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Prevalence and Determinants of Appropriate Complementary Feeding Practices Among Children Aged 6-23 Months in Popokabaka, DRC: A Cross-Sectional Study

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Abstract

Background: Appropriate complementary feeding is critical for preventing malnutrition in children aged 6-23 months. In the Democratic Republic of Congo, optimal practices remain suboptimal, particularly in rural areas like Popokabaka (Kwango province), where local data are scarce. This study aimed to determine the prevalence and factors associated with appropriate complementary practices in this rural health zone.

Methods: We conducted a cross-sectional study from June to August 2025 among 338 mother-child pairs (children 6-23 months) selected via two-stage probability sampling in the Popokabaka health zone. Practices were assessed using WHO indicators: Minimum Dietary Diversity, Minimum Meal Frequency, and Minimum Consistency. Data on sociodemographics, economics, and maternal health service use were collected via structured questionnaire. Nutritional status was assessed by anthropometry. Logistic regression identified independent factors.

Results: Only 12.1% (95% CI: 8.7-15.9%) of children received appropriate complementary feeding. The prevalence of Minimum Dietary Diversity, Minimum Meal Frequency, and Minimum Consistency was 24.3%, 56.2%, and 91.7%, respectively. Independent factors included: postnatal care (aOR=3.7; 95% CI: 1.6-8.9), maternal secondary education or higher (aOR=3.9; 95% CI: 1.4-11.2), high socioeconomic status (aOR=4.8; 95% CI: 1.4-18.3), ≥4 antenatal visits (aOR=3.0; 95% CI: 1.3-7.2), safe water access (aOR=2.6; 95% CI: 1.2-5.9), and child age 12-23 months (aOR=2.7; 95% CI: 1.1-6.8). Children with inadequate practices had significantly more underweight (25.1% vs. 7.3%, p=0.02).

Conclusion: Prevalence of appropriate complementary feeding in Popokabaka is alarmingly low. Practices are significantly influenced by maternal health service utilization, maternal education, socioeconomic conditions, and water access. These findings support integrated interventions strengthening the continuum of maternal care, women's education, household food security, and water access to improve child nutrition in this rural region.

Keywords: Complementary feeding; appropriate practices; children 6-23 months; determinants; Popokabaka.

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1. Background

Appropriate complementary feeding (CF) for children aged 6 to 23 months is a critical intervention for preventing malnutrition and promoting optimal growth and development, as recommended by the World Health Organization (WHO) [1]. Globally, nearly 48% of children in this age group do not receive the minimum recommended meals, contributing to nutritional deficiencies and inadequate growth [2]. This problem is particularly acute in sub-Saharan Africa, where inadequate practices persist despite international guidelines [3].

The consequences of inadequate complementary feeding CF are severe, affecting half of all children aged 6-23 months and increasing the risk of acute and chronic malnutrition and underweight [1]. Systematic reviews show that factors like low maternal education and limited access to diverse foods exacerbate these poor practices [4]. In the Democratic Republic of Congo (DRC), malnutrition profoundly affects children under five, especially in rural areas, where exclusive breastfeeding rates are low and appropriate CF is estimated at only 5.5% in some regions [5]. Nationally, the prevalence of acute malnutrition (11.9%), stunting (37%), and underweight (26.8%) are linked to suboptimal feeding practices and recurrent infections [6].

In the Kwango province, where the Popokabaka Health Zone is located, nutritional challenges are amplified by rural poverty, food insecurity, recurrent conflicts, and poor access to health services [7]. This context favors feeding practices based on simple mixtures like cassava flour, oil, and sugar [7]. Despite WHO recommendations, CF practices in Popokabaka remain inadequate, contributing to persistent malnutrition, with locally under-explored determinants.

This study aimed to determine the prevalence and factors associated with appropriate complementary feeding practices among children aged 6-23 months in Popokabaka, DRC. Our primary hypothesis was that the prevalence of appropriate practices would be below 20%, similar to other rural Congolese areas.

2. Materials and Methods

2.1. Study Design and Setting

We conducted a descriptive and analytical cross-sectional study from June to August 2025 in the Popokabaka Health Zone, a rural territory in Kwango province, southwestern DRC. This region is characterized by a predominantly agricultural population, seasonal food insecurity, and limited access to health services [7]. The study period coincided with the rainy season, which increases the availability of local produce but also the risk of diarrheal infections.

2.2. Population and Sampling

The target population comprised all children aged 6-23 months residing in Popokabaka and their mothers/primary caregivers. We included children aged 6-23 completed months, residing in Popokabaka for at least six months, with available and consenting mothers. We excluded children with congenital malformations, severe chronic pathologies, or those hospitalized or in intensive nutrition care at the time of the survey.

A two-stage probability sampling was used to ensure representativeness:

1° First stage: Simple random selection of 6 health areas out of the 12 in Popokabaka.

2° Second stage: Systematic random selection of households with children aged 6-23 months from vaccination center registers.

Sample Size: Calculated using the prevalence formula [8]: $n = Z^2 \cdot p \cdot (1-p) / d^2$

Where $Z=1.96$, $p=0.15$ (estimated prevalence of appropriate practices based on Congolese studies [5]), and $d=0.05$. This gave $n=196$. With a 10% non-response rate and a design effect of 1.5 for rural areas, the final target sample size was 350 children. A total of 338 mother-child pairs participated (response rate: 96.6%).

2.3. Variables and Data Collection

Our primary dependent variable was appropriate complementary feeding practice, defined as a binary criterion (yes/no) according to WHO indicators (2023) [1]. A practice was considered appropriate when it simultaneously met three components:

- Minimum Dietary Diversity (MDD): Consumption of at least four food groups in the previous 24 hours.
- Minimum Meal Frequency (MMF): At least three meals per day for breastfed children and four for non-breastfed children.
- Minimum Consistency (MCF): Food is solid, semi-solid, or soft.

Independent variables included: sociodemographic (maternal age, education, occupation; child age, sex; household size), economic (socioeconomic status assessed by an asset score [9]), health (exclusive breastfeeding, access to safe water, recent diarrheal episodes, vaccinations, maternal health service use: antenatal care [ANC], delivery location, postnatal care [PNC]), and nutritional (anthropometric Z-scores for weight-for-height, height-for-age, and weight-for-age according to WHO 2006 standards [10]).

We used a structured questionnaire based on WHO IYCF guidelines (2023) [1]. Anthropometric measurements were taken using a SECA 874 electronic scale (precision 10g), a SECA 417 length board, and a stadiometer [10]. Child age and vaccination history were verified from health cards. Face-to-face interviews were conducted at home by six trained investigators.

2.4. Data Analysis

Data were entered using EpiData version 2.0 and analyzed using R version 4.3.2. Descriptive analyses included frequencies, means with standard deviations, and prevalence estimates with 95% confidence intervals. Bivariate analyses used Chi-square or Fisher's exact tests for categorical variables. Variables with a p-value < 0.25 were entered into a multivariate logistic regression model using a stepwise backward elimination procedure. Adjusted odds ratios (aOR) with 95% confidence intervals were computed, and significance was set at $p < 0.05$. We checked for multicollinearity using the Variance Inflation Factor (VIF < 5) and explored interactions between maternal education and income.

2.5. Ethical Considerations

The study protocol received approval from the Provincial Health Division of Kwango. Written informed consent was obtained from each mother/primary caregiver after oral information in local languages. The possibility to withdraw from the study at any time was clearly stated. Confidentiality was guaranteed by anonymization with codes, password-protected data, and destruction of information after analysis. The study's benefits included malnutrition screening and referral to health centers when needed.

3. Results

3.1. Characteristics of the Study Population

The mean age of the children (n=338) was 14.2 months (SD ± 5.1), with 65.4% (n=221) in the 12-23 months group. Sex distribution was balanced (50.6% male). The mean maternal age was 27.8 years (SD ± 6.9). Maternal education was low, with 55.9% (n=189) having no formal education, 33.1% (n=112) primary, and only 10.9% (n=37) secondary or higher. The majority of mothers were farmers/homemakers (85.8%, n=290). Household food insecurity (HFIAS) was prevalent in 74.3% (n=251) of households.

Regarding maternal health service use, only 29.0% (n=98) of mothers had at least 4 ANC visits, 39.1% (n=132) delivered in a health facility, and a mere 22.5% (n=76) attended a PNC consultation. Access to safe drinking water was reported by 38.8% (n=131) of households.

3.2. Prevalence of Complementary Feeding Practices

The overall prevalence of appropriate complementary feeding practice (MAD + MMF + MCF) was 12.1% (95% CI: 8.7-15.9). Table 1 summarizes the individual indicator prevalences.

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Table 1: Prevalence of Complementary Feeding Indicators (n=338)

Indicator	n	Prevalence (%)	95% CI
Minimum Dietary Diversity (MDD)	82	24.3	[19.7 – 29.0]
Minimum Meal Frequency (MMF)	190	56.2	[50.8 – 61.6]
Minimum Consistency (MCF)	310	91.7	[88.6 – 94.8]
Appropriate Practice (MAD+MMF+MCF)	41	12.1	[8.7 – 15.9]

3.3. Factors Associated with Appropriate CF Practices

3.3.1. Bivariate Analysis

Bivariate analysis identified several variables associated with appropriate practices ($p < 0.25$), which were included in the multivariate model.

Table 2: Bivariate Analysis of Factors Associated with Appropriate CF Practice

Variable	Modality	Appropriate (n=41)	Non-Appropriate (n=297)	p-value
Maternal Education	None	10 (8.9%)	179 (94.7%)	<0.001
	Primary	18 (16.1%)	94 (83.9%)	
	Secondary+	13 (35.1%)	24 (64.9%)	
Socioeconomic Status	Low	4 (3.5%)	111 (96.5%)	<0.001
	Middle	15 (12.0%)	110 (88.0%)	
	High	22 (22.4%)	76 (77.6%)	
Antenatal Care (≥4 visits)	Yes	26 (26.5%)	72 (73.5%)	<0.001
	No	15 (6.3%)	225 (93.7%)	
Place of Delivery	Facility	28 (21.2%)	104 (78.8%)	<0.001
	Home	13 (6.3%)	193 (93.7%)	
Postnatal Care	Yes	20 (26.3%)	56 (73.7%)	<0.001
	No	21 (8.0%)	241 (92.0%)	
Safe Drinking Water	Yes	28 (21.4%)	103 (78.6%)	<0.001
	No	13 (6.3%)	194 (93.7%)	
Child Age	6-11 months	8 (6.8%)	109 (93.2%)	0.01
	12-23 months	33 (14.9%)	188 (85.1%)	
Recent Diarrhea	Yes	12 (8.5%)	130 (91.5%)	0.04
	No	29 (14.8%)	167 (85.2%)	

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3.3.2. Multivariate Analysis

Logistic regression identified six factors independently associated with appropriate practices (Table 3). The final model had good discriminatory power (AUC ROC = 0.82).

Table 3: Factors Independently Associated with Appropriate CF Practice (Multivariate Logistic Regression)

Variable	Modality	aOR	95% CI	p-value
Maternal Education	None	1		
	Primary	1.5	[0.6 – 3.6]	0.342
	Secondary+	3.9	[1.4 – 11.2]	0.011
Socioeconomic Status	Low	1		
	Middle	2.4	[0.7 – 8.6]	0.158
	High	4.8	[1.4 – 18.3]	0.017
Antenatal Care (≥4 visits)	Yes vs No	3.0	[1.3 – 7.2]	0.012
Postnatal Care	Yes vs No	3.7	[1.6 – 8.9]	0.003
Safe Drinking Water	Yes vs No	2.6	[1.2 – 5.9]	0.021
Child Age	12-23 vs 6-11 mo	2.7	[1.1 – 6.8]	0.037

Note: Model also adjusted for place of delivery, maternal age, child sex, and recent diarrhea (all non-significant).

3.4. Association with Nutritional Status

Children with inadequate practices had a significantly higher prevalence of underweight (25.1% vs. 7.3%, p=0.02). While a similar trend was observed for wasting (10.3% vs. 4.9%, p=0.40) and stunting (42.6% vs. 34.1%, p=0.39), the differences were not statistically significant, likely due to the small sample size of the group with appropriate practices (n=41).

Table 4: Association between Appropriate CF Practice and Nutritional Status

Nutritional Status	Appropriate (n=41)	Non-Appropriate (n=291)	p-value
Wasting (WHZ < -2)	2 (4.9%)	30 (10.3%)	0.40
Stunting (HAZ < -2)	14 (34.1%)	124 (42.6%)	0.39
Underweight (WAZ < -2)	3 (7.3%)	73 (25.1%)	0.02

WHZ: Weight-for-Height Z-score; HAZ: Height-for-Age Z-score; WAZ: Weight-for-Age Z-score.

4. Discussion

This study in the rural Popokabaka health zone revealed that only 12.1% of children aged 6-23 months received appropriate complementary feeding, a figure that is alarmingly low and consistent with findings from other rural areas in the DRC [5,6]. This

result validates our primary hypothesis and underscores the persistent challenge of suboptimal feeding practices in resource-limited settings.

The analysis of individual components showed that Minimum Dietary Diversity (24.3%) was the most critical gap, with diets dominated by cereals and tubers and a very low consumption of animal-source proteins. This finding aligns with the observed high household food insecurity (74.3%) and reflects the economic constraints and seasonal availability of diverse foods [7]. While Minimum Meal Frequency (56.2%) and Minimum Consistency (91.7%) were more frequently met, the latter might be overestimated due to social desirability bias, as field observations suggested that porridges were often very liquid.

One of the most significant findings of this study is the strong, independent association between appropriate CF practices and the use of maternal health services, particularly PNC (aOR=3.7) and ANC (aOR=3.0). This highlights the critical role of the continuum of maternal care as a platform for delivering and reinforcing nutritional counseling. Mothers who interact with the health system during and after pregnancy are more likely to receive, remember, and implement feeding recommendations. This is a potent and actionable finding, as these services are already existing structures that can be strengthened. The fact that only 22.5% of mothers attended PNC, a key opportunity to address CF as the child approaches 6 months, represents a major missed opportunity.

Our results also confirm the strong influence of maternal education (aOR=3.9) and socioeconomic status (aOR=4.8). This is consistent with a wide body of literature [4,5] and highlights the need for long-term investments in girls' education and poverty reduction. Moreover, access to safe drinking water (aOR=2.6) emerged as a significant protective factor, likely acting as a marker of overall household development and reducing the burden of diarrheal diseases that impair nutritional status and appetite.

The study has several strengths, including its rigorous sampling, use of standardized WHO indicators, and high response rate. However, limitations must be considered. The cross-sectional design precludes establishing causality. Recall and social desirability biases are inherent in dietary assessment methods. Furthermore, the small number of children with appropriate practices limited the statistical power for some subgroup analyses.

Despite these limitations, our findings have clear programmatic implications. Interventions should move beyond simple nutritional messaging to an integrated, multi-sectoral approach. Firstly, efforts to improve CF must be deeply integrated into the routine continuum of maternal and child health services, ensuring every ANC visit, delivery, and PNC contact includes targeted, practical nutritional counseling. Secondly, addressing the underlying determinants, such as maternal education, food insecurity, and water access is essential for long-term, sustainable change.

5. Conclusion

The prevalence of appropriate complementary feeding practices in Popokabaka is critically low (12.1%), driven by poor maternal health service utilization, low education, poverty, and lack of safe water. Strengthening the continuum of maternal care, empowering women, and improving household food and water security are essential, integrated strategies to combat child malnutrition in this region and similar rural settings in the DRC.

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Competing Interests

The authors declare no competing interests.

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Author Contributions

MTC: Conceptualization, Data curation, Writing Original draft. TMP: Formal analysis, Methodology. NKP: Investigation, Supervision. LMJ: Validation, Writing Review & Editing.

Ethical Approval

The study was approved by the Provincial Health Division of Kwango, DRC. All procedures were conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments.

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