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Gender and dietary diversity among children aged 6-24months – evidence from a nationally representative survey

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Abstract

Background Malnutrition among children remains a critical public health challenge in India. WHO's IYCF model recommends that children should feed on five out of eight food categories daily. The objective of the study is to assess dietary diversity and associated risk factors among children, focusing on complex interplay of socio-economic and demographic factors.

Methods The study utilized nationally representative data from the National Family Health Survey (NFHS-5) conducted in 2019–2021, focusing on a sample of 62,553 children aged 6–24 months. Minimum Dietary Diversity (MDD) was assessed using children received foods from ≥ 5 food group out of eight specified food groups over the 24 h preceding the survey. Logistic regression employed to examine the association between DD and its predictors (p value < 0.05).

Results Overall, 52% of the children were male, while the remaining 48% were female. Only 23.3% of the children across India achieved MDD. Mother's education was positively associated with dietary diversity (OR:1.15; 95% CI:0.92–1.4). Factors significantly associated with dietary diversity were children aged 19–23 months (OR:4.03; CI:3.46–4.69), working mothers (OR:1.30; 95% CI:1.14–1.5) and children belonged to middle (OR:1.22; CI:1.05–1.43) and rich socio-economic status (OR:1.48; CI:1.26–1.8) as compared to their counterparts. Additionally, no difference found in dietary diversity among male and female children (OR:1.01; CI:0.9–1.11) and urban and rural areas (OR:101; CI:0.87–1.17). Those children belonged to Northeast region had around 70% higher dietary diversity as compared to Central region.

Conclusion This study highlights a concerning low prevalence of dietary diversity among young children in India. Interventions and policies should target on implementing comprehensive nutrition education programs for caregivers, coupled with targeted financial support and community engagement.

Keywords Gender, Dietary diversity, Children aged 6–24 months, Malnutrition, Public health, India

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Introduction

More than half of all child fatalities caused by undernutrition, which lead to 300,000 deaths annually [1]. Although, the prevalence of Malnutrition reduced, it still affects 200+millions children across globe [2]. Global nutritional programs being suggested as a preventive measure, potentially sparing 3 million lives, and reducing 20% various effects of malnutrition among under-5-year-olds [3]. Millions of children suffered from malnutrition, which included under nutrition, overweight/obesity, and micronutrient deficiencies, particularly highly prevalent in low- and middle-income countries (LMICs) [4] adding up to 21% to the Disability Adjusted Life Years (DALY), globally [5]. Micronutrient deficiencies, such as iron, vitamin A, zinc, folate, vitamin B12, vitamin D, and iodine were associated with serious health consequences [6]. Human potential was hampered by micronutrient deficiencies, which raised the prevalence of morbidity and mortality [3]. According to FAO, the prevalence of undernourished in southern Asia was 15.6% in the year 2022 [7]. In India, recent national estimates of 2020 reported widespread burden of stunting, wasting and underweight [8].

The importance of proper nutrition during the first two years of a child's life considered crucial for optimal growth and development, making it of paramount importance for global health [9]. The World Health Organization's Infant and Young Child Feeding recommends that children should consume at least five out of eight food categories including breast milk on every day [10].

Globally, only 28% of children between the ages of 6 and 23 months received the diversified diet [9, 11]. Undernutrition induced due to low diet diversity was one of the nutritional problems in LMICs. A retrospective cohort study reported 74% of low diet diversity, exposing its burden in LMICs [12]. Additionally, 37% of the children in South Asia met with minimum dietary diversity (MDD) [13]. In India, various studies utilized the fourth round of National Family Health Survey (NFHS) data to explore regional wise prevalence of dietary diversity. The results revealed that MDD ranged from 12% in central region to 33% in southern region of the country [14, 15].

As per several studies, the role of gender in diet diversity plays no significant role [16, 17]. The gender specific determinants of diet diversity among eight Asia Pacific countries found no disparity or evidence of gender's role in diet diversity [13]. However, there were significant difference in micronutrients levels between male and female children [18, 19].

In developing countries, impoverished populations faced significant challenges in achieving dietary diversity. Many researchers from low-and middle-income countries (LMICs) have documented differences in dietary diversity and socioeconomic classes by urban rural population. Evidence from other countries found the relationship between wealth and place of residence with dietary diversity. However, none of the studies have examined this association in India [3, 20, 21]. Urbanization induced substantial changes in urban food systems, and lifestyles, contributing significantly to the differences in access to diversified dietary intake [21].

Factors contributing to dietary diversity include family characteristics, birth order, birth weight and socioeconomic status. Adequate diet diversity among children was influenced by breastfeeding and child-rearing practices followed by mother, cooking practices, and their socioeconomic position of the household [22]. Mother's dietary diversity was linked with the growth and development of the child. In countries with low maternal dietary diversity, the prevalence of MDD among children was insufficient [1, 14, 23].

Inadequate dietary practices were higher in rural regions (38.4%), among Muslim children (37.9%), those belonging to scheduled caste and tribes (40.8%), and those from low-income families (47.9%) [24, 25]. Over the past decade, India has seen a 6.8% reduction in the failure of MDD, dropping from 87.4% in 2005-06. In addition to the most consistent factors mentioned hitherto, community healthcare services and more than four antenatal visits were indirectly proportional with MDDF [26].

Based on available literature, there are potential gaps and requirement to extensive understanding of risk factors. These includes MDDF (minimum dietary diversity failure), demographic burden, luxuries, role of gender and influence of maternal nutrition. Additionally, there is a need to explore their association with MDD and malnutrition among children.

This study aims to assess dietary diversity and its associated risk factors among children aged 6–24 months in India, shedding light on the complex interplay of socioeconomic, cultural, and demographic factors affecting children's nutritional status.

Methods

The present study utilized the most recent and nationally representative NFHS data (2019-21). The study included 62,610 children aged 6–24 months. The NFHS is a nationally representative household survey that provides country, state and district-level information about health and nutrition profile of the population in the country. The NFHS (2019-21) was the fifth round of the national survey conducted by the International Institute of Population Science (IIPS), Mumbai [8]. Technical assistance was provided by ICF International. A cross-sectional survey with multistage random sampling was used for household selection.

Study variables

Outcome variable: Minimum Dietary Diversity was assessed using children receive foods from 5 or more food group out of eight specified food groups over the 24 h preceding the survey. Children with dietary diversity scores ≥ 5 were classified as they attained adequate dietary diversity, whereas those with scores < 5 were classified as inadequate dietary diversity.

Independent Variables: The study included determinants of maternal, individual, and household characteristics.

Maternal Characteristics – Mother's education was categorized as no education, primary, secondary, and higher secondary and above. Similarly, mother's working status (yes, no), mother's age at first birth (< 18 years, > 18 years), mother's age at first marriage (< 18 years, > 18 years) and mother's BMI (underweight, normal BMI, overweight & obese).

Individual characteristics – Child age in months (6-11 months, 12-18 months and 19-23 months) , sex (male, female), birth order (first, second, third and above), birth weight (underweight, normal, overweight) and current breastfeeding status (yes, no).

Household Characteristics – Household-related factors were wealth status (poor, middle, rich), religion (Hindu, muslim and others), region (north, central, east, northeast, west and south), caste (schedule caste, schedule tribe, OBC and others), number of living children in household (1–2, 3–4, 5 and above), place of residence (urban, rural) and sex of household head (male, female). Wealth status was categorized into three categories based on family's socio-economic status as per NFHS-5 guidelines. Wealth status was determined using Principal Component Analysis (PCA).

Statistical analysis

Fifth round of National Family Health Survey data were analysed using software STATA version 16.0 to fulfil the study objective. Descriptive statistics was employed to examine the background characteristics of children. Multivariate logistic regression was employed to examine the association between dietary diversity and its predictors among children. The odds ratio (OR) with 95% confidence interval was calculated in order to assess the risk of independent variables. The coefficient with p value < 0.05 were considered as statistically significant. Additionally, the absolute difference was calculated to examine the disparity in dietary diversity between males and females.

Ethical approval

The National Family Health Survey (2019-21) is the fifth round of national survey which was conducted by International Institute for Population Sciences, Mumbai. The technical assistance on this survey is provided by ICF international. The study used a secondary dataset of NFHS from the Demographic Health Survey, which contains no information that may be used to identify the survey participants personally. This survey used the usual questionnaire to get consent before and throughout the investigation. This dataset is freely available online in public domain on the Demographic and Health Survey site; however, access is only permitted after registering and submitting the required research interest.

Results

Participant characteristics

The socio-demographic characteristics of children included in the survey are summarized in Table 1. Out of 62,610, male children were slightly higher than female children. More than half of the mothers (53.5%) were secondary educated and 19% of the mothers had no formal education. There were 57.2% of mothers got married at the age of 18 years and above whereas most of the mothers (81.6%) were > 18 years at the time of first birth. Around 60.7% of the mothers had normal BMI and around 63% children born with normal birth weight. Three fourth (74%) proportion of mothers were belonged to Hindu religion and had one to two children (74.6%). Around half of the mothers (49.2%) were belonged to poor socio-economic status. The proportion of mothers residing in rural area and belonged to central region were 79.7% and 25.4%, respectively. Most of the households (84.8%) were headed by male. Children between the age of 12–18 months were 40.7%. Around 38.6% of the children were born first in their family. The proportion of children who were currently breastfed were 86.0%.

Table 2 represents the prevalence of adequate and inadequate dietary diversity as per individual, household and maternal characteristics. The dietary diversity among children increased with the increase in mothers' educational status (5.0%) from non-educated to highly educated, mother's Nutritional status (5.1%) from undernourished to over nourished and mother's wealth status (2.3%) from poor to rich. Children of working mothers (7.5%) had more dietary diversity than non-working. The highest dietary diversity, at 28.2%, was found among children belonged to scheduled tribes. Children in urban areas had a slightly higher dietary diversity (1.5%) compared to those in rural areas. The highest dietary diversity, at 31.6%, was observed among children from the Northeast region, while the lowest was found among those from the central region, at 16.5%. The gender of the child did not impact the consumption of a diversified diet. The dietary diversity among female headed households (2.6%) were more as compared to male headed households. As the age of the child increased, along with a higher birth weight, there was a noticeable increase in the consumption of a diversified diet. Children born as

Table 1 Distribution of socio-demographic characteristics of household, mothers and their children aged 6–23 months

Socio-demographic characteristics	*n*	%
Mother's education		
No education	12,034	19.22
Primary	7,318	11.69
Secondary	33,524	53.54
Higher secondary & above	9,734	15.55
Mother's currently working status		
No	7,939	12.7
Yes	1,589	2.5
Missing cases	53,082	84.8
Mother's age at first birth		
< 18 years	11,545	18.4
> 18 years	51,065	81.6
Mother's age at first marriage		
< 18 years	26,690	42.6
> 18 years	35,819	57.2
Missing cases	101	0.2
Mother's BMI		
Underweight	13,522	21.6
Normal BMI	38,007	60.7
Overweight & obese	9,498	15.2
Missing cases	1,583	2.5
Religion		
Hindu	46,323	74.0
Muslim	8,891	14.2
Others	7,396	11.8
Caste		
SCs	12,778	20.4
STs	12,534	20.0
OBC	24,005	38.3
Others	10,006	16.0
Missing cases	3,287	5.2
Number of living children in HH		
1–2 children	46,717	74.6
3–4 children	13,122	21.0
5 & above children	2,771	4.4
Wealth status		
Poor	30,800	49.2
Middle	12,384	19.8
Rich	19,426	31.0
Type of place of residence		
Urban	12,733	20.3
Rural	49,877	79.7
Region		
North	11,113	17.7
Central	15,872	25.4
East	12,495	20.0
Northeast	9,098	14.5
West	5,737	9.2
South	8,295	13.2
Sex of household head		
Male	53,073	84.8
Female	9,537	15.2
Child's sex		

Table 1 (continued)

Socio-demographic characteristics	*n*	%
Male	32,521	51.9
Female	30,089	48.1
Child's age		
6–11 months	21,490	34.3
12–18 months	25,473	40.7
19–23 months	15,647	25.0
Child's birth order		
First	24,173	38.6
Second	21,095	33.7
Three and above	17,342	27.7
Child's birth weight		
Underweight	9,881	15.8
Normal	39,431	63.0
Overweight	8,332	13.3
Missing cases	4,966	7.9
Child's currently breastfeeding		
No	8,778	14.0
Yes	53,832	86.0
Total (N)	**62,610**	**100.0**

Note: SCs-Scheduled Castes; STs -Scheduled Tribes; BMI- Body Mass Index; HH-Household

the second child in the family exhibited greater dietary diversity compared to those born as the first child or as the third child and beyond. Dietary diversity was higher among currently breastfed children (5.1%) in comparison to those who were not breastfed.

Table 3 describes result of logistic regression analysis showing association between dietary diversity among children and their risk factors. The analysis confirms that education was positively associated with the diversified diet in children (OR=1.15; 95% CI=0.92–1.4). The dietary diversity was significantly higher in those children, whose mothers were working (OR=1.30; 95% CI=1.14–1.5), who were born second in the family (OR=1.26; CI=1.11–1.42), living in female headed household (OR=1.19; CI=1.03–1.38) and currently breastfed (OR=1.96; CI=1.67–2.32) as compared to their counterparts. Children those belonged to Muslim religion (OR=1.36; CI=1.06–1.51) and scheduled tribes (OR=1.43; CI=1.19–1.71) community had more dietary diversity as compared to those children belonged to other categories of religions and caste, respectively. The multivariate analysis also confirms that dietary diversity was higher among children belonged to middle (OR=1.22; CI=1.05–1.43) and rich (OR=1.48; CI=1.26–1.8) wealth status as comparted to other wealth categories. Bivariate analysis found significant association between place of residence and dietary diversity where multivariate analysis found almost no difference in dietary diversity among those residing in urban and rural areas (OR=1.01; CI=0.87–1.17). Additionally, no difference in dietary diversity among male and female children (OR=1.01; CI=0.90–1.11). Multivariate analysis confirmed that those children belonged to Northeast region (OR=1.47; CI=1.71–1.84) had more dietary diversity whereas those belonged to west region (OR=0.82; CI=0.67–1.03) had low dietary diversity. Children aged 19–23 months had more dietary diversity as compared to other age groups (OR=4.03; CI=3.46–4.69).

Table 4 presents the percentage distribution of food consumption among children in different age groups (6–11 months, 12–18 months, and 19–23 months). Results indicates that children aged 6–11 months minimally consumed flesh foods, eggs, legumes, and nuts, while the highly consumed food item was breast milk. Children aged 12–18 months predominantly consumed all the food groups, ranging from 40 to 47%. Among children aged 19–23 months, dairy products were minimally consumed at 29.1%, while the highest consumption was observed for flesh food, reaching 37.6%. The observed differences in food group consumption among age groups were statistically significant (p-value<0.001).

Table 5 shows the proportion of children aged 6–23 months who consumed adequate dietary diversity, categorized by gender (male vs. female), in various states and union territories (UTs) of India. The "Absolute Difference" column represents the absolute difference between the proportions for males and females in each region. Results indicates that there is a small gender difference at the national level, with male children (23.0%) having a slightly lower proportion of adequate dietary diversity compared to females (23.3%). Overall, the table highlights the state wise variations in the dietary diversity

Table 2 Prevalence of Minimum Dietary Diversity by selected socio-demographic characteristics in children aged 6–23 months

Socio-demographic characteristics	Minimum Dietary Diversity					*p*-value
	Inadequate dietary diversity		Adequate dietary diversity		Total	
	n	%	*n*	%	*N*	
Mother's education						< 0.001
No education	9,619	79.9	2,415	20.1	12,034	
Primary	5,657	77.3	1,661	22.7	7,318	
Secondary	25,542	76.2	7,982	23.8	33,524	
Higher secondary & above	7,290	74.9	2,444	25.1	9,734	
Mother's currently working status						< 0.001
No	6,130	77.2	1,809	22.8	7,939	
Yes	1,108	69.7	481	30.3	1,589	
Mother's age at first birth						= 0.131
< 18 years	8,809	76.3	2,736	23.7	11,545	
> 18 years	39,299	77.0	11,766	23.0	51,065	
Mother's age at first marriage						< 0.001
< 18 years	20,797	77.9	5,893	22.1	26,690	
> 18 years	27,238	76.0	8,581	24.0	35,819	
Mother's BMI						< 0.001
Underweight	10,640	78.7	2,882	21.3	13,522	
Normal BMI	29,225	76.9	8,782	23.1	38,007	
Overweight & obese	6,995	73.6	2,503	26.4	9,498	
Religion						< 0.001
Hindu	36,495	78.8	9,828	21.2	46,323	
Muslim	6,653	74.8	2,238	25.2	8,891	
Others	4,960	67.1	2,436	32.9	7,396	
Caste						< 0.001
SCs	9,968	78.0	2,810	22.0	12,778	
STs	9,002	71.8	3,532	28.2	12,534	
OBC	19,108	79.6	4,897	20.4	24,005	
Others	7,647	76.4	2,359	23.6	10,006	
Number of living children in HH						< 0.001
1–2 children	35,820	76.7	10,897	23.3	46,717	
3–4 children	10,233	78.0	2,889	22.0	13,122	
5 & above children	2,055	74.2	716	25.8	2,771	
Wealth status						< 0.001
Poor	23,959	77.8	6,841	22.2	30,800	
Middle	9,479	76.5	2,905	23.5	12,384	
Rich	14,670	75.5	4,756	24.5	19,426	
Type of place of residence						< 0.001
Urban	9,631	75.6	3,102	24.4	12,733	
Rural	38,477	77.1	11,400	22.9	49,877	
Region						< 0.001
North	8,708	78.4	2,405	21.6	11,113	
Central	13,255	83.5	2,617	16.5	15,872	
East	9,240	73.9	3,255	26.1	12,495	
Northeast	6,227	68.4	2,871	31.6	9,098	
West	4,698	81.9	1,039	18.1	5,737	
South	5,980	72.1	2,315	27.9	8,295	
Sex of household head						< 0.001
Male	40,991	77.2	12,082	22.8	53,073	
Female	7,117	74.6	2,420	25.4	9,537	
Child's sex						= 0.419
Male	25,031	77.0	7,490	23.0	32,521	
Female	23,077	76.7	7,012	23.3	30,089	

Table 2 (continued)

Socio-demographic characteristics	Minimum Dietary Diversity					*p*-value
	Inadequate dietary diversity		Adequate dietary diversity		Total	
	n	%	*n*	%	*N*	
Child's age						< 0.001
6–11 months	18,923	88.1	2,567	11.9	21,490	
12–18 months	18,623	73.1	6,850	26.9	25,473	
19–23 months	10,562	67.5	5,085	32.5	15,647	
Child's birth order						< 0.001
First	18,868	78.1	5,305	21.9	24,173	
Second	15,799	74.9	5,296	25.1	21,095	
Three and above	13,441	77.5	3,901	22.5	17,342	
Child's birth weight						< 0.001
Underweight	7,807	79.0	2,074	21.0	9,881	
Normal	30,094	76.3	9,337	23.7	39,431	
Overweight	6,260	75.1	2,072	24.9	8,332	
Child's currently breastfeeding						< 0.001
No	7,127	81.2	1,651	18.8	8,778	
Yes	40,981	76.1	12,851	23.9	53,832	
Total (N)	**48,108**	**76.8**	**14,502**	**23.2**	**62,610**	

Note: SCs-Scheduled Castes; STs -Scheduled Tribes; BMI- Body Mass Index; HH-Household

among children aged 6–23 months in India, with gender disparities present in several states and UTs. Understanding and addressing these differences are crucial for targeted interventions to improve nutritional outcomes for children across the country.

Figure 1 shows percentage distribution of children aged 6–23 months as per the number of food groups received during the previous day (in the last 24 h). A total of 23.2% of children had received five and more food groups during the previous day which indicates adequate dietary diversity.

Figure 2 presents the percentage distribution of children based on the types of food groups they received. Most of the children (86.0%) received breastmilk during the previous day. About half of the children (50.7%) received dairy products, including infant formula, milk, yogurt, and cheese. A smaller percentage of children received other fruits and vegetables (28.4%), legumes and nuts (18.1%) and eggs (17.6%). Lesser proportion of children received flesh foods, such as meat, fish, poultry, and organ meats (9.9%).

Discussion

The current study used NFHS 5 data to evaluate the factors contributing to dietary variety. Only 23% of children between the age of 6 and 23 months had viable minimal dietary variety, which suggests that dietary diversity score is below ideal among more than 2/3rd of the study children. In our country, POSHAN Abhiyaan, also known as National Nutrition Mission, is the Government of India's flagship programme aims to reduce malnutrition amongst children through multi-departmental convergence in a time bound manner with fixed target [27, 28]. Furthermore, we noticed that a relatively small percentage of children consumed food meals derived from animals. Additionally, there was a significant correlation found between children's MDD and the mother's education, occupation, age at first marriage, belief systems, caste, number of children in the family, wealth index, geographical area, sex of the head of the household, the age of the child, birth order, birth weight, and the fact that the child is currently breastfed.

Prevalence of MDD was achieved by only quarter of the population; however, it was slightly more when compared to a study conducted in Pune, Maharashtra reported 16.4% of diet diversity in its study population [29]. A study from Pakistan, detailed to have 21% of its respondents achieved minimal dietary diversity [30]. A similar study from India which used NFHS 3 and NFHS 4 data, reported 21.6% of the children aged between 6 and 24 months received MDD [21]. Study from Afghanistan (22%), Bangladesh (27%), Nepal (45%), Sri Lanka (71%) reported range of scores [31–36]. This difference on the score could be because of the variation in the calculated points and the number of food groups considered for the estimation of the diet diversity score. The current study meets the requirements of the WHO guidelines for diet diversity scoring.

Multivariate logistic regression analysis showed that dietary diversity was significantly associated with a wide range of maternal characteristics. In our study, education of the mother was not significantly associated with MDD. A meta-analysis assessed the impact of maternal education on nutritional status of children, stated that

Table 3 Results of logistic regression analysis of Minimum Dietary Diversity by selected socio-demographic characteristics in children aged 6–23 months

Socio-demographic characteristics	Odds Ratio	[95% C.I.]
Mother's education		
No education®	1.00	[1,1]
Primary	0.96	[0.776,1.188]
Secondary	1.08	[0.920,1.278]
Higher secondary & above	1.15	[0.923,1.423]
Mother's currently working status		
No®	1.00	[1,1]
Yes	1.307***	[1.138,1.502]
Mother's age at first birth		
< 18 years®	1.00	[1,1]
> 18 years	0.91	[0.768,1.084]
Mother's age at first marriage		
< 18 years®	1.00	[1,1]
> 18 years	1.214**	[1.058,1.395]
Mother's BMI		
Underweight®	1.00	[1,1]
Normal BMI	1.06	[0.924,1.218]
Overweight & obese	1.08	[0.900,1.298]
Religion		
Hindu®	1.00	[1,1]
Muslim	1.264**	[1.058,1.510]
Others	1.17	[0.956,1.437]
Caste		
SCs®	1.00	[1,1]
STs	1.426***	[1.189,1.710]
OBC	0.87	[0.746,1.009]
Others	0.96	[0.799,1.157]
Number of living children in HH		
1–2 children®	1.00	[1,1]
3–4 children	1.00	[0.674,1.476]
5 & above children	1.955**	[1.243,3.075]
Wealth status		
Poor®	1.00	[1,1]
Middle	1.225**	[1.050,1.428]
Rich	1.480***	[1.259,1.739]
Type of place of residence		
Urban®	1.00	[1,1]
Rural	1.01	[0.874,1.167]
Region		
North®	1.00	[1,1]
Central	0.758**	[0.634,0.907]
East	1.299**	[1.081,1.562]
Northeast	1.468***	[1.171,1.841]
West	0.82	[0.658,1.032]
South	1.526***	[1.263,1.844]
Sex of household head		
Male®	1.00	[1,1]
Female	1.190*	[1.031,1.373]
Child's sex		
Male®	1.00	[1,1]
Female	1.01	[0.902,1.119]
Child's age (in months)		

Table 3 (continued)

Socio-demographic characteristics	Odds Ratio	[95% C.I.]
6–11 months®	1.00	[1,1]
12–18 months	3.113***	[2.706,3.581]
19–23 months	4.032***	[3.461,4.698]
Child's birth order		
First®	1.00	[1,1]
Second	1.256***	[1.108,1.424]
Three and above	0.99	[0.671,1.448]
Child's birth weight		
Underweight®	1.00	[1,1]
Normal	1.200*	[1.031,1.395]
Overweight	1.273*	[1.049,1.545]
Child's currently breastfeeding		
No®	1.00	[1,1]
Yes	1.962***	[1.660,2.320]

Note:® - reference category; *p < 0.05; **p < 0.01; ***p < 0.001; SCs-Scheduled Castes; STs -Scheduled Tribes; BMI- Body Mass Index; HH-Household; CI- Confidence Interval

Table 4 Distribution of intake of eight food groups for children aged 6–23 months during the previous day (in last 24 h)

Food groups	6–11 Months (%)	12–18 months (%)	19–23 months (%)	Total (*N*)	*P*-value
a) Breastmilk	37.3	40.6	22.1	53,819	< 0.001
b) Grains, roots and tubers	25.3	45.0	29.6	41,224	< 0.001
c) Legumes and nuts	18.9	46.2	34.9	11,338	< 0.001
d) Dairy products (infants' formula, milk, yogurt, cheese)	26.5	44.4	29.1	31,768	< 0.001
e) Flesh foods (meat, fish, poultry and liver/organ meats)	15.8	46.6	37.6	6,223	< 0.001
f) Eggs	17.0	47.0	36.0	11,036	< 0.001
g) Vitamin A rich fruits and vegetables	19.4	46.8	33.8	26,119	< 0.001
h) Other fruits and vegetables	18.6	47.0	34.4	17,801	< 0.001
Total	**34.3**	**40.7**	**25.0**	**62,610**	

the link between child growth and mother education differs according to a country's income and education levels [29]. Employed mothers were found to be significantly associated with MDD among children. Similar to our findings, other studies also displayed a positive association of occupation of mothers with MDD among their children [30, 37]. This could be because of being young and unemployed is linked to ignorance and unawareness, while being older and employed may indicate strict eating regimens and affordability [30, 37, 38].

Our study illustrates that age of the mother during their marriage plays an important role, as women who married after 18 years of age significantly achieved more MDD for their children [37, 38]. In our study, ascending BMI of the mother was in relation with adequate DD. However, it was not significant.

Religion (Muslim: 1.26) and caste (ST: 1.42) of the household increased the odds of achieve the MDD by 1.2 and 1.4 times, respectively. This could be dependent on the frequency and usage of animal-based food groups in the household that delivers micronutrients compared to population in socioeconomically better category give reference [15]. Wealth status of the household had an influence on MDD, as the middle (1.2) and rich (1.4) group were better able to reach MDD compared to poor. This result was corresponding to other studies, this could be due to the financial flexibility and affordability to different sources of food by the household [31]. These outcomes might be attributed to high levels of maternal education, the flexibility to engage with individuals outside of the family at social events and markets and to share information, as well as media exposure [38, 39].

Geographical regions of India were also a factor that influenced the MDD among 6 to 24 months children, this could be linked with the rigorous functionality of Anganwadi centres [40–42]. Anganwadi centres serve as platforms for delivering take home ration to children under the ICDS program [40].

With increase in every month of age the adherence to MDD increases by 3.1 and 4 times among 12–18 months and 19–23 months, when compared to infants respectively. This was similar with a study using NFHS 3 data [23]. This is evidenced by a study in Bangladesh at two points in time with same samples. It reports older babies had an increased likelihood of reaching the minimum dietary diversity compared to infants, with the 18–23-month age group showing a substantial increase in meeting the minimum dietary diversity. Families' wealth and

Table 5 Proportion of children aged 6–23 months consuming adequate dietary diversity (Male vs. Female) by State and Union territories in India

State/UT	Male (%)	Female (%)	Absolut difference (%)
Chandigarh	50.0	12.5	37.5
Lakshadweep	30.3	48.5	18.2
Sikkim	47.4	55.7	8.3
NCT (Delhi)	22.1	29.8	7.6
Puducherry	37.1	29.7	7.4
Andaman & Nicobar Island	29.4	36.5	7.1
West Bengal	50.0	45.3	4.7
Mizoram	26.2	29.5	3.3
Dadra & Nagar Haveli	23.6	26.9	3.3
Andhra Pradesh	19.0	15.8	3.2
Punjab	23.2	26.3	3.2
Uttarakhand	17.4	14.8	2.6
Goa	44.6	47.1	2.4
Tripura	25.0	22.7	2.3
Kerala	44.8	47.0	2.2
Haryana	21.0	18.9	2.2
Nagaland	23.6	21.4	2.2
Odisha	39.8	38.0	1.8
Gujarat	18.2	16.7	1.5
Bihar	16.6	18.0	1.4
Jharkhand	20.1	21.3	1.2
Tamil Nadu	27.3	28.4	1.2
Uttar Pradesh	13.4	14.5	1.1
Arunachal Pradesh	35.1	34.0	1.1
Telangana	24.0	22.9	1.1
Manipur	34.5	35.5	1.0
Maharashtra	16.6	17.6	1.0
Karnataka	29.0	28.1	0.9
Meghalaya	51.0	51.6	0.6
Jammu & Kashmir	35.6	35.1	0.5
Ladakh	38.8	38.6	0.2
Rajasthan	14.5	14.6	0.1
Assam	22.1	22.0	0.1
Himachal Pradesh	27.4	27.4	0.0
Madhya Pradesh	18.1	18.1	0.0
Chhattisgarh	23.3	23.3	0.0
India	**23.0**	**23.3**	**0.3**

Note: UTs = Union Territories

the decision making were important predictors during infancy, whereas education and media exposure were important predictors during childhood [43]. This difference could be due to the delayed introduction of complementary diets and contributing to increased breast feedings post 6 months [23].

Diet adequacy was significantly associated with the birth order of the child. Our findings aligned with other studies; this could be because of likelihood of introducing supplemental feeding in contrast to first-birth order. Furthermore, implying that knowledge of suitable supplemental feeding techniques might be enhanced by prior birthing experience [44–46]. With increase in every unit of weight, the odds of increase in MDD were 1.2 and 1.27 times among normal and overweight children when compared to underweight children, respectively. This was in contrast with studies conducted in Maharashtra and other similar studies where they stated that the child with very low/ low birth weight was more likely to receive extensively diversified food compared to others [30, 47, 48]. This difference could be because of mothers may find it difficult to achieve nutrition diversity in informal circumstances. Reduced food diversity in underweight children may also have been influenced by lack of awareness and early childcare in mothers [30, 47, 48].

Our study reported that the odds of children currently breastfed receives 1.9 times more diversified food when compared to the non-breastfed children. This was also similar to many other studies across nations. Along with breast milk to satisfy all nutritional needs, supplemental feeding should be initiated. A healthy breastfed infant should eat two to three meals a day at six to eight months of age, three to four times at nine to eleven months, and three to four times plus one or two extra nutrient-dense snacks at twelve to twenty-three months of age. This promotes the children's healthy development [49–52].

Conclusion

The present study indicates that there is no difference in dietary diversity among male and female children, except few states showing variations in this regard across the country. The study suggests that there is need for educating mothers and employing them, especially from poor socio-economic background, to improve the dietary diversity prevalence. The region/state specific intervention should be planned based on local based food needs of children. The strategies should address the suboptimal practices including inadequate quality or quantity of foods, poor feeding practices, complementary feeding being initiated too early or too late, or being provided in quantities that are too small or infrequent etc. There is need for behaviour change communication strategies in the community regarding the infant and young child feeding practices. There is also scope for further synthesis of evidence in dietary diversity and micro-nutrients deficiencies.

Limitations of the Study

The study utilizes NFHS-5 2019-21 data collected at single time point. This cross-sectional nature limits the ability to establish causation or capture changes over time. Longitudinal data could provide a more comprehensive understanding of the dynamics of dietary diversity and associated factors. The assessment of MDD relies on

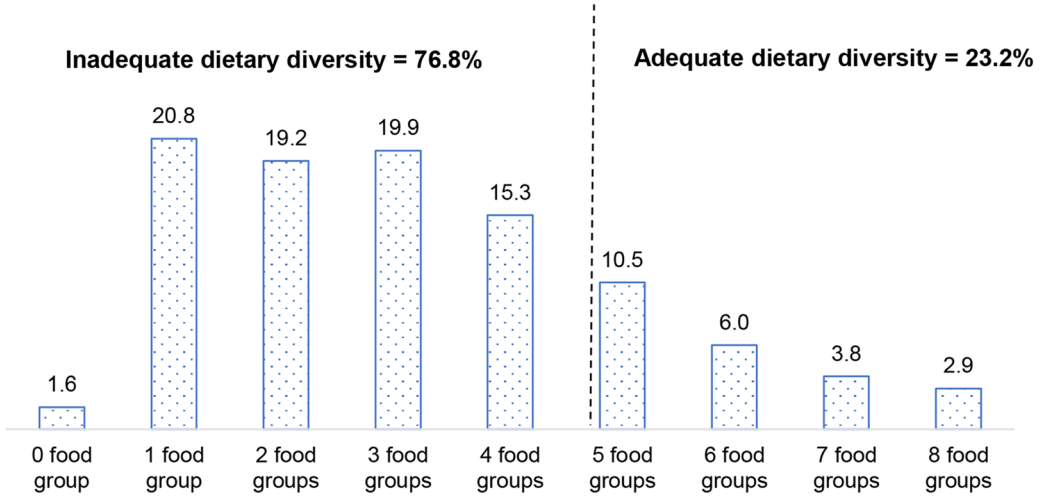

Fig. 1 Distribution of children aged 6–23 months living with their mothers received number of food groups during the previous day (in last 24 h), (*N = 62610*)

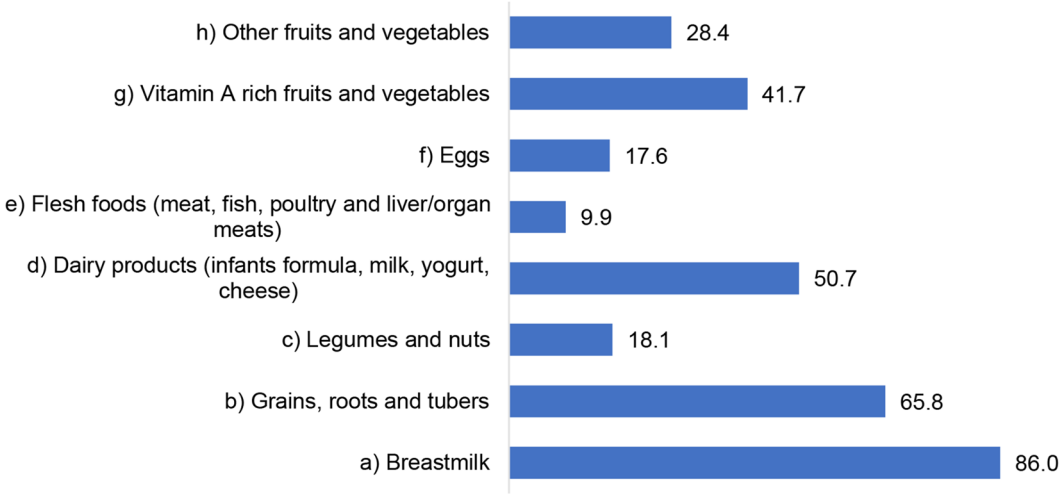

Fig. 2 Distribution of children aged 6–23 months living with their mother's received food groups during the previous day (in last 24 h), (*N = 62610*)

self-reported data from mothers about their children's food intake in the last 24 h. This introduces the potential for recall bias, as memory limitations may affect the accuracy of reported dietary information.

While the study explores socio-economic factors like mother's education and wealth status, other relevant socio-economic factors such as household income, access to healthcare, and cultural practices may not have been fully accounted for, potentially limiting the depth of the analysis. The abstract briefly mentions that there was no significant difference in dietary diversity between male and female children. However, the scope of gender analysis may be limited, and a more in-depth examination of gender-specific factors influencing dietary diversity could provide richer insights.

The study is based on nationally representative data, but the results may not be fully generalizable to specific regional or local contexts. Regional variations in dietary patterns, cultural practices, and socio-economic conditions could influence the applicability of findings.

Strengths

The study utilized large scale dataset to assess the dietary diversity among less than two-year children. Results found high dietary diversity failure among children which highlights the urgent need for targeted nutrition interventions to integrate behavior change communication for caregivers, families and fostering community mobilization. Study strongly supported that gender and place of residence was not significantly associated with the minimum dietary diversity. Nutrition interventions integrate.

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Author contributions
Kamalesh Kumar Patel: Data acquisition, data analysis, methodology, tabulation, figures creation, manuscript reviewing. Jyoti Vijay: conceptualization, writing-original draft, reviewing, editing, validation. Arunesha Babu Saroja: support in writing, reviewing and editing.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethical approval
The study used a secondary dataset from the Demographic Health Survey of India's National Family Health Survey (NFHS), which contains no information that may be used to identify the survey participants personally. NFHS used the usual questionnaire to get consent before and throughout the investigation. The datasets are available on the DHS site; however, access is only permitted after registering and submitting the required research interest.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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