

Infant and young child feeding practices and nutritional status in two Health Zones of South Kivu, Eastern Democratic Republic of Congo: a community-based study.

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Research

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Abstract

Background: In DRC, childhood undernutrition remains a serious public health concern. Internationally recommended infant and young child feeding (IYCF) practices may improve child nutritional status. This study aimed to describe IYCF practices, factors associated with inappropriate complementary feeding, and infant's nutritional status.

Methods: A community-based cross-sectional study including 1,009 mother-infant pair was conducted in August 2019 in 32 health areas (16 in rural health zone and 16 in urban one) of South Kivu, Democratic Republic of Congo (DRC), among mothers who had infants under 24 months of age. Infant's nutritional status was assessed using WHO Anthro plus software. To describe IYCF practices, we used the indicators recommended by the WHO. To study the factors associated with inappropriate complementary feeding practices, we performed univariable and multiple logistic regression analyzes. The data was analyzed in SPSS version 25.

Results: The prevalence of early initiation of breastfeeding and exclusive breastfeeding up to 6 months of age was 73.7% and 42.2% respectively. Of the 746 infants aged 6–23.9 months, 246 (32.3%) received appropriate complementary feeding. Of the 997 infants who had valid anthropometric parameters, 416 (41.7%) were well-nourished, 374 (37.5%) were undernourished and 207 (20.8%) were overweight. Multivariable logistic regression analysis revealed that residence in rural area [Adjusted Odds Ratio (AOR): 2.38 (95% Confidence Interval (CI): 1.49, 3.78)], non-attendance at postnatal care (AOR 1.63; 95% CI 1.12, 2.96), low household socioeconomic (AOR 1.72; 95% CI 1.14, 2.59) and low maternal education (AOR 1.83; 95% CI 1.20, 2.77) were factors associated with inappropriate complementary feeding. Mothers with inappropriate complementary feeding practices were 6.88 times more likely to have undernourished infants than their counterparts (AOR 6.88; 95% CI 1.24, 18.37).

Conclusion: Findings from this study provide strong evidence, both of association between inappropriate complementary feeding and undernutrition, and of the double burden of malnutrition with the co-existence of under- and overnutrition in the infant population in South Kivu. Interventions should focus on both preventing undernutrition and overweight to promote child well-being.

Introduction

Child undernutrition remains an enormous public health challenge worldwide: 151 million and 52 million children under-5 are stunted and wasted, respectively [1]. Additionally, 5.4 million children die before their fifth birthday each year. Almost half of these childhood deaths occur in children with malnutrition, predominantly in sub-Saharan Africa and South Asia [2, 3].

The first 1000 days (period beginning at conception and ending at the start of the third postnatal year) of a child's life are particularly important, as optimal nutrition during this period lowers morbidity and mortality, reduces the risk of chronic disease, and fosters better development overall [4, 5]. The damage to physical growth, brain development, and human capital formation that occurs during this period is extensive and largely irreversible. Therefore, interventions should focus on this window of opportunity, and improving maternal and infant nutrition during the 1000-day period should be a high global priority [6, 7].

WHO and UNICEF jointly developed the Global Strategy for Infant and Young Child Feeding (IYCF) [8], including: (i) early initiation of breastfeeding within 1 hour of birth; (ii) exclusive breastfeeding for the first 6 months of life and (iii) introduction of nutritionally-adequate and safe complementary (solid) foods at 6 months together with continued breastfeeding up to 2 years of age or beyond. Improving IYCF practices based on this recommendation, whether the child is healthy or sick, is one of the strategies to prevent undernutrition and its consequences [9]. To monitor and guide IYCF practices, WHO developed 8 core and 7 optional IYCF indicators (Box 1) [10, 11]. In several studies using these indicators, recommended IYCF practices were found to be protective against undernutrition [12–16].

Little is known about IYCF practices in South Kivu, Eastern Democratic Republic of Congo (DRC). The Demographic and Health Surveys provided an overall description of the practices observed, but these national data hide regional, provincial or cultural disparities. The Eastern areas of DRC were important food producers. Since the three past decades, this food production has been impacted by looting of crops, general insecurity, and poor infrastructure. The impact of ongoing insecurity on agricultural and pastoral practices has resulted in widespread food insecurity [17, 18]. In this study, we analyze IYCF practices and associated factors, infant's nutritional status, and relationship between inappropriate complementary feeding and infant's nutritional status.

Methods

Study setting

This study was conducted in South Kivu, Eastern DRC, in 32 health areas (HA), including 16 HA in Ibanda Health Zone (IHZ), an urban area, and 16 HA in Kabare Health Zone (KHZ), a rural one. IHZ and KHZ were selected by simple random sampling from the 3 Health Zones of Bukavu urban city (Kadutu, Bagira, Ibanda) and 5 surrounding rural areas of Bukavu (Nyantende, Walungu, Kabare, Katana, Miti-Murhesa), respectively. Each of these 2 selected Health Zones encompasses 16 HA.

The IHZ is located in the municipality of Ibanda, city of Bukavu, in the South Kivu province of DRC. Bounded on the north by Lake Kivu and on the east by Rwanda, IHZ is an area with mountainous relief, clayey soil, grassy vegetation and a tropical highland climate. At the last census in 2018, it had a recorded population of 452,608 with a population density of 32 per km². Infants < 24 months of age were estimated at 9,053. The main activities are small-scale trading and administration. Secondary activities are subsistence agriculture, small livestock farming and artisanal fishing. The staple food is cassava, cereals

(maize, rice and sorghum), other tubers (taro, sweet and white potatoes) and bananas. These foods are generally served with vegetables, fish, beans and meat, which helps to balance the family dish. On average, two to three meals are consumed per day [19].

KHZ is located in the Kabare administrative zone of South Kivu province in the DRC. It is situated 17km from the city of Bukavu. It is an area with high plains and hills at elevations between 900 and 1900m, with a tropical highland climate. At the last census in 2018, it had a recorded population of 213,882 with a very high population density of 856 per km². Infants under 24 months of age were estimated at 17,111. The population of this area is devoted to agriculture, livestock and small-scale trade. Bananas, cassava, taro, sweet and white potatoes, corn and sugar cane are the main crops grown there. However, the soil is not very fertile, and most of the population of the area leaves the fields to sell labor in the city of Bukavu [20].

Study design, population and sample

A community-based cross-sectional study was conducted in August 2019 in 32 HA among mother-infant pair. The sample size was calculated using Emergency Nutrition Assessment (ENA) 2011 software. The variable used to calculate the sample size was the South Kivu exclusive breastfeeding up to 6 months rate, estimated to 51% according DRC Multiple Indicator Cluster Survey 2017-2018 [21]. The variable "exclusive breastfeeding up to 6 months" was considered since it gives a largest sample size compared to the other IYCF practices. Aiming at an absolute precision of 5% at the 95% confidence level, further assuming a design effect of 2.0 and allowing for 10% refusals and incomplete questionnaires, the required minimum sample size was 920, equivalent to 460 in each Health Zone. Sampling was systematic and proportional to the population (infants) size for each HA.

In each HA, a complete list of all households was compiled and all the households were serially numbered. To get the sampling interval, the total number of households in a HA was divided by the required sample size. The first household was then randomly selected by picking any number within the sample interval. Subsequent selections were made by adding the sampling interval to the selected number in order to locate the next household to visit. If the selected household did not have a target respondent, then next household was selected using the systematic sampling procedure. This process continued until the required sample size was obtained. In each household, only one eligible participant was surveyed using simple random sampling.

Data collection procedure and tools

Data were collected by using face-to-face interview during house-to-house visit from mothers who had children under 24 months using structured questionnaire. The questionnaire contained the information on sociodemographic characteristics of participants, infant feeding practices and anthropometry. To determine household socioeconomic status, we used wealth index from modern household assets [22-25].

Ten health extension workers and one public health professional were recruited as data collector and supervisor respectively. For data quality control, the questionnaire was first developed in French and translated to local language (Swahili and Mashi language) and then back-translated to French by an independent translator for consistency. Training was given to health extension workers and supervisor for 2 days. The questionnaire was pre-tested in 25 (5%) of mothers in IHZ and 25 (5%) of mothers in KHZ, which was not included in actual study, to assess the content and approach of the questionnaire. To assure the quality of the data, the supervisor and investigator closely reviewed the data collection technique on daily basis, reviewed the filled questionnaire for completeness and returned any incomplete questionnaire to the data collectors for correction. There was also debriefing every day.

Assessment of IYCF Practices

WHO has defined 15 indicators (8 core and 7 optional) to assess IYCF practices (Table 1). In this study, we assess IYCF practices using all 8 core and 3 out of the 7 optional feeding practices (children ever breastfed, continued breastfeeding at 2 years, and bottle feeding). Optimal feeding practice was assessed based on compliance to WHO recommended practices for each indicator. All indicators were assessed based on a 24-h recall method.

In accordance with the WHO rating on IYCF practices, the early initiation of breastfeeding prevalence of 0–29% was considered as poor, 30–49% as fair, 50–89% as good and 90–100% as very good. Exclusive breastfeeding prevalence of 0–11% was considered as poor, 12–49% as fair, 50–89% as good and 90–100% as very good. Timely initiation of complementary feeding prevalence of 0–59% was considered as poor, 60–79% as fair, 80–94% as good and 95–100% as very good [26].

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Four core IYCF indicators were used to define whether complementary feeding practice was appropriate or inappropriate: timely initiation of complementary feeding, minimum dietary diversity, minimum meal frequency and minimum acceptable diet. We defined as appropriate if the mother responded correctly to all four indicators, and inappropriate if at least one indicator was not correctly fulfilled.

Nutritional status assessment

The anthropometric indicators, comprising weight-for-age (WAZ), length-for-age (LAZ), weight-for-length (WLZ), mid-upper arm circumference (MUAC) and the presence or not of bilateral pitting edema were determined according to standard procedures described by WHO [27, 28]. Underweight was defined by WAZ < -2 according to the 2006 WHO growth standards in children aged 0–59 months; stunting by LAZ < -2; wasting by WLZ < -2 or MUAC < 125 mm, and overweight by WLZ > +2 [28]. Undernutrition was defined as wasting and/or stunting and/or underweight [29].

Statistical data analyses

Data were entered and analyzed using SPSS for Windows version 25 (SPSS Inc. Version 25.0, Chicago, Illinois). Characteristics of mothers and infants were summarized as mean and standard deviation (SD) for continuous variables with a normal distribution, or as median and range for *continuous variables* with a *non-normal distribution*, and as number or percentages for categorical variables. Normality of continuous variables was explored visually (Q-Q plots and histogram) and numerically (Shapiro-Wilk and Kolomogorov-Smirnov tests). For categorical variables, we compared proportions using the chi-square or Fischer exact test; for continuous variables, medians were compared using the Wilcoxon rank-sum test. WHO Anthro plus 2011 version 1.0.4 (WHO, Geneva, Switzerland) was used to assess anthropometric z-scores with WHO 2006 reference. The age, gender, presence or not of bilateral pitting edema, and anthropometric measurements of infants were imported into WHO Anthro plus software, which then calculated WAZ, LAZ and WLZ and identified outliers: < -6 and > 5 for WAZ, < -6 and > 6 for LAZ and < -5 and > 5 for WLZ. These values were excluded. Finally, this software assessed the infant's nutritional status according to z-scores, MUAC, and the presence or not of bilateral pitting edema.

To study the factors associated with inappropriate complementary feeding practice, we conducted univariable and multiple logistic regression analyzes. The variables were imported into the multiple regression model on the basis of a value $p \leq 0.25$ and/or on the basis of biological plausibility. The unadjusted and adjusted odds ratios with their 95% confidence intervals were used to measure the association between the variables and inappropriate complementary feeding practice.

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Results

Sample Characteristics

Of the 460 sampled mother-infant pair in each Health Zone, 509 were successfully included in IHZ and 500 in KHZ, making the response rate of 110.6% and 108.7% respectively. All mothers in the selected households consented to participate in the survey. One thousand five out of 1009 (99.6%) of the interviewees in the survey were the infants' own mothers. For the other 4 interviewees, 3 were grandmothers and one was aunt, living in the same household with infants' parents, both in KHZ. The median age of the children was 12 (range: 0.5- 23.9) months with 74.0% being in the age group 6–23.9 months. Five hundred and ten (50.5%) children were male. Eight hundred and eighteen (81.4%) households had a low socio-economic level and 416 (41.2%) had a low maternal educational level. Low socio-economic and maternal educational levels were more prevalent in rural areas than in urban ones ($p < 0.05$). The post-natal care follow-up rate was 12.0%, higher in rural areas than in urban ones ($p < 0.05$). The other socio-demographic characteristics are summarized in Table 2.

Infants' nutritional status

Of the 1,009 infants measured and weighed, 12 (1.2%) had outliers' measurements. Of the 997 infants with valid anthropometric parameters, 416 (41.7%) were well-nourished, 374 (37.5%) were undernourished and 207 (20.8%) were overweight. No infant had edema. The stunting, underweight, wasting (WLZ < -2 and/or MUAC < 125 mm) and overweight rates were 46.9%, 18.9%, 16.6% and 20.8% respectively (Table 2). Underweight was significantly high in rural area while overweight was significantly important in urban area ($p < 0.05$). Undernutrition was more prevalent among infants between 6-23.9 months of age and those with inappropriate complementary feeding practices. Indeed, 322 (86.0%) undernourished infants were 6-23.9 months of age ($p < 0.05$) and they were 2.19 times as likely to be undernourished than their counterparts (AOR 2.19; 95% CI 1.12, 5.74; $p < 0.000$). Three hundred and one (93.5%) infants with inappropriate complementary feeding practices were undernourished. Mothers with inappropriate complementary feeding practices were 6.88 times more likely to have undernourished infants than their counterparts (OR 6.88; 95% CI 1.24, 18.37; $p < 0.000$).

IYCF practice

IYCF practices are summarized in Table 3. Almost all (99.3%) of the infants in our sample were breastfed, with 68.0% of infants still breastfeeding through the second year of life. The early initiation of breastfeeding rate was 73.7%, significantly higher in urban (79.8%) than in rural area (67.8%) ($p < 0.05$). The exclusive breastfeeding rate for the first six months was 42.2%, significantly higher in urban (50.9%) than in rural area (37.7%) ($p < 0.05$). Complementary foods were given to 76% of infants 6–8.9 months of age. Among 746 children 6–23.9 months of age, 474 (63.5%) had minimum meal frequency, 250 (33.5%) had minimum dietary diversity and 203 (27.2%) had minimum acceptable diet, with rates higher in urban than in rural areas for all these indicators ($p < 0.05$). Two hundred and forty-one (32.3%) infants had appropriate complementary feeding, with rates significantly higher in urban (36.0%) than in rural areas (28.0%) ($p < 0.05$). Figure 1 shows monthly trends in both exclusive breastfeeding and complementary feeding from birth to 12 months of life. Four hundred and thirty-four (43.0%) infants received complementary feeding at 4 months of age; all infants were fed with solid, semi-solid or soft foods at 8 months of age.

Factors associated with inappropriate complementary feeding

The univariate analysis showed that residence Health Zone, attendance at postnatal care, household socioeconomic status, maternal education status and polygamous were statistically associated with inappropriate complementary feeding practice. In the multivariable logistic regression analysis, residence Health Zone, attendance at postnatal care, household socioeconomic status, and maternal education status were independent predictors for inappropriate complementary feeding practice (Table 4). Mothers living in rural area were 2.38 times as likely to have inappropriate complementary feeding practice than those living in urban area (AOR 2.38; 95% CI 1.49, 3.78). Mothers who didn't have postnatal care follow up were 1.63 times more likely to have inappropriate complementary feeding practice than those who attend postnatal care (AOR 1.63; 95% CI 1.12, 2.96). Mothers with low education level were 1.83 times as likely to have inappropriate complementary feeding practice than their counterparts (AOR 1.83; 95% CI 1.20, 2.77). Mothers with low household socioeconomic were 1.72 times more likely to have inappropriate complementary feeding practice than those with good household socioeconomic (AOR 1.72; 95% CI 1.14, 2.59).

Discussion

This study sought to describe IYCF practices and nutritional status among infants < 24 months in food security crisis context.

Breastfeeding

Breastfeeding is a universal practice in DRC. Nationally and in South Kivu province, 98.7% and 98.9% of newborns are breastfed respectively [21]. Our study found the same trends with 99.3% of breastfed newborns. Nationally, however, only 47% of newborns are breastfed within the first hour after birth [21]. In this study, the early initiation of breastfeeding rate (73.7%) appears to be good compared to WHO grades on IYCF practices. It is high compared to that reported in

South Kivu province according to DRC MICS 2017-2018 (58.4%) [21]. It remains also high compared to that we reported, three years ago (65.9%), in a hospital-based study conducted in 2 maternity wards (urban and rural) in South Kivu (DRC) [30]. A systematic review of 18 studies conducted in Africa, South America and Asia found the early initiation of breastfeeding prevalence ranged from 11.4% to 83.3% [31]. Additionally, a recent national survey report from WHO European region countries showed the early initiation of breastfeeding prevalence ranged from 5% to 84% [32].

The exclusive breastfeeding prevalence found in this study is low compared to that of DRC MICS 2017-2018 (53.5%). Compared to WHO grades on IYCF practices, this prevalence is fair. The exclusive breastfeeding practices the first six months is in a growing trend in DRC; it was estimated 24% in 2001 [33], 36% in 2007 [34], 37% in 2010 [35], 48% in 2014 [36] and 53.5% in 2018 [21]. In Africa, the exclusive breastfeeding rate remains also fair compared to the WHO rating on IYCF practices. Indeed, only 37% of infants under 6 months of age were exclusively breastfed in 2017 [37].

The early initiation of breastfeeding and the exclusive breastfeeding refer to the best practice recommendation by the WHO [38]. The short and long-term health benefits of breastfeeding for children and mothers have been well documented: the "skin to skin" contact between mother and newborn immediately after birth favors the newborn's skin colonization by the mother's microbiota, facilitates the regulation of body temperature, maintains the blood glucose levels stable, and contributes to cardiorespiratory stability [39, 40]. In Nepal [41] and in Ghana [42], the early initiation of breastfeeding has been associated with a 19% and 22% reduction in deaths respectively. The exclusive breastfeeding is an IYCF associated with lower neonatal mortality. It prevents morbidities such as diarrhea, pneumonia and neonatal septicemia. It reduces the risk of nutritional disorders such as undernutrition, obesity and diabetes mellitus later in life [43-46].

Several recent systematic review and meta-analysis conducted in low-and middle income countries have identified several factors and barriers to breastfeeding, including cesarean section, low family income, mother's age below 25 years, mother's low schooling level, absence of antenatal clinic visits, home birth, lack of prenatal guidance in regard to breastfeeding and prematurity [47-49].

The DRC Ministry of Public Health promotes early initiation of breastfeeding and exclusive breastfeeding for the first 6 months, with education and support provided to mothers during antenatal and postnatal consultations. However, more than one-third of women do not have access to a health clinic and are thus not receiving information on optimal IYCF practices [21].

Community involvement has proven to be an effective strategy to promote breastfeeding. In this strategy, community volunteers, after being trained themselves by the caregivers, are given the task of promoting exclusive breastfeeding from birth in their respective villages through door-to-door visits and community meetings. A study conducted in 2 rural areas of South Kivu (DRC) to assess the effectiveness of community volunteers in promoting exclusive breastfeeding from birth, showed that the proportion of infants receiving exclusive breastfeeding at six months of age was higher in the intervention area than in the comparison area: 57.7% (95% Confidence Interval, CI, 50.9 to 64.5) versus 2.7% (95%CI, 1.1 to 6.6) ($p < 0.001$) [50]. Similar results have been reported, particularly in Sub-Saharan Africa (Burkina Faso, Uganda and South Africa) [51], Bangladesh [52], Mexico [53], India [54], Bolivia and Madagascar [55].

Complementary feeding practice and associated factors

In this study finding, the overall appropriate complementary feeding practice prevalence was 32.3%, which is consistent with studies' findings of 32% in South India [56], 35% in Kenya [57], 37% in Zambia [58], and in Ethiopia [59]. Low prevalence was reported in Benin (24%) [60] and in Ghana (15.7%) [61]. The differences in health services such like health education and advice on breastfeeding and complementary feeding during prenatal and postnatal care, region-dependent feeding cultural practices and the study's time difference could be the factors explaining these differences.

In this report, rural residence, non-attendance at postnatal care, low household socio-economic and low maternal education were factors associated with inappropriate complementary feeding practices. A study aiming to characterize IYCF practices and barriers to optimal child feeding in South Kivu (DRC) have identified poverty, high work burden, lack of decision-making power in the household, and perceived milk insufficiency as barriers to optimal child feeding [62].

In the rural areas of the DRC, subsistence agriculture (the major livelihood for the majority of the households) faces several constraints: infrastructure is poor, farmers have limited access to agricultural input, they rely on traditional cultivation technologies and cultivate small land-holdings. The civil war has worsened the situation, leading to a massive rural exodus of the population. Additionally, the subsistence agricultural sector has also been seriously neglected by the government and development agencies [63-66]. The urban-rural gap in nutritional indicators has also been attributed to other factors: low maternal education, lack in access to quality food due to low household socioeconomic, and lack of availability of health services [67-72]. Our findings corroborate this reality by showing a large proportion of households with low socio-economic and maternal education levels in rural areas than in urban ones ($p < 0.05$). Furthermore, in rural areas, studies in South Asia have shown discrimination against girls in food allocation being more common among girls than boys [73-75], while in sub-

Saharan Africa, research on gender inequalities in nutrition have been inconclusive [76-78]. All these factors contribute to inappropriate complementary feeding in rural areas.

A significant association was observed between inappropriate complementary feeding practice and non-attendance at postnatal care, which is consistent with study findings in Kenya [79], Ethiopia [80], Tanzania [81], and in India [81]. This might be due to the result of information and counseling on IYCF practice that the mothers received from health workers during their postnatal visits.

Low maternal education was associated with inappropriate complementary feeding practice, which is consistent with study findings reported elsewhere [79-84]. However, studies from Nepal [85] and Lebanon [86] did not find this association. Several factors explain the low rate of inappropriate complementary feeding among educated mothers: educated mothers may have a better understanding of feeding practices than less educated mothers or mothers without formal education; they have more access to information on feeding practices through books, pamphlets, magazines, and media than their counterparts; they also have access to more household resources than an uneducated mother; Finally, they are more likely to be in paid employment.

Our study also indicated that lower household wealth status was strongly associated with inappropriate complementary feeding practice. Mothers from poor households typically do not have sufficient resources to provide their children with foods of the required nutritional value. The main limiting factor for providing children with nutritious complementary foods is the limited opportunities for access such foods, as reported in a study conducted in Tibet [87]. Several studies have also shown that improved household wealth has a significant effect on adequate complementary feeding practices [82, 88-90].

Nutritional status

Our study found a high prevalence of undernutrition (37.5%) and overweight (20.8%) in the same infant population. The prevalence of stunting reported in our study (46.9%) is close to that described in South Kivu (48.0%) in DRC MICS 2017-2018. On the other hand, we recorded a prevalence of wasting and overweight, respectively 6 times and 4 times higher than that described in South Kivu in the DRC MICS 2017-2018 (16.6% versus 2.6% for wasting; 20.8% versus 5.1% for overweight; $p < 0.05$). The study's time difference (2017 versus 2019) and the different study population (children under 5 years of age versus children under 2 years of age) are the main factors that may explain these differences. Indeed, the DRC MICS 2017-2018 also reports wasting prevalence close to 10% among infants aged 6-11 months.

The co-existence of under- and overnutrition, a phenomenon known as the "double burden of malnutrition (DBM)", poses a novel public health challenge. Undernutrition continues to cause approximately 45% of deaths in children under 5, while low- and middle-income countries now witness a simultaneous rise in childhood overweight and obesity (increasing at a rate 30% faster than in richer nations) [91, 92]. Initially documented in adults, the DBM has also been seen in children from Brazil, China, Russia and South Africa [93-97]. It is characterized by the coexistence of undernutrition along with overnutrition within individuals, households and populations throughout life [97]. In 2017, about 190 million undernourished children under-5 out of 200 million were located in Sub-Saharan Africa and Asia. At the same time, about 27 million overweight children under-5 out of 38 million were located in the same setting [1].

The relationship between undernutrition and overnutrition is more than a coexistence. According to several recent evidence studies, undernutrition early in life, even in utero, may predispose to overweight and noncommunicable diseases such as diabetes mellitus and heart disease later in life. Overweight in mothers is also associated with overweight and obesity in their offspring. Rapid weight gain early in life may predispose to long-term weight excess [96].

Study limitations

Our study has some limitations. Firstly, IYCF practices was assessed based on a 24-h recall method. Recall bias may be possible and affect the validity of the results. Secondly, the cross-sectional nature of the study may be a limiting factor in the interpretation of causality because the problem of endogeneity cannot be formally ruled out.

Declarations

Ethics approval and consent to participate: Ethical approval was granted by the Ethical Committee of the Université Catholique de Bukavu (UCB/CIES/NC/08/2018). Informed consent was obtained after needed information and explanation. Participation was voluntary and each woman signed (or provided a thumb print if she was uneducated) a statement of an informed consent after which she was interviewed.

Consent for publication: Not applicable.

Availability of data and material: The raw data can be made available to interested researchers by the authors of this article if requested.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: RMK and DVDL designed the study and reviewed the manuscript for important intellectual content. SN, BRC, AB and KCM were responsible for collecting the data. GAN supervised the team of surveyors. GAN and JBK analyzed the data. RMK wrote the manuscript. RMK and DVDL critically revised the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. WHO-recommended core and optional indicators for measuring IYCF practices (WHO 2010)

Core indicators	
1. Early initiation of breastfeeding	Children 0-23.9 months who were breastfed within 1 h of birth
1. Exclusive breastfeeding under 6 months	Children 0-5.9 months of age who had consumed nothing other than breast milk
1. Continued breastfeeding at 1 year	Children 12-14.9 months who were being still breastfed
1. Introduction of solid, semi-solid or soft foods	Children 6-8.9 months who received solid, semi-solid or soft foods at least once on the day preceding the survey date
1. Minimum dietary diversity	Children 6-23.9 months who received four or more food groups out of seven food groups [grains, roots and tubers, legumes and nuts, dairy products (milk, yogurt, cheese), flesh foods (meat, fish, poultry and liver/organ meats), eggs, vitamin-A-rich fruits and vegetables, and other fruits and vegetables]
1. Minimum meal frequency	Breastfed children 6-23.9 months who were fed a minimum recommended number of times each day. Minimum is defined as 2 times for breastfed infants 6-8.9 months, 3 times for breastfed children 9-23.9 months, 4 times for non-breastfed children 6-23.9 months
1. Minimum acceptable diet	Children 6-23.9 months old who met age-specific minimum recommended diet diversity and minimum recommended meal frequency and consumed a source of dairy (or were breastfed)
1. Consumption of iron-rich or iron-fortified foods	Children 6-23.9 months who received iron-rich/iron-fortified foods
Optional indicators	
1. Children ever breastfed	children 0-23.9 months who were ever breastfed
1. Continued breastfeeding at 2 years	Children 21-23.9 months who were still breastfed
1. Age-appropriate breastfeeding	Age-appropriate patterns of breastfeeding for children 0-23.9 months (i.e. exclusively breastfed for children 0-5.9 months old; still breastfed for children 6-23.9 months)
1. Predominant breastfeeding under 6 months	Children 0-5.9 months old, receiving breast milk and other non-nutritive liquids (e.g. water)
1. Duration of breastfeeding	duration of breastfeeding among children less than 36 months of age
1. Bottle feeding	Children 0-23.9 months old, who were fed with a bottle in the last 24h
1. Milk feeding frequency for non-breastfed children	children 6-23.9 months who receive at least 2 milk feedings

Table 2. Baseline characteristics of the study participants

Characteristics	Total (N=1,009)	Urban (N=509)	Rural (N=500)
Sociodemographic characteristics			
Infants age (in months), median (range)	12 (0.5 - 24)	13 (1 - 24)	12 (0.5 - 24)
Infants aged between 6-23.9 months, n (%)	746 (74.0)	397 (78.0)	349 (69.8)
Mothers age (in months), median (range)	27 (15 - 43)	29 (22 - 42)	28 (15 - 43)
Mothers aged between 18-35 years of age, n (%)	804 (79.7)	482 (94.7)	322 (64.4)
Female sex, n (%)	499 (49.5)	262 (51.5)	237 (47.4)
Home delivery*, n (%)	61 (6.0)	18 (3.5)	43 (8.6)
Non-attendance at postnatal care*, n (%)	121 (12.0)	43 (8.5)	78 (15.6)
Low socioeconomic level*, n (%)	818/1,005 (81.4)	339/505 (67.1)	479 (95.8)
Maternal education less than secondary***, n (%)	416 (41.2)	83 (16.3)	333 (66.6)
Children live with both biological parents, n (%)	939/1,007 (93.2)	454/508 (89.4)	485/499 (97.2)
Children live in polygamous family***, n (%)	415/999 (41.5)	52/505 (10.3)	363/494 (73.5)
Number of household members, median (range)	6 (2 - 20)	6 (2 - 18)	6 (3 - 20)
Sibling size, mean (SD)	5 (3)	4 (2)	6 (4)
Child fully immunized, n (%)	612/1,005 (60.9)	330/506 (65.2)	282/499 (56.5)
Anthropometric data			
Weight-for-age z-score			
Mean score	- 0.6 (1.7)	- 0.3 (1.8)	- 0.9 (1.6)
Score < -2**, n (%)	189/997 (18.9)	71/501 (14.1)	118/496 (23.8)
Height-for-age z-score			
Mean score	- 1.7 (2.5)	- 1.7 (2.9)	- 1.7 (2.1)
Score < -2, n (%)	468/997 (46.9)	245/501 (48.9)	223/496 (44.9)
Weight-for-height z-score			
Mean score	0.5 (2.5)	0.9 (2.7)	0.1 (2.4)
Score < -2, n (%)	157/997 (15.7)	73/501 (14.6)	84/496 (16.9)
Score > +2**, n (%)	207/997 (20.8)	149/501 (29.7)	58/496 (11.7)
MUAC (children 6-23.9 months)			
Mean circumference, in mm (SD)	130 (17)	134 (15)	126 (19)
Circumference <125 mm*, n (%)	131/746 (17.6)	55/397 (13.8)	76/349 (21.8)

*: p < 0.05; **: p < 0.01; ***p < 0.001; IYCF: Infant and Young Child Feeding; MUAC: mid-upper arm circumference; SD: Standard Deviation

Table 3. WHO criteria assessing infant and young child feeding practice.

Variable	Total	Urban	Rural
Children ever breastfed (children 0-23.9 months), n (%)	1,002/1,009 (99.3)	502/509 (98.6)	500/500 (100)
Started breastfeeding within 1 h (children 6-23.9 months) *, n (%)	744/1,009 (73.7)	345/509 (67.8)	399/500 (79.8)
Exclusive breastfed the first six months (children 0-5.9 months) *, n (%)	111/263 (42.2)	56/110 (50.9)	57/151 (37.7)
Continued breastfeeding at 1 year (children 12-15.9 months), n (%)	164/168 (97.6)	66/69 (95.9)	98/99 (98.9)
Continued breastfeeding at 2 years (children 20-23.9 months) *, n (%)	170/250 (68.0)	86/133 (64.6)	84/117 (71.8)
Bottle feeding (children 0-23.9 months) **, n (%)	61/1,009 (6.0)	41/509 (8.0)	20/500 (4.0)
Introduction of solid, semi-solid or soft foods (children 6-8.9 months), n (%)	76/100 (76.0)	41/53 (77.3)	35/47 (74.5)
Took minimum meal frequency (children 6-23.9 months) **, n (%)	474/746 (63.5)	294/397 (74.0)	180/349 (51.6)
Took minimum dietary diversity (children 6-23.9 months) **, n (%)	250/746 (33.5)	179/397 (45.0)	71/349 (20.3)
Took minimum acceptable diet (children 6-23.9 months) **, n (%)	203/746 (27.2)	155/397 (39.0)	48/349 (13.7)
Consumed iron-rich foods (children 6-23.9 months) **, n (%)	372/746 (49.8)	227/397 (57.2)	145/349 (41.5)
Had appropriate complementary feeding (children 6-23.9 months) *, n (%)	241/746 (32.3)	143/397 (36.0)	98/349 (28.0)

*: p < 0.05; **: p < 0.01

Table 4: Univariate and multivariable logistic regression analysis of factors associated with inappropriate complementary feeding practice.

*p < 0.25; **p < 0.05; ***p < 0.01; AOR: adjusted odd-ratio; CI: Confidence interval; COR: Crude odd-ratio; IYCF: Infant and young child feeding

Variables and categories	IYCF practice		COR (95%CI)	AOR (95%CI)
	Inappropriate n (%)	Appropriate n (%)		
Residence Health Zone				
Rural	290 (83.6)	56 (16.4)	1.56 (1.41 - 1.74) ***	2.38 (1.49 - 3.78) ***
Urban	212 (53.4)	185 (46.6)	1	1
Place of delivery				
Home	30 (58.8)	21 (41.2)	0.98 (0.73 - 1.32)	
Health facility	472 (62.2)	220 (31.8)	1	
Attended PNC				
No	92 (82.9)	19 (17.1)	1.44 (1.25 - 1.84) **	1.63 (1.12 - 2.96) **
Yes	410 (64.9)	222 (35.1)	1	1
Socioeconomic status				
Low	436 (72.9)	162 (27.1)	1.63 (1.35 - 1.97) ***	1.83 (1.20 - 2.77) ***
Good	66 (45.5)	79 (55.5)	1	1
Maternal education				
Less than secondary	242 (82.6)	50 (17.4)	1.43 (1.30 - 1.57) ***	1.72 (1.14 - 2.59) **
Secondary and above	260 (57.6)	191 (42.4)	1	1
Polygamous family				
Yes	227 (81.9)	50 (18.1)	1.41 (1.28 - 1.54) ***	
No	275 (59.0)	191 (41.0)	1	
Parents live with children				
No	33 (67.3)	16 (32.7)	0.99 (0.81 - 1.22)	
Yes	469 (67.6)	225 (32.4)	1	
Household size				
> 10	77 (72.0)	30 (28.0)	1.06 (0.92 - 1.33) *	
5 - 10	239 (66.2)	122 (33.8)	0.98 (0.88 - 1.09)	
< 5	186 (67.4)	89 (32.6)	1	

Figures

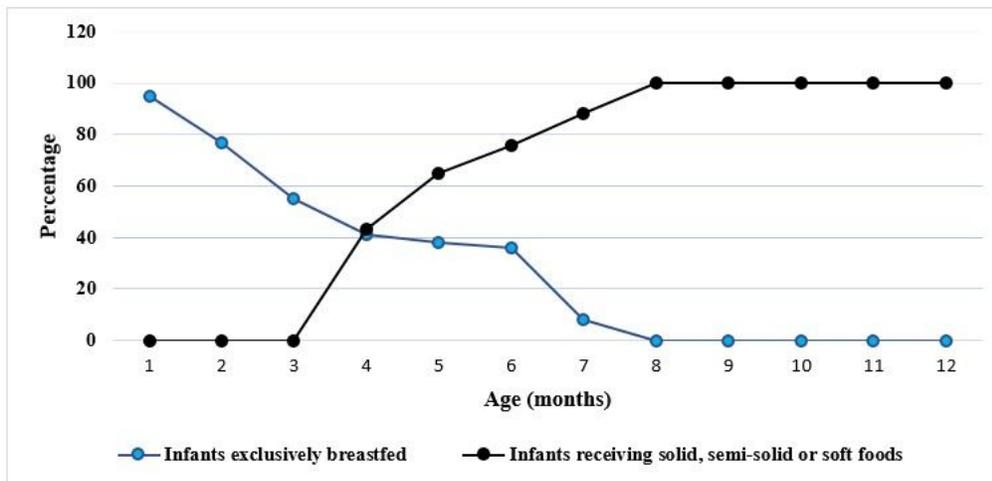


Figure 1

Percentage of infants exclusively breastfed and those receiving solid, semi-solid or soft foods.