

Complementary Feeding Practices and Nutritional Status of Children Aged 6 – 23 Months - A Hospital - Based Cross - Sectional Study

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Abstract

Background: Appropriate complementary feeding in the first two years of life is critical for child growth and development. India bears a disproportionate burden of early childhood stunting, yet data on WHO IYCF indicator achievement in urban tertiary-care settings remain limited.

Objectives: Primary — to estimate the prevalence of minimum dietary diversity (MDD) achievement in children aged 6–23 months. Secondary — to assess minimum meal frequency (MMF) and minimum acceptable diet (MAD) achievement, characterise

nutritional status by anthropometric z-scores, and examine associations between sociodemographic variables and nutritional outcomes.

Methods: A hospital-based cross-sectional study was conducted over 15 months at the Department of Paediatrics, TNMC and BYL Nair Charitable Hospital, Mumbai. Sample size was calculated using the formula $n = Z^2pq/d^2$ ($p = 0.28$, $d = 0.05$, $Z = 1.96$), yielding $n = 310$; with 10% non-response allowance the required sample was 341, and 385 were enrolled.

Three WHO IYCF indicators were assessed by 24-hour dietary recall. Anthropometric z-scores were calculated

using WHO Anthro Plus software. Categorical associations were tested by Chi-square or Fisher's exact test; Odds Ratios (ORs) with 95% confidence intervals (CIs) are reported as effect sizes. Significance was set at $p < 0.05$.

Results: MDD was achieved by 140 children (36.4%; 95% CI 31.6–41.1%). MMF was achieved by 234 (60.8%; 95% CI 55.9–65.7%), and MAD by 99 (25.7%; 95% CI 21.3–30.1%). Achievement of all three indicators increased progressively with age and was highest in the 18–23-month group. Stunting was the most prevalent nutritional deficit (19.2%; 95% CI 15.3–23.5%). Continued breastfeeding at 12 months was significantly associated with maternal age ($p < 0.001$) and child sex ($p = 0.017$).

WAZ was significantly associated with child's sex ($p = 0.001$), maternal age ($p < 0.001$), and maternal education ($p = 0.002$). No significant association was found between any IYCF indicator and anthropometric z-scores.

Conclusions: MDD achievement remains substantially below WHO targets in this urban population. Maternal education and maternal age are stronger correlates of child nutritional status than binary IYCF indicator achievement, indicating that structural determinants require targeted intervention alongside individual feeding guidance.

Keywords: Complementary feeding; infant and young child feeding; nutritional status; anthropometry; stunting

Introduction

Globally, 60% of infant deaths are attributable to incorrect feeding practices; two-thirds of these are linked to sub-optimal breastfeeding.¹ The first 1,000 days, conception through 24 months represent a window during which nutritional deficits produce developmental

consequences that are largely irreversible.² WHO recommends exclusive breastfeeding for six months, followed by timely introduction of nutritionally adequate complementary foods while breastfeeding continues for at least two years.³

In low- and middle-income countries, early childhood malnutrition is associated with impaired motor, sensory, and cognitive development and an increased lifetime risk of non-communicable disease.⁴

India's progress in reducing under-five malnutrition has been disproportionately slow relative to its economic growth trajectory.⁵ Optimising complementary feeding practices alone has been estimated to avert up to 6% of under-five deaths, irrespective of household food-security status.⁶

Most published data on complementary feeding practices in India address rural or peri-urban populations. Evidence from urban tertiary-care centres where socioeconomically heterogeneous populations seek care and where mothers receive dietary advice from multiple sources is limited. It remains unclear how WHO IYCF indicator achievement in this setting compares with national benchmarks, and which sociodemographic factors most strongly predict nutritional outcomes in hospital-attending urban children.

We therefore conducted this cross-sectional study with the primary objective of estimating the prevalence of minimum dietary diversity (MDD) achievement among children aged 6–23 months attending a tertiary-care paediatric unit in Mumbai. Secondary objectives were to assess MMF and MAD achievement, characterise nutritional status by WHO anthropometric z-scores, and examine associations between sociodemographic variables and nutritional outcomes.

Materials and Methods

Study Design and Setting

This was a hospital-based cross-sectional study conducted at the Department of Paediatrics, TN Medical College and BYL Nair Charitable Hospital, Mumbai, between January 2018 to March 2019. The institution is a tertiary-care public hospital serving a mixed urban and peri-urban catchment population. Ethical clearance was obtained from the Institutional Ethics Committee, TNMC-Nair [IEC reference number – ECARP/2018/63 dated 20-12-2018.] Written informed consent was obtained from all participants prior to enrolment.

Participants

Mothers of children aged 6–23 months attending the Paediatric OPD and Well Baby Clinic were consecutively enrolled.

Inclusion criteria

- child aged 6–23 months
- attending for routine well-child care or minor illness
- mother able to provide consent and complete the interview.

Exclusion criteria

- child with diagnosed systemic illness, chronic disease, or congenital anomaly
- mother not competent to provide a reliable history.

Sample Size

Sample size was calculated a priori using the single-proportion formula $n = Z^2pq/d^2$, with expected MDD prevalence $p = 0.28$ based on Semahegn et al. (2014),¹ $q = 0.72$, precision $d = 0.05$, and $Z = 1.96$ (95% confidence). This yielded $n = 310$. Adding a 10% non-response allowance gave a minimum required sample of 341. The enrolled sample of 385 exceeded this requirement.

Outcomes and Measurements

Primary outcome

Minimum Dietary Diversity (MDD) achievement, defined as receipt of foods from ≥ 4 of 7 WHO food groups in the preceding 24 hours.

Secondary outcomes

Minimum Meal Frequency (MMF) receipt of solid, semi-solid, or soft foods at the age-appropriate minimum frequency (twice daily for breastfed 6–8-month infants; thrice daily for breastfed 9–23-month children; four times daily for non-breastfed 6–23-month children). Minimum Acceptable Diet (MAD) the composite of MDD and MMF. Nutritional status by WHO anthropometric z-scores: stunting ($LAZ < -2$), underweight ($WAZ < -2$), wasting ($WLZ < -2$), and overweight ($WLZ > +2$).

IYCF indicators were assessed by structured 24-hour dietary recall administered in the respondent's preferred language (English, Hindi, or Marathi).

Sociodemographic data were captured by structured questionnaire: maternal age, maternal education, and household socioeconomic status by the modified Kuppuswamy scale (2021 CPI update). Weight was recorded using a calibrated digital scale (nearest 0.1 kg); recumbent length was measured using a standard infantometer (nearest 0.1 cm).

Anthropometric z-scores were calculated using WHO AnthroPlus software (version 1.0.4; WHO, Geneva, 2011) against the WHO Child Growth Standards (2006).

Statistical Analysis

Quantitative data were expressed as mean $\pm$ SD. Categorical variables were summarised as frequency and percentage with 95% Wilson confidence intervals for prevalence estimates. For the primary outcome (MDD achievement) and secondary outcomes, prevalence was

estimated with 95% CI across all three age strata. Categorical associations were tested using the Chi-square test; Fisher's exact test was applied where any expected cell count fell below 5. Odds Ratios (ORs) with 95% CIs were reported as effect sizes for significant associations. All p-values are two-tailed; values below 0.001 are reported as $p < 0.001$. The non-breastfed subgroup ($n = 8$) was too small for inferential comparison and is presented descriptively only.

Among the breastfed cohort, continued breastfeeding at 12 months (rather than 'ever-breastfed' status, which lacked distributional variance) was used as the binary feeding outcome for association testing. All analyses used IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY, USA). MDD achievement was pre-specified as the primary comparison; all other tested associations are exploratory and should be interpreted as hypothesis-generating.

Results

Participant Characteristics

Of 385 enrolled children, 180 were male (46.8%) and 205 females (53.2%). By age stratum: 130 were 6–11

months, 105 were 12–17 months, and 150 were 18–23 months. The majority of mothers (271; 70.4%) were aged 21–25 years; 85 (22.1%) were 26–30 years; 18 (4.7%) were ≤ 20 years; and 11 (2.9%) were > 30 years. Secondary-level education was the most common attainment (214; 55.6%), with 67 (17.4%) completing primary level and 28 (7.3%) reporting no formal schooling. By modified Kuppaswamy classification, upper-middle class was the largest stratum (137; 35.6%). A total of 377 children (97.9%) were breastfed; only 8 (2.1%) were not.

Primary Outcome: Minimum Dietary Diversity

MDD was achieved by 140 of 385 children (36.4%; 95% CI 31.6–41.1%) — the primary outcome of this study. Achievement increased progressively with age: 19.2% (25/130; 95% CI 12.4–26.1%) at 6–11 months, 42.9% (45/105; 95% CI 33.3–52.4%) at 12–17 months, and 46.7% (70/150; 95% CI 38.7–54.7%) at 18–23 months. Table 1 presents the full distribution by age group and breastfeeding status.

Table 1: Minimum dietary diversity (MDD) by age group and breastfeeding status.

	6–11 months (n=130)		12–17 months (n=105)		18–23 months (n=150)		6–23 months (n=385)	
	BF	NBF	BF	NBF	BF	NBF	BF	NBF
MDD achieved	25	0	44	1	69	1	137	3
MDD not achieved	103	2	58	2	79	1	240	5
Total	128	2	102	3	148	2	377	8

BF = Breastfed; NBF = Non-breastfed. NBF ($n = 8$ total) presented descriptively only; no inferential comparison performed.

Secondary Outcomes

MMF and MAD

MMF was achieved by 234 children (60.8%; 95% CI 55.9–65.7%), with the 18–23-month group recording the highest rate (69.3%; 95% CI 61.8–76.9%). MAD—the composite indicator—was met by 99 children (25.7%; 95% CI 21.3–30.1%); here too, the 18–23-month group led (38.7%; 95% CI 30.9–46.4%). Tables 2 and 3 present the full distributions.

Table 2: Minimum meal frequency (MMF) by age group and breastfeeding status

	6–11 months (n=130)		12–17 months (n=105)		18–23 months (n=150)		6–23 months (n=385)	
	BF	NBF	BF	NBF	BF	NBF	BF	NBF
MMF achieved	73	2	53	2	102	2	228	6
MMF not achieved	55	0	49	1	46	0	149	2
Total	128	2	102	3	148	2	377	8

BF = Breastfed; NBF = Non-breastfed. NBF presented descriptively only.

Table 3: Minimum acceptable diet (MAD) by age group and breastfeeding status

	6–11 months (n=130)		12–17 months (n=105)		18–23 months (n=150)		6–23 months (n=385)	
	BF	NBF	BF	NBF	BF	NBF	BF	NBF
MAD achieved	19	1	20	1	57	1	96	3
MAD not achieved	109	1	82	2	91	1	281	5
Total	128	2	102	3	148	2	377	8

BF = Breastfed; NBF = Non-breastfed. NBF presented descriptively only.

Table 4: Prevalence of IYCF indicator achievement and nutritional deficits

IYCF Indicator	6–11 months n (%)	12–17 months n (%)	18–23 months n (%)
MDD achieved	25 (19.2%)	45 (42.9%)	70 (46.7%)
MMF achieved	75 (57.7%)	55 (52.4%)	104 (69.3%)
MAD achieved	20 (15.4%)	21 (20.0%)	58 (38.7%)
Stunting (LAZ<-2)	—	—	—
Underweight (WAZ<-2)	—	—	—
Wasting (WLZ<-2)	—	—	—

Nutritional Status

Stunting was the predominant nutritional deficit, affecting 74 children (19.2%; 95% CI 15.3–23.5%). Burden was greatest in the 18–23-month group (41/150; 27.3%). Underweight was present in 28 (7.3%; 95% CI 4.7–9.9%), wasting in 20 (5.2%; 95% CI 3.0–7.4%), and overweight in 9 (2.3%). Among stunted children, 45 (60.8%) were male. Male children had higher prevalence of underweight (17/28; 60.7%) and wasting (12/20; 60.0%) as well.

Sociodemographic Associations

Continued breastfeeding at 12 months was significantly associated with maternal age ($p < 0.001$) and child sex

($p = 0.017$). MAD achievement was significantly associated with maternal education ($p = 0.003$). WAZ was significantly associated with child sex ($p = 0.001$), maternal age ($p < 0.001$), and maternal education ($p = 0.002$). WLZ was significantly associated with maternal education ($p = 0.005$). Socioeconomic class, maternal education, and child sex were not significantly associated with LAZ ($p > 0.05$ for all). No significant association was found between any IYCF indicator (MDD, MMF, or MAD) and WAZ, LAZ, or WLZ. All associations other than the primary outcome (MDD prevalence) are exploratory.

Discussion

This cross-sectional study of 385 children at an urban tertiary-care hospital in Mumbai found that MDD achievement the primary outcome was 36.4%, substantially below the WHO benchmark and consistent with estimates from comparable low-resource settings in South Asia. One in four children received a minimum acceptable diet, and stunting affected nearly one in five, with the 18–23-month age group bearing the heaviest burden.

The age-related gradient in IYCF indicator achievement with all three indicators peaking in the 18–23-month group—mirrors findings from multi-country data by Arimond and Ruel,⁸ who reported that dietary diversity was positively associated with nutritional status, particularly height-for-age, and that this association was most apparent after 12 months. The probable explanation is that complementary feeding practices accumulate over time through maternal experience, and the child's progressive motor and oral development facilitates dietary widening. At 6–11 months, however, MDD achievement was only 19.2%, and a third of 6–8-month infants had not yet initiated complementary feeding at all—pointing to a critical early-period gap. Basnet et al.⁷ identified perceived insufficient breast milk, maternal employment, and the belief that breast milk alone is adequate beyond six months as common drivers of late initiation; these barriers were observable in the present cohort.

The absence of a significant association between binary IYCF indicators and anthropometric z-scores is unlikely to reflect the irrelevance of feeding quality to nutritional outcomes. Rather, it is consistent with the structural limitation of composite threshold indicators: a child who receives foods from exactly four food groups is coded

identically to one receiving all seven. The cumulative adequacy, energy density, and inter-meal consistency of feeding over weeks and months—the dimensions most proximal to linear growth—are not captured by 24-hour recall-based binary scores. Stewart et al.⁹ characterised stunting as the consequence of chronic, cumulative feeding inadequacy, which a cross-sectional snapshot of three binary indicators is poorly positioned to detect. This interpretation is further supported by Ruel and Menon,¹⁰

who found that feeding – practice – anthropometry associations became statistically apparent only when multiple positive practices clustered together in older infants.

Maternal education was the most consistent correlate of nutritional outcomes across multiple domains—associated with MAD achievement ($p=0.003$), WAZ ($p=0.002$), and WLZ ($p=0.005$). Younger maternal age was associated with less favourable breastfeeding continuation and WAZ. These findings are consistent with evidence that maternal educational attainment is associated with improved health literacy, greater feeding autonomy, and better resistance to unhelpful community feeding norms. They suggest that interventions addressing foundational maternal knowledge and decision-making capacity may yield larger nutritional gains than indicator-specific educational messaging alone.

Strengths of this study include an enrolled sample that exceeded the pre-specified minimum, the use of validated WHO IYCF indicators, and standardized anthropometric measurement with WHO AnthroPlus z-score calculation. The cross-sectional design precludes causal inference; temporality and directionality of associations cannot be established. The 24-hour dietary

recall is susceptible to recall bias and may not represent habitual practice. As a single-centre urban study, findings may not generalize to rural populations where dietary access and feeding barriers differ substantially. The non-breastfed subgroup (n=8) was insufficient for comparative analysis. Future research should employ longitudinal designs with repeated dietary recall to clarify the temporal relationship between IYCF indicator achievement and growth outcomes in Indian urban settings.

Conclusion

MDD achievement of 36.4% in this urban hospital-attending cohort falls well below WHO targets, with stunting affecting 19.2% of children—predominantly in the second year of life. Maternal education and age are the most consistent correlates of child nutritional outcomes, pointing to the value of foundational capacity-building in complementary feeding counseling. The absence of a significant IYCF indicator–z-score association reflects the insensitivity of binary composite scores to cumulative dietary quality, not the irrelevance of feeding practice to growth. Systematic anthropometric monitoring at every paediatric contact, combined with targeted feeding counseling stratified by maternal education level, represents the most pragmatic intervention strategy in this setting.

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