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Research Article

Keywords: Complementary feeding, Knowledge, attitudes and practices, Minimum dietary diversity, Minimum acceptable diet, Unhealthy foods, Stunting, Rwanda

Posted Date: October 5th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11244502/v1>

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Additional Declarations: The authors declare no competing interests.

Knowledge, attitudes and practices regarding complementary feeding among mothers and caregivers of children aged 6–23 months in Rwamagana District, Rwanda: a cross-sectional study using the 2021 WHO/UNICEF indicators

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Abstract

Background: Poor complementary feeding is a major cause of child undernutrition. Rwanda has reduced stunting, but district-level evidence on caregivers' knowledge, attitudes and practices, measured with the 2021 World Health Organization (WHO) and UNICEF indicators, is limited.

Objectives: To describe knowledge, attitudes and practices regarding complementary feeding among mothers and caregivers of children aged 6–23 months in Rwamagana District, and to explore factors associated with feeding practices.

Methods: A cross-sectional study was conducted at Gishari and Rwamagana health centres in April 2024. Ninety-two caregivers were interviewed with a structured questionnaire that included a 24-hour dietary recall. WHO/UNICEF indicators were calculated for 84 children aged 6–23 months. Data were analysed with descriptive statistics, Fisher's exact tests and logistic regression.

Results: Most children were breastfed (92.9%). Minimum dietary diversity was met by 77.4% (95% CI 67.4–85.0), minimum meal frequency by 80.0% and minimum acceptable diet by 62.7%. Dietary diversity rose from 54.2% at 6–8 months to 90.2% at 12–23 months ($p = 0.004$). Only 32.1% of children had eaten eggs, while 60.7% had eaten sweet foods. Most caregivers (81.5%) had adequate knowledge, and 97.8% knew complementary foods should start at six months, but only 10.9% chose thick porridge as best for a young child. Nearly half (45.7%) found it difficult to give varied foods each day. Knowledge was not associated with any feeding indicator. Minimum acceptable diet was associated with caregiver secondary or higher education (adjusted odds ratio [aOR] 3.85, 95% CI 1.20–12.37) and confidence in preparing food (aOR 4.19, 1.19–14.82).

Conclusions: Caregivers had good knowledge and most older children had diverse diets, but infants aged 6–8 months, low egg intake, frequent sweet foods and poor knowledge of food consistency are clear gaps. Knowledge alone did not predict good practice. Counselling should build practical skills and confidence, focus on the first months of complementary feeding, and be linked with support for household food access.

Keywords: Complementary feeding; Knowledge, attitudes and practices; Minimum dietary diversity; Minimum acceptable diet; Unhealthy foods; Stunting; Rwanda

Introduction

Complementary feeding is the process of giving other foods and liquids alongside breast milk once breast milk alone is no longer enough to meet a child's nutritional needs [1–3]. WHO recommends exclusive breastfeeding for the first six months of life, followed by safe, nutritionally adequate and age-appropriate complementary foods from six months, with breastfeeding continuing to two years or beyond [1,2]. Between 6 and 23 months, children grow fast and need a lot of energy, protein, iron, zinc and vitamin A for their size. Poor feeding in this window contributes to stunting, micronutrient deficiencies and impaired development, and these effects are difficult to reverse later in life [4,5].

Child diets remain poor in many low- and middle-income countries. Across 80 such countries, a large share of children aged 6–23 months do not reach minimum dietary diversity or a minimum acceptable diet, with wide gaps by household wealth and maternal education [6]. Dietary diversity is a practical proxy for diet quality and is associated with better child growth [7]. Animal-source foods, including eggs, support growth but are often the least consumed food group [8,9]. At the same time, sweet snacks and other commercial foods are increasingly given to young children, even in low-income settings, and can displace nutrient-rich foods [10,11]. In 2021, WHO and UNICEF updated the standard infant and young child feeding indicators. The update revised minimum dietary diversity to eight food groups, including breast milk, and added indicators for egg and flesh food consumption, zero vegetable or fruit consumption and unhealthy food consumption [12].

In Rwanda, chronic malnutrition remains an important public health concern. Stunting among children under five fell from 33% in 2019–20 to 27% in 2025, and the number of districts with stunting above 30% fell from 20 to 11 [13,14]. Stunting rises sharply during the complementary feeding period [14]. National data and earlier studies show that many young Rwandan children do not receive a minimum acceptable diet, and that feeding practices are linked to stunting [14–17]. Qualitative work in rural and semi-urban Rwanda found that cost, food availability, workload and household beliefs shape complementary feeding choices [18].

Rwanda's nutrition programmes have invested heavily in community counselling, including advice on when to start complementary foods. However, studies in other countries show that good knowledge does not always lead to good practice [19–23]. Knowledge, attitude and practice (KAP) studies help identify where this gap lies and what programmes should target [24]. Evidence from trials and reviews suggests that nutrition education improves complementary feeding most when it is practical and combined with support for food access [25,26]. In Rwanda, few district-level studies have measured caregiver knowledge and attitudes alongside the updated WHO/UNICEF practice indicators, and little is known about how practices change across the 6–23-month period.

This study therefore aimed to (1) describe caregivers' knowledge and attitudes about complementary feeding in Rwamagana District; (2) describe complementary feeding practices among children aged 6–23 months using the 2021 WHO/UNICEF indicators; and (3) explore whether caregiver knowledge, attitudes and characteristics are associated with these practices.

Methods

Study design and setting

A quantitative, exploratory cross-sectional study was conducted at two public health centres, Gishari Health Centre and Rwamagana Health Centre, in Rwamagana District, Eastern Province, Rwanda. The study is reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline [27]. Rwamagana District was purposively selected because of its high fertility rate, estimated at about four children per woman [28], which places pressure on maternal and child health services. The two health centres serve the largest populations in the district and run well-established Integrated Management of Childhood Illness and child vaccination programmes, giving structured access to caregivers of young children. Data were collected on 4 and 5 April 2024, during the main rainy season. The study was conducted as part of the authors' undergraduate nursing degree at the University of Rwanda.

Study population and eligibility

The accessible population was 597 mothers of children aged 6–23 months, identified from the administrative records of the two health centres (Gishari 350; Rwamagana 247). Because of time and logistical constraints, the study focused on caregivers attending vaccination services, with an average daily attendance of about 65 at Gishari and 50 at Rwamagana. Caregivers were excluded if the child was ill at the time of data collection, or if the person accompanying the child did not know the child's usual diet. Most respondents were mothers; three were other caregivers (a father, an aunt and a grandmother) who were responsible for feeding the child, and they were retained in the analysis. Child age was calculated from the recorded date of birth and the interview date. Children outside the 6–23-month range, or with an invalid date of birth, were excluded from the WHO practice indicators but kept in the analysis of caregiver knowledge and attitudes.

Sample size and sampling

Yamane's formula was used to estimate the minimum sample size for this exploratory study, with a 10% margin of error, giving about 86 participants. In total, 92 caregivers took part: 33 at Gishari and 59 at Rwamagana. Participants were recruited by convenience sampling among caregivers attending the clinics on the data collection days. In standard terms, a sample of 92 drawn from 597 estimates a proportion of 50% to within about $\pm 9.4\%$ at 95% confidence after a finite population

correction. This precision is adequate for describing overall proportions, but limits subgroup analysis and the power to detect associations.

Data collection tool and procedures

Data were collected using a structured questionnaire developed from a review of relevant literature and previous KAP studies [19–22], and from the WHO/UNICEF indicator guidance [12]. The tool was written in English and Kinyarwanda, with both languages shown for every question, and administered on mobile devices using Google Forms. It covered caregiver and child characteristics, including the child's date of birth; breastfeeding the previous day; a list-based 24-hour dietary recall; the number of times the child ate solid, semi-solid or soft foods the previous day; and caregiver knowledge, attitudes, perceived difficulties and confidence. The questionnaire was pre-tested and revised based on feedback before use.

For the dietary recall, the caregiver was first asked to describe what the child ate and drank the previous day and night, including the ingredients of porridges and sauces. The data collector then read a list of 15 food items and recorded each as eaten or not eaten. The list covered roots and tubers; beans, peas, lentils, nuts and seeds; milk; yoghurt; cheese; organ meat; other meat; fish; eggs; yellow or orange vegetables; dark green leafy vegetables; ripe mango or papaya; other fruits and vegetables; foods made with oil or fat; and sweet foods such as sweets, chocolate, biscuits and cakes. To assess knowledge of food consistency, caregivers were shown pictures of thick and watery porridge and asked which should be given to a young child.

Data collectors were trained on the study objectives, the administration of the questionnaire, and the protection of participants' privacy and confidentiality. No names or physical addresses were entered in the analysis dataset.

Study variables and definitions

Practice outcomes were the 2021 WHO/UNICEF indicators for children aged 6–23 months [12].

Minimum dietary diversity (MDD) was defined as eating at least five of eight food groups the previous day: (1) breast milk; (2) grains, roots, tubers and plantains; (3) pulses, nuts and seeds; (4) dairy products; (5) flesh foods (meat, fish and organ meat); (6) eggs; (7) vitamin A-rich fruits and vegetables; and (8) other fruits and vegetables. Minimum meal frequency (MMF) was defined as at least two feeds of solid, semi-solid or soft foods for breastfed children aged 6–8 months, at least three for breastfed children aged 9–23 months, and at least four for non-breastfed children.

Minimum acceptable diet (MAD) required both MDD and MMF. We also calculated egg and/or flesh food consumption (EFF), zero vegetable or fruit consumption (ZVF), and sweet food

consumption as the measure of unhealthy food consumption. Nine caregivers who did not know how many times the child had eaten were excluded from MMF and MAD.

Caregiver knowledge was measured with seven items, each scored 1 for a correct answer: the age at which complementary foods should start (six months); why foods are needed from six months (breast milk alone is no longer enough); the recommended duration of breastfeeding (24 months or beyond); whether breastfeeding beyond six months is beneficial; whether feeding a child more than three times a day is beneficial; whether giving different foods each day is good; and choosing thick porridge as best for a young child. A score of 5 or more out of 7 was classed as adequate knowledge. We also report which foods caregivers would add to enrich porridge (multiple answers allowed) and whether they knew ways to encourage a child to eat. Attitudes and practical barriers were measured as perceived difficulty of giving varied foods each day, feeding the child several times a day and continuing breastfeeding beyond six months (difficult or sometimes difficult vs not difficult), and confidence in preparing food for the child.

Explanatory variables were child age group (6–8, 9–11 and 12–23 months; and 6–11 vs 12–23 months), child sex, caregiver age (under 30 vs 30 years or older), number of children (1–3 vs 4 or more), caregiver education (primary or none vs secondary or higher), health centre, knowledge, confidence in preparing food, and perceived difficulty of giving varied foods.

Data management and statistical analysis

Data were exported from Google Forms, cleaned, coded and analysed in IBM SPSS Statistics. Each variable was checked for impossible or inconsistent values. Child age in months was calculated as the number of days between date of birth and interview, divided by 30.4375. Six children were younger than six months and two had a date of birth identical to the interview date; all eight were excluded from the WHO practice indicators. Following the study team's coding, ripe mango and papaya were grouped with other fruits and vegetables; classifying them as vitamin A-rich, as WHO recommends, gave the same prevalence of MDD (77.4%). An item recording whether the child received only breast milk conflicted with the food list for several children and was not used.

Categorical variables are presented as numbers and percentages and continuous variables as medians with interquartile ranges (IQRs). For the main indicators we calculated 95% confidence intervals (CIs) using the Wilson score method, which performs well in small samples [29].

Differences across the three age groups were tested with the chi-square test. Crude associations between explanatory variables and MDD, EFF, MAD and sweet food consumption were assessed with odds ratios (ORs) and Fisher's exact test, because several cells had small expected counts. We then fitted binary logistic regression models for MDD, EFF and MAD that included caregiver

knowledge, the main exposure of interest, and three variables chosen because they were plausibly linked to feeding and showed some association in crude analyses: child age group, caregiver education and confidence in preparing food. Models were limited to four variables because of the small number of children not meeting each indicator (18 to 27), and adjusted results are interpreted as exploratory. Model fit was checked with the Hosmer–Lemeshow test. Analyses with missing values used complete cases. Confidence intervals and regression models were computed in Python 3.11 (SciPy and statsmodels). Because several tests were performed, we report effect sizes with confidence intervals and do not rely on $p < 0.05$ alone.

Ethical considerations

Ethical clearance was obtained from the Institutional Review Board of the College of Medicine and Health Sciences, University of Rwanda (Ref: CMHS/IRB/020/2024), and the study followed the Rwanda National Ethics Committee guidelines and the Declaration of Helsinki. Written informed consent was obtained from all participants before data collection, and participants were told they could withdraw at any time without penalty. No personally identifiable information was included in the analysis dataset.

Results

Characteristics of participants

Ninety-two caregivers took part, 59 (64.1%) from Rwamagana and 33 (35.9%) from Gishari Health Centre. Most were mothers (96.7%), and more than three-quarters (77.2%) were aged 20–35 years; 8.7% were under 20. Over half had one (27.2%) or two (28.3%) children. Among the 90 caregivers with education recorded, most had primary (44.4%) or secondary (41.1%) education, 6.7% had university education and 7.8% had no formal education. Of the 92 children, 84 (91.3%) were aged 6–23 months and were included in the practice indicators, with a median age of 11.7 months (Table 1).

Table 1. Socio-demographic characteristics of caregivers and children

Characteristic	n (%)
Caregivers (N = 92)	
Health centre: Rwamagana	59 (64.1)
Health centre: Gishari	33 (35.9)
Relationship to child: mother	89 (96.7)
Relationship to child: father, aunt or grandmother	3 (3.3)
Age in years, median (IQR)	28 (23–33)
Under 20 years	8 (8.7)
20–35 years	71 (77.2)
Over 35 years	13 (14.1)
Number of children: 1	25 (27.2)

Characteristic	n (%)
Number of children: 2	26 (28.3)
Number of children: 3	20 (21.7)
Number of children: 4	13 (14.1)
Number of children: 5 or more	8 (8.7)
Education (n = 90)*	
No formal education	7 (7.8)
Primary	40 (44.4)
Secondary	37 (41.1)
University	6 (6.7)
Children (N = 92)	
Female	49 (53.3)
Male	43 (46.7)
Aged 6–23 months (included in WHO indicators)	84 (91.3)
6–8 months	24 (26.1)
9–11 months	19 (20.7)
12–23 months	41 (44.6)
Excluded from WHO indicators: under 6 months	6 (6.5)
Excluded from WHO indicators: invalid date of birth	2 (2.2)
Age in months among included children, median (IQR)	11.7 (8.7–15.4)

*IQR: interquartile range. *Valid percentages; education was missing for 2 caregivers.*

Knowledge and attitudes

Knowledge of timing was very high: 97.8% of caregivers knew that complementary foods should start at six months, and 81.5% knew why. Most (80.4%) knew that breastfeeding should continue to 24 months or beyond, and 70.7% felt that feeding a child more than three times a day was beneficial. Knowledge of what and how to feed was weaker. Only 10.9% chose thick porridge as best for a young child; 64.1% chose watery porridge and 25.0% said both were suitable. When asked how to enrich porridge, caregivers most often named pulses or nuts (71.7%) and vitamin A-rich fruits or vegetables (64.1%), while fewer than half (44.6%) named animal-source foods. One in five (19.6%) did not know any way to encourage a child to eat. The median knowledge score was 6 out of 7 (IQR 5–6), and 81.5% had adequate knowledge (Table 2).

Attitudes were very positive: almost all caregivers felt that giving different foods each day (98.9%) and breastfeeding beyond six months (96.7%) were good. However, many found good practices hard. Nearly half (45.7%) said giving different foods each day was difficult, and 35.9% found it difficult to feed the child several times a day; some gave poverty or lack of money as the reason. Continuing breastfeeding was easier, with 83.5% reporting no difficulty. Most caregivers (77.8%) felt confident preparing food for their child (Table 2).

Table 2. Caregiver knowledge, attitudes and perceived barriers (N = 92)

Item	n (%)	95% CI
Knowledge (items in the 7-item score)		
Complementary foods should start at 6 months	90 (97.8)	92.4–99.4
Knows why foods are needed from 6 months (breast milk no longer enough)	75 (81.5)	72.4–88.1
Breastfeeding should continue to 24 months or beyond	74 (80.4)	71.2–87.3
Breastfeeding beyond 6 months is beneficial	89 (96.7)	90.8–98.9
Feeding the child more than three times a day is beneficial	65 (70.7)	60.7–79.0
Giving different foods each day is good	91 (98.9)	94.1–99.8
Chose thick porridge as best for a young child	10 (10.9)	6.0–18.9
Adequate knowledge (score ≥ 5 of 7)	75 (81.5)	72.4–88.1
Other knowledge items		
Chose watery porridge as best for a young child	59 (64.1)	53.9–73.2
Said both porridges are suitable	23 (25.0)	17.3–34.7
Named pulses or nuts to enrich porridge§	66 (71.7)	61.8–79.9
Named vitamin A-rich fruits or vegetables to enrich porridge§	59 (64.1)	53.9–73.2
Named animal-source foods to enrich porridge§	41 (44.6)	34.8–54.7
Did not know any way to encourage a child to eat	18 (19.6)	12.8–28.8
Perceived difficulty and self-efficacy		
Giving different foods each day is not difficult	50 (54.3)	44.2–64.1
Feeding the child several times a day is not difficult	59 (64.1)	53.9–73.2
Continuing breastfeeding beyond 6 months is not difficult	76/91 (83.5)	74.6–89.7
Confident preparing food for the child	70/90 (77.8)	68.2–85.1

CI: confidence interval (Wilson method). Denominators other than 92 reflect missing responses. §Multiple answers allowed.

Complementary feeding practices

Breastfeeding was almost universal: 92.9% of children aged 6–23 months had been breastfed the previous day. The most commonly eaten food groups were pulses, nuts and seeds (83.3%) and vitamin A-rich fruits and vegetables (73.8%). Flesh foods were eaten by 63.1% of children, mainly fish (46.4%), followed by other meat (22.6%) and organ meat (3.6%). Eggs were eaten by only 32.1%, and egg intake did not increase with age. Most food groups were eaten less often by infants aged 6–8 months than by older children, with the largest gaps for grains, roots and tubers (29.2% vs 73.2% at 12–23 months), flesh foods (41.7% vs 75.6%) and vitamin A-rich fruits and vegetables (54.2% vs 82.9%) (Table 3; Figure 1).

Overall, 77.4% of children met MDD, with a median of six food groups (IQR 5–6). When all 92 children were included regardless of age, the proportion was similar (76.1%). MDD rose steeply with age, from 54.2% at 6–8 months to 78.9% at 9–11 months and 90.2% at 12–23 months ($p = 0.004$). Of the 75 children with known meal frequency, 80.0% met MMF and 62.7% met MAD, which ranged from 42.1% at 6–8 months to 73.0% at 12–23 months. Egg and/or flesh foods were eaten by 72.6%. Nearly three in ten infants aged 6–8 months (29.2%) had eaten no fruit or vegetables the previous day, compared with almost none of the older children ($p = 0.001$). Six in ten

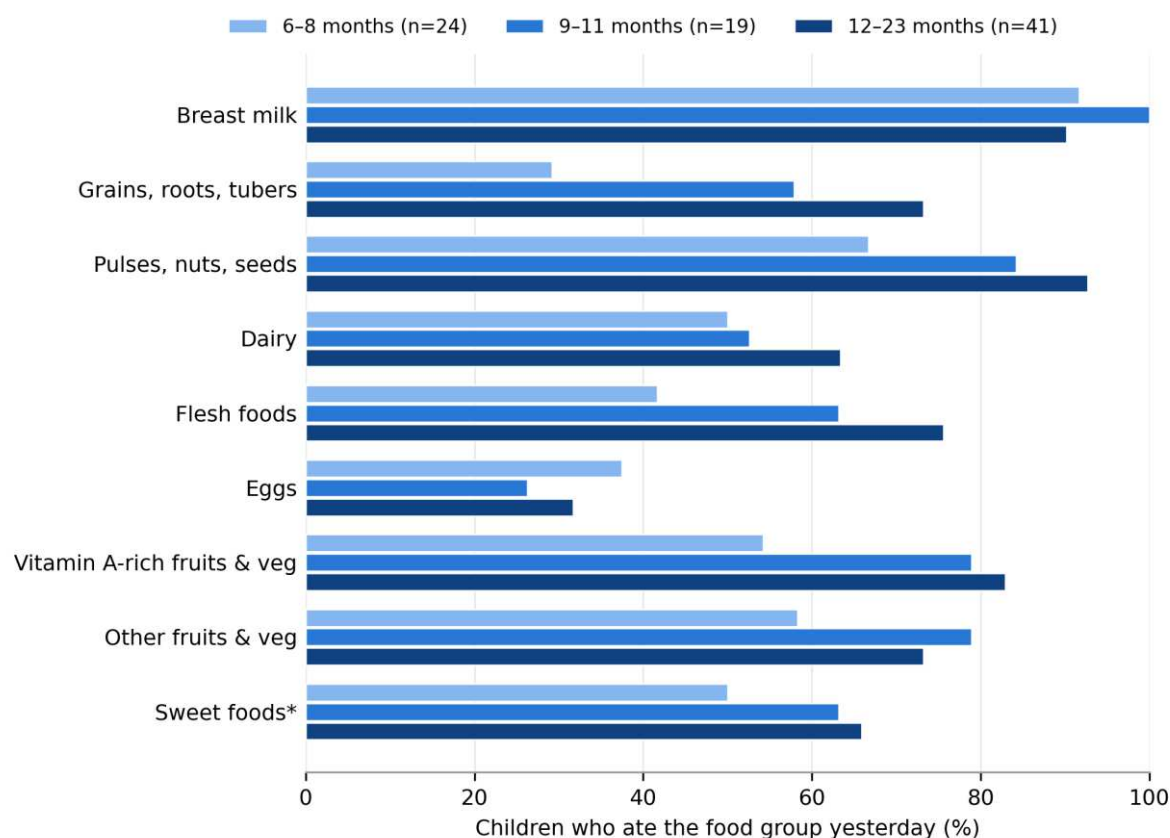
children (60.7%) had eaten sweet foods such as sweets, biscuits or cakes, including half of infants aged 6–8 months (Table 3).

Table 3. Breastfeeding, food groups and WHO/UNICEF 2021 indicators among children aged 6–23 months, overall and by age group

Indicator	All, n/N (%) [95% CI]	6–8 m	9–11 m	12–23 m	p*
Breastfed yesterday	78/84 (92.9) [85.3–96.7]	91.7	100.0	90.2	0.380
Food groups eaten yesterday					
Grains, roots and tubers	48/84 (57.1) [46.5–67.2]	29.2	57.9	73.2	0.003
Pulses, nuts and seeds	70/84 (83.3) [73.9–89.8]	66.7	84.2	92.7	0.025
Dairy	48/84 (57.1) [46.5–67.2]	50.0	52.6	63.4	0.518
Flesh foods (meat, fish, organ meat)	53/84 (63.1) [52.4–72.6]	41.7	63.2	75.6	0.024
Eggs	27/84 (32.1) [23.1–42.7]	37.5	26.3	31.7	0.735
Vitamin A-rich fruits and vegetables	62/84 (73.8) [63.5–82.0]	54.2	78.9	82.9	0.033
Other fruits and vegetables	59/84 (70.2) [59.8–79.0]	58.3	78.9	73.2	0.289
WHO/UNICEF 2021 indicators					
Minimum dietary diversity (MDD)	65/84 (77.4) [67.4–85.0]	54.2	78.9	90.2	0.004
Minimum meal frequency (MMF)†	60/75 (80.0) [69.6–87.5]	73.7	84.2	81.1	0.701
Minimum acceptable diet (MAD)†	47/75 (62.7) [51.4–72.7]	42.1	63.2	73.0	0.077
Egg and/or flesh food consumption (EFF)	61/84 (72.6) [62.3–81.0]	54.2	73.7	82.9	0.043
Zero vegetable or fruit consumption (ZVF)	8/84 (9.5) [4.9–17.7]	29.2	0.0	2.4	0.001
Sweet food consumption‡	51/84 (60.7) [50.0–70.5]	50.0	63.2	65.9	0.437

Age-group columns show percentages (6–8 months $n = 24$; 9–11 months $n = 19$; 12–23 months $n = 41$). CI: confidence interval (Wilson method). *Chi-square test across age groups. †Excludes 9 caregivers who did not know the number of meals ($n = 75$; 19, 19 and 37 by age group). ‡Sweets, chocolates, biscuits, cakes or pastries, used as the measure of unhealthy food consumption.

Figure 1. Percentage of children who ate each food group the previous day, by age group (n = 84)



*Sweets, chocolates, biscuits, cakes or pastries (not one of the 8 WHO food groups).

Factors associated with feeding practices

In crude analyses, children aged 12–23 months were more likely than those aged 6–11 months to meet MDD (90.2% vs 65.1%; OR 4.96, 95% CI 1.48–16.57; $p = 0.008$). Children of caregivers with secondary or higher education were more likely to eat eggs or flesh foods (85.7% vs 63.8%; OR 3.40, 1.11–10.40; $p = 0.043$) and to meet MAD (78.6% vs 53.3%; OR 3.21, 1.09–9.41; $p = 0.045$). Children of caregivers who felt confident preparing food were more likely to meet MAD (70.2% vs 35.3%; OR 4.31, 1.37–13.56; $p = 0.021$). Adequate knowledge was not associated with any indicator: for example, 78.3% of children of caregivers with adequate knowledge met MDD, compared with 73.3% of those with inadequate knowledge ($p = 0.736$). Caregiver age, number of children, child sex, health centre and perceived difficulty of giving varied foods were not associated with any indicator, and no factor was associated with sweet food consumption (Table 4).

Table 4. Crude associations between caregiver and child characteristics and selected feeding indicators

Factor / group	MDD %	MDD OR (95% CI); p	EFF %	EFF OR (95% CI); p	MAD %	MAD OR (95% CI); p
Child age						
12–23 months	90.2	4.96 (1.48–16.57); 0.008	82.9	2.88 (1.04–8.00); 0.051	73.0	2.43 (0.93–6.38); 0.095
6–11 months (ref.)	65.1	1	62.8	1	52.6	1
Caregiver education						
Secondary or higher	85.7	2.29 (0.73–7.19); 0.184	85.7	3.40 (1.11–10.40); 0.043	78.6	3.21 (1.09–9.41); 0.045

Factor / group	MDD %	MDD OR (95% CI); p	EFF %	EFF OR (95% CI); p	MAD %	MAD OR (95% CI); p
Primary or none (ref.)	72.3	1	63.8	1	53.3	1
Caregiver age						
30 years or older	78.4	1.11 (0.39–3.11); 1.000	70.3	0.81 (0.31–2.12); 0.806	69.4	1.76 (0.68–4.54); 0.340
Under 30 years (ref.)	76.6	1	74.5	1	56.4	1
Number of children						
1–3	76.6	0.82 (0.24–2.82); 1.000	70.3	0.59 (0.17–2.01); 0.567	60.7	0.71 (0.24–2.16); 0.596
4 or more (ref.)	80.0	1	80.0	1	68.4	1
Child sex						
Female	77.3	0.99 (0.35–2.75); 1.000	68.2	0.62 (0.23–1.65); 0.463	65.9	1.35 (0.53–3.46); 0.633
Male (ref.)	77.5	1	77.5	1	58.8	1
Health centre						
Rwamagana	78.2	1.14 (0.39–3.31); 0.791	70.9	0.78 (0.28–2.17); 0.798	60.4	0.76 (0.28–2.05); 0.628
Gishari (ref.)	75.9	1	75.9	1	66.7	1
Caregiver knowledge						
Adequate (≥ 5 of 7)	78.3	1.31 (0.36–4.71); 0.736	73.9	1.42 (0.43–4.71); 0.542	63.1	1.14 (0.29–4.45); 1.000
Inadequate (ref.)	73.3	1	66.7	1	60.0	1
Confidence preparing food						
Confident	79.4	1.78 (0.57–5.57); 0.359	74.6	1.71 (0.58–5.10); 0.386	70.2	4.31 (1.37–13.56); 0.021
Not confident (ref.)	68.4	1	63.2	1	35.3	1
Giving varied foods daily						
Not difficult	79.5	1.30 (0.47–3.61); 0.795	79.5	2.09 (0.79–5.57); 0.150	63.2	1.04 (0.41–2.66); 1.000
Difficult (ref.)	75.0	1	65.0	1	62.2	1

MDD: minimum dietary diversity ($n = 84$); EFF: egg and/or flesh food consumption ($n = 84$); MAD: minimum acceptable diet ($n = 75$). Percentages are the proportion of children in each group meeting the indicator. OR: crude odds ratio (Woolf 95% CI); p: Fisher's exact test. Analyses of education and confidence exclude missing values. No factor was associated with sweet food consumption (all $p > 0.17$; data not shown). ref.: reference group.

In the adjusted models, knowledge remained unrelated to all three indicators (Table 5). Child age remained associated with MDD (aOR 4.78, 95% CI 1.39–16.51). Caregiver education remained associated with EFF (aOR 3.42, 1.08–10.81) and MAD (aOR 3.85, 1.20–12.37), and confidence in preparing food remained associated with MAD (aOR 4.19, 1.19–14.82). The Hosmer–Lemeshow test showed adequate fit for all models (all $p > 0.70$).

Table 5. Adjusted associations with selected feeding indicators (binary logistic regression)

Factor	MDD aOR (95% CI); p	EFF aOR (95% CI); p	MAD aOR (95% CI); p
Adequate caregiver knowledge (vs inadequate)	0.96 (0.21–4.45); 0.960	1.27 (0.31–5.28); 0.743	1.03 (0.19–5.57); 0.976
Child aged 12–23 months (vs 6–11)	4.78 (1.39–16.51); 0.013	2.76 (0.94–8.07); 0.064	2.45 (0.84–7.09); 0.099
Caregiver secondary or higher education (vs primary or none)	2.24 (0.68–7.42); 0.186	3.42 (1.08–10.81); 0.036	3.85 (1.20–12.37); 0.024
Caregiver confident preparing food (vs not confident)	1.27 (0.35–4.62); 0.711	1.27 (0.38–4.27); 0.701	4.19 (1.19–14.82); 0.026
Children in model (meeting indicator)	80 (62)	80 (58)	72 (45)
Hosmer–Lemeshow test	3.48, $p=0.747$	3.53, $p=0.740$	3.73, $p=0.714$

aOR: adjusted odds ratio; each model includes all four variables shown. Complete cases only. Results are exploratory because of the small number of children not meeting each indicator.

Discussion

This study measured caregivers' knowledge and attitudes alongside the 2021 WHO/UNICEF feeding indicators in Rwamagana District. Four main findings emerge. First, knowledge and attitudes were good, especially about timing and breastfeeding, but knowledge of food consistency and animal-source foods was weak. Second, overall dietary diversity and meal frequency were good, but infants aged 6–8 months lagged well behind older children. Third, sweet foods were eaten by most children, while eggs were eaten by only one in three. Fourth, knowledge was not linked to feeding practice, whereas caregiver education and confidence in preparing food were.

Knowledge and attitudes

Most caregivers had adequate knowledge (81.5%), and almost all knew when to start complementary foods. This is higher than in several KAP studies in Nepal, Ghana and Ethiopia [19–22], and likely reflects Rwanda's sustained counselling through health centres and community health workers. However, knowledge was uneven. Only one in ten caregivers chose thick porridge as best for a young child, and fewer than half named animal-source foods as a way to enrich porridge. Thin porridge has low energy and nutrient density per spoonful, and young children's small stomachs limit how much they can eat; WHO therefore recommends thicker foods that stay on the spoon [2,30,31]. Watery porridge has also been reported as common in Tanzania [23]. Because we measured porridge consistency as a belief rather than observed practice, we cannot say how thick children's porridge actually was, but this belief is a clear and practical target for counselling.

Attitudes were very positive, but almost half of caregivers found it difficult to give varied foods each day, and some named poverty as the reason. This pattern, in which caregivers agree with recommendations but struggle to follow them, is consistent with qualitative findings from Rwanda that cost and food availability shape feeding choices [18].

Dietary diversity and the critical first months

The proportion of children meeting MDD (77.4%) and MAD (62.7%) was higher than typically reported in national surveys across low- and middle-income countries [6] and in earlier Rwandan studies [14,15]. Several factors may explain this. Rwanda has sustained community-based nutrition programmes for over a decade. The study took place in April, during the rainy season, when vegetables and fruit are widely available. Participants were recruited at health facilities, which may select families more engaged with health services. A list-based recall can also lead to more foods

being reported than an open recall [12]. These figures should therefore not be taken as representative of the whole district.

A more important finding is the steep age gradient. Only half of infants aged 6–8 months met MDD, and nearly three in ten had eaten no fruit or vegetables at all, compared with nine in ten children aged 12–23 months. Similar patterns have been reported in large multi-country analyses, where younger infants consistently have the least diverse diets [6,32]. The first months of complementary feeding are when nutrient needs per kilogram of body weight are highest and when foods are most often thin and limited to a few staples [2,31]. Counselling at the six-month visit, with follow-up in the months after, may therefore offer the greatest benefit.

Eggs, animal-source foods and sweet foods

Although flesh foods were eaten by most children, this was mainly fish. In Rwanda, fish given to young children is often small dried fish added in small amounts to porridge or sauce, so how often it is eaten does not necessarily mean enough is eaten. Eggs were eaten by only one in three children and did not increase with age. Eggs are an affordable, nutrient-dense food, and a trial in Ecuador found that one egg a day for six months improved child growth [9]. Low egg intake despite good overall diversity suggests that cost, household priorities or beliefs may limit their use [18].

Six in ten children had eaten sweets, biscuits or cakes the previous day, including half of infants aged 6–8 months. This is consistent with studies in African and Asian cities showing that commercial snacks are widely given to young children [10], and with evidence from Nepal linking such snacks to lower diet adequacy and poorer growth [11]. WHO now advises that these foods should not be given to young children and has added unhealthy food consumption to the core indicators for this reason [2,12]. Sweet foods already appear to be a common part of young children's diets in this district, even where diet diversity looks good, and nutrition counselling should address this explicitly.

The knowledge–practice gap

Caregiver knowledge was not associated with any feeding indicator, in crude or adjusted analyses. This may partly reflect a ceiling effect, as most caregivers scored highly, which limits the ability of the score to separate caregivers. It is also consistent with evidence that nutrition education alone has modest effects on complementary feeding, and works best when it is practical and combined with support for household food access [25,26,33,34]. A non-significant result in a small sample does not prove that knowledge has no effect, but it does suggest that knowledge is not the main constraint in this setting.

In contrast, caregiver education and confidence in preparing food were associated with better diets, and these associations remained after adjustment. Formal education is closely linked to household income, decision-making and access to information, and maternal education is one of the strongest predictors of complementary feeding in multi-country analyses [6]. Confidence, or self-efficacy, reflects whether a caregiver feels able to act on what she knows. Together with the high reported difficulty of giving varied foods, these findings suggest that resources, skills and confidence matter more than knowledge of timing. Household income was not measured in this study and may explain part of the association with education.

Strengths and limitations

This study has several strengths. It combined a KAP approach with the 2021 WHO/UNICEF indicators, including the new indicators on egg and flesh foods, fruit and vegetables and unhealthy foods, which few Rwandan studies have used. Child age was calculated from date of birth, which allowed indicators to be correctly calculated for the 6–23-month age range and by age group. The questionnaire was bilingual, used pictures to assess food consistency, and was completed electronically, which limited missing data and entry errors. All indicators were checked against the original responses.

The study also has important limitations. First, it was conducted as part of an undergraduate degree, with limited time and no dedicated funding, which limited the sample to 92 caregivers at two health centres over two days. Subgroup estimates therefore have wide confidence intervals, and the study had limited power to detect associations. Second, participants were recruited by convenience sampling at health facilities. Caregivers who attend clinics may differ from those who do not, so the findings cannot be generalised to the whole district, and confidence intervals assume random sampling. Third, dietary data came from a single list-based 24-hour recall, which does not capture usual intake, may lead to over-reporting, and may be affected by recall and social desirability bias. Fourth, data were collected in the rainy season, and diets may differ at other times of the year. Fifth, the food list asked about roots and tubers but did not explicitly list grains, so grains may have been under-reported and dietary diversity underestimated. Sixth, milk feeds for the six non-breastfed children were not counted, so their meal frequency could not fully follow WHO guidance. Seventh, the unhealthy food indicator was limited to sweet foods; sugar-sweetened drinks and savoury snacks were not measured. Eighth, porridge consistency was measured as a belief, not observed. Ninth, the questionnaire was not formally validated, and the knowledge score had a ceiling effect. Tenth, household income was not measured. Finally, the regression models included few variables and had few children not meeting each indicator, and because the design was cross-sectional, associations cannot be interpreted as causal.

Implications for practice, policy and research

Rwanda's counselling has succeeded in teaching caregivers when to start complementary feeding. The next step is practical support on what and how to feed. For health centres and community health workers, our findings suggest four priorities: more intensive support for infants aged 6–8 months, including follow-up after the six-month visit; cooking demonstrations on thick, enriched porridge using affordable local foods such as eggs, small fish and pulses; clear messages on avoiding sweets, biscuits and other unhealthy foods; and approaches that build caregivers' confidence, such as hands-on practice and peer support. Because many caregivers find varied diets hard to afford, counselling should be linked with programmes that improve household food access, such as small livestock, kitchen gardens and economic empowerment [25,35]. Larger community-based studies across seasons are needed, using open 24-hour recalls with a complete food list, measures of sugar-sweetened drinks and snacks, household income, and direct observation of food consistency.

Conclusion

In Rwamagana District, caregivers had good knowledge of complementary feeding and most older children had diverse diets. However, infants aged 6–8 months had much poorer diets, eggs were rarely eaten, sweet foods were common, and few caregivers knew that thick porridge is best. Knowledge did not predict better practice, while caregiver education and confidence in preparing food did. Nutrition programmes should move beyond “when to start” towards practical, skills-based support that builds caregivers' confidence in feeding young infants, addresses unhealthy foods, and is linked with support for household food access.

Abbreviations

aOR: adjusted odds ratio; CI: confidence interval; EFF: egg and/or flesh food consumption; IQR: interquartile range; KAP: knowledge, attitudes and practices; MAD: minimum acceptable diet; MDD: minimum dietary diversity; MMF: minimum meal frequency; OR: odds ratio; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; UNICEF: United Nations Children's Fund; WHO: World Health Organization; ZVF: zero vegetable or fruit consumption.

Declarations

Ethics approval and consent to participate: This study was conducted in accordance with the Declaration of Helsinki and Rwanda National Ethics Committee guidelines. Ethical clearance was obtained from the Institutional Review Board of the College of Medicine and Health Sciences, University of Rwanda (Ref: CMHS/IRB/020/2024). Written informed consent was obtained from all participants before data collection.

Consent for publication: Not applicable.

Availability of data and materials: The dataset analysed during the current study is available from the corresponding author on reasonable request.

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

Funding: This study received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Authors' contributions: SN, NI, AT, AS and VD conceived the study, developed the methodology and collected the data. AS and SN performed the statistical analysis. SN drafted the manuscript. All authors contributed to revising the manuscript and approved the final version.

Acknowledgements: We thank the mothers and caregivers who took part, and the staff of Gishari and Rwamagana health centres and Rwamagana District for their support.

Preprint: An earlier version of this work was posted on Research Square (doi:10.21203/rs.3.rs-8881023/v1). This version is based on a full re-analysis of the original data using the 2021 WHO/UNICEF indicators and corrects figures reported in the earlier version.

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