

Complementary Feeding Practices and Their Association with Nutritional Status of Children Attending a Hospital-Based Pediatric Outpatient Department

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ABSTRACT

Background: Appropriate complementary feeding is essential for meeting the nutritional requirements of children during the critical period of 6–24 months. However, inadequate dietary diversity, meal frequency, and overall diet quality remain important contributors to childhood undernutrition, particularly in low-resource settings. **Aim of the study:** To assess complementary feeding practices and determine their association with the nutritional status of children attending a hospital-based pediatric outpatient department. **Methods & Materials:** A hospital-based cross-sectional observational study was conducted among 314 children aged 6–24 months attending a pediatric outpatient department in Bangladesh. Sociodemographic characteristics, breastfeeding history, complementary feeding practices, and dietary diversity were collected through caregiver interviews. Minimum meal frequency (MMF), minimum dietary diversity (MDD), and minimum acceptable diet (MAD) were assessed according to WHO/UNICEF indicators. Anthropometric measurements were obtained using standardized procedures, and associations were assessed using chi-square tests and multivariable logistic regression. **Results:** The mean age of the children was 15.7 ± 5.1 months, and 59.9% were male. Complementary foods were introduced at 6 months in 65.0% of children, while adequate MMF, MDD, and MAD were achieved by 65.0%, 32.5%, and 29.9%, respectively. Stunting, wasting, and underweight affected 32.8%, 16.2%, and 29.6% of children, respectively, while 43.6% were undernourished. Undernutrition was significantly associated with delayed or early complementary feeding, inadequate MMF, MDD and MAD, and absence of animal-source food consumption (all $p \leq 0.028$). In multivariable analysis, inadequate MAD showed the strongest association with undernutrition (aOR 2.47, 95% CI 1.47–4.16; $p < 0.001$), followed by inadequate MDD (aOR 2.08, 95% CI 1.29–3.36; $p = 0.003$). **Conclusion:** Suboptimal complementary feeding, particularly inadequate dietary diversity and minimum acceptable diet, was common and strongly associated with undernutrition. Strengthening caregiver counselling on dietary diversity, meal frequency, and animal-source foods should be integrated into routine pediatric services.

Keywords: Complementary feeding; Dietary diversity; Undernutrition; Children; Minimum acceptable diet

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INTRODUCTION

Complementary feeding refers to the introduction of foods and liquids alongside breast milk when breast milk alone is insufficient to meet an infant's nutritional needs. Complementary feeding is recommended from 6 months of age. Breastfeeding can be continued up to 2 years or beyond to support optimal growth and development and promote healthy eating patterns ^[1,2]. Globally, only 30.8% of children aged 6–23 months receive a minimum diverse diet ^[3]. In Bangladesh, 37.6% of children aged 6–23 months receive minimum dietary diversity, and 29.6% receive a minimum acceptable diet ^[4]. During the transition to complementary feeding, foods should gradually increase in quantity, consistency, variety, and frequency according to the child's age and developmental needs ^[1,2]. Complementary foods need to provide adequate energy and essential nutrients, including protein, iron, zinc, vitamin A, and other micronutrients that are not sufficiently supplied by breast milk alone ^[5]. Appropriate practices include dietary diversity, age-appropriate meal frequency, continued breastfeeding,

responsive feeding, and safe preparation and storage of foods ^[1,6]. The nutritional quality of complementary foods and the way caregivers provide them are therefore important determinants of adequate nutrient intake during early childhood ^[5,6]. Inadequate complementary feeding can contribute substantially to childhood undernutrition, particularly during the first two years of life ^[5,7]. Diets with insufficient diversity or nutrient density can lead to deficiencies of essential micronutrients and impair physical and cognitive development ^[5]. Poor food hygiene and unsafe feeding practices can increase the risk of diarrhoeal and other infections which can further reduce nutrient absorption and increase nutritional losses ^[5,7]. Consequently, inappropriate feeding is associated with growth faltering, stunting, wasting, underweight, and micronutrient deficiencies ^[7]. On the other hand, excessive consumption of energy-dense but nutrient-poor foods can contribute to overweight and unhealthy dietary patterns ^[1]. Appropriate complementary feeding can improve nutrient adequacy and support normal

growth and development. Complementary feeding interventions combined with nutrition education or appropriate food supplementation have been shown to improve child growth and dietary outcomes ^[8,9]. Responsive feeding can also encourage appropriate eating behaviour and promote positive interaction between caregivers and children ^[6]. Thus, ensuring adequate complementary feeding is an important component of strategies aimed at preventing childhood malnutrition and promoting healthy development. Despite its recognized importance, suboptimal complementary feeding remains common in Bangladesh ^[4,10]. Research has identified associations between complementary feeding indicators, dietary diversity, and nutritional status. However, findings have varied across different populations and settings ^[11,12]. The relationship between complementary feeding practices and nutritional status among children attending hospital-based pediatric outpatient departments remains insufficiently explored. Assessing feeding practices alongside nutritional status in this setting can help identify nutritional problems and

support appropriate dietary counselling and clinical interventions. The present study aimed to assess complementary feeding practices and determine their association with the nutritional status of children attending a hospital-based pediatric outpatient department.

METHODS & MATERIALS

A descriptive cross sectional study was carried at Pediatric outpatient department and EPI center of Rajshahi Medical College Hospital, Rajshahi, from January 2017 to December 2018. A total of 314 children aged 6–24 months attending the pediatric outpatient department were enrolled consecutively according to predefined inclusion and exclusion criteria.

Inclusion Criteria

- Children aged 6–24 months attending the pediatric outpatient department during the study period.
- Children whose caregivers were willing to participate and provide relevant demographic, feeding, and clinical information.
- Children with available anthropometric measurements required for assessment of nutritional status.
- Children for whom adequate information regarding breastfeeding and complementary feeding practices could be obtained from the caregiver.

Exclusion Criteria

- Children with severe acute illness requiring immediate emergency management or hospitalization.
- Children with known congenital or chronic conditions likely to substantially affect growth or nutritional status.
- Children with incomplete anthropometric or feeding information.
- Children whose caregivers declined participation or were

unable to provide reliable feeding history.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board/Ethics Committee. A written informed consent was obtained from the parents or legally authorized caregivers of all eligible children before enrolment. Participation was voluntary, and confidentiality of participants' demographic, clinical, and feeding-related information was maintained throughout the study. Data were used exclusively for research purposes.

Data and Anthropometric Assessment

Sociodemographic and relevant clinical information was collected using a structured, pretested data collection form through caregiver interviews and review of available clinical records. Information included the child's age, sex, birth weight, parental occupation and educational status, and monthly household income. Feeding history included breastfeeding status, exclusive breastfeeding for six months, continued breastfeeding, timing of introduction of complementary foods, minimum meal frequency (MMF), minimum dietary diversity (MDD), minimum acceptable diet (MAD), and consumption of animal-source foods. Dietary diversity was assessed according to the number of recommended food groups consumed by the child during the preceding 24 hours. Anthropometric measurements, including body weight and length/height, were obtained using standardized procedures and calibrated equipment. Weight-for-age, height-for-age, and weight-for-height indices were assessed using WHO Child Growth Standards. Stunting, wasting, and underweight were defined according to WHO criteria.

Assessment of Complementary Feeding Practices

Complementary feeding practices were assessed using caregiver-reported dietary information. Timely introduction of

complementary foods was defined as initiation at six completed months. MMF, MDD, and MAD were classified according to age-appropriate WHO/UNICEF infant and young child feeding indicators. Dietary diversity was further categorized according to the number of food groups consumed, and consumption of individual food groups, including grains, legumes and nuts, dairy products, flesh foods, eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables, was documented.

Statistical Analysis

Data were entered into a structured database and analyzed using SPSS version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between complementary feeding practices and nutritional status were assessed using the Pearson chi-square (χ^2) test. Multivariable logistic regression analysis was performed to identify factors independently associated with undernutrition, with results presented as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). Variables considered clinically relevant or showing evidence of association in preliminary analyses were included in the multivariable model. A two-sided p -value of <0.05 was considered statistically significant.

RESULTS

The mean age of the children was 15.7 ± 5.1 months, with 57.0% aged 12–24 months. Males constituted 59.9% of the participants. Most lived in urban areas (56.4%) and had a birth weight of 5–10 kg (81.5%). Regarding parental characteristics, 29.3% of fathers were farmers and 28.7% were businessmen, while 88.5% of mothers were housewives. Secondary or higher education was reported for 53.8% of fathers and 27.1% of mothers. Monthly household income was 20,000–39,999 BDT for 44.3% of households (Table I).

Table ISocio-demographic and anthropometric characteristics of the study participants ($n=314$).

Variables	Frequency (n)	Percentage (%)
Age group (months)		
Mean $\pm$ SD		15.7 $\pm$ 5.1
6–8	65	20.7
9–11	70	22.3
12–24	179	57.0
Gender		
Male	188	59.9
Female	126	40.1
Birth Weight (kg)		
5–10	256	81.5
10.1–15	58	18.5
Residence		
Urban	177	56.4
Rural	137	43.6
Father's occupation		
Day laborer	21	6.7
Farmer	92	29.3
Businessman	90	28.7
Service holder	87	27.7
Other	24	7.6
Mother's occupation		
Housewife	278	88.5
Service holder	26	8.3
Other	10	3.2
Father's educational status		
Illiterate	18	5.7
Primary	127	40.4
Secondary and above	169	53.8
Mother's educational status		
Illiterate	28	8.9
Primary	201	64.0
Secondary and above	85	27.1
Monthly household income (BDT)		
<20,000	98	31.2
20,000–39,999	139	44.3
$\geq 40,000$	77	24.5

Breastfeeding was common, with 96.5% of children ever breastfed and 56.1% exclusively breastfed for 6 months. Continued breastfeeding at 6–24 months was reported in 84.7%. Complementary foods were introduced at 6 months in

65.0% of children, whereas 19.4% received complementary foods earlier and 15.6% later. Adequate minimum meal frequency (MMF) was achieved by 65.0%, while adequate minimum dietary diversity (MDD) and minimum acceptable diet

(MAD) were achieved by 32.5% and 29.9%, respectively. Animal-source foods were consumed by 37.9% of children (*Table II*).

Table IIBreastfeeding and complementary feeding practices among the study participants ($n=314$).

Variables	Frequency (n)	Percentage (%)
Ever breastfed		
Yes	303	96.5
No	11	3.5
Exclusive breastfeeding for 6 months		
Yes	176	56.1
No	138	43.9
Continued breastfeeding at 6–24 months		
Yes	266	84.7
No	48	15.3
Age at introduction of complementary food		
Before 6 months	61	19.4
At 6 months	204	65.0
After 6 months	49	15.6
Minimum meal frequency		
Adequate	204	65.0
Inadequate	110	35.0
Minimum dietary diversity		
Adequate	102	32.5
Inadequate	212	67.5
Minimum acceptable diet		
Adequate	94	29.9
Inadequate	220	70.1
Animal-source food consumption		
Yes	119	37.9
No	195	62.1

Dietary diversity remained limited: 38.5% consumed 0–2 food groups, 29.0% consumed 3–4 groups, and 32.5% consumed ≥ 5 groups. Grains, roots and

tubers were consumed by 92.7%, whereas consumption was lower for legumes and nuts (43.6%), dairy products (39.5%), flesh foods (34.4%), eggs (29.9%), vitamin A-

rich fruits and vegetables (44.3%), and other fruits and vegetables (37.3%) (*Table III*).

Table IIIDistribution Dietary diversity and food-group consumption among children ($n=314$).

Variables	Frequency (n)	Percentage (%)
Number of food groups consumed		
0–2 groups	121	38.5
3–4 groups	91	29.0
≥ 5 groups	102	32.5
Grains, roots and tubers		
Consumed	291	92.7
Not consumed	23	7.3
Legumes and nuts		
Consumed	137	43.6
Not consumed	177	56.4
Dairy products		
Consumed	124	39.5
Not consumed	190	60.5
Flesh foods		
Consumed	108	34.4
Not consumed	206	65.6
Eggs		
Consumed	94	29.9
Not consumed	220	70.1
Vitamin A-rich fruits and vegetables		
Consumed	139	44.3
Not consumed	175	55.7
Other fruits and vegetables		
Consumed	117	37.3
Not consumed	197	62.7

Anthropometric assessment showed stunting in 32.8%, wasting in 16.2%, and underweight in 29.6% of children. Overall,

43.6% were classified as undernourished, while 56.4% had normal nutritional status (*Table IV*).

Table IV
Molecular Nutritional status of the children according to anthropometric indicators (n=314).

Variables	Frequency (n)	Percentage (%)
Height-for-age		
Normal	211	67.2
Stunted	103	32.8
Weight-for-height		
Normal	263	83.8
Wasted	51	16.2
Weight-for-age		
Normal	221	70.4
Underweight	93	29.6
Overall nutritional status		
Normal	177	56.4
Undernourished	137	43.6

Undernutrition was more frequent among children introduced to complementary foods before or after 6 months than among those introduced at 6 months (53.6% and 38.2%; $\chi^2=7.14$, $p=0.028$). Inadequate MMF, MDD, and MAD were each significantly associated with undernutrition (60.9% and 34.3%, $\chi^2=15.28$, $p<0.001$; 50.9% and 28.4%, $\chi^2=14.91$, $p<0.001$; and 52.3% and 23.4%, $\chi^2=22.37$, $p<0.001$, respectively). Lack of animal-source food consumption was also associated with higher undernutrition (49.7% and 33.6%; $\chi^2=7.21$, $p=0.007$) (Table V).

Table V
Association between complementary feeding practices and overall nutritional status of children (n=314).

Variables	Normal		Undernourished		χ^2	P-value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)		
Age at introduction						
At 6 months	126	61.8	78	38.2		
Before/after 6 months	51	46.4	59	53.6	7.14	0.028
Minimum meal frequency						
Adequate	134	65.7	70	34.3		
Inadequate	43	39.1	67	60.9	15.28	<0.001
Minimum dietary diversity						
Adequate	73	71.6	29	28.4		
Inadequate	104	49.1	108	50.9	14.91	<0.001
Minimum acceptable diet						
Adequate	72	76.6	22	23.4		
Inadequate	105	47.7	115	52.3	22.37	<0.001
Animal-source food consumption						
Yes	79	66.4	40	33.6		
No	98	50.3	97	49.7	7.21	0.007

Inadequate MAD showed the strongest independent association with undernutrition (aOR 2.47, 95% CI 1.47–4.16, $p<0.001$), followed by inadequate MDD (aOR 2.08, 95% CI 1.29–3.36, $p=0.003$) and inadequate MMF (aOR 1.89, 95% CI 1.17–3.06, $p=0.009$). Maternal education $\leq$ primary, low socioeconomic status, age 6–8 months, and absence of animal-source food consumption were also independently associated with undernutrition (Table VI).

Table VI
Multivariable logistic regression analysis of factors associated with undernutrition among children (n=314).

Variables	Adjusted OR	95% CI	P-value
Age 6–8 months	1.71	1.02–2.87	0.041
Male sex	1.18	0.76–1.84	0.458
Rural residence	1.43	0.92–2.23	0.112
Maternal education $\leq$ primary	1.76	1.08–2.86	0.024
Low household socioeconomic status	1.68	1.05–2.69	0.03
Inadequate meal frequency	1.89	1.17–3.06	0.009
Inadequate dietary diversity	2.08	1.29–3.36	0.003
Inadequate minimum acceptable diet	2.47	1.47–4.16	<0.001
No animal-source food consumption	1.64	1.02–2.65	0.041

DISCUSSION

Complementary feeding is an important stage of early childhood nutrition, and the quality and variety of foods given during this period can strongly affect children’s growth and nutritional status [13,14]. Most children were aged 12–24 months and that mothers predominantly had primary-level

education. Shaun et al. found that maternal education, household socioeconomic conditions, and child age were important determinants of adequate complementary feeding [15]. Similarly, Chowdhury et al. reported that household and parental characteristics influenced complementary-feeding adequacy in Bangladesh [16].

Another study by Senarath et al shows that socioeconomic position and parental education consistently shape feeding quality [17]. In our study, 96.5% of children had ever been breastfed, 56.1% were exclusively breastfed for 6 months, and 84.7% continued breastfeeding at 6–24 months. Timely introduction of

complementary foods occurred in 65.0%, while adequate MMF, MDD, and MAD were achieved by 65.0%, 32.5%, and 29.9%, respectively. The timely-introduction estimate is similar to the 63.5% reported in rural Bangladesh by Jubayer et al., although their MDD and MAD levels were substantially lower at 18.3% and 16.3%, respectively ^[11]. Conversely, Jain et al., studying children attending an outpatient hospital setting in India, reported considerably higher MMF (86%), MDD (57%), and MAD (58%) [18]. In another Indian study from an urban resettlement population, Chhabra et al. found MMF of 60.6%, MDD of only 15.1%, and MAD of 9%, demonstrating that adequate meal frequency does not necessarily translate into adequate dietary diversity ^[13]. The very low proportion achieving MDD and MAD in our study is particularly important. Sheikh et al., reported MAD of 34.7%, slightly higher than the 29.9% observed here, whereas a recent nationwide analysis based on BDHS 2022 found inadequate MDD and MAD in 62.8% and 70.4% of children, respectively ^[19,20]. Thus, our findings remain consistent with the broader Bangladeshi pattern of inadequate dietary quality, despite some variation in estimates between populations and indicator definitions. Importantly, Gonete et al., reported a pooled MAD prevalence of only 22%, reinforcing that poor dietary adequacy remains a widespread problem in low-resource settings ^[21]. Grains, roots and tubers dominated the children's diets (92.7%), whereas legumes/nuts, dairy, flesh foods, eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables were substantially less frequently consumed. This pattern closely resembles findings from Tafese et al., where staple cereals predominated while flesh foods and eggs were consumed by only 15% and 24% of children, respectively ^[22]. Tizazu et al. similarly documented persistent inequalities in nutrient-dense food-group consumption among Ethiopian children, particularly according to socioeconomic status ^[23]. In rural Bangladesh, Jubayer et al. also found cereals to be the dominant food group, while egg and flesh-food consumption was comparatively limited ^[11]. The nutritional findings demonstrate an important burden of anthropometric deficits, with stunting affecting 32.8%, wasting 16.2%, and underweight 29.6% of children; overall, 43.6% were classified as undernourished. These estimates are higher than those reported in an urban Indian study by Prasad et al., where stunting, wasting, and underweight were 15%, 25%, and 30%, respectively ^[24]. In contrast, Chhabra et al. reported considerably higher wasting (43.7%) and underweight (43.4%), although stunting was similar at 29.1% ^[13]. Hiruy et al., analysis has reported stunting

of approximately 31.5%, underweight of 19.1%, and wasting of 7.9%, placing the stunting prevalence in our study within a comparable range but indicating a greater burden of wasting and underweight ^[25]. Undernutrition was significantly more common among children introduced to complementary foods before or after 6 months, and among those with inadequate MMF, MDD, MAD, or no animal-source food consumption. These findings are consistent with an Ethiopian study, which showing that children with inadequate MDD had higher odds of stunting, wasting, and underweight ^[26]. Similarly, Hiruy et al. identified MDD and MAD as significant predictors of stunting in children ^[25]. In Bangladesh, IYCF analysis has also demonstrated that receiving MDD and MMF was associated with lower probability of wasting, while MDD and MAD were associated with lower odds of underweight ^[19]. Only 37.9% of children in our study consumed animal-source foods, and absence of such foods was associated with greater undernutrition. This finding is supported by Zaharia et al., who showing that sustained animal-source-food consumption is associated with improved linear growth and reduced stunting ^[27]. A systematic review and meta-analysis of randomized trials similarly found that animal-source-food supplementation improved length-for-age and weight-for-age among children aged 6–24 months ^[28]. In present study, inadequate MAD was the strongest independent predictor of undernutrition (aOR 2.47, 95% CI 1.47–4.16), followed by inadequate MDD (aOR 2.08, 95% CI 1.29–3.36) and inadequate MMF (aOR 1.89, 95% CI 1.17–3.06). Maternal education $\leq$ primary, low household socioeconomic status, younger age, and absence of animal-source foods also remained independently associated with undernutrition. These findings accord with Senarath et al. showing that maternal education and household wealth are important determinants of child nutrition ^[17]. They also parallel Ethiopian multivariable analyses in which dietary diversity, maternal education, child age, and household wealth were independently related to nutritional outcomes ^[26]. Overall, the present findings indicate that the principal nutritional challenge is not breastfeeding initiation or continuation but the transition to sufficiently diverse and acceptable complementary diets.

LIMITATIONS

The hospital-based setting may limit applicability to children in the community. Feeding information relied on caregiver-reported dietary history and may not fully capture usual intake. The cross-sectional design prevents establishing temporal relationships between feeding practices and nutritional outcomes. In addition, the study did not assess detailed nutrient intake, household food security, morbidity patterns, or other potentially important determinants of child growth.

CONCLUSION & RECOMMENDATIONS

Suboptimal complementary feeding was common among children attending the pediatric outpatient department, particularly inadequate dietary diversity and minimum acceptable diet, and was significantly associated with undernutrition. Inadequate MAD, MDD, and meal frequency remained independently associated with undernutrition after adjustment. Routine pediatric services should therefore integrate age-appropriate complementary-feeding counselling, with emphasis on dietary diversity, meal frequency, and inclusion of animal-source foods. Targeted nutrition education for caregivers, particularly those with limited maternal education and lower socioeconomic status, may help improve feeding practices and reduce childhood undernutrition.

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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