



Complementary Feeding Practices Associated with Wasting of Children 6 - 23 Months Old in Dilala, Lualaba Province, Democratic Republic of the Congo, 2017

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Abstract

Background: Malnutrition is in high prevalence in some developing countries, like Democratic Republic of the Congo mostly among children from six to 23 months. Complementary feeding is among the main causes of malnutrition worldwide.

Objective: The present study aimed to assess the complementary feeding practices associated with acute malnutrition in Democratic Republic of the Congo.

Design (Methodology): A community-based cross-sectional study was conducted from October 23rd to November 25th 2017 in DILALA Health Zone, using a three-stage stratified sampling technique. In 10 Health Areas, 698 children six to 23 months old were assessed on nutritional status and their mothers interviewed on complementary feeding practices. Household questionnaire pretested and revised, standardized anthropometry equipment and World Health Organization recommendations were used with trained data collectors. ENA for SMART and Logistic regression on SPSS 23 were used to data analysis.

Results: Wasting was associated with lack of knowledge on minimum meal frequency (adjusted odds ratio = 2.4, CI 1.14 - 5.11), minimum dietary diversity (adjusted odds ratio = 0.23, CI 0.055 - 0.981) and protected source of drinking water (adjusted odds ratio = 0.50, CI 0.26-0.93).

Conclusion: Wasting was more increased among children whose mothers were without knowledge on minimum meal frequency of complementary feeding, but more prevented in children having met minimum dietary diversity and in children from household with protected source of drinking water.

Keywords: Acute Malnutrition; Children 6 - 23 Months; Complementary Feeding Practices; Democratic Republic of the Congo; Nutritional Status

Abbreviations

CF: Complementary Feeding; CI: Confidence Interval; DHS: Demographic Health Survey; GCM: General des Carrières et des Mines; HAZ: Height for Age Z-score; HHD: Household; ITCF: Introduction

Time of Complementary Feeding; IYCF: Infant and Young Child Feeding; MAD: Minimum Acceptable Diet; MAHWP: Minimum Acceptable Hands Washing Practices; MDD: Minimum Dietary Diversity; MMF: Minimum Meal Frequency; PCA: Principal Component

Analysis; NMAHWP: None Minimum Acceptable Hands Washing Practices; SD: Standard Deviation; WHO: World Health Organization; WHZ: Weight for Height Z-score; WAZ: Weight for Age Z-score

Introduction

Background and Objective

The World Health Organization (WHO) has recommended, since 1998, that children should exclusively be breastfed for the first six months, followed by continued breastfeeding (BF) with complementary feeding (CF) from 6 months up to two years or over two years [1-5] in order to achieve optimal growth, development and health child. In spite of the WHO Infant and Young Child Feeding (IYCF) recommendations, malnutrition is always one of the main public health challenges of the 21st century, particularly in developing countries [6-9,23,24]. In 2016, wasting affected almost 51.5 million children less than 5 years worldwide and was attributable to 12.6% of 6.9 million deaths with more than one third related to inappropriate CF [6,8-12]. Nineteen million of them were severely affected and at higher death risk with large majority from sub-Saharan Africa countries including Democratic Republic of the Congo (DRC). Democratic Republic of the Congo is one of the 34 countries in the world with the greatest load (> 90%) of malnutrition. More than 6 million of children under 5 years were wasted, and 1.9 million of severe acute malnutrition cases waited in 2017. Around 600000 children under 5 years dies every year from consequences of malnutrition [13]. Food insecure household were approximately 80 million in 2015 and 108 million in 2016 [14].

Inappropriate Complementary Feeding (CF) is one of the main causes of malnutrition [13,21,25-29]. Complementary feeding has been shown to be an effective child survival strategy ranked among the top life-saving interventions for children under 5 years. Alone, CF was estimated to prevent almost 6 to 20% of under-five mortality (more than 220.000 lives saved) in developing countries [8,19,20,29]. The determinants of inappropriate CF are inadequate CF practices and inadequate hygiene practices of available weaning food [6,8,13,17,18].

Aim of the Study

This study aimed to assess the CF practices associated with Wasting in DRC-2017.

Methodology

Study site

The study has covered the 10 Health Areas of DILALA Health Zone corresponding to GCM Cities, in Kolwezi town. DILALA Health

Zone is one of 14 Health Zone, that covers the LUALABA Province, chosen randomly among the 3 (FUNGURUME, LUBUDI and DILALA) where a nongovernmental organization had implemented in 2016 a nutritional project aiming to reduce prevalence of acute malnutrition in children less than 5 years old. The total population of DILALA Health Zone was 252277 whose children from six to 23 months were estimated to 14380 (5.69%). LUALABA Province is a mining province, with many health problems such as endemic malaria, recurring epidemics of measles, recurrent infections and high mortality rate due to malnutrition [34]. The main staple food is maize, rice, vegetable, beans, peanuts, soya and many imported foods. The boom-mining phenomenon leads to a population exodus in the Province with consequence, the reduction of the local food production, the dependence of imported food from Zambia country and a severe acute food insecurity of 16% [15].

Study design and study population

A community-based cross-sectional study was conducted in DILALA HZ, from October 23rd to November 25th 2017. The 698 children from six to 23 - mother pairs were assessed. We included in study, mother with children aged from six to 23 months whose parents have residential household in the GCM mining city, in DILALA Health Zone, Kolwezi town. We excluded all ¶children malnourished in treatment in a medical structure, children of the households in transit or being moved and children whose mothers were absent.

Data collection

Training, process, tools and supervision of data collectors

Data collectors, which completed at least the secondary school, were recruited in the community intensively well trained for two days on the content of questionnaire and on general approaches to data collection before the study. Standardized techniques, anthropometry equipment and the WHO recommendations [39] used to assess nutritional status. The age of the child was determined based on date of birth and date of survey. Principal Component Analysis (PCA) used to determine HHD socio-economic status (wealth index) from modern HHD assets [18]. Structural questionnaire was tested and revised to assess CF practices of the mothers by a 24 hours dietary recall method, especially for MMF and MDD data according to WHO recommendations.

Data quality control measures

A two- day training session organized for data collectors ensured: reliability and validity of data collected, good understanding and acquisition of skills for effective and efficient administration of

data collection tools, field-testing of data collection tools and the competence of data collectors. The HHD questionnaire was pretested and revised and each team supervised every day. All challenges were attended immediately in field.

Data analysis

Data collected were encoded and analyzed in IBM SPSS version 23 using computer. Particularly, we calculated anthropometric Index (HAZ, WHZ, and WAZ) by ENA for Smart software, in accordance with WHO standard recommendations, and imported them in SPSS for analysis. Nutritional status (wasting) was dummy variable after transformation in IBM SPSS using the WHO 2006 growth reference value with SMART cut-offs. After collecting and encoding data from 734 pair's participants (child/mother), we cleaned dataset and refusal or uncompleted data. From 734 collected data, 698 (95%) were valid and analyzed. All quantitative data were codified for statistical analysis in IBM SPSS Statistics 23 in order to make statistically valid population inferences and computed standards errors from sample data. Descriptive analysis was used to determine the prevalence of all variables. Both univariate and multinomial analyses were performed at 95% confidence intervals (CI) to identify the determinants of acute malnutrition among CF practices and to best fit the wasting model at p value ≤ 0.05 , to the nearest 0.01 in present study.

Variables

Wasting is a categorical variable defined as Weight for Height Z-score (WHZ) index below minus two (-2) Standard Deviation (SD). The severe form of wasting was defined as WHZ index below minus three (-3) SD [36]. We accomplished this by adapting the Child Growth Standards of the World Health Organization [37].

Introduction time of complementary feeding (CF) defined as the proportion of infants from six to eight months who received solid, semi-solid or soft food. Early CF was defined as the proportion of infants aged from six to 23 months whose mothers reported introduction of solid, semi-solid and soft foods from age less than 6 months (0 - 5 months). Late CF was defined as the proportion of infants aged from 6 to 23 months whose mothers reported introduction of solid, semi-solid and soft foods from age over 6 months old [5,18,33,38].

Minimum Meal Frequency (MMF) is defined as the proportion of children from six to 23 months who received appropriate com-

plementary food (solid, semi-solid or soft food, including milk for no breast fed children) at least the minimum recommended number of times in the last 24 hours [5,18,33,38].

Minimum Dietary Diversity (MDD): Defined as the proportion of children 6-23 months who received at least four food group or more food groups of eight food groups in the 24 previous hours [5,18,33,38].

The 8 food groups used for calculation of WHO minimum diversity diet indicator are (i) Grains, roots and tubers, (ii) Legumes and nuts, (iii) Dairy products, (iv) Flesh foods (meat, fish, poultry and liver/organ meats), (v) Eggs, (vi) Fruits and vegetables with high content in Vitamin A and (vii) Others fruits and vegetables. An eighth group may be added, (viii) Food with high content in Iron. The dietary diversity score therefore ranged from zero to eight with minimum zero if none of the food group was consumed and maximum eight if all food groups were consumed [5,18,33,38].

Minimum Acceptable Diet (MAD) is a composite indicator of MMF and MDD. Breastfed children who met both MMF and MDD were attaining the WHO recommended Minimum Acceptable Diet.

Breastfed children who met both timely introduction of CF and MAD were attaining Adequate CF [5,18,33,38].

Main source of drinking water supply: Protected sources of drinking water supply included the tap, the protected dug pit, and pit with pump/drilling and protected source of water. Unprotected source of drinking water supply: included dug pit not protected, not protected source of water, river and other.

Type of toilet facility used in HHD: Improved toilet facility included latrine with flush toilet connected to a septic tank, self-ventilated improved cesspool and cesspool with flagstone. Unimproved toilet facility included cesspool without flagstone, opened hole and no latrine or bush.

Hand washing practices of the mother: Five key times for washing hands were in account to keep hygiene of weaning foods, in CF period, specifically before eating, after having managed the saddles of the child, after having been in the toilets, before preparing the meals and before breastfeeding the child. There was Minimum Acceptable Hands Washing Practices (MAHWP) if the mother practiced the hands washing at least four key times. No Minimum

Acceptable Hands Washing Practices (NMAHWP) if the mother practiced the hands washing at less than four key times. This measured the safe CF practice meaning that we wanted to verify if foods were hygienically stored, prepared and fed with clean hands.

Potential biases

Type I and type II errors was minimized in calculating sample size using ENA for SMART Software version 2011 updated in 2015 with desired precision of 5%, design effect of 1.5. Bias of skewed information and misclassification (differential and no differential) was mitigated using WHO standardized anthropometric techniques and equipment, the well-trained data collectors, and defining clearly all study variables. Biases of skewed selection were mitigated by fixing inclusion and exclusion criteria and memory bias mitigated by a good in deep interview. Multinomial logistic regression, using IBM SPSS Statistics 23 performed to fit wasting model in adjusting possible confusion factors' biases.

Complementary feeding practices

Ethical consideration

The permission to carry out this study sought from Health Province authorities. The committee of medical ethic of the University of Lubumbashi (UNILU) approved study protocol in order to guarantee respect of person, benevolence and equitable and honest distribution's risks and benefit of study.

Results

Socio economic and demographic characteristics

The mean (\pm SD) age was 14.44 (\pm 5.18) months for children and 27.6 (\pm 6.14) years for mothers. Two third of children were aged 12-23 months. The sex ratio was 1.1 for children. About 698 mothers interviewed, more than three quarters (86.1%) were married. More than half of them (55.4%) were 20 - 29 years old, homemaker (58.5%) and were in household with a middle socioeconomic status (56.2%). Less than one-third (29.9%) of mothers were protestant by religion against less than one-fifth (16.2%) who were catholic.

Complementary feeding practice	N = 698	Percentage = 100	CI 95%	
			Lower	Upper
Initiation time of CF				
Initiation of CF at 6 th month	353	50.6	48.0	53.1
Initiation of CF at 6 th month	205	29.4	26.9	32.8
Initiated after 6 th month	140	20.0	19.0	21.0
Minimum meal frequency of CF				
Minimum meal frequency met	204	29.2	25.9	32.8
Low meal frequency of CF	494	70.8	67.2	74.1
Minimum dietary diversity of CF				
Minimum dietary diversity met	81	11.6	9.3	14.0
Poor dietary diversity	617	88.4	86.0	90.7
Minimum acceptable diet in CF				
Minimum acceptable diet eaten	44	6.3	4.6	8.3
None Minimum acceptable diet	654	93.7	91.7	95.4
Adequate CF given to child				
Adequate CF	21	3.0	1.9	4.3
Inadequate CF	677	97.0	95.7	98.1
Knowledge on MMF by mother				
Had knowledge on MMF	63	9.0	7.0	11.2
Had lack of knowledge on MMF	635	91.0	88.8	93.0

Knowledge on CF time initiation				
Had knowledge on ITCF(6thmo)	472	67.6	63.0	72.8
Had lack of knowledge on ITCF	226	32.4	27.2	37.0
Type of source of drinking water supply				
Protected source of drinking water	430	61.6	57.9	65.5
Not Protected Source of drinking water	268	38.4	34.5	42.1
Type of toilet facility used in household				
Improved toilet facility	405	58.0	54.3	61.9
Not improved toilet facility	293	42.0	38.1	45.7
Hands washing practices at least 4 key time				
Hands washing practices	297	42.6	39.0	46.1
Not hands washing practices	401	57.4	53.9	61.0
Knowledge of mother on hands washing				
Yes knew at least 4 key times	233	33.4	30.2	37.0
No didn't know at least 4 key times	465	66.6	63.0	69.8

Table 1: Prevalence of CF practices in children 6-23 months old in LUALABA Province, DRC.

In this study, less than one-tenth of children received adequate CF (3.0%), acceptable diet (6.3%), were from mothers with knowledge on MMF (9.0%) and almost one-tenth (11.6%) of children met minimum dietary diversity. While nearly one third of mothers gave appropriate meal frequency to their children (29.2%) and initi-

ated timely the CF (29.4%). Less of half of mothers (42.6%) practiced Hand Washing at least 4 key times. But around three fifth of HHD used improved toilet facility (58.0%) and protected source of drinking water supply (61.5%) (Table 1).

Nutritional status/health status in children 6 - 23 months old

Nutritional status/Heath status		N = 698	Percent = 100	CI 95%	
				Lower	Upper
Good Nutritional Status	(HAZ ≥ -2)	(n = 311)	44.5	36.5	52.5
Stunting	(HAZ < -2)	(n = 226)	32.4	28.9	35.7
Moderate Stunting	(-3 ≤ HAZ < -2)	119	17.1	10.7	22.9
Severe Stunting	(HAZ < -3)	107	15.3	12.8	18.2
Underweight	(WAZ < -2)	(n =104)	14.9	12.3	17.6
Moderate Underweight	(-3 ≤ WAZ < -2)	74	10.6	6.4	14.7
Severe Underweight	(WAZ < -3)	30	4.3	2.9	5.9
Wasting	(WHZ < -2)	(n = 57)	8.2	6.3	10.2
Moderate Wasting	(-3 ≤ WHZ < -2)	38	5.5	2.1	8.6
Severe Wasting	(WHZ < -3)	19	2.7	1.6	4.2
Recurrent Infection of child					
Yes he had Recurrent Infection		164	23.5	20.3	26.6
No he had not Recurrent Infection		534	76.5	73.4	79.7
Optimal breastfeeding of child					
Yes he had optimal breastfeeding		162	23.2	19.9	26.6
He had not optimal breastfeeding		536	76.8	73.4	80.1
Birth weight of child					
Low birth weight (<2.500 kg)		44	6.3	4.6	8.2
Normal birth weight (≥ 2.500kg)		654	93.7	91.8	95.4

Table 2: Nutritional/health status of children 6-23 months old in LUALABA Province, DRC, 2017.

Table 2 shows that one-third (32.4%) were stunted from which around half in severe form (15.3%). Almost one out of ten children (8.2%) was wasted whose more than one quarter (2.7%) in severe

form. Less than one-tenth of children 6-23 months (6.3%) had low birth weight while almost a quarter of them (23.5%) did recurrent infection and (23.2%) met optimal breastfeeding from their mothers.

Univariate analysis

CF Practices	Wasting (WHZ)		p-value	OR	95% C.I (OR)	
	Yes (<-2)	No (≥-2)			Lower	Upper
Introduction time of Complementary Feeding (ITCF)						
Not timely initiated	40	453		1.0		
Timely initiated	17	188	0.46	0.97	0.54	1.80
Minimum dietary diversity (MDD)						
Did not met MDD	55	562	0.023	3.86	1.98	23.9
Had met MDD	2	79		1.0		
Minimum meal frequency (MMF)						
Did not met MMF	45	449	0.07	1.6	0.84	3.22
Had met MMF	12	192		1.0		
Knowledge on MMF						
Without Knowledge	47	588		1.0		
With Knowledge	10	53	0.009	0.42	0.20	0.92
Source of drinking water supply						
Unprotected source	14	254		1.0		
Protected Source	43	387	0.012	0.50	0.25	0.91
Washing hands practices at the 5 key times						
Washing hands at less than 4 key times	31	370	0.47	1.01	0.66	1.54
Wash hands at least 4 key times	26	271		1.0		
Type of toilet facility						
Not improved toilet	20	273		1.0		
Improved toilet	37	368	0.13	0.72	0.4	1.27

Table 3: Association of malnutrition (wasting) with CF practices in children 6-23 months in LUALABA Province, DRC, 2017.

Children who had consumed less than four food groups in their CF were around 4 times more likely to be wasted. Children from household (HHD) having used drinking water from unprotected source were 2 times more like to be in acute malnutrition. Children whose mother had not knowledge on MMF of CF were 2.4 times more like to be wasted. Therefore initiation time of CF, meal frequency of CF, hands washing practices of mothers and type of toilet facility used by household were not associated with acute malnutrition (Table 3).

Multinomial logistic regression analysis

As shown in table 4, mother’s knowledge on MMF, Source of drinking water supply and minimum dietary diversity were draw in the wasting model. Children whose mothers had poor knowledge on minimum meal frequency of CF were 2.4 times more likely to be wasted. Children from household using protected source of water supply in household were 2 times less likely to be wasted. Consuming minimum dietary diversity in CF was 4.3 times less likely to be wasted than consuming poor dietary diversity in CF.

Wasting (Lowest thru -2)	Sig.	AOR	95 % CI (AOR)	
			Lower	Upper
Knowledge on Minimum Meal Frequency (MMF)				
Without Knowledge of MMF	.021	2.4	1.140	5.112
With Knowledge of MMF		1.0		
Type of Source of drinking water supply				
Protected source	.031	.50	.267	.938
Not Protected source		1.0		
Minimum dietary diversity (MDD)				
Children met MDD	.047	.23	.055	.981
Children didn't meet MDD		1.0		

Table 4: Modeling of Wasting in children 6-23 months in town, LUALABA Province, DRC, 2017.

Discussion

Nutritional status

The very low CF practices indicators found in present study conducted in LUALABA Province could explain the higher prevalence of malnutrition. Finding on nutritional status is similar to national prevalence of stunting, underweight and wasting found in 2013 - 2014 by DRC-DHS [22]. Comparing our results study to DRC-DHS 2013 - 2014, prevalence of wasting in LUALABA Province was lower. Moreover, there was a provincial intervention project implemented in 2016, aiming to reduce rate of acute malnutrition in children less than 5 years. However, our results are higher than the 2011 Nepal DHS finding [21] and those found in 7 remote and poor countries of China in 2012 [12]. The higher prevalence of malnutrition in our study finding could be the consequences of high food insecurity carried out in August 2016 in LUALABA Province, DRC, which was 71% of which 16% in severe form [15]. Dietary diversity and meal frequency are all food security proxy-indicators of availability and access to food while nutritional status results from utilization of that available and accessible food (quality and quantity). Nutritional status becomes itself a food security indicator (within utilization pillar) among the four pillars of food security [39]. It is lower than the Myanmar children situation in 2016 [40].

Complementary feeding practices indicators

None of the CF practices covered the WHO IYCF recommended indicators ($\geq 80\%$). The prevalence of timely introduction of solid, semi-solid food or soft food, MMF, MDD and MAD were under 80% of recommended coverage. Worsened CF practices could be

the consequences of low and middle socioeconomic status found in high proportion in present survey. GCM company workers were unemployed for several years. No project on IYCF implemented after the DRC – DHS-2013-2014 still the end of 2017. All CF practices indicators found in LUALABA Province were lower than DRC national level finding in 2013 [22]. Prevalence of timely initiation of CF and of adequate CF in our study is very lower than that found in India, at Coastal South Indian, in Ethiopia, in Northeast Ethiopia, in Saudi Arabia and in Southern Ethiopia [3,7,8,42,43]. But it is higher than Nigerian finding (19.3%) in 2015 [45]. In Southern Ethiopia, in Bangladesh and in Nigeria the practices of timely initiation of CF, MMF, MDD and MAD were too higher than our finding [7,26,44]. Poor MMF and timely initiation of CF are due to high proportion of mothers without knowledge on IYCF in general and on MMF and on timely initiation of CF particularly as shown in our results. The CF hygiene practices' indicators assessed were too worsened (table 1). In LUALABA Province, GCM City, all worsened indicators could be linked to several factors, particularly lack of IYCF intervention combined with water and sanitation hygiene practices undertaken from 2013 still 2017, poor socio economic status making household (HHD) unable to improve toilet facility and source of drinking water supply leading to poor CF hygiene practices and severe food insecurity.

Strength of association between inappropriate CF practices and wasting

Our finding showed that children who had consumed poor dietary diversity, water from unprotected source and without know-

ing on appropriate MMF were strongly associated with wasting. In LUALABA Province, more than three quarter of HHD had middle level and low level of socio-economic status as shown in our study. At the same time, in LUALABA Province, the boom mining directed the majority of people towards the mining careers in minimizing agricultural activity; this decreased the food production by supporting the rise in the prices of local and imported food products. In addition, non-IYCF project implemented, in the past three years to improve knowledge of the mothers' children. These results are consistent with those found in Ghana where poor meal frequency and poor dietary diversity practices of mothers had highly increased prevalence of malnutrition in children 6 - 23 months old [31]. It is known that worsened complementary feeding practices, coupled with food insecurity of household, lead to malnutrition [47]. Present results are similar with several others published by previous studies where low water sanitation and hygiene of weaning foods were the cause of recurrent infection and associated with malnutrition [6,8,9,17,18,48].

Limitation of the Study

This research, using cross sectional study, could not confirm the causality of the association found. Study can be limited by memory bias mitigate by good in deep interview. It was very hard to believe some findings due to fat wide confident interval such as in the association between MDD and wasting in cross table analysis. However, after adjusting in the model it was associated with wasting.

Conclusion

Finding of the present study confirms the strength of wasting risk attributable to three CF practices. Improving MDD, knowledge on appropriate meal frequency and using protected source of drinking water supply was respectively 4.3 times, 2.4 times and 2 times more likely to decrease wasting in children 6-23 months in GCM City, DILALA Health Zone, in the new Province of LUALABA, in DRC 2017. Malnutrition had high prevalence and CF practices worsened. All CF practices indicators were lower than WHO recommended coverage ($\geq 80\%$).

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Conflict of Interest

Authors declare no conflict of interest exist.

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