



Determinants of minimum acceptable diet feeding among children aged 6–23 months in Odisha, India

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Abstract

Objective: To assess the level, pattern and determinants of minimum acceptable diet (MAD) feeding in Odisha, India.

Design: Utilising cross-sectional data, the MAD was estimated through a dietary assessment method wherein the child's mother was asked to recall all the food intake of the youngest child the previous day and night of the surveyed date.

Setting: National Family Health Survey 2015–2016.

Participants: Children aged 6–23 months, living with mother and for whom complete information on MAD was available (*n* 3073).

Results: Only 8.4 % of the children aged 6–23 months were fed MAD, and the MAD feeding varies considerably by socio-demographic characteristics. Children aged 12–17 months had two times (OR: 2.51, 95 % CI (1.48, 4.26)) and those aged 18–23 months had three times (OR: 3.77, 95 % CI (2.25, 6.30)) higher odds of having a MAD than their counterparts aged 6–8 months. Children whose mother was exposed to any mass media had a higher chance of MAD feeding (OR: 1.46, 95 % CI (1.01, 2.11)).

Conclusions: The children of higher age, second or higher-order births, with mother exposed to mass media are significantly more likely to be fed with a MAD. At the same time, children from scheduled caste (SC) households have a lower probability of MAD feeding. The lower MAD feeding among the SC households suggests strengthening the ongoing programmes with a higher emphasis on the inclusion of this disadvantaged and marginalised group. Findings from the current study would assist policymakers, and public health managers improve MAD feeding practices in Odisha, India, in a targeted manner.

Keywords
Minimum acceptable diet
Children aged 6–23 months
Determinants
Odisha
India

Minimum acceptable diet (MAD) is one of the eight core indicators for assessing infant and young child feeding (IYCF) practices for children aged 6–23 months that combines minimum dietary diversity (MDD) and minimum meal frequency (MMF)⁽¹⁾. Breast milk is inadequate to meet the nutritional requirements of infants and young children after 6 months, suggesting the need to initiate complementary feeding of other foods besides breast milk⁽²⁾. Complementary feeding is the process starting when breast milk alone is no longer sufficient to meet the nutritional needs of infants, and hence other foods and liquids are required, along with breast milk. A nutritionally adequate diet is necessary for optimal growth, health and development of children below 2 years. The dietary diversity is a

proxy for adequate micronutrient density of foods, and MMF is a proxy for a child's energy requirements.

The determinants of MAD feeding are complex and multi-dimensional, while malnutrition has been found to affect the physical and cognitive development of the child and higher morbidity and mortality among children. Globally, more than two-fifths (45 %) of all deaths in children under 5 years are linked to poor nutrition, highlighting the unacceptably high burden of malnutrition⁽³⁾. India, like many other developing countries, records a low nutritional status of children, with only 6 % of the children aged 6–23 months fed a MAD⁽⁴⁾. Infants and young children are vulnerable to undernutrition, especially stunting and micronutrient deficiencies, and increased morbidity and mortality,

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in the absence of a MAD feeding^(5–9). Evidence reveals lower odds of stunting among Indian children who achieved the MDD indicator⁽¹⁰⁾. Stunting in early life is found to have long-term effects on health, physical and cognitive development, learning and earning potential⁽¹¹⁾. Nutritious complementary foods, along with breast-feeding, can reduce stunting among children aged 6–23 months⁽¹²⁾.

Odisha is one of the Empowered Action Group states (socio-economically and demographically backward) identified by the Government of India to focus on monitoring and facilitating the attainment of national health goals. Of the 42 million state's population, 83 % live in rural areas. It has the third-largest tribal population in the country, and 40 % of its people are scheduled tribes (ST) and scheduled castes (SC)⁽¹³⁾. With 32.59 % of the population below the poverty line against the national average of 21.92 %, Odisha ranks second among bigger states with a maximum number of populations below the national poverty line⁽¹⁴⁾. The state has done remarkably well in health and nutrition outcomes over the past two decades⁽¹⁵⁾. It has been identified as a 'positive deviant' in nutrition policymaking⁽¹⁶⁾. However, despite progress in child and maternal health indicators, Odisha is plagued by a high malnutrition level. The latest estimate reveals that 34 % of the under-five children are stunted and underweight, and 20 % is wasted in the state⁽¹⁷⁾. Wasting has remained unchanged between 2005–2006 and 2015–2016. Among Indian districts, Odisha has the highest inequality between districts for all three child growth failure indicators in 2017⁽¹⁸⁾. Additionally, Odisha has the highest proportion of newborns (18.25 %) with low birth weight in 2017–2018⁽¹⁹⁾. Odisha jointly with Madhya Pradesh topped the list of states in early neonatal mortality rate (24 per 1000 live births), had the highest rate of perinatal mortality (36 per 1000 live births and stillbirths) and was second in under-five mortality rate (47 per 1000 live births) in 2017⁽²⁰⁾. IYCF practices significantly affect child nutrition and are deemed to be influenced by the state's socio-cultural, demographic and economic condition, reinforcing the need for more state-specific research on predictors of IYCF practices. The state-specific concurrent monitoring survey reveals meagre coverage of all IYCF practices except exclusive and continued breast-feeding in rural Odisha⁽²¹⁾. Moreover, the survey found only 8 % of the children in the nutritionally high burdened districts (attributed with disadvantages such as high poverty rate, low female literacy, high proportion of the tribal population, high infant mortality rate) had a MAD compared with 12 % of their counterparts from not-high burdened districts. Appropriate complementary feeding is, however, projected to avert about half of the total stunting cases in the state by 2030⁽²²⁾.

An insightful assessment of MAD feeding practices among different subgroups with varying socio-economic and demographic characteristics using a large representative sample will have better policy implications to improve

the IYCF practices and reduce child morbidity and mortality. Since MAD is seemingly a complex metric, it is equally essential that various facets of MAD as a critical indicator of IYCF practices are thoroughly investigated. There is, however, no empirical study based on a representative sample of children that unfolds the determinants of MAD in Odisha, though deemed necessary for nutrition-focused policy and programme. Thus, the present study is an effort to assess the level, socio-economic differentials and determinants of MAD feeding in Odisha. To our knowledge, this is the first-ever comprehensive study based on a large representative sample of children gathered through the National Family Health Survey (NFHS-4) that aims to explain the child, maternal, household and community-level determinants of MAD in the state. The study results deemed to provide the evidence required to formulate/strengthen strategies and programmes for appropriate complementary feeding interventions. Information on the determinants of inadequate MAD feeding will help target high-risk groups to formulate appropriate health and nutrition programmes to enhance the proportion of children meeting the MAD. The MAD indicator is also associated with child anthropometric status, especially stunting; hence, it is useful for population-level assessment. The essence of this paper may also be considered for the context setting of the child's dietary sufficiency for further programme focus and strategy building by the agencies responsible for promoting child nutrition.

Methods

Data

The present study used data from the NFHS-4, a nationally representative survey conducted during 2015–2016. A total of 699 686 women aged 15–49 years, 112 122 men aged 15–54 years and 243 867 children under-five years were surveyed from 601 509 households covering all districts in the country. The NFHS-4 provides information for a wide range of monitoring and impact evaluation indicators of population, health and nutrition. The sampling design of the NFHS-4 is a stratified two-stage sample with an overall response rate of 98 %. The primary sampling unit, that is, the survey villages in rural areas and Census Enumeration Blocks in urban areas, were selected using probability proportional to size sampling. The selection of households within a primary sampling unit preceded complete household mapping and listing operation. The households were randomly selected with systematic sampling in each of the selected primary sampling unit for the survey. The data were gathered using computer-assisted personal interviewing by trained research investigators. Informed consent procedures were followed, and only those respondents who voluntarily consented to participate in the survey were interviewed. A more detailed survey design, questionnaire, quality control measures

and survey management information can be obtained elsewhere⁽¹⁷⁾. The present analysis was carried out for youngest children aged 6–23 months, living with mother and for whom complete information on MAD was available in the survey for the state of Odisha (*n* 3073).

Outcome variable

The outcome variable considered for the analysis was the MAD feeding classified as '0' if the child was not fed MAD and '1' if the child was fed a MAD. Children aged 6–23 months were considered to be fed with a MAD if they are breast-feeding or not breast-feeding and receiving two or more feedings of commercial infant formula, fresh, tinned and powdered animal milk, and yogurt; are fed the MDD (i.e., children receive foods from four or more of the following food groups: (a) infant formula, milk other than breast milk, cheese or yogurt or other milk products; (b) foods made from grains or roots, including porridge or gruel, fortified baby food; (c) vitamin A-rich fruits and vegetables; (d) other fruits and vegetables; (e) eggs; (f) meat, poultry, fish, shellfish, or organ meats and (g) beans, peas, lentils, or nuts) and are fed the MMF (i.e., for breastfed children, MMF is receiving solid or semi-solid food at least twice a day for infants 6–8 months and at least 3 times a day for children 9–23 months; and for non-breastfed children aged 6–23 months, MMF is receiving solid or semi-solid food or milk feeds at least 4 times a day⁽²⁾). The MAD was estimated through a dietary assessment method, wherein the child's mother was asked to recall all the food intake of the youngest child living with her, the previous day and night or the past 24 h of the surveyed date. The 24-h food recall was gathered through a face-to-face interview during the household visit for the survey. Specifically, the survey asked the question – Now I would like to ask you about liquids or foods that (NAME) had yesterday during the day or at night. I am interested in whether your child had the item I mention, even if it was combined with other foods. Did (NAME) drink/eat.

MDD means that the child has received foods from four or more groups from the seven groups in a 24-h time period. MMF means that the child received complementary foods the minimum recommended number of times in the past 24 h. For a breastfed child, the frequency should be at least two times for 6–8 months, and at least three times for 9–23 months of age. For a non-breastfed child, it should be at least four times in the last 24 h. Meal frequency for a non-breastfed child counts the number of times the child was given milk products (formula milk, milk or yogurt), which are not included in the count for a breastfed child.

Predictor variables

The predictor variables used in the analysis were chosen based on the extensive literature review^(23–29) and available information in the NFHS-4. The child characteristics included in the analysis were child's age in months (6–8,

9–11, 12–17, 18–23), gender (male, female), birth order (first, second and above), birth weight (< 2.5 kg – written card, 2.5 kg and above – written card, < 2.5 kg – mother's recall, 2.5 kg and above – mother's recall, not weighted/do not know), initiation of breast-feeding (within 1 h of birth, after 1 h of birth) and received any benefit from Integrated Child Development Scheme (ICDS) in last 12 months (no, yes). Mother's age (15–24, 25–29, 30–49), age at marriage (19 and below years, 20 years and above), years of schooling (illiterates, < 10 years, 10 years and above), media exposure (no, yes), number of antenatal care (ANC) visit for last pregnancy (< 4, 4 and above visits) and place of delivery of the youngest child (institutional, others) were included in the analysis to assess the importance of the mother's characteristics in MAD feeding. The household features like social groups (SC, ST, other backward classes (OBC), non-SC/ST/OBC) and wealth index (poorest/poorer, middle, richer/ richest) were included in the analysis to understand the socio-economic impact of household-level predictors of the MAD feeding. The wealth index is a measure of a household's living standard and was calculated using data on household's ownership of selected assets, materials used for housing construction and types of water access and sanitation facilities. Additionally, community-level characteristics such as the place of residence (urban, rural), geographical regions (coastal, northern, southern) and nutritionally classified type of districts⁽³⁰⁾ (high burdened districts, low burdened districts) were considered to study their role in MAD feeding. The National Sample Survey Office classification of the region⁽³¹⁾ was followed to classify districts into regions.

Statistical analysis

Descriptive analysis was first conducted to present the socio-demographic profile of children aged 6–23 months. Bivariate analyses followed this to understand the individual association between the predictors and outcome variable. The binary logistic regression was carried out to examine the adjusted effect of MAD feeding's socio-economic and demographic predictors. The regression model's outcome variable was categorised into binary, that is, 1 = yes, 0 = no. The variables 'age of the mother' and 'place of delivery' were dropped from the regression analysis as they are closely related to 'age at marriage of the mother' and 'frequency of ANC visits for the last pregnancy'. The variables 'region' and 'classification of the district by nutritional burden' are the combination of districts and are overlapping; the latter was dropped from the regression model. The final list of variables included for regression analysis was finalised after checking multicollinearity among the predictor variables. The variable inflation factor test was done to check multicollinearity. All the predictor variables included in the model had a variable inflation factor score below three, ruling out multicollinearity. The goodness of fit was checked through the Pearson χ^2 goodness-of-fit



test⁽³²⁾. State-level sample weight was used to adjust the non-responses. STATA (V.16) was used for analyses.

Results

Sample characteristics

Table 1 presents the socio-economic and demographic characteristics of children aged 6–23 months surveyed in Odisha. Of the children, 16% were 6–8 months old, 18% were 9–11 months old, 32% were 12–17 months old and the rest aged 18–23 months. Boys comprised 53% of the total children. Forty-two percentage of the children were first-order births, while the remaining were of birth order two and above. According to the written card, 58% of the children were weighed at least 2.5 kg at the time of birth, and 15% weighed < 2.5 kg. Only 4% of the children were below 2.5 kg at birth, according to the mother's recall. Initiation of breast-feeding was within 1 h of birth for more than two-thirds (69%) of the children. Ninety-one percentage of the children received any benefit from ICDS in the 12 months preceding the survey. Forty-two percentage of the mothers were aged between 15 and 24 years, 37% were between 25 and 29 years and the remaining between 30 and 49 years. Nearly three-fifths (57%) of the mothers were married before 20 years of age. About a quarter (26%) of the mothers were non-literates. More than seven out of every ten mothers had mass media exposure. Sixty-three percentage of the mothers had 4+ ANC visits for their last pregnancy. Most of these children (87%) were born in an institution. Two-thirds of these children belong to the poorest/poorer households. Of the total children, 32% were from OBC, 29% from ST, 23% from SC and 17% from the non-SC/ST/OBC category. A majority (85%) of the children reside in rural areas. Thirty-seven percentage of the children belong to southern regions, 34% to the coastal area and 29% to the northern part of the state. More than half (52%) of the children were from nutritionally low burdened districts.

Socio-economic and demographic differential in the minimum dietary diversity, minimum meal frequency and minimum acceptable diet feeding

MDD was found in about one-fifth (21%) of the children aged 6–23 months (Table 2). MDD was found higher among children aged 12 months plus, males, breastfed after 1 h of birth, received any benefit from ICDS, having a mother with 10+ years of schooling, whose mother was exposed to mass media, delivered in an institution, from richer/richest households, from non-SC/ST/OBC households, belong to the coastal region and from nutritionally low burdened districts than their respective counterparts. The analysis found two-fifths (40%) of the children aged 6–23 months were fed a MMF. MMF was found higher among children aged 6–8 months, second or higher birth

order, breastfed within 1 h of birth, received any benefit from ICDS, whose mother had 4+ ANC visit for last pregnancy, delivered in an institution, from non-poorest/poorer households, from OBC households, belong to the southern region and from nutritionally high burdened districts than their respective counterparts.

Only 8.4% of the children aged 6–23 months were fed a MAD. The highest proportion of MAD feeding was noted among the 18–23 months age group (12%), while the lowest percentage came from the 6–8 months age group (4%). Nine out of every 100 boys found to be fed with a MAD compared with eight out of every 100 girls. Eight percentage of the first-order births were fed a MAD, while the corresponding figure was 9% for those second- or higher-order births. A relatively higher percentage of the children whose measured weight was < 2.5 kg at the time of births were fed a MAD than those who weighed at least 2.5 kg (10% *v.* 8%).

A higher percentage of the children born to older mothers found to be fed with a MAD. For example, 7% of the children of mothers aged 15–24 years were fed with a MAD, as against 10% of those with mothers aged 30 years and above. Seven percentage of the children of non-literate mothers were fed with a MAD, while the corresponding figure was 9% for those children whose mothers had ten and above years of schooling. Nine percentage of the children whose mothers had mass media exposure were fed a MAD compared with 6% of their counterparts with mothers without mass media exposure. A higher percentage of the children whose mothers had 4+ times ANC visits were fed a MAD than their peers whose mothers had < 4 times of ANC visits (9% *v.* 6%). Nine percentage of the children born in an institution were fed a MAD compared with 7% of those non-institutional deliveries.

Ten percentage of the children from the non-SC/ST/OBC category were given a MAD compared with 6% of the SC children. Nine percentage of the children each from the ST and OBC categories were fed a MAD. The MAD feeding is found to increase with the uptrend of the economic status of the household – 7, 10 and 11% of the children, respectively, from poorest/poorer, middle and richer/richest households were fed a MAD. The MAD feeding of children did not vary by place of residence, that is, urban *v.* rural. Higher percentages of the children from the coastal region (10%) were fed with a MAD compared with those from the northern (8%) and the southern (7%) region. There is no difference in MMF feeding between nutritionally high and low burdened districts (8% in each group of districts). At the district level, the percentage of children with MAD feeding varied from 3% in Kalahandi to 17% in Puri (Fig. 1).

Determinants of minimum acceptable diet feeding

The logistic regression revealed that after adjusting the effect of predictors used in the model, the likelihood of

**Table 1** Socio-economic and demographic characteristics of children aged 6–23 months, Odisha, India, 2015–2016

Characteristics	% distribution of children	Number of children
Child's age in months		
6–8	16.4	504
9–11	17.7	544
12–17	32.3	994
18–23	33.5	1031
Child's gender		
Male	53.1	1632
Female	46.9	1441
Child's birth order		
First	42.4	1303
Second and above	57.6	1770
Child's birth weight		
Less than 2.5 kg – written card	14.5	445
2.5 kg and above – written card	58.4	1796
Less than 2.5 kg – mother's recall	4.4	133
2.5 kg and above – mother's recall	17.8	548
Not weighted/do not know	4.9	151
Child's initiation of breast-feeding		
Within 1 h of birth	68.6	2107
After 1 h of birth	31.4	966
Child received any benefit from ICDS in the last 12 months		
No	8.8	269
Yes	91.2	2804
Current age of mother		
15–24 years	42.2	1296
25–29 years	36.6	1126
30–49 years	21.2	651
Age at marriage of the mother		
19 and below years	56.6	1720
20 and above years	43.4	1321
Years of schooling of the mother		
No schooling	25.8	793
Less than 10 years	51.2	1574
10 and above years	23.0	706
Mass media exposure of the mother		
No	28.1	863
Yes	71.9	2210
Antenatal care visits for the last pregnancy		
<4 times	37.5	1152
4+ times	62.5	1921
Place of delivery of the youngest child		
Others	12.6	386
Institutional	87.4	2686
Wealth index of the household		
Poorest/poorer	65.5	2013
Middle	19.7	604
Richer/richest	14.8	456
Social group of the household		
Non-SC/ST/OBC	17.1	524
Scheduled caste (SC)	22.5	691
Scheduled tribe (ST)	28.5	875
Other backward class (OBC)	32.0	983
Place of residence		
Urban	14.7	452
Rural	85.3	2621
Region*		
Coastal	33.7	1035
Northern	29.2	896
Southern	37.1	1141
Nutritionally classified type of districts†		
High burdened districts (HBD)	47.5	1461
Low burdened districts (LBD)	52.5	1612
Total children aged 6–23 months	100.0	3073

*Coastal (nine districts, namely Baleshwar, Bhadrak, Kendrapara, Jagatsinghapur, Cuttack, Jajapur, Nayagarh, Khordha, Puri), Northern (nine districts, namely Bargarh, Jharsuguda, Sambalpur, Debagarh, Sundargarh, Kendujhar, Mayurbhanj, Dhenkanal, Angul) and Southern (twelve districts, namely Ganjam, Gajapati, Kandhamal (Phoolbani), Boudh, Sonapur, Balangir, Nuapada, Kalahandi, Rayagada, Nabarangpur, Koraput, Malkangiri).

†HBD – Angul, Bhadrak, Balangir, Gajapati, Jharsuguda, Kalahandi, Kandhamal, Keonjhar, Koraput, Malkangiri, Nowrangpur, Nuapada, Rayagada, Sambalpur and Sundergarh. LBD – rest of the fifteen districts.

**Table 2** Percentage of youngest children aged 6–23 months living with their mother who are fed a MDD, MMF and MAD based on child, maternal, household and community characteristics, Odisha, India, 2015–2016

Characteristics	Minimum dietary diversity	Minimum meal frequency	Minimum acceptable diet	<i>n</i>	χ^2 value
Child's age in months					48.03***
6–8	4.7	46.5	3.5	504	
9–11	13.5	35.0	5.6	544	
12–17	23.1	37.8	8.6	994	
18–23	30.4	41.7	12.1	1031	
Child's gender					2.35
Male	22.1	40.8	9.1	1632	
Female	19.4	39.1	7.7	1440	
Child's birth order					1.78
First	20.9	37.5	7.7	1303	
Second and above	20.8	41.9	9.0	1770	
Child's birth weight					1.85
Less than 2.5 kg – written card	23.5	37.7	9.7	445	
2.5 kg and above – written card	20.6	40.5	8.1	1796	
Less than 2.5 kg – mother's recall	15.1	35.2	8.3	133	
2.5 kg and above – mother's recall	21.4	40.8	8.3	548	
Not weighted/do not know	19.2	42.3	8.6	151	
Child's initiation of breast-feeding					0.11
Within 1 h of birth	19.8	42.3	8.6	2107	
After 1 h of birth	23.2	35.1	8.1	966	
Child received any benefit from ICDS in the last 12 months					0.37
No	18.0	36.4	8.0	269	
Yes	21.1	40.2	8.4	2804	
Current age of mother					1.55
15–24	18.4	38.2	7.2	1296	
25–29	23.4	39.9	9.0	1126	
30–30	21.2	43.9	9.9	651	
Age at marriage of the mother					0.53
19 and below years	20.3	38.6	8.1	1720	
20 and above years	21.1	41.4	8.5	1321	
Years of schooling of the mother					2.07
No schooling	17.1	39.3	6.9	793	
Less than 10 years	20.8	41.1	8.9	1574	
10 and above years	25.0	38.4	9.2	706	
Mass media exposure of the mother					5.07**
No	16.4	40.3	6.3	863	
Yes	22.6	39.9	9.3	2209	
Antenatal care visits for the last pregnancy					2.02**
<4 times	19.5	36.8	7.3	1152	
4+ times	21.6	42.0	9.1	1921	
Place of delivery of the youngest child					1.44
Others	16.5	38.4	6.7	386	
Institutional	21.4	40.3	8.7	2686	
Wealth index of the household					10.12***
Poorest/poorer	18.3	38.5	7.4	2013	
Middle	22.8	43.6	10.0	604	
Richer/richest	29.3	42.2	11.1	456	
Social group of the household					5.39
Non-SC/ST/OBC	23.7	37.0	10.4	524	
Scheduled caste (SC)	18.5	36.5	6.0	690	
Scheduled tribe (ST)	20.4	39.8	8.7	875	
Other backward class (OBC)	21.4	44.3	8.8	983	
Place of residence					0.22
Urban	20.9	41.4	8.4	452	
Rural	20.8	39.8	8.5	2620	
Region					2.33
Coastal	24.7	38.8	10.0	1036	
Northern	22.4	37.6	8.1	896	
Southern	16.1	43.1	7.3	1141	
Nutritionally classified type of districts					0.17
High burdened districts (HBD)	18.2	43.0	8.4	1461	
Low burdened districts (LBD)	23.2	37.3	8.4	1612	
Total	20.8	40.0	8.4	3073	

Significant at ** $P < 0.05$, *** $P < 0.01$.

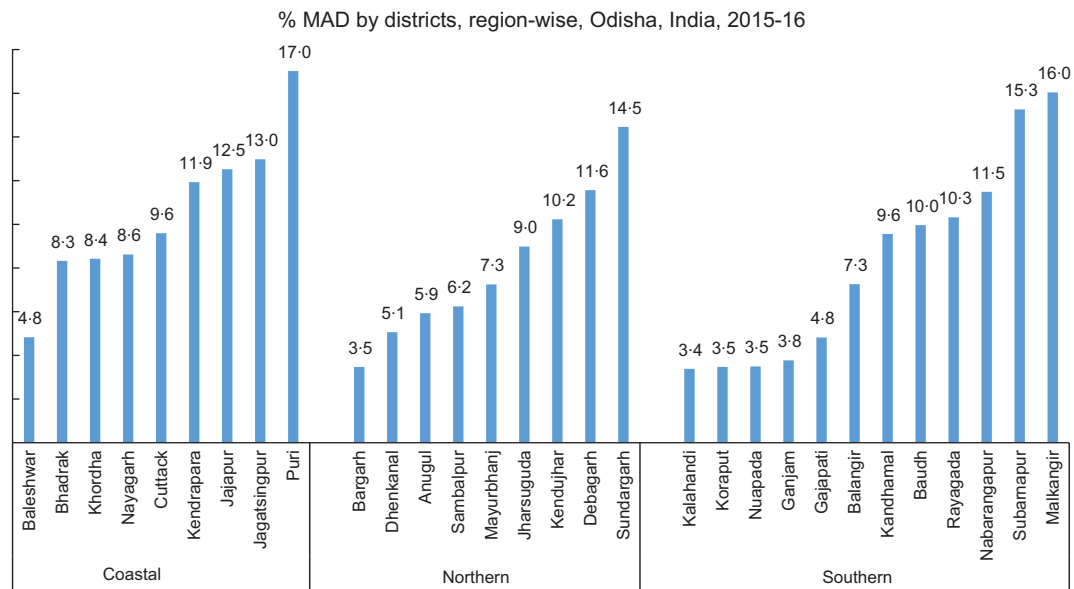


Fig. 1 (colour online) Percentage of children aged 6–23 months given a MAD by districts and region-wise, Odisha, India, 2015–2016

MAD feeding increased with the child's increased age (Table 3). For example, compared with children aged 6–8 months, children aged 12–17 months had two times (OR: 2.51, 95 % CI (1.48, 4.26)) and those aged 18–23 months had three times (OR: 3.77, 95 % CI (2.55, 6.30)) higher odds of having a MAD. Children of the second or higher birth order were more likely (OR: 1.38, 95 % CI (1.04, 1.83)) to be fed with a MAD than those of the first-order births. Children whose mother was exposed to any mass media had a higher chance of MAD feeding (OR: 1.46, 95 % CI (1.01, 2.11)) compared with children whose mother was not exposed to any mass media. Children from the SC category were less likely (OR: 0.63, 95 % CI (0.40, 0.99)) to have received a MAD than those from the non-SC/ST/OBC category.

Discussion

The study found a considerably low percentage of the children aged 6–23 months were fed with a MAD, and the MAD feeding varies considerably by socio-demographic characteristics. Higher age of the children, second- or higher-order births and mother's mass media exposure are significant predictors of MAD feeding. Additionally, children from SC households are significantly less likely to be fed with a MAD. The MAD feeding is found to increase with the age of the children, and this finding is consistent with evidence from south-east Asia and Africa^(12,23–26). The possible reason for the higher rate among older children might be attributed to the late introduction of complementary feeding and gradual stage-wise introduction of feeding starting with milk or cereal products⁽³³⁾. Traditional beliefs on food items and the perceived unsuitability of specific food items for very young children may also be another possibility.

Higher birth order children found to have advantages in MAD feeding. An earlier study assessing factors associated with complementary findings among Indian children also revealed that compared with first-born children, second to fourth-born children in the Northern, Eastern, Central and North-Eastern regions were more likely to meet MAD⁽²⁷⁾. This may be because of better awareness and exposure to the determinants of child nutrition/health among the mothers based on their experience of the first child. A past study in the Philippines also suggests that with increasing parity, mothers gain more knowledge on how to feed the child appropriately⁽²¹⁾. Mother's exposure to mass media influenced the MAD feeding positively, and a similar finding was found in a past study in Ethiopia⁽³³⁾. The study found SC children were less likely to be fed with a MAD. This may be because of inadequate awareness about the importance of diet diversity and inability to afford the required diet diversity and meal frequencies. There is enough evidence to suggest lower literacy among the SC people and their economically weaker status^(17,34,35). Another possibility may be continuing social group-based inequalities in accessing health services and health services utilisation measures, SC communities being the disadvantaged group^(36–39).

Under the broader umbrella of ICDS, the state government is implementing various programmes in community-based approaches like 'SURYAMUKHI' and 'PADA POSHAN KARIYAKRAMA' to prevent malnutrition in early childhood. They focus on awareness generation through community outreach and reaching out to children in remote areas where regular Anganwadi services are absent. Such programmes are perceived to influence MAD feeding in the state. The government is also implementing MAMTA Diwas (otherwise known as Village Health, Sanitation and Nutrition Day) and Pushtikar Diwas (Nutrition Day)

**Table 3** Adjusted OR (AOR) for minimum acceptable diet (MAD) feeding among children aged 6–23 months, Odisha, India, 2015–2016

Characteristics	AOR	95 % CI
Child's age in months		
6–8 [®]	1.00	
9–11	1.64	0.90, 2.99
12–17	2.51***	1.48, 4.26
18–23	3.77***	2.25, 6.30
Child's gender		
Male [®]	1.00	
Female	0.82	0.63, 1.07
Child's birth order		
First [®]	1.00	
Second and above	1.38**	1.04, 1.83
Child's birth weight		
Less than 2.5 kg – written card [®]	1.00	
2.5 kg and above – written card	0.78	0.53, 1.13
Less than 2.5 kg – mother's recall	0.86	0.42, 1.77
2.5 kg and above – mother's recall	0.75	0.47, 1.18
Not weighted/do not know	1.09	0.55, 2.18
Child's initiation of breast-feeding		
Within 1 h of birth [®]	1.00	
After 1 h of birth	0.93	0.70, 1.24
Child received any benefit from ICDS in the last 12 months		
No [®]	1.00	
Yes	1.11	0.67, 1.84
Age at marriage of the mother		
19 and below years [®]	1.00	
20 and above years	0.95	0.72, 1.26
Years of schooling of the mother		
No schooling [®]	1.00	
Less than 10 years	1.13	0.76, 1.67
10 and above years	1.06	0.65, 1.73
Mass media exposure of the mother		
No [®]	1.00	
Yes	1.46**	1.01, 2.11
Antenatal care visits for the last pregnancy		
<4 times [®]	1.00	
4+ times	1.32	0.99, 1.76
Wealth index of the household		
Poorest/poorer [®]	1.00	
Middle	1.33	0.93, 1.89
Richer/richest	1.51	0.98, 2.34
Social group of the household		
Non-SC/ST/OBC [®]	1.00	
Scheduled caste (SC)	0.63**	0.40, 0.99
Scheduled tribe (ST)	1.20	0.77, 1.85
Other backward class (OBC)	0.90	0.61, 1.32
Place of residence		
Urban [®]	1.00	
Rural	1.19	0.80, 1.78
Region		
Coastal [®]	1.00	
Northern	0.71	0.50, 1.02
Southern	0.73	0.52, 1.03
Pearson χ^2 (2754) = 2649.51		
Prob > χ^2 = 0.9218		

[®]Reference category.

**Significant at $P < 0.05$.

***Significant at $P < 0.01$.

observed on the 15th of every month at the Block PHC/CHCs) to increase child nutrition⁽⁴⁰⁾. Efforts under Pushtikar Diwas include the identification of the high-risk pregnant mothers and undernourished children, promotion of improved child feeding, counselling of mothers, caregiving and care-seeking practices at the facility, family and community levels⁽⁴¹⁾. Additionally, the Nutrition

Rehabilitation Centre operates to address the health and nutrition aspects of the severely undernourished children. An earlier study highlights the contributing role of transformation in the health system to the narrowing gap between nutrition outcomes of children from marginalised area and community, compared with the state average⁽¹⁶⁾. The Women and Child Development department in



September 2019 has also launched a comprehensive communication strategy and unveiled a mascot, 'Tiki Mausi' (typical friendly neighbourhood aunty), to provide information about women and child nutrition. The campaign 'Tiki Mausi kuhe' (Tiki Mausi says) aims to ensure last mile penetration in every corner of the state through social media, folk media, radio jingles, animated videos, and walls paintings and hoardings.

The proportion of children receiving a MAD was lower than the national average signalling the continuing problem of child undernutrition in the state. The low level of MAD feeding despite targeted programmes and policies may be attributed to various reasons. There is a lack of/poor inter-sectoral convergence between nutrition-focused schemes implemented in the state. For example, take home ration being implemented through ICDS and Public Distribution System implemented through Food Supply and Consumer Welfare department has no coordination, though both the schemes supply food grains to households under some criteria. A sizable percentage of the households falls below the poverty line, which mainly depend on government food schemes (like 1 rupee/kg of rice) for survival; thus, ensuring diet diversity in the absence of food security seems difficult. Additionally, there seems no effort to link agricultural diversity to nutrition, for example, lack of nutrition garden in Anganwadi centres. Better inter-sectoral coordination and diet diversity in ongoing food schemes/programmes are expected to enhance the MAD feeding in the state further.

The strengths of the study could be attributed to the findings that are based on a large representative sample of children covered in the recently concluded NFHS-4 with a robust sampling design, and thus the results are contemporary. The study documents the current MAD feeding and disparities by socio-demographic attributes and presents the adjusted estimates with higher acceptability. It further identifies predictors of MAD feeding at the community, household, maternal and children levels. The study finding that children from the SC category are least likely to be fed with a MAD against the general view that ST children are the most vulnerable is noticeable and indicates the need for more customised interventions even among the socially disadvantaged populations. The study found that MAD feeding was high among children with mothers exposed to mass media. This finding can be attributed to community-based approaches like 'SURYAMUKHI' and 'PADA POSHAN KARIYAKRAMA', and MAMTA Diwas implemented by the state. This new evidence indicates the success of ongoing nutrition-focused awareness generation programmes in the absence of any evaluation of the programmes mentioned above. The study also revealed inter-district variations in MAD feeding, which may lead to a strategic target setting through tailor-made health and nutrition programmes/interventions to enhance MAD feeding.

The cross-sectional design of the survey, however, limits the causal association of MAD feeding with socio-demographic factors drawn from the current analysis. Additionally, other factors like agricultural diversity, availability of different food types, household food consumption pattern/practice like region-specific preferences of food and consumption practices have not been accounted for. For example, in tribal dominant regions of the state, the consumption of '*Kbichdi*' (mix of rice with dal and vegetables) is not widespread. However, it has an excellent nutritional value, wholesome food, easy to cook and digest. Similarly, '*Dalama*' (a mix of dal with vegetables) is also not popular in the tribal pocket, although it is very much acceptable in the coastal region of the state. These food preferences and consumption practices coupled with traditional beliefs about different foods and their perceived impact on child and mother health may further affect MAD feeding, which could not be included in the analysis due to paucity of data. Despite this, the study's findings would help formulate new policy/programme or strengthen the existing ones to increase the MAD feeding in Odisha/India and other developing countries with similar socio-economic and demographic characteristics, thus ensuring better child nutrition. Policy formulators should delve into niceties of the socio-economic and demographic variances on MAD and design-specific interventions.

The MAD feeding practices among children aged 6–23 months were not satisfactory and varied considerably by socio-demographic characteristics in Odisha. The children of higher age, second- or higher-order births, with mother exposed to mass media had a significantly higher likelihood, and those from SC households had a lower prospect of MAD feeding. The results suggest the need for multi-sectoral programme and interventions. Social Behaviour Change Communication activities on the importance of MAD and diet diversity would be useful to improve the MAD prevalence. More intensive counselling of mothers through peers, community facilitators and health care providers would be necessary targeting, especially the groups with suboptimal MAD feeding, in addition to the ongoing programmes. The lower MAD feeding among the SC households suggests the need to strengthen the ongoing programmes with a higher emphasis on the inclusion of this disadvantaged and marginalised group. Findings from the current study would assist policymakers and public health managers in improving MAD feeding practices in Odisha in a targeted manner.

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