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Original Research Article

Complementary feeding practices and their determinants among children aged 6–23 months in Aligarh, North India

Jhilmil Agrawal[1], Ali J. Abedi[2]*, Saira Mehnaz[2], M. A. Ansari[2]

[1]Department of Community Medicine, NMCRC, Kanpur, Uttar Pradesh, India
[2]Department of Community Medicine, JNMC, AMU, Aligarh, Uttar Pradesh, India

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***Correspondence:**
Dr. Ali J. Abedi,
E-mail: sbcciycf@gmail.com

ABSTRACT

Background: Appropriate complementary feeding during the first two years of life is essential for optimal growth, development and prevention of malnutrition. This study assessed complementary feeding practices and identified their determinants among children aged 6–23 months.
Methods: This baseline assessment of a community-based quasi-experimental study included children aged 6–23 months. Data were collected using a pretested semi-structured questionnaire based on WHO infant and young child feeding guidelines. Information on socio-demographic characteristics and feeding practices was obtained. Minimum meal frequency (MMF), minimum dietary diversity (MDD) and minimum acceptable diet (MAD) were assessed. Multivariable logistic regression analysis was performed to identify determinants of inappropriate feeding practices and adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated.
Results: MMF was achieved by 83.5% of children, whereas MDD and MAD were achieved by only 17.25% and 14.25%, respectively. Children aged 13–23 months had lower odds of inappropriate MMF (OR=0.375, CI: 0.179–0.784; p=0.009), MDD (OR=0.189, CI: 0.067–0.533; p=0.002) and MAD (OR=0.189, CI: 0.055–0.654; p=0.009). Normal birth weight was associated with lower odds of inappropriate MDD (OR=0.264, CI: 0.105–0.663; p=0.005) and MAD (OR=0.218, CI: 0.074–0.639; p=0.006). Lack of mass media exposure increased the odds of inappropriate MDD (OR=2.382, CI: 1.222–4.646; p=0.011) and MAD (OR=2.556, CI: 1.306–5.001; p=0.006). Non-overcrowding reduced the odds of inappropriate MDD (OR=0.429, CI: 0.220–0.839; p=0.013) and MAD (OR=0.341, CI: 0.176–0.659; p=0.001), while Muslim religion (OR=2.246, CI: 1.092–4.622; p=0.028) and higher maternal education (OR=6.533, CI: 1.437–29.704; p=0.015) were associated with inappropriate MMF.
Conclusions: Complementary feeding determinants can guide targeted social and behaviour change communication interventions to improve feeding practices and nutritional outcomes among young children.

Keywords: Complementary feeding practices, IYCF indicators, Minimum meal frequency, Minimum dietary diversity, Minimum acceptable diet, Social and behaviour change communication

INTRODUCTION

The first two years of life form a vital foundation for a child's physical growth, brain development and long-term health. Within this formative window, proper nutrition supports development and reduces the risk of illness and death. Complementary feeding emerges as a crucial milestone and key determinant of child nutrition during this period. This marks the transition from exclusive breastfeeding to the gradual incorporation of soft, semi-solid and solid foods from six months of age. This phase not only bridges nutritional gaps but also ensures that children aged 6 to 23 months receive the diverse and adequate nourishment essential for optimal development, resilience and lifelong well-being.[1] The World Health Organisation (WHO) recommends introduction of complementary foods at six months of age, MMF, MDD

and MAD ensuring meals are timely, adequate in quantity and quality. Proper tracking identifies nutritional gaps, reduces child mortality and prevents lifelog developmental stunting.[2]

Undernutrition contributes to 45% of child deaths globally, with less than quarter of infants receiving adequate diets.[3] Globally, among infants aged 6–8 months, only 69.5% consume any solid food. For children aged 6–23 months, just 53.1% meet the recommended MMF and fewer than one in three (29.3%) achieve MDD. Consequently, less than one in five (18.9%) receive a MAD.[4] These global figures are reflective of regional disparities as well, among South Asian Countries, only 50.2% of children were introduced to complementary foods at 6 months of age. However, only 21.9% of children received a diverse diet and the prevalence of MMF and MAD was 39.9% and 12.8% respectively.[5]

Further emphasizing the severity of the issue, evidence from India reveals the lowest proportion of children i.e., 15% and 9% who met the MDD and MAD respectively among breastfed children in South Asia.[6] As per National Family Health Survey-6 (NFHS-6), only 15.3% of children aged 6–23 months receive an adequate diet, with significant variations and disparities across regions, castes and socioeconomic groups. In U.P., 59.6% of children aged 6-8 months receive solid or semi-solid food and breastmilk while only 17.1% of total children aged 6-23 months receive an adequate diet which shows that there is wide gap between the initiation and, type and amount of complimentary foods given over time from 6-23 months.[7]

Despite the availability of national and global recommendations on infant and young child feeding, inappropriate complementary feeding practices continue to be highly prevalent in India. Although numerous studies have identified determinants of complementary feeding practices, there is limited evidence from community-based settings including both urban and rural areas, exploring context-specific factors influencing feeding practices. Understanding and identifying these locally relevant determinants and modifiable influences on feeding behaviours is essential for in intervention planning. Therefore, the present study was conducted to assess complementary feeding practices, infant and young child feeding indicators and their determinants among children aged 6–23 months to generate evidence for the development of targeted SBCC interventions aimed at improving feeding practices and nutritional outcomes.

METHODS

Study area, design and period

This study forms part of a larger community-based Quasi-experimental study assessing the effectiveness of an SBCC intervention on complementary feeding practices among children aged 6-23 months. It was conducted in the urban and rural study areas of Aligarh district from March 2023 to March 2025. Aligarh is located in Doab region (between the Ganga River & the Yamuna River) and climate is of tropical monsoon type with the maximum temperature reaches up to 47˚C (varies between 30-43℃) in summers while the minimum temperature is about 3-5℃ (varies between 5-25℃) in winters. It receives an average rainfall of about 22 inches which normally starts in the second half of July and lasts up to first half of September.

Population

The study population were children of 6-23 months of ages, sampling unit is household and study unit were randomly selected households of children in the age group of 6-23 months residing in chosen areas were taken. One registered Jamalpur and one unregistered MA Nagar had been chosen as study areas from urban settings which are situated on either side of the road. Each area has one UHP (Urban Health Post) for primary care services to the residents. For rural population, three Family Adoption Villages (FAP)- Manjoorgarhi, Siya Khas and Rafipur Siya were taken as study areas which comes under Jawan Sikanderpur Block in Aligarh district.

Inclusion and exclusion criteria

All children aged 6–23 months and their fathers, mothers and grandmothers who were willing to participate in the study were included. Additionally, ASHAs, ANMs, AWWs, local leaders and religious influencers of the study areas who consented to participate were also included in the study. Infants below 6 months of age and children above 23 months were excluded from the study. Fathers, mothers, grandmothers, ASHAs, ANMs, AWWs, local leaders and religious influencers who were unwilling to participate were also excluded. All children of age 6-23 months who were having any congenital malformation and all households who are food insecure were excluded from the study.

Sample size and sampling procedure

The sample size was estimated for comparison of two proportions between the intervention and control groups.[8] Based on the district nutrition profile of Aligarh, Uttar Pradesh, the prevalence of MAD among children aged 6–23 months was assumed to be 10%.[9] An absolute improvement of 10 percentage points following the intervention was considered clinically meaningful. Assuming 80% power and a 95% confidence level, the minimum sample size was calculated and inflated by 10% to account for possible non-response and loss to follow-up. Accordingly, 200 children were included in each study group, giving a total sample size of 400 children. A list of households with eligible children aged 6–23 months was prepared in each study area. Households were selected using simple random sampling with computer-generated random numbers. In the event of non-availability of the selected child or refusal to

participate, the next eligible household was approached until the required sample size was achieved

Data quality assurance

Before the commencement of the study, pilot study was done on 10% of total sample size using the questionnaire. Then, necessary changes were done after having responses from the participants and small group discussion with ANM, AWW and ASHA who were present there at the time of data collection at two immunisation sessions where pilot study was done. The data collected was not included in the present study. Then, baseline assessment was done after required changes by using semi-structured questionnaire which was validated by the experts.

Data collection tools and procedure

A house-to-house survey was conducted to collect the required information. Each interview began with a general conversation to build rapport and gradually progressed to specific questions. During the interview, a semi-structured questionnaire with direct questions was used. The questionnaire based on the WHO infant and young child feeding (IYCF) indicators.[2,10] All the data was collected in presence of either ASHA or AWW to make an easy access to the homes of the locals and also helps in further communication process.

Outcome

The study assessed the status of complimentary feeding indicators and the determinants of MDD, MMF and MAD in terms of Socio-demographic child and parental, housing and community characteristics.

Data analysis

Analysis of the data was done. Data was first entered in Excel sheet, then after cleaning imported to IBM SPSS 20.0 for further analysis. Continuous variables were summarized with mean, percentage and standard deviation. Categorical variables were summarized as proportions. Regression analysis was done to find out determinants of feeding practices. Univariate analysis was done and all explanatory variables with p value≤0.25 was regressed on to multivariable analysis. Multivariate logistic regression analysis was done to quantify the effect of determinants on complimentary feeding practices and the adjusted effect measures were considered as the main results.

Adjusted odds ratio (AOR), 95% confidence interval and p value less than or equal to 0.05 was used to decide a statistically significant association with the outcome variable. Model fitness was assessed by using Hosmer and Lemeshow test. Multicollinearity was checked by using variance inflation factor (VIF) and tolerance test. The result of VIF was <2 while the tolerance test was>0.1, which was within the normal limit.

Ethical considerations

Approval for the study was obtained from the Institutional ethical committee, JNMCH, Aligarh. Before the commencement of data collection, written and informed consent was obtained from each participant after explaining the purpose, procedures and potential benefits with the study. Participants were assured of complete confidentiality and anonymity throughout the study.

RESULTS

Socio-demographic child and parental, housing and community characteristics

A total of 400 children were included in the study. Table 1 shows more than half of the children were in the 13–23-month age group (56%), followed by 25.75% in the 9-12 months group and 17.25% aged 6-8 months. The sex distribution was nearly equal (52.5% males and 47.5% females). Most children (78.25%) had a normal birth weight (2.5-4 kg) and the majority were born at term (92.25%). Institutional deliveries accounted for 89.5% of births, while 10.5% occurred at home. About one-third of the children were first-born (33.25%), followed by second-born (35%). A large proportion of children were fully immunized (87.5%), with only 3.5% remaining unimmunized.

Regarding parental characteristics as shown in Table 1, most mothers had primary or middle-school education (29% and 30.25%, respectively), while 20.75% were illiterate. Almost all mothers were homemakers (93.5%). Fathers showed a similar educational pattern, with 27% educated up to middle school and 25.75% up to primary school, more than half (54.5%) were laborers. Most mothers delivered between 20–30 years of age (85.5%). More than half of the households had one or two children and 58.5% of mothers reported exposure to mass media. Adequate ante-natal care (ANC) was received by 74.5% of the women.

In terms of housing characteristics in Table 1, 64% of families lived in pucca houses, while 79% reported overcrowding. Access to improved drinking water sources was high (95%) and 86.5% of households had improved toilet facilities.

Community level characteristics in Table 1, shows 62.25% of participants were Muslim and 37.75% Hindu, with the majority belonging to the other backward classes (OBC) category (78.75%). The study population was evenly split between urban and rural areas. Joint families were slightly more common (55.25%) than nuclear families. Most households belonged to socioeconomic Class four (64.5%), followed by Class three (23.25%).

Health-seeking behaviour was satisfactory, with 94.25% of caregivers seeking appropriate care when the child was ill.

Feeding practices of children

As shown in Table 2, almost all children had been breastfed at some point (94.5%), although continued breastfeeding at the time of survey was reported for only 61.4% of children. Bottle feeding was common (59%) and three-fourths of children (75%) consumed formula milk or animal milk on the previous day. Timely introduction of complementary foods was satisfactory, with 67% receiving semi-solid or solid foods at six months, however, 8% started before six months and 23.25% after six months. The consistency of foods was predominantly thin (89.3%) and only 8.4% of children received age-appropriate thick consistency. More than half of caregivers used a separate bowl to feed (56.5%) and 57.8% added ghee or oil to enhance energy density. Handwashing practices before food preparation and feeding were almost universal (95%).

The quantity of food offered varied widely while only 12.5% receiving meal quantities appropriate for age. Dietary diversity was notably poor, only 17.25% of children achieved MDD. In contrast, MMF was adequate in 83.5% of children. Due to this, only 14.25% of children met the MAD, highlighting major gaps in dietary diversity and meal adequacy.

These results indicate that while meal frequency is relatively well-maintained, but the lack of dietary diversity poses a challenge, potentially impacting the nutritional status of children in this age group according to WHO guidelines as shown in Figure 1 also.

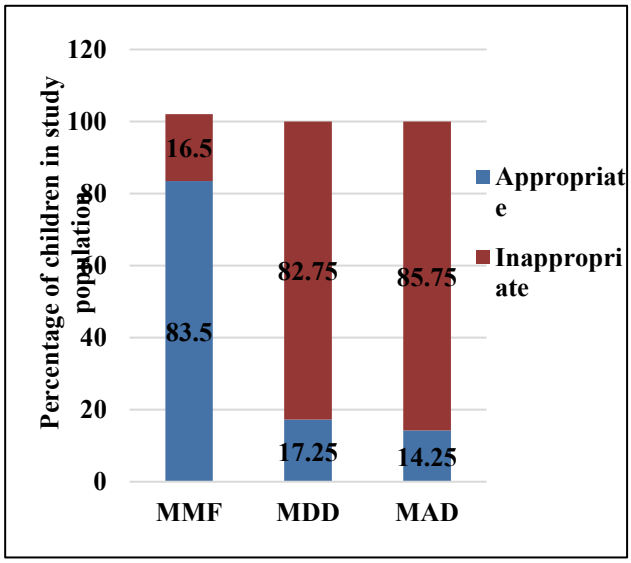

Figure 1: Total children aged 6-23 months receiving MMF, MDD, MAD in study population.

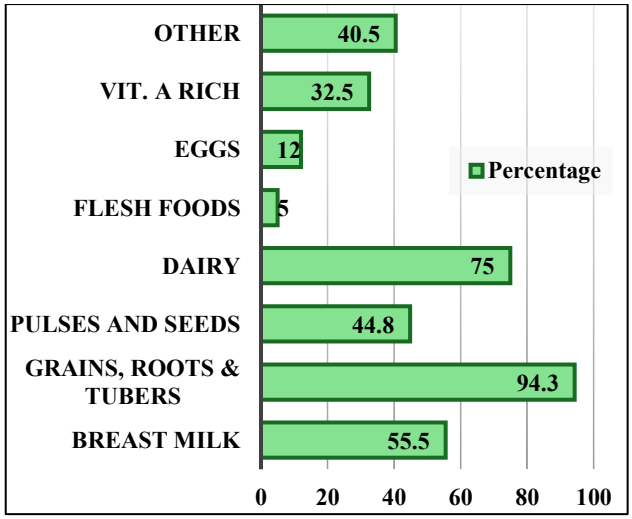

Figure 2: Total proportion of children consuming particular food group in study groups.

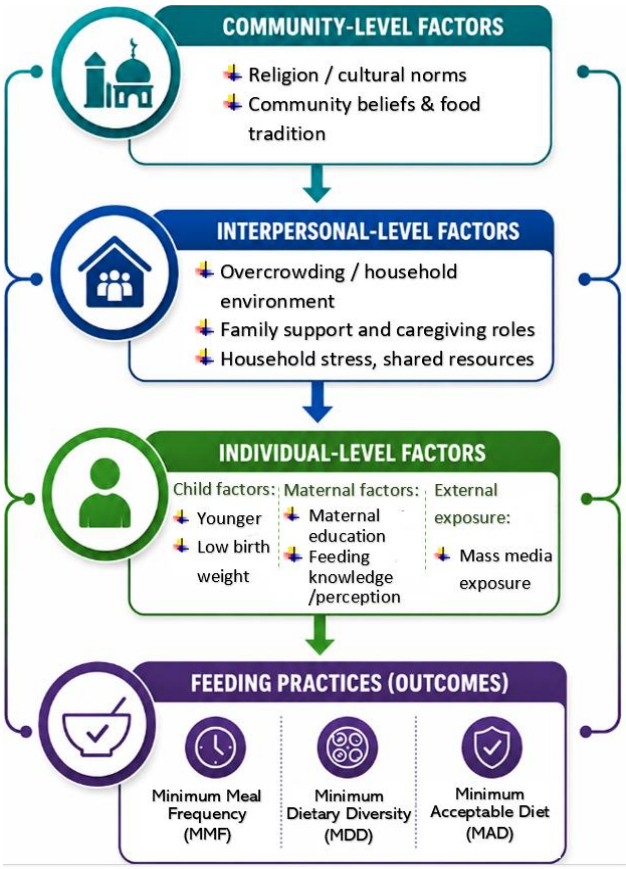

Figure 3: Determinants of complementary feeding practices according to socio-ecological levels.

Consumption of eggs or flesh foods was low (16.5%), while intake of sweet beverages (73.25%) and unhealthy foods (77.25%) was high. Nearly 38% of children had zero intake of fruits or vegetables. Feeding practices during illness were mostly inappropriate (78.25%), although responsive feeding based on hunger and cues was reported in 71.25% of cases. All non-breastfed

children met the minimum recommended milk feeding frequency.

Figure 2 presents the proportion of children consuming foods from different food groups. Most children consumed grains, roots and tubers (94.3%), making these the staple component of the diet. Intake of dairy products was also high (75%), followed by pulses and seeds (44.8%). More than half of the children (55.5%) continued to receive breast milk. Consumption of vitamin A rich fruits and vegetables was moderate at 32.5%, while other fruits and vegetables were consumed by 40.5% of children.

In contrast, intake of animal-source foods was very poor, with only 12% consuming eggs and 5% consuming flesh foods. This pattern shows high reliance on cereals and dairy, moderate plant-based foods and very low animal-source foods which helps in explaining the low dietary diversity MDD and MAD observed in the study.

Significant determinants of inappropriate complementary feeding practices

Univariate and multivariate logistic regression analyses identified several significant determinants of inappropriate complementary feeding practices among children aged 6 to 23 months and the results are presented in table 3, 4 and 5. Age of the child was a consistent determinant across all three indicators. Children aged 13–23 months had significantly lower odds of receiving inappropriate MMF (AOR: 0.375; p=0.009), MDD (AOR: 0.189; p=0.002) and MAD (AOR: 0.189; p=0.009) compared to children aged 6-8 months, indicating that feeding practices improve as children grow older. A paradoxical association was observed between higher maternal education and MMF, children of graduate mothers had higher odds of inappropriate MMF (AOR: 6.533; p=0.015), possibly reflecting competing time demands or the limited sample within this subgroup.

Religion was also associated with MMF, with Muslim children having higher odds of inappropriate MMF compared to Hindu children (AOR: 2.246; p=0.028). Birth weight significantly influenced both MDD and MAD. Children with birth weight >2.5 kg had substantially lower odds of inappropriate MDD (AOR: 0.264; p=0.005) and MAD (AOR: 0.218; p=0.006), suggesting that children born with normal weight receive better dietary adequacy and diversity. Lack of exposure to mass media was a strong determinant of inadequate dietary practices, children whose mothers lacked media exposure had higher odds of inappropriate MDD (AOR: 2.382; p=0.011) and MAD (AOR: 2.556; p=0.006), highlighting the role of information access in shaping feeding behaviour. Household environment also influenced dietary adequacy. Children from non-overcrowded households had significantly lower odds of inappropriate MDD (AOR: 0.429; p=0.013) and MAD (AOR: 0.341; p=0.001) compared with those living in overcrowded settings. Overall, the main determinants of inappropriate MMF, MDD and MAD in the study population were child age, maternal education, religion, birth weight, exposure to mass media and household overcrowding.

Table 1: Distribution of child, parental, housing and community characteristics of study population.

Characteristics			Frequency (%)
Child characteristics			
Age (in months)	6-8 months		69 (17.25)
	9-12 months		103 (25.75)
	13-23 months		228 (56)
Sex	Male		210 (52.5)
	Female		190 (47.5)
Birth weight	< 2.5		85 (21.25)
	2.5 - 4.0		313 (78.25)
	> 4.0		2 (0.5)
Place of delivery	Hospital		358 (89.5)
	Home		42 (10.5)
	Home	Trained	12 (3)
		Untrained	30 (7.5)
Birth order	1		133 (33.25)
	2		140 (35)
	3		82 (20.5)
	> 3		45 (11.25)
Birth	Term		369 (92.25)
	Pre-term		17 (4.25)
	Post-term		14 (3.5)
Vaccination status	Fully immunised		350 (87.5)
	Partially immunised		47 (11.75)
	Unimmunised		14 (3.5)

Continued.

Characteristics		Frequency (%)
Parental characteristics		
Mother's education	Illiterate	83 (20.75)
	Primary school	116 (29)
	Middle school	121 (30.25)
	High school	47 (11.75)
	Intermediate or post high school	18 (4.5)
	Graduate or post-graduate	15 (3.75)
Mother's occupation	Working (government/private+self-employed+labourer/maid)	26 (6.5)
	Homemaker	374 (93.5)
Father's education	Illiterate	82 (20.5)
	Primary school	103 (25.75)
	Middle school	108 (27)
	High school	52 (26)
	Intermediate or post high school	36 (9)
	Graduate or post-graduate	19 (4.75)
Father's occupation	Working (government/private)	31 (7.75)
	Self-employed	141 (35.25)
	Labourer	218 (54.5)
	Nothing	10 (2.5)
Mother's age at delivery	<20	16 (4)
	20-30	342 (85.5)
	30-40	42 (10.5)
Number of children	1	122 (30.5)
	2	145 (36.75)
	3	89 (22.25)
	> 3	44 (11)
Exposure to mass media	Yes	234 (58.5)
	No	166 (41.5)
Anc (ante-natal care) status	Complete	298 (74.5)
	Incomplete+not applicable	102 (25.5)
Housing characteristics		
Type of house	Kachcha	7 (1.75)
	Semi-Pucca	137 (34.25)
	Pucca	256 (64)
Overcrowding	Yes	316 (79)
	No	84 (21)
Source of drinking water	Improved	380 (95)
	Unimproved	20 (5)
Toilet facility	Improved	346 (86.5)
	Unimproved	54 (13.5)
Community characteristics		
Religion	Hindu	151 (37.75)
	Muslim	249 (62.25)
Caste	General	53 (13.25)
	Other backward classes (OBC)	315 (78.75)
	Scheduled caste (SC)	32 (8)
Residence	Urban	200 (50)
	Rural	200 (50)
Type of family	Nuclear	179 (44.75)
	Joint	221 (55.25)
Socioeconomic status (SES)	I	5 (1.25)
	II	25 (6.25)
	III	93 (23.25)

Continued.

Characteristics		Frequency (%)
	IV	258 (64.5)
	V	19 (4.75)
Health seeking behaviour	Present	385 (94.25)
	Absent	15 (3.75)

Table 2: Feeding practices of children 6 to 23 months of age at baseline.

Characteristics		Frequency (%)
Ever breastfed (n=400)	Yes	378 (94.5)
	No	22 (5.5)
Breast feeding continued (n=378)	Yes	232 (61.4)
	No	146 (38.6)
Number of non-breastfed children (n=400)	Yes	168 (42)
	No	232 (58)
Bottle feeding (n=400)	Yes	236 (59)
	No	164 (41)
Formula/ milk from animals yesterday during the day or the night? (n=400)	Yes	300 (75)
	No	100 (25)
Introduction of semi-solid, solid foods (n=400)	Before 6 months	32 (8)
	At 6 months	268 (67)
	After 6 months	93 (23.25)
	Not yet started	7 (1.75)
Consistency of food (n=393)	Thick	33 (8.4)
	Thin	351 (89.3)
	Very thin	9 (2.3)
Separate bowl to feed (n=393)	Yes	222 (56.5)
	No	171 (43.5)
Add ghee or oil (n=393)	Yes	227 (57.8)
	No	166 (42.2)
Wash hands with soap and water before cooking and feeding (n=400)	Yes	380 (95)
	No	20 (5)
Quantity of solid/semi-solid foods often feed to child (n=393)	2-5 teaspoon	97 (24.7)
	2-5 tablespoon	104 (26.5)
	½ of 250 ml cup	160 (40.7)
	¾ of 250 ml cup	24 (6.1)
	Full 250 ml cup	8 (2)
Meal quantity according to age (n=400)	Appropriate	50 (12.5)
	Inappropriate	350 (87.5)
Minimum dietary diversity (n=400)	≥ 5	69 (17.25)
	< 5	331(82.75)
Minimum meal frequency (n=400)	Appropriate	334 (83.5)
	Inappropriate	66 (16.5)
Minimum acceptable diet (n=400)	Yes	57 (14.25)
	No	343(85.75)
Minimum milk feeding frequency for non-breastfed (n=400)	Appropriate	168 (100)
	Inappropriate	0
Egg and/or flesh food consumption (n=400)	Yes	66 (16.5)
	No	334 (83.5)
Sweet beverage consumption (n=400)	Yes	293(73.25)
	No	107 (26.75)
Unhealthy food consumption (n=400)	Yes	309 (77.25)
	No	90 (22.5)
Zero vegetable or fruit consumption (n=400)	Yes	152 (38)
	No	248 (62)

Characteristics		Frequency (%)
Feeding during illness (n=400)	Appropriate	87 (21.75)
	Inappropriate	313 (78.25)
Responsive feeding (according to hunger & cues) (n=400)	Appropriate	285 (71.25)
	Inappropriate	115 (28.75)

Table 3: Significant determinants of inappropriate MMF of children aged 6-23 months in study population.

Determinant	Unadjusted odd's ratio (95% CI)	Adjusted odd's ratio (95% CI)	P value
Age of child			
6–8 Months	1	1	0.009
13–23 Months	0.429 (0.22-0.83)	0.375 (0.179-0.784)	
Mother's education			
Illiterate	1	1	0.015
Graduate	2.152 (0.58-7.87)	6.533 (1.437–29.704)	
Religion			
Hindu	1.000	1	0.028
Muslim	2.583 (1.38-4.85)	2.246 (1.092–4.622)	

Table 4: Significant determinants of inappropriate MDD of children aged 6-23 months in study population.

Determinant	Unadjusted odd's ratio (95% CI)	Adjusted odd's ratio (95% CI)	P value
Age of child			
6–8 months	1	1	0.002
13–23 months	0.278 (0.11-0.73)	0.189 (0.067–0.533)	
Birth weight			
<2.5 Kg	1		0.005
>2.5 Kg	0.304 (0.13-0.73)	0.264 (0.105–0.663)	
Exposure to mass media			
Yes	1	1	0.011
No	2.745 (1.51-5.00)	2.382 (1.222–4.646)	
Overcrowding			
Yes	1.000	1	0.013
No	0.492 (0.28-0.88)	0.429 (0.220–0.839)	

Table 5: Significant determinants of inappropriate MAD of children aged 6-23 months in study population.

Determinant	Unadjusted odd's ratio (95% CI)	Adjusted odd's ratio (95% CI)	P value
Age of child			
6–8 Months	1	1	0.009
13–23 Months	0.201 (0.20-0.06)	0.189 (0.055–0.654)	
Birth weight			
<2.5 Kg	1	1	0.006
>2.5 Kg	0.244 (0.086-0.70)	0.218 (0.074–0.639)	
Exposure to mass media			
Yes	1	1	0.006
No	2.444 (1.29-4.63)	2.556 (1.306–5.001)	
Overcrowding			
Yes	1.000	1	0.001
No	0.422 (0.23-0.77)	0.341 (0.176–0.659)	

DISCUSSION

In the present study, 83.5% of children aged 6 to 23 months met the MMF criterion, indicating relatively good adherence compared to many national estimates. Similar high compliance has been reported in hospital-based study at AIIMS Bhopal (86%) and community-based study in peri-urban Aligarh (87.4%), suggesting that settings with better access to healthcare and counselling may demonstrate improved feeding frequency.[11,12] In contrast, studies from Uttar Pradesh, including Sankaran

et al documented much lower rates of 14%.[13] These disparities highlight the influence of local context, service availability and community exposure to health messages. Although MMF was largely adequate, only 17.25% of children aged 6–23 months achieved MDD, highlighting substantial gaps in the quality of complementary feeding. Only 8.4% of children received thick, age-appropriate food consistency and merely 12.5% were offered recommended meal quantities. The predominance of thin preparations appears driven by cultural beliefs that infants cannot digest thick foods, an issue widely noted in other LMICs.[6,14-16] These findings reinforce that satisfactory meal frequency does not necessarily translate into adequate nutrient intake.

Diets were dominated by grains (94.3%) and dairy products (75%), while consumption of pulses (44.8%), vitamin A–rich fruits and vegetables (32.5%), other fruits and vegetables (40.5%), eggs (12%) and flesh foods (5%) remained low, reflecting limited access to nutrient-dense food groups. These findings align with evidence from Uttar Pradesh, where Sankaran et al reported an MDD prevalence of 11% and more recent studies from Raipur and Pune slums showed very low dietary diversity (4.1% and 16.4%, respectively).[13,17,18]

Studies from Lucknow similarly reported 16% MDD adherence.[19] Slightly higher values observed in hospital-based study at AIIMS Bhopal (57%), likely reflect better caregiver awareness and health-seeking behaviour rather than general community practices.[11] Global research also shows consistently low dietary diversity in LMICs. South Asian data and African studies report similarly poor diversity patterns, particularly low intake of animal-source and micronutrient-rich foods.[6,14,16,20] Collectively, both national and international evidence confirm that limited dietary diversity is a widespread challenge driven by cultural norms, affordability constraints and community awareness.

Only 14.25% of children in the study met the MAD criteria, indicating serious deficits in both meal frequency and dietary diversity. This finding is consistent with broader Indian evidence. NFHS-6 (2026) reported an 15.3% MAD prevalence at the national level, while studies across Central and Northern India, consistently report MAD values below 20% and in some cases as low as 2–4%.[17-19,21,22] Although some facility-based studies report higher compliance, these likely reflect selective populations with greater exposure to nutrition counselling.[11]

Internationally, MAD remains low across South Asia, Sub-Saharan Africa and even parts of East Asia such as rural China, emphasizing that inadequate complementary feeding is a global concern across LMICs.[14,16,23] The consistent pattern of high reliance on cereals, poor intake of animal-source proteins and low fruit and vegetable consumption underscores structural, behavioural and educational barriers.

Determinants of complementary feeding practices according to socio-ecological levels (Figure 3)

Individual level determinants

In this study, younger child age (6–8 months) was significantly associated with inappropriate MMF, MDD and MAD, a pattern also reported by Senarath et al and Akanbonga et al.[6,15] Children in the early complementary feeding phase often receive limited meal frequency and poor dietary variety due to delayed initiation or caregiver hesitation in introducing thicker textures or diverse foods. Low birth weight emerged as an important determinant of inappropriate MDD and MAD, consistent with findings from Jeyakumar et al.[18] Low-birth-weight infants may face feeding difficulties, prompting caregivers to adopt overly cautious practices that restrict dietary diversity and adequacy. Exposure to mass media was positively associated with appropriate MDD and MAD, similar to Acharya et al and Senarath et al, highlighting the importance of information access in shaping positive feeding behaviours.[6,22]

An unexpected finding was that higher maternal education was associated with higher odds of inappropriate MMF. While the majority of literature suggests that maternal education improves IYCF practices, our result may reflect contextual realities such as employed mothers having limited time for child feeding or dependence on substitute caregivers.[11,19,21] This underscores the need for supportive, practical and tailored counselling even among educated mothers. Though, the findings should be interpreted cautiously because the number of graduate mothers was small, resulting in wide confidence interval.

Overall, individual-level determinants point to the complex interplay of child characteristics, caregiver behaviours and informational access in shaping feeding practices.

Interpersonal-level determinants

Household overcrowding was a significant interpersonal determinant of inappropriate MDD and MAD. Children from less crowded households had significantly better odds of meeting dietary diversity and adequacy standards. Overcrowding may reduce caregiver time, increase household stress and dilute availability of food and attention, factors well-documented in studies such as Nsiah-Asamoah et al.[24]

Evidence from India is mixed. While Jain et al, reported better MAD in joint families due to shared caregiving, the present findings indicate that it is the degree of crowding, not family type that influences feeding outcomes. Jeyakumar et al also reported that family size alone did not predict dietary diversity, reinforcing that living conditions and caregiver bandwidth matter more than household structure.[11,18] These findings suggest that improving complementary feeding requires more than

knowledge-based interventions, it may also require addressing interpersonal and household-level constraints affecting caregiving capacity.

Community-level determinants

Religion emerged as a significant community-level determinant of MMF in this study, with children from Muslim households having higher odds of inappropriate MMF. This may reflect cultural norms, dietary beliefs or caregiving practices associated with religious affiliation. Similar influences were reported by Issaka et al in African DHS (Demographic and Health Survey) analyses and Dhami et al in India, where cultural context shaped complementary feeding patterns.[21,25]

However, not all studies identify religion as a major determinant. Researches by Acharya et al, Jeyakumar et al and Abedi et al emphasized socioeconomic factors, caste or wealth index over religion.[12,18,22] This suggests that religious influence varies by context, likely mediated by local customs, food norms and access to health information.

CONCLUSION

Overall, the findings indicate that although MMF was relatively adequate as compared to very low MDD and MAD, substantial gaps persisted in the quality of complementary feeding, particularly in terms of dietary diversity, consistency and quantity. Feeding practices were influenced by determinants operating at individual (child age, birth weight, maternal education), interpersonal (household overcrowding) and community (mass media exposure, religion) levels. This highlights the need for strengthened social and behaviour change communication (SBCC) interventions that focus not only on when and how often to feed, but also on what and how to feed, emphasizing thick, nutrient-dense, age-appropriate complementary foods. Sustainable improvements in child nutrition require multisectoral collaboration integrating nutrition with agriculture, WASH, women's empowerment and social protection programmes.

The cross-sectional nature of the baseline assessment limits causal inference and reliance on caregiver self-report and a single 24 hours dietary recall may have introduced recall and social desirability bias. Furthermore, the study did not comprehensively explore sociocultural beliefs, caregiving dynamics and contextual factors underlying feeding behaviours, including unexpected findings such as the association between higher maternal education and inappropriate MMF, highlighting the need for further research to understand dynamics of feeding behaviours.

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