothesis was accepted. No statistically significant relationship between breastfeeding baby's nutrition status and mother's age or condition

Legend: Table 2 suggesting that: 1.6 % of breastfed children had severe malnutrition, that 2.4 % of them had moderate malnutrition and that 96 % of these children had a normal nutritional status while the breastfeeding mothers malnutrition prevalence was 15.2% with relative risk estimated (Odd ratio) at 18.46 and with an etiological risk fraction (FERe+) at 0.9458 almost 95 %.

The absence of this relationship was also confirmed by the fact that the breastfed babies' malnutrition level was 4% (Table 2 and Figure 2. In fact Table 2 and Figure 2 suggest that 1.6 % of breastfed children had severe malnutrition and that 2.4 % of them had moderate malnutrition. This supposes that 96 % of these children had a normal nutritional status while the breastfeeding mothers malnutrition prevalence was 15.2% with relative risk estimated (Odd ratio) at 18.46 and with an etiological risk fraction (FERe+) at 0.9458 almost 95 %.

**Table 2: Distribution of breastfeeding babies' nutritional status**

Nutritional status	Frequency %	Relative frequency %
Normal Zscore > or =-2.0 E.T	240	96
Moderate malnutrition -3 ET < or =Zscore < -2.0 ET	6	2,4
Severe malnutrition Zscore < -3.0 ET	4	1.6
<b>TOTAL</b>	<b>250</b>	<b>100</b>

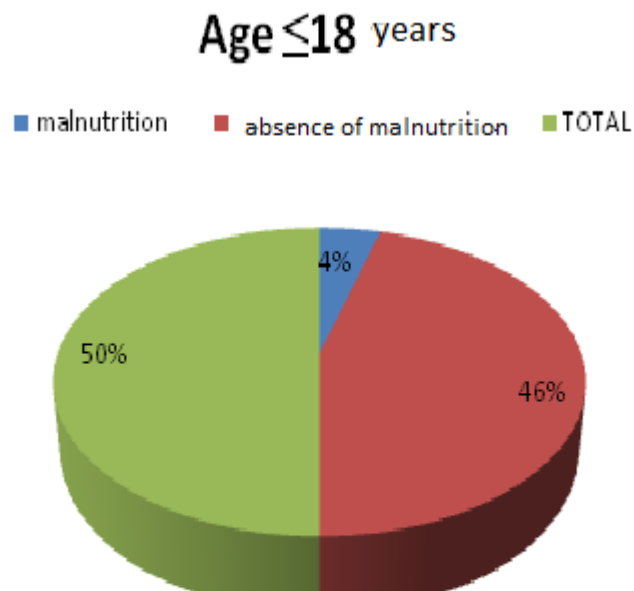


Figure 2: Nutritional status of breastfeeding babies

The absence of the relationship confirmed by the fact that the breastfed babies' malnutrition level was 4% ( Figure 2) while for the mothers' one was higher

### 3. Nutritional status of 6 to 59 months old children following IPC approach indicators (IPC: Indicators Phase nutrition Classification)

#### 3.1 Sentinel settings of under five children with normal birth weight showing deficiency of gained weight (or weight loss) during PSMC

This was observed at the sentinel sites of *Mukanga* and *Mutshatsha* . In these sites, children under five-year old babies presented a weight deficiency of more than 10% during the PSMC.

#### 3.2 Sentinel Sites with increased proportions of mature neonates (born at or after 38 weeks) but with a feeble birth weight.

Globally, the sentinel settings of *Dilolo* and *Mutshatsha* had high rates of mature children with feeble birth weight: more than 10%.

#### 3.3 Sites with high rate of reduced of PB(brachial perimeter)< à 12.5 cm

In these settings the frequency of children with the PB<12.5cm was 10% during the last visits. There were 7 out of 12 (7/12) sanitary districts under survey: *Mukanga*, *Mulongo*, *Lwamba*, *Malemba Nkulu*, *Lualaba*, *Mutshatsha* et *Kasaji*.

#### 3.4 Sentinel settings with progression of edematous children

The alteration of nutritional situation was noted at the *Malemba Nkulu* site where the malnutrition prevalence increased from 4.2% to 6.5% .with a proportion of edematous children of more than 2% suggesting indicating a nutritional emergency.

### 3.5 Survivor's families' strategy in various sanitary zones in December 2012.

At this period of 2012, the average survivor's strategy was poor. The indicators of this strategy improved only in three sanitary districts out of twelve (3/12): *Kisanga, Mulongo et and Dilolo*. The other sanitary zones presented a poor nutritional situation.

### 4 Sanitary districts nutritional and food safety map, and building of epidemiological survey organization

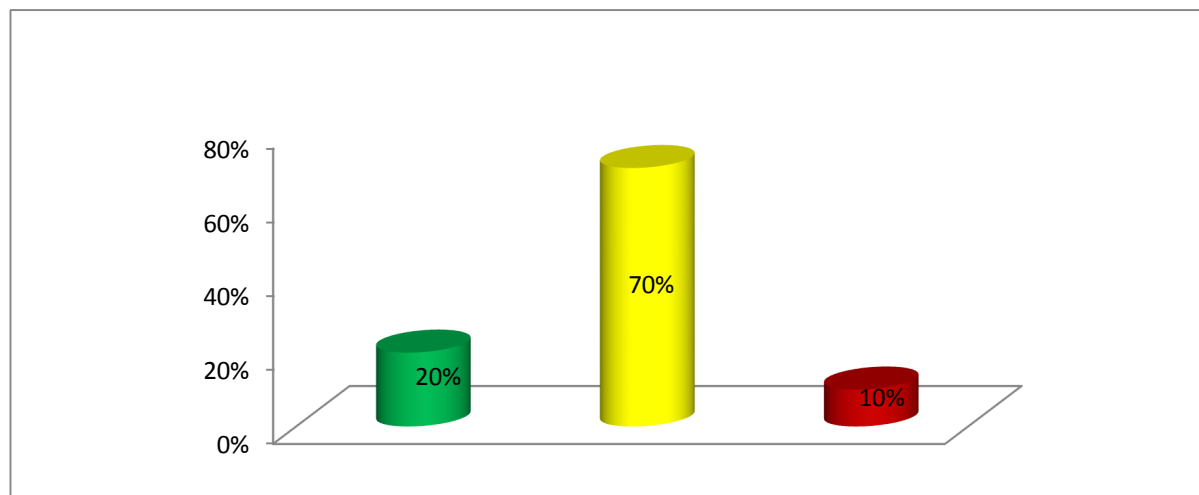
For the 1200 resident families, nutrition and food security was classified using four categories according to the observed situation: acceptable, limited, poor and insufficiency by triangulation (Tables 3 and 4, and Figure 3)

**Table 3: Families and Food safety (South East DR Congo) Food Consumption**

N	Acceptable	Limited	Poor	( not satisfactory)
1200	66,3%	23,4%	10,3%	(33,7%)

**Table 4: Global situation of studied sanitary districts**

<i>Territories / community</i>	<i>Health Zone</i>	<i>Routine nutritional indicators</i>	<i>Families' data collection indicators</i>	<i>General appreciation</i>
<b>Urban Settings</b>				
Katuba	<i>Katuba</i>	Acceptable	Acceptable	Under control
	<i>Kisanga</i>	Acceptable	Acceptable	Under control
Kamalondo	<i>Kamalondo</i>	Acceptable	Acceptable	Under control
<b>Territories Rural Settings</b>				
Malemba Nkulu	<i>Lwamba</i>	Acceptable	To follow closely	To follow closely
	<i>Malemba Nkulu</i>	Acceptable	Point 0 Red Alert	Point 0 Red-Alert
	<i>Mukanga</i>	Acceptable	To follow closely	To follow closely
	<i>Mulongo</i>	Acceptable	To follow closely	To follow closely
Muthshatsha	<i>Lualaba</i>	Acceptable	To follow closely	To follow closely
	<i>Kanzenze</i>	Acceptable	To follow closely	To follow closely
	<i>Mutshatsha</i>	Acceptable	To follow closely	To follow closely
Dilolo	<i>Kasaji</i>	Acceptable	To follow closely	To follow closely
	<i>Dilolo</i>	Acceptable	To follow closely	∓ To follow closely



**Figure 3: Global view of malnutrition : Green (20%), Yellow (70%), Red (10)**

#### ***Under control area (green color area)***

In this area, two nutritional indicators are inferior to 10% level during a three month period; percentage of resident families with poor food consumption is below 5% if there is decrease of the SCI.

#### ***Area to follow closely (yellow color area)***

An area is designated as such if nutritional indicators are above 10%, the percentage of resident families' poor food consumption is above 5% and if the SCI increasing.

#### ***Area at "point 0" or at "point for alert" (red color area)***

Such an area is characterized by two nutritional indicators greater than 10% (>10%), the percentage of resident families with poor food consumption above 5% and the SCI tremendously increasing during three months.

The study permits making up an epidemiological survey model specific to one region, province, or sanitary district or zone as stated below.

- Every week, we surveyed for collect list price of 5 to 6 basic food products at the site market after having selected the sites, taking into account their physical accessibility and function capability.
- Every month, we gathered on routine nutritional status from the children at precise times e.g. at the PSMC. The indices we looked out for were as follows:
  - Weight insufficiency
  - malnourished children
  - Mature neonates with feeble birth weigh
  - Under five aged mortality
- Every three months, we gathered data from the resident families on food safety, for example:
  - 6-59 month children with PB <12,5 cm.
  - proportion of oedematous children
  - Resident family food consumption (SCA : score alimentary consumption)
  - Survivor's strategy indicator (CSI)

These series of gathered data enabled us conduct statistical calculations to classify sites in accordance with alimentary situation (acceptable alimentary consumption, limited or poor or insufficient alimentary consumption) and also to classify the food security of the families (under control, to follow closely or at the alert point) so that appropriate measures can be taken on time and with a rapid response mode.



## DISCUSSION

This study showed an average duration of 7 weeks (1 month and 3 weeks) and the chance to be exclusively breastfed during one month and two weeks as 31, 2%. It indicated that only 20% of mothers breastfed their children up to 6 months. In the Democratic Republic of Congo, these observations remained the same during the last 10 years, despite multiple sensitizing campaigns [6]. However, other national studies mention increasing rates of exclusive breastfeeding during the six first months and estimated it at 24% in 2001 (MICS2), 36% in 2007 (EDS-RDC I), 37% in 2010 (MICS) and 48% in EDS-RDC II of 2013-2014 [7]. In Senegal the prevalence of exclusive breastfeeding up to 6 months seemed more feeble [8], concerning only 5% of babies.

This study indicated breastfeeding mothers malnutrition's prevalence of to be 15,2%, with relative risk estimated (Odd ratio) at 18,46 and the etiological fraction risk (FERe+) at 0,9458 almost 95 %. The results are in accordance with those found by Kalombo et al [9] who reported a prevalence of 15% to 17% for exclusively breastfeeding mothers' malnutrition going to the six month. This proportion of breastfeeding mothers' malnutrition level, should decrease if the mothers under 18 years were not breastfeeding (had no babies to breastfeed: a public health problem of early wedding and early pregnancy). However, in view of the positive role played by the mother's milk, the exclusive breastfeeding should still be encouraged as recommended by Wembonyama O. [10] On other hand, babies from malnourished breastfeeding mothers below 18 years are not always in the high malnutrition level.

The prizes at local market were one of determinants of families' appropriate nutrition. Thus, the tendencies analysis could have predicted possible nutritional status reduction. Five basic products were considered in the analysis above: manioc powder, maize powder, rice, beans, and palm cooking oil. Fuel prize as well as Congolese currency exchanging rate against foreign currencies (US dollar among others) was of significant importance. During the study period however, the Congolese Franc exchange rate was almost stable while the fuel prizes was hectic in different sentinel settings.

-Considering the mortality rate of under five aged children during a three month period in sentinel settings, Mukanga and Kasaji sanitary zones registered higher rates that increased in the Mukanga from 6 to 9 and in Kasaji from 0 to 4 (from August to November 2012).

With regard to weight insufficiency observed, the various sites of three zones had to be followed closely (Mukanga, Mulongo and Mutshatsha) since during the entire period, the proportions of under weight curves were above 10%. This was similar to that was said by Global Partners [11] (Partenaires globaux IPC) in 2012. It could also be read in Anaes [12] the same year (2012).

Considering the mature children with weak birth weight, the proportions of above 10 % prevalence were noted in Kasaji and Dilolo zones between August and November 2012, pointing out a public health problem. This finding was similar to that reported by Okitolonda et al [13] in Ngaba sanitary zone of Kinshasa

The high proportions of children with PB  $\leq$  less than 12,5 cm.(10%) were found in seven sites out of twelve (Mukanga, Mulongo, Lwamba, Malemba, Lualaba, Mutshatsha et Kasaji.) In some settings, the situation remained unchanged during two consecutive periods at critical rate of 10% (sanitary zones of Lwamba, Malemba Nkulu, Mulongo, Lualaba, Mutshatsha and Kasaji).

The under five aged children with increasing nutritional oedemas were found mainly in Malemba Nkulu where the prevalence raised from 4,2% to 6,5 % but also in Lwamba where the prevalence moved from 0,7% to 3,7%.

With regard to the December 2012 period, the survivor's strategy indicator or indicator was only slightly improved in three sanitary out of twelve within the coverage zone of this study: Kisanga, Mulongo and Dilolo. The situation continued to deteriorate elsewhere. It has even been noted that in the sanitary zone of Dilolo, a very high proportion of poor food consumption (40% of the families) was observed, followed by the sanitary zone of Lwamba (25% of families). This was despite the fact that our data collection was done in the period after sowing. In view of the results on the evaluation of the 5<sup>th</sup> phase of FSMS, almost 9,1% of assessed families had poor food consumption from the global point of assessment, 22,7% had limited food consumption and 68,2% had acceptable food consumption. This shows that almost one third of this population still had poor access to adequate food. Hence, there is need to increase survivor strategy

Further details and information can be obtained by reading the UNICEF report of 1977 [14], the Fund Agricultural Organization (DRC branch) on Food security in Katanga August 2010, p2-4 [15] and the FAO policy laid down in Roma [16] ( principles of quality Health Policy )

## CONCLUSION

The malnutrition, essentially of under five children is more complex and challenging more than the occasional delivery of food. It requires more involvement of the government and its partners in seeking its fundamental sources.

The epidemiological survey as established in the study is simple and easy to conduct, leading to classification of nutritional needs and the food safety in favour of the under five aged children and their family as it was done in this study. It provides a "common language" for harmonization of all stakeholders.

This epidemiological survey was based on the better knowledge of sentinel sites data and their diversities: local products (nature, costs), nutritional indicators for both breast feeding mothers and breastfed neonates, babies and infants.

The performance of precise and regular visits paid to the structures will bring knowledge of food consumption and of the families' survivor strategy by simple enquiries. They will allow the alimentary classification situation as acceptable, limited or poor, while the knowledge of the food security were stated as under control, to closely follow up or at alert point; which enables appropriate measures to be taken.

This model does not aim to produce representative statistical data of the site but to point out local intervening changes that could provide localized measures for each period of the year.

Therefore, the system during the target period indicated the following: persistence of inconsistent exclusive breastfeeding (even in urban settings), where it was almost 7 weeks, making a total of one month and three weeks; the 12 sanitary zones IPC approach indicated that: eight sites required to closely follow up (Lwamba, Mukanga, Mulongo, Lualaba, Mutshatsha, Kasaji, Dilolo et Kanzenze); three were under control (Kamalondo, Katuba, Kisanga) and one site was at alert point (Malemba Nkulu); climate change, rising prizes, extinction of natural resources, population growth, extension of urbanism and other dynamics, increase pressures on food security.

## STUDY CONTRIBUTION

Before this study, the following points were known and done regarding the fight against the children's malnutrition in general and of the under five aged children, particularly in Democratic Republic of Congo.

- High prevalence of fewer than 5 aged children's malnutrition in the Country in general and in the Austrian sanitary districts in particular.
- Several programmes had been effected to treat affected children in severely affected zones without epidemiological studies
- Frequent recurrences of unpredictable sudden food crisis at the periods

### **This epidemiological-survey has brought the following innovations**

- It allowed us to map several sanitary districts with their characteristics and their classifications with regard to nutritional needs and food safety
- It allowed us to develop measures to prevent food nutritional crisis that by acting works appropriately on families, stakeholders and other partners.
- A model that is simple, cost-effective, dynamic and easily adjustable.

## RECOMMENDATIONS

- 1) Promotion of this study by carrying out related studies in other sanitary districts countrywide and for longer periods.
- 2) Dissemination of the results of this study and incorporate them in policies that fight under five aged children's malnutrition.

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## CONFLICTS OF INTERESTS

The authors do not declare any conflict of interest for this article all along its realization

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