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RESEARCH ARTICLE

Impact of feeding practices on nutritional status of infants aged 12 to 23 months in Lubumbashi, DRC: A community based cross-sectional study

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Abstract: Purpose: In the Democratic Republic of the Congo (DRC), malnutrition remains a public health problem despite interventions to improve the nutritional status of children. The objective of this study is to determine the degree of association between dietary practices and malnutrition among infants aged 12 to 23 months in Lubumbashi (DRC). Methods: We conducted a community-based cross-sectional study of 574 infants between 12 and 23 months of age from urban and semi-urban areas. Door to door survey was done to collect data. Nutritional status was assessed and compared with feeding practices. A multivariate analysis was conducted to evaluate the association between dietary practices and malnutrition in these children. Results: Bottle feeding before 6 months (adjusted odds ratio [aOR] = 1.8 [1.2-2.8]; p = 0.006), introduction of solid, semi-solid or soft foods before 6 months (aOR = 2.1 [1.0-4.3]; p = 0.042), and insufficient minimum dietary diversity (aOR = 2.3 [1.6-3.5]; $p < 0.0001$) were independently associated with stunting. Late breastfeeding initiation (aOR = 2.4 [1.1-5.0]; p = 0.023) increases the risk of wasting. Conclusion: Infant malnutrition is sometimes a reflection of inappropriate eating practices from the early stages of a child's life. Adherence to sufficient nutritional recommendations at birth can reduce this burden in developing countries.

Keywords: infant feeding practices, nutritional status, preschool children, Lubumbashi

1 Introduction

During the first two years of a child's life, food is crucial for health, growth and development [1]. Its impact on infant and child morbidity and mortality is undeniable. Poor breastfeeding and food diversification practices often lead to nutritional deficiencies [2]. At least one in three children under 5 years of age suffers from one of the visible forms of malnutrition [3]. Malnutrition contributes to almost 50% of child deaths worldwide [4].

The World Health Organization (WHO) has developed key assessment indicators and recommended practices for Optimum Infant and Young Child Feeding (OIYCF), including starting breastfeeding within one hour of birth, exclusive breastfeeding for the first six months of life, and continuing breastfeeding for two years or more [5]. According to norms, just two out of every five infants under six months receive exclusive breastfeeding. However, 820,000 children around the world may be saved each year from death by exclusive breastfeeding [3].

Multicarential malnutrition in children is a cluster of disorders characterized primarily by stunted or stunted growth. There are three main types of multicarential malnutrition including wasting, stunting, and underweight. In the Democratic Republic of the Congo (DRC), wasting, underweight, and stunting are 3%, 7%, and 23% of children respectively [6].

An examination of the literature reveals that there is little information on infant feeding practices in Lubumbashi city, DRC. The current study has been conducted to examine the nutritional status of preschool children and to evaluate the association and effect of feeding practices with nutritional status among infants aged 12 to 23 months of Lubumbashi city in order to obtain more detailed information on the child feeding situation and prevalence of undernutrition among preschool children.

2 Materials and methods

2.1 Study setting and design

We conducted a cross-sectional study, covering the period from 1st July 2020 to 1st September 2020 (2 months).

It was conducted in the province of Haut-Katanga (DRC), both in an urban area (Lubumbashi municipality) and a semi-urban area (Annexe municipality) in Lubumbashi city.

2.2 Study population

It looked at infants between 12 and 23 months of age whose parents have lived in the above-mentioned areas for more than 12 months. Children included in the study were those whose mothers agreed to participate in the study by responding to the questionnaire and agreed to take their children's anthropometric parameters.

2.3 Data collection

Sampling was systematic and prospective. An equal number of avenues per municipalities had been selected on the basis of random draws. House numbering and selection were done at random at one plot on 5 per avenue. In a multi-household plot with infants targeted in our survey, a single household was drawn to investigate one household per plot.

The minimum sample size of was calculated from the formula n+ n/10 and n = $(e^2. p. q)/d^2$ with a prevalence of malnutrition in the DRC estimated at 23.4% in 2013 [6]. The following variables were studied:

(1) Socio-demographic characteristics of mothers or nannies: municipality of residence, age, number of children alive, level of education;

(2) Demographic and anthropometric characteristics of infants: gender, age, weight, height;

(3) Indicators to assess feeding practices: early breastfeeding initiation, exclusive breastfeeding, bottle-feeding before 6 months, continued breastfeeding 12-23 months, introduction of solid, semi-solid or soft foods before 6 months, first food of dietary diversity, and minimum dietary diversity [7].

2.4 Data Analysis

The statistical analyzes were carried out using the software STATA 16. Nutritional status was evaluated by the weight-to-height, weight-to-age, and height-to-age z-scores, which made it possible to determine wasting, underweight, and stunting, respectively. Z-scores were calculated using the ENA (Emergency Nutrition Assessment) software for SMART. The association between feeding practices and nutritional status was measured by calculating the odds ratios and their 95% confidence intervals. The Pearson Chi-square test was used to compare the observed proportions. Statistical significance was set at $p < 0.05$. All variables with a significance level of less than 0.2 in the bivariate analysis were integrated into a multivariate logistic regression analysis to determine the independent influence of feeding practices on the nutritional status of the respondents.

2.5 Ethical considerations

The study was conducted with the free and informed verbal consent of the parents present for each infant, after a brief explanation of the purpose of our study. Confidentiality of the subjects of our study was ensured. The protocol of this work has been submitted for approval to the Department of Pediatrics at the Faculty of Medicine of the University of Lubumbashi.

3 Results

3.1 Socio-demographic characteristics of mothers and their infants

The majority (59.58%) of the respondents were living in the semi-urban area. Age groups of the most represented mothers were, in descending order, those aged 20-29 years and 30-39 years, respectively. The mean age of mothers was 27.9±6.5 years. The majority (38.50%) of mothers had a primary educational level; mothers with higher educational level were 11.32% of the cases. The mean number of children per mother was 3.4±2.0 children per mother. More than half of the children were female (51.92%). Infants aged between 12 and 17 months accounted for 55.06% of the cases and those aged between 18 and 23 months accounted for 44.95% of the cases. The mean age of children was 17.5±4.6 months (Table 1).

3.2 Infant feeding practices

We found that 47.9% of infants had received an early breastfeeding initiation; 76.5% of infants had been exclusively breastfed for less than 6 months. Infants fed bottle-feeding before 6 months accounted for 30.5% and 94.8% of infants had received continued breastfeeding 12-23 months. Introduction of solid, semi-solid or soft foods before 6 months had occurred in 74.04% of infants before 6 months of age; it was made in 92.3% of infants through the introduction of

industrial cereal-based formulas. Minimum dietary diversity was insufficient in more than 6 in 10 (61.5%) infants (Table 2).

Table 1 Socio-demographic characteristics of the respondents

Variable	Number (N = 574)	Percentage
Residence		
Semi-urban	342	59.58
Urban	232	40.42
Mother's age (years)		
≤ 20	38	6.62
20 – 29	320	55.75
30 – 39	185	32.23
≥ 40	31	5.40
Mean $\pm$ SD	27.9 $\pm$ 6.5	(range: 15-53)
Educational level		
Illiterate	90	15.68
Primary	221	38.50
Secondary	198	34.49
Higher	65	11.32
Number of children by mother		
≤ 5	477	83.10
6 – 10	94	16.38
≥ 11	3	0.52
Mean $\pm$ SD	3.4 $\pm$ 2.0	(range: 1-13)
Child's gender		
Female	298	51.92
Male	276	48.08
Child's age (months)		
12 – 17	316	55.05
18 – 23	258	44.95
Mean $\pm$ SD	17.5 $\pm$ 4.6	

Table 2 Distribution of children according to feeding practices

Variable	N = 574	Percentage (%)
Breastfeeding initiation		
Early	275	47.91
Late	299	52.09
Exclusive breastfeeding up to 6 months		
Yes	135	23.52
No	439	76.48
Bottle feeding before 6 months		
Yes	175	30.49
No	399	69.51
Continued breastfeeding 12–23 months		
Yes	544	94.77
No	30	5.23
Introduction of solid, semi-solid or soft foods before 6 months		
No	149	25.96
Yes	425	74.04
First food of dietary diversity		
Fruits and vegetables	44	7.67
Industrial cereal preparations	530	92.33
Minimum dietary diversity		
Sufficient	221	38.50
Insufficient	353	61.50

3.3 Infant nutritional status

Stunting was observed in 34.8% of the cases, underweight and wasting were observed in 12% and 6.8% of the cases, respectively (Table 3).

3.4 Correlation between nutritional status and feeding practices

Stunting was independently associated with bottle-feeding before 6 months (adjusted odds ratio [aOR] = 1.8; p = 0.006), introduction of solid, semi-solid or soft foods before 6 months (aOR = 2.1; p = 0.042), and insufficient minimum dietary diversity (aOR = 2.3; $p < 0.0001$) (Table 4).

Wasting was independently associated with late breastfeeding initiation (aOR = 2.4; p = 0.023) (Table 5).

Table 3 Distribution of children according to nutritional status

Variable	Number (N = 574)	Percentage (%)
Weight-for-age z-score		
≥ -2 SD (no underweight)	505	87.98
< -2 SD (underweight)	69	12.02
Height-for-age z-score		
≥ -2 SD (no stunting)	374	65.16
< -2 SD (stunting)	200	34.84
Weight-for-height z-score		
≥ -2 SD (no wasting)	535	93.21
< -2 SD (wasting)	39	6.79

Table 4 Correlation between stunting and feeding practices

Variable	Total (N = 574)	Stunting		Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
		Present (n = 200)	Absent (n = 374)				
Breastfeeding initiation							
Early	275	90 (32.7%)	185 (67.3%)	1.0		1.0	
Late	299	110 (36.8%)	189 (63.2%)	1.2 (0.8-1.7)	0.351	0.9 (0.7-1.4)	0.786
Exclusive breastfeeding up to 6 months							
Yes	135	34 (25.2%)	124 (91.8%)	1.0		1.0	
No	439	166 (37. 8%)	381 (86.8%)	1.8 (1.2-2.8)	0.010	0.9 (0.4-1.9)	0.742
Bottle feeding before 6 months							
No	399	118 (29.5%)	281 (70.4%)	1.0		1.0	
Yes	175	82 (46.9%)	93 (53.1%)	2.1 (1.5-3.0)	< 0.0001	1.8 (1.2-2.8)	0.006
Continued breastfeeding 12–23 months							
Yes	544	191 (35.1%)	353 (64.9%)	1.0		1.0	
No	30	9 (30.0%)	21 (70.0%)	0.8 (0.4-1.8)	0.708	0.6 (0.3-1.4)	0.275
Introduction of solid, semi-solid or soft foods before 6 months							
No	149	38 (25.5%)	111 (74.5%)	1.0		1.0	
Yes	425	162 (38.1%)	263 (61.9%)	1.8 (1.2-2.7)	0.007	2.1 (1.0-4.3)	0.042
First food of dietary diversity							
Fruits and vegetables	44	8 (18.2%)	36 (81.8%)	1.0		1.0	
Industrial cereal preparations	530	192 (36.2%)	338 (63.8%)	2.6 (1.2-5.6)	0.024	1.8 (0.8-4.1)	0.170
Minimum dietary diversity							
Sufficient	221	51 (23.1%)	170 (76.9%)	1.0		1.0	
Insufficient	353	149 (42.2%)	204 (57.8%)	2.4 (1.7-3.6)	< 0.0001	2.3 (1.6-3.5)	< 0.0001

Table 5 Correlation between underweight and feeding practices

Variable	Total (N = 574)	Stunting		Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
		Present (n = 69)	Absent (n = 505)				
Breastfeeding initiation							
Early	275	26 (9.4%)	249 (90.6%)	1.0		1.0	
Late	299	43 (14.4%)	256 (85.6%)	1.6 (0.9-2.7)	0.092	1.5 (0.9-2.6)	0.130
Exclusive breastfeeding up to 6 months							
Yes	135	11 (8.2%)	124 (91.8%)	1.0		1.0	
No	439	58 (13.2%)	381 (86.8%)	1.7 (0.9-3.4)	0.152	1.1 (0.3-3.6)	0.895
Bottle feeding before 6 months							
No	399	49 (12.3%)	350 (87.7%)	1.0		1.0	
Yes	175	20 (11.4%)	155 (88.6%)	0. 9 (0.5-1.6)	0.880	0.7 (0.4-1.3)	0.294
Continued breastfeeding 12–23 months							
Yes	544	66 (12.1%)	478 (87.9%)	1.0		1.0	
No	30	3 (10.0%)	27 (90.0%)	0.8 (0.2-2.7)	0.727	0.7 (0.2-2.4)	0.551
Introduction of solid, semi-solid or soft foods before 6 months							
No	149	10 (6.7%)	139 (93.3%)	1.0		1.0	
Yes	425	59 (13.9%)	366 (82.1%)	2.2 (1.1-4.5)	0.030	2.4 (0.7-7.8)	0.150
First food of dietary diversity							
Fruits and vegetables	44	2 (4.6%)	42 (95.4%)	1.0		1.0	
Industrial cereal preparations	530	67 (12.6%)	463 (87.7%)	3 (0.8-26.5)	0.147	3 (0.7-13.2)	0.146
Minimum dietary diversity							
Sufficient	221	22 (9.9%)	199 (90.1%)	1.0		1.0	
Insufficient	353	47 (13.3%)	306 (86.7%)	1.4 (0.8-2.4)	0.283	1.3 (0.7-2.3)	0.389

In addition, underweight was associated with introduction of solid, semi-solid or soft foods before 6 months (crude OR = 1.8; p = 0.007) in bivariate analysis but not in multivariate analysis (Table 6).

Table 6 Correlation between wasting and feeding practices

Variable	Total (N = 574)	Stunting		Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
		Present (n = 39)	Absent (n = 535)				
Breastfeeding initiation							
Early	275	11 (4.0%)	264 (96.0%)	1.0		1.0	
Late	299	28 (9.4%)	271 (90.6%)	2.5(1.2-5.1)	0.017	2.4(1.1-5.0)	0.023
Exclusive breastfeeding up to 6 months							
Yes	135	8 (5.9%)	127 (94.9%)	1.0		1.0	
No	439	31 (7.1%)	408 (92.9%)	1.2(0.5-2.7)	0.79	0.9(0.2-3.7)	0.838
Bottle feeding before 6 months							
No	399	25 (7.0%)	371 (93.0%)	1.0		1.0	
Yes	175	11 (6.3%)	164 (93.7%)	0.9(0.4-1.8)	0.89	0.7(0.3-1.6)	0.469
Continued breastfeeding 12–23 months							
Yes	544	37 (6.8%)	507 (93.2%)	1.0		1.0	
No	30	2 (6.7%)	28 (93.3%)	1(0.1-9.0)	1	0.9(0.2-3.9)	0.870
Introduction of solid, semi-solid or soft foods before 6 months							
No	149	7 (4.7%)	142 (95.3%)	1.0		1.0	
Yes	425	32 (7.5%)	393 (92.5%)	1.7(0.7-3.8)	0.321	2.1 (0.5-8.8)	0.327
First food of dietary diversity							
Fruits and vegetables	44	1 (2.3%)	43 (97.7%)	1.0		1.0	
Industrial cereal preparations	530	38 (7.2%)	492 (92.8%)	3.3(0.5-137.7)	0.348	3.1(0.4-24.3)	0.280
Minimum dietary diversity							
Sufficient	221	13 (5.9%)	208 (94.1%)	1.0		1.0	
Insufficient	353	26 (7.4%)	327 (92.6%)	1.3(0.6-2.5)	0.605	1.1(0.5-2.2)	0.875

4 Discussion

In developing countries like the DRC, child malnutrition is still a serious issue for public health [8]. Children continue to be the most susceptible due to infectious diseases, inadequate care, and unequal food distribution within the household [9, 10]. The comparison of our results and the 2013-2014 DRC Demographic Health Survey (2013-2014 DRC-DHS) shows 12.02% vs 7% for underweight, 6.79% vs 3% for wasting, and 34.84% vs 23% for stunting [6]. The generality of 2013-2014 DRC-DHS would explain lower rates of malnutrition than our rates. Nutrition surveys have shown that stunting is the predominant type of malnutrition in children in the literature [11–14]. Chronic malnutrition and/or persistent or repeated infectious illnesses are probably to blame for this. The WHO advises starting exclusive breastfeeding early in the hour following birth up to a maximum of 6 months and continuing for at least 12 months. Breast milk can provide half or more of the energy needs of the child aged 6 to 12 months, and one third of the energy needs of the child aged 12 to 24 months [15]. In the present study, exclusive breastfeeding for a period of at least 6 months was observed in 23.52% of the cases. In the 2013-2014 DRC-DHS, the exclusive breastfeeding rate up to 6 months at the national level was estimated at 21.8% [6]. Our study found an early initiation rate of breastfeeding of 47.91%. A study carried out in Senegal had reported a 'low' rate of early breastfeeding initiation of the order of 2%. This low rate of early breastfeeding was explained by the use of holy water or "tokental" in Wolof or sugar water before the first breastfeeding [17].

We also observed a rate of non-continued breastfeeding up to 12 months in 5.23% of the cases. Bottle-feeding is not recommended for young children as it is most often associated with an increased risk of disease, particularly diarrhoeal disease [18, 19]. We observed that bottle-feeding before 6 months was done in 30.49% of infants in our series. The 2013-2014 DRC-DHS notes that 2% of children under 2 months of age had been bottle-fed in the 24 hours prior to the interview, and this pattern of feeding increased in proportion to the age of the children [6]. In developing countries, some parents perceive the increasing use of baby bottles and infant formula milk as a positive step towards modernization [20]. However, access to safe drinking water, which contributes to the preparation and maintenance of the bottle, remains difficult in these countries. This leads to recurrent exposure of infants to water-borne diseases that would affect their growth.

The introduction of solid, semi-solid or soft foods before 6 months, according to the WHO, is the introduction of any food other than breast milk, with the exception of drinking water, oral rehydration solutions, vitamin, and mineral supplements [5]. This complementary feeding may be tolerated if initiated in a child between 17 weeks and 26 weeks of age [22]. We observed a rate of introduction of solid, semi-solid or soft foods before 6 months of 74.04%. Infants are particularly vulnerable during the transition period when food diversification begins, as introduced foods must be tolerated and must cover their quantitative and qualitative needs

for good growth. The concept of food with adequate diversification refers to the concept of "minimum dietary diversity". Sufficient minimum dietary diversity implies the consumption of foods belonging to at least 4 out of 7 distinct food groups [7]. In this respect, we observed a sufficient minimum dietary diversity rate of 38.50%. In a geographical context close to ours, a lower level of sufficient minimum dietary diversity of around 17.5% was observed [23]. Sufficient minimum dietary diversity rates remain low in our environment due to a low level of maternal knowledge about this food practice [24]. The diversification takes place gradually in terms of food texture and type of food. We found that 7.67% of the infants started with vegetables and fruits; and 92.23% of the infants had been subjected initially to industrial cereal preparations. In a French series, it was noted that the first dietary diversity was fruit juice or herbal tea in 30% of the cases, industrial cereal preparations and porridge in 30% of the cases and sweets given on the tip of the tongue in 10% of cases and the remaining 30% generally received vegetable purees or fruits [25].

The present study shows that stunting was consistently associated with three feeding practices: bottle-feeding before 6 months, introduction of solid, semi-solid or soft foods before 6 months, and insufficient minimum dietary diversity. In Rwanda, stunting was found to be negatively associated with breastfeeding for more than one year. This result is explained by the fact that prolonged breastfeeding would delay the introduction of complementary foods in Rwanda [26]. These feeding practices associated with stunting tend to confirm the likelihood that stunting is the result of chronic insufficient nutrition and/or recurrent infectious diseases.

In the present study, wasting was only influenced by late breastfeeding initiation. In Nepal, wasting was significantly associated with bottle-feeding and dietary diversity initiation before or after 6 months [4]. Therefore, wasting may be strongly influenced by the season in which the data were collected. This type of malnutrition is often the result of insufficient nutrition in the period prior to observation and/or weight loss due to disease (e.g. severe diarrhea or anorexia).

In bivariate analysis, our results show that underweight proved to be influenced exclusively by introduction of solid, semi-solid or soft foods before the age of 6 months. After adjusting for confounding factors in multivariate analysis, it was found that underweight was not influenced by any feeding practices. A survey in Haiti found that factors influencing underweight included short-term exclusive breastfeeding, late breastfeeding initiation, and insufficient minimum dietary diversity [27].

The present study provides an illustration of the nutritional status and independent nutritional determinants of malnutrition among infants in urban and semi-urban areas in Lubumbashi city.

Interpretation of the results of this study should consider certain limitations. First, because the study is cross-sectional, it prevents the establishment of any relationship between the results and the associated factors. The memory bias at the time of the survey and the lack of consideration of the quantitative aspect of foods ingested may limit the interpretation of the results to some extent.

5 Conclusion

Multicarential malnutrition in Lubumbashi remains an issue that should concern health-care providers in every respect. Stunting, wasting, and underweight, which we have observed at 34.84%, 6.79% and 12.02% respectively, must continue to be the subject of nutritional strategies adapted to our contexts with a view to their eradication. Stunting, the form of malnutrition in which a large number of children are recruited, has been significantly influenced by bottle-feeding before 6 months, introduction of solid, semisolid or soft foods before 6 months, and insufficient minimum dietary diversity. In addition, wasting was independently influenced by the late breastfeeding initiation. Adherence to proper early feeding practices could already contribute to reducing the burden of multicarential malnutrition among infants in developing countries.

Conflicts of interest

The authors declare no conflict of interest.

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