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ORIGINAL ARTICLE

FACTORS ASSOCIATED WITH SUBOPTIMAL COMPLEMENTARY FEEDING PRACTICES AMONG MOTHERS OF INFANTS AND YOUNG CHILDREN IN INDIA

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ABSTRACT

Objectives. To examine the current complementary feeding practices among infants and young children aged 6 to 23 months in India, and factors influencing these practices at child, parental, household and community levels.

Material and methods. Data on 74,095 last-born children aged 6 to 23 months used in this study were obtained from the 2015 India Demographic and Health Survey (IDHS). Complementary feeding indicators (timely introduction of complementary foods to infants aged 6 to 8 months old, minimum meal frequency, minimum dietary diversity, and minimum acceptable diets) were estimated, and their associated factors were identified using descriptive and multivariate (logistic regression) analyses.

Results. The prevalence of the timely introduction of complementary foods to infants aged 6 to 8 months was 45.1%. The proportion of children between ages 6 to 23 months who received the minimum meal frequency, minimum dietary diversity and minimum acceptable diets were 36%, 21% and 9.1%, respectively. Findings from the multivariate analyses revealed that mothers of infants delivered at home, mothers who had no antenatal check-up, mothers who are Hindus, mothers living in rural areas or those from the Western/Northern geographical regions of India were at higher risk of suboptimal complementary feeding practices.

Conclusions. Our findings indicate that, among other factors, achieving the recommended four or more antenatal visits was consistently associated with improved complementary feeding practices. Thus, policies that ensure increased coverage and quality of antenatal check-up could improve complementary feeding practices of mothers in India, and help towards achieving sustainable development goal 2, targeted at eradicating hunger and malnutrition.

Key words: *complementary feeding, infant and child nutrition, India, developing countries*

INTRODUCTION

Nutrition in early childhood is a fundamental determinant of survival, health and productivity of an individual throughout lifetime [3]. In 2016, an estimated 5.6 million children under the age of five died worldwide. The International Food Policy and Research Institute on global nutrition reported that more than two–thirds of these deaths are associated with suboptimal infant and young child feeding practices which occur during child's first two years of life [12]. Globally, age-appropriate and safe complementary feeding practices have been shown to improve physical growth and mental development of children. However, in low - and middle - income countries, children between the ages of 6 and 23 months still have the highest risk of growth faltering due to malnutrition [29].

Micronutrient deficiency, stunting, underweight and wasting are the major implications of childhood malnutrition in developing countries [15, 20]. India still records one of the highest rates of poor child nutritional status in the world. According to the 2017 national family health report, it was estimated that about 38.4% of children under-five were stunted, 21% were wasted and 35.7% were underweight in India [13]. These outcomes are a reflection of missed opportunities during the complementary feeding period. Nutritional deficit that occur during the complementary feeding period has immediate consequences of increased mortality, morbidity, poor development of the child's brain and other components of the nervous system [

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20]. In addition, these deficits are almost impossible to compensate for after the first two years of life [6, 15]. Thus, complementary feeding period provides a critical window of opportunity for the prevention of malnutrition, and accordingly, the reduction in its related burden of retarded growth and development, morbidity and mortality.

In 2007, the World Health Organization (WHO) developed four core complementary feeding indicators, which are: time of introduction to solid foods, semi-solid or soft foods; minimum meal frequency; minimum dietary diversity; and minimum acceptable diet [30]. WHO and the United Nations Children's Fund (UNICEF) recommended exclusive breastfeeding for the first six months of a child's life, after which complementary feeding should gradually be introduced, alongside continued breast feeding up until child's second year or beyond. Despite numerous efforts to promote appropriate and safe feeding practices in India and several parts of the developing world, challenges during complementary feeding continues to pose a threat to proper nutrition in infants and young children. Although most of these challenges are context specific, many are common across different settings and are often characterized by suboptimal feeding practices and poor dietary quality of complementary foods [5, 16, 24]. Previous studies have shown that achieving optimal complementary feeding practices is influenced by socio-economic and demographic characteristics such as child's age, gender, breast feeding status, preceding birth interval, maternal education and age, mother's working status and exposure to media, father's educational and occupational status, household family size, household wealth index and geographical location [4, 8, 10, 17, 21]. Other factors include knowledge about infant's nutritional needs, cultural beliefs, taboos on child feeding practices, health care utilization, antenatal care visits and complementary feeding counselling by health professionals [2, 14].

Few studies in India had reported on the determinants of complementary feeding practices using the IDHS data. However, these studies did not include data on non-breastfed children in the computation of the minimum acceptable diet indicator, apparently because the relevant data were not collected in the 2006 IDHS and earlier surveys [13, 22]. Interestingly, the most recent IDHS (2015–2016), used in this present study, collected data for non-breastfed children [13]. This is therefore the first study on India to include the data on non-breastfed children in the computation of the minimum acceptable diet indicator. These data are very important to getting more accurate estimates of complementary feeding practices. Thus, the present study would provide valuable and updated information for health policy makers and children nutrition programme managers.

MATERIALS AND METHODS

This is a population-based cross-sectional study using data from IDHS, 2015-2016. This nationally representative survey is the fourth and the most recent in the IDHS series for India. Data collection took place from January 2015 to December 2016 (International Institute for Population Sciences (IIPS) and ICF 2017). The survey covered the thirty-six (36) states/union territories of India, and utilizes a stratified sample selected in two stages. A total of 601,509 households and 699,686 women were interviewed. The response rates for all eligible households and women were 98% and 97%, respectively [13]. Comprehensive details about the sampling design and survey methodology can be found in IDHS report [13]. Based on WHO recommendation *Ickes* et al. [10] analyses in this study only included data on children between the ages of six and twenty-three months, that were alive and were last-born of mothers between the ages of 15 and 49 years. The total analytic sample size for this study was 74,095.

Outcome

This study examined complementary feeding as the outcome of interest. The first indicator of complementary feeding in infants and young children is the timely introduction of solid, semi-solid or soft foods, defined as the proportion of children aged 6 to 8 months who received solid, semi-solid or soft foods. The second indicator is minimum dietary diversity, defined as the proportion of children aged 6 to 23 months who received foods and drinks from four or more of seven food groups in the previous day. The seven food groups are grains, roots and tubers; legumes and nuts; flesh foods (meat, fish, poultry and liver/organ meats); dairy products (milk, yogurt, and cheese); eggs; vitamin-A rich fruits and vegetables; and other fruits and vegetables [31]. The third indicator is minimum meal frequency, defined as the proportion of children aged 6 to 23 months who received solid, semi-solid or soft foods at least 2 times for breast-fed infants aged 6 to 8 months, 3 times for breast-fed children aged 9 to 23 months, and 4 times for non-breast-fed children aged 6 to 23 months (including milk feeds for non-breast-fed children) the previous day. The fourth indictor is minimum acceptable diet, defined as the proportion of children aged 6 to 23 months who received both minimum dietary diversity and minimum meal frequency the previous day [31].

Dependent variables (introduction to complementary feeding at 6 to 8 months, minimum dietary diversity, minimum meal frequency and

minimum acceptable diet) were coded 0 = no (i.e. the recommended minimum was not achieved) or 1= yes (i.e. the recommended minimum was achieved).

Potential factors of interest

The independent factors included in this study were chosen *a priori* based on evidence from previous studies. These variables are child characteristics (child's age, current breastfeeding status, stunting, diarrheal, birth weight); maternal characteristics (mothers age, body mass index (BMI), working status, education, those who watch television); household characteristics (wealth index, maternal decision making on household purchases); and community characteristics (place of child delivery, number of antenatal clinic visits, place of residence and geographical region)

Statistical analysis

Descriptive statistics was deployed to express the characteristics of the study population. Categorical data were describe using frequencies and percentages. Univariate, bivariate and multivariate analyses were performed on the data using statistical package for social sciences (SPSS) version 25. Multivariable logistic regression was used to determine the independent effect of potential factors on the complementary feeding practice indicators. Associations between the variables were calculated at 95% confidence interval and statistical association for all tests was considered significant at p-value less than 0.05. Underlying assumptions for logistic regression were checked while variance inflation factor was used to check for multicollinearity. The fitness of the model was assessed using Akaike information criterion (AIC).

RESULTS

Table 1 presents the descriptive characteristics of the 74,095 last born children aged 6 to 23 months, enrolled in IDHS 2015-2016, according to attributes of the individual child, parent, household, health care services and the community. Well over half of the children (66%) are a year or older. The majority of mothers in the study were in the age bracket of 20–34 years (88.9%) and only a very small proportion were teenagers (4.2%). Additionally, the proportion of mothers and fathers with no formal education were 28.3% and 17.0%, respectively. Most of the mothers (85.4%) were not currently working and nearly half (48.6%) belonged to poor families. About 20.2% of the mothers had no antenatal clinic (ANC) visits, and only 45.8% met the recommended minimum of four ANC visits.

Table 1. Child, parental, household, and community level characteristics of children 6 to 23 months of age, India 2015–2016

Characteristics	n	percentage	Characteristics	n	percentage
Child characteristics			**Religion (74,095)**		
Sex of child (74,095)			Hindu	53567	72.3
Male	38728	52.3	Muslim Christian	11667	15.7
Female	35367	47.7	Others	6052	8.20
Age of child (74,095)			**Reads newspaper (74,095)**		
6–8	13048	17.6	No	2809	3.80
9–11	12138	16.4	Yes	61039	82.4
12–17	24701	33.3	**Listens to radio (74,095)**		
18–23	24208	32.7	No	13056	17.6
Birth interval (46,496)			Yes	67455	91.0
<24 months	12004	25.8	**Watches television (74,095)**		
>=24 months	34492	74.2	No	6640	9.00
Currently breastfed (74,095)			Yes	29 474	39.8
No	10804	14.6	***Household characteristics***		
Yes	63291	85.4	**Wealth Index (74,095)**		
Stunting (68,221)			Poorest	44 621	60.2
No	43639	64.0	Poorer	18821	25.4
Yes	24582	36.0	Middle	17203	23.2
Birth weight (74,095)			Richer	15065	20.3
Small <2.5kg	10134	13.7	Richest	12644	17.1
Normal >2.5kg	63961	86.3	**Decision making (12,964)**		
Diarrhoea (74,095)			Mother involved	10362	14.0
No	63616	85.9	Mother not involved	8940	69.0
Yes	10479	14.1			

Characteristics	n	percentage	Characteristics	n	percentage
Parental characteristics			***Community level characteristics***		
Mother's age (74,095)			**Place of delivery (74,095)**		
15–19 years	3145	4.20	Home	4024	31.0
20–34 years	65861	88.9	Health facility	15437	20.8
35–49 years	5089	6.90	**Antenatal visits (74,095)**		
Mother's education (74,095)			None	58658	79.2
No education	21000	28.3	1-3	14939	20.2
Primary	10355	14.0	4+	25212	34.0
Secondary	34905	47.1	**Residence (74,095)**		
Higher	7835	10.6	Urban	33944	45.8
Mother's literacy (73,591)			Rural	17579	23.7
Cannot read	28575	38.8	**Region (72,063)**		
Can read	45016	61.2	North	56516	76.3
Working status (13,110)			East	20537	28.5
Not working	11192	85.4	West	15781	21.9
Working	1918	14.6	South	9745	13.5
Mother's BMI (74,095)			Central	6197	8.60
Too thin <18.5	19876	26.8	North-East	9284	12.9
Normal =18.5-24.99	44826	60.5		10519	14.2
Overweight/obese>25.0	9393	12.7			
Father's education (13,057)					
No education	2217	17.0			
Primary	1775	13.6			
Secondary	7245	55.5			
Higher	1820	13.9			

Due to no response or missing values, the total for each variable is different and is stated within brackets next to the variable.

Table 2. Adjusted determinants of complementary feeding indicators of children aged 6 to 23 months in India (2015 – 2016)

Characteristics	TIC (6-8 months) AOR (95%CI)		MDD AOR (95%CI)		MMF AOR (95%CI)		MAD AOR (95%CI)	
Child age								
6-8	----		1.00		1.00		1.00	
9-11	-----		2.20***	(1.33-3.62)	0.67***	(0.49-0.90)	1.02	(0.77-1.35)
12-17	1.00		5.31***	(3.43-8.21)	1.19	(0.93-1.52)	2.21***	(1.76-2.77)
18-23	0.99	(0.79-1.24)	7.21***	(4.65, 11.17)	1.19	(0.92-1.53)	2.62***	(2.09-3.28)
Currently breastfeeding								
No	1.00		1.00		1.00		1.00	
Yes	1.26	(0.95-1.66)	0.67***	(0.52-0.87)	3.90***	(3.07-4.97)	1.21**	(1.02-1.43)
Stunting								
Not stunted	-----		1.00		1.00		1.00	
Stunted	-----		0.85	(0.68-1.06)	1.00	(0.84-1.20)	1.10	(0.96-1.26)
Birth weight								
<2500	1.00		1.00		1.00		1.00	
>2500	1.24	(0.89-1.73)	1.09	(0.79-1.50)	0.68***	(0.52-0.89)	0.80**	(0.66-0.98)
Diarrhoea								
No	0.97	(0.73-1.29)	1.00		1.00		1.00	
Yes	1.00		1.29	(0.99-1.69)	0.78	(0.63-0.96)	0.90	(0.75-1.08)
Mother age								
15–19	1.24	(0.91-1.70)	1.00		1.00		1.00	
20–34	1.20	(0.93-1.56)	0.83	(0.50-1.38)	0.78	(0.52-1.14)	1.06	(0.74-1.51)
35–49	1.21	(0.81-1.80)	0.88	(0.46-1.71)	1.00	(0.58-1.71)	1.37	(0.90-2.09)
Mother's BMI (kg/m2)								
Overweight/obese	1.00		1.00		1.00		1.00	
Too thin <18.50	1.00	(0.77-1.30)	1.30	(0.89-1.90)	1.10	(0.80-1.51)	0.91	(0.73-1.14)
Normal =18.5-24.99	1.91***	(1.19-3.06)	1.23	(0.88-1.72)	1.06	(0.80-1.41)	0.99	(0.82-1.20)

Mother's education								
No education	1.21	(0.72-2.02)	1.00		1.00		1.00	
Primary	1.00		0.68**	(0.46-0.99)	1.18	(0.89-1.57)	0.94	(0.73-1.19)
Secondary	1.50***	(1.13-1.98)	0.82	(0.61-1.09)	1.08	(0.85-1.36)	1.22**	(1.01-1.47)
Higher	1.00		0.81	(0.52, 1.24)	1.00	(0.70-1.45)	1.21	(0.92-1.59)
Parent's religion								
Hindu	1.04	(0.79-1.37)	1.00		1.00		1.00	
Muslim	1.00		1.26	(0.95-1.66)	1.00	(0.74-1.26)	1.38***	(1.16-1.64)
Christian	1.15	(0.83-1.59)	1.73**	(1.08-2.75)	1.14	(0.74-1.74)	1.54***	(1.19-2.01)
Others	1.00		0.86	(0.46-1.62)	0.85	(0.50-1.45)	1.17	(0.84-1.63)
Mothers working status								
Not working	1.10	(0.87-1.40)	1.00		1.00		1.00	
Working	1.00		1.14	(0.86-1.51)	0.92	(0.73-1.15)	0.76***	(0.64-0.90)
Reads newspaper								
No/< once a week Once	1.45**	(1.09-1.94)	1.00		1.00		1.00	
a week/every day	1.40*	(1.00-1.98)	0.96	(0.70-1.31)	1.11	(0.85-1.45)	1.10	(0.92-1.31)
Listens to radio								
No/< once a week	1.29	(0.87-1.91)	1.00		1.00		1.00	
Once a week/every day	1.09	(0.70-1.68)	1.28	(0.92-1.78)	0.80	(0.60-1.07)	0.68***	(0.56-0.83)
Watches television								
No/less than once a	1.00		1.00		1.00		1.00	
once a week/every d	0.87	(0.71-1.06)	1.36**	(1.24-1.48)	0.99	(0.80-1.23)	1.07	(0.90-1.27)
Household Wealth Index								
Poorest	1.00		1.00		1.00		1.00	
Poorer	1.45**	(1.09-1.94)	1.10	(0.80-1.50)	1.02	(0.80-1.30)	1.24*	(1.00-1.54)
Middle	1.40*	(1.00-1.98)	1.33	(0.91, 1.93)	1.09	(0.80-1.47)	1.26*	(0.99-1.61)
Richer	1.29	(0.87-1.91)	1.34	(0.87-2.04)	1.15	(0.81-1.62)	1.24	(0.94-1.63)
Richest	1.09	(0.70-1.68)	1.36	(0.84-2.22)	1.39	(0.93-2.09)	1.35*	(0.99-1.84)
Decision making								
Mother involved	1.00		1.00		-----		1.00	
Mother not involved	0.87	(0.71-1.06)	0.79**	(0.63, 0.99)			1.18**	(1.02-1.37)
Place of delivery								
Home	1.00		1.00		-----		1.00	
Health centre	0.91	(0.70-1.18)	1.23	(0.93-1.64)			1.26**	(1.05-1.52)
Antenatal								
No	1.00		1.00		1.00		1.00	
1-3	0.99	(0.74-1.32)	0.85	(0.63-1.14)	1.47***	(1.16-1.86)	1.11	(0.90-1.38)
4+	1.51***	(1.12-2.03)	1.41**	(1.05-1.90)	1.80***	(1.41-2.31)	1.94***	(1.58-2.38)
Type of residence								
Urban	1.00		1.00		1.00		1.00	
Rural	0.74**	(0.58-0.95)	1.38	(1.01-1.88)	1.87	(0.67-1.14)	0.83**	(0.70-0.98)
Geographical region								
North	1.00		1.00		1.00		1.00	
East	0.99	(0.75-1.29)	1.26	(0.95-1.67)	0.82*	(0.65-1.02)	1.23**	(1.01-1.51)
West	0.72**	(0.53-0.96)	0.50***	(0.31, 0.80)	0.67**	(0.49-0.92)	0.46***	(0.35-0.61)
South	1.46**	(1.02-2.10)	3.31***	(2.31-4.73)	0.96	(0.69-1.33)	2.17***	(1.76-2.67)
Central	0.79	(0.57-1.11)	1.20	(0.78-1.87)	1.17	(0.84-1.64)	1.06	(0.83-1.35)
North-East	1.39*	(0.95-2.03)	2.20***	(1.45-3.35)	0.86	(0.60-1.27)	1.32**	(1.03-1.68)

***P < 0.01, **P < 0.05, *P < 0.1.

TIC, timely introduction to complementary foods; MDD, minimum dietary diversity; MMF, minimum meal frequency; MAD, minimum acceptable diet; AOR, adjusted odd ratios.

Determinants of timely introduction to complementary foods

The independent determinants of timely complementary feeding practice among children are shown in Table 2. Mothers dwelling in rural areas were less likely (AOR = 0.74, 95% CI: 0.58-0.95, p<0.05) to introduce complementary foods at the appropriate age, compared with mothers living in urban areas.

Working mothers were 50% more likely (AOR = 1.50, 95% CI: 1.19-3.06, p<0.01) to introduce solid food on time than mothers who were not working, and those in the poorer quintile (AOR =1.45, 95% CI: 1.09-

1.94, p<0.05) were less likely to delay complementary feeding, more than mothers in poorest quintile. Mothers who attended four or more antenatal check-ups were more likely to introduce complementary feeding at the appropriate age (AOR = 1.51, 95% CI: 1.12-2.03, p<0.01), compared with those who did not attend any antenatal clinics. Mothers who are Christians (AOR =1.91, 95% CI: 1.19-3.06, p<0.01) were significantly more likely to introduce complementary feeding at the appropriate age than Hindu mothers.

Determinants of minimum dietary diversity

Mothers from Western India (AOR = 0.50, 95% CI: 0.31-0.80, p<0.01) were at increased risk of suboptimal dietary diversity, compared with Northern mothers. However, mothers in the Southern (AOR = 3.31, 95% CI: 2.31-4.73, p<0.01) and North-Eastern regions (AOR = 2.20, 95% CI: 1.45-3.35, p<0.01) are 3.31 and 2.20 times more likely to offer varied diets than those from the North. Higher rates of achieving minimum dietary diversity were observed among children of mothers who watched television at least once a week or almost every day (AOR = 1.36, 95% CI: 1.24-1.48, p<0.05) and also among those who had four or more antenatal clinic visits (AOR =1.41, 95% CI: 1.05-1.90, p<0.05), compared to those with no visits. Children aged 9-11, 12-17 and 18-23 months were more likely to receive a varied diet compared with children aged 6-8 months old, (AOR = 2.20, 95% CI: 1.33-3.62, p<0.01), (AOR = 5.31, 95% CI: 3.43-8.21, p<0.01) and (AOR = 7.21, 95% CI: 4.65-11.17, p<0.01) respectively. Breastfed children were less likely to receive a varied diet when compared with those not breastfed (AOR = 0.67, 95% CI: 0.52-0.87, p< 0.01). Compared with uneducated mothers, those who had only primary education were less likely (AOR = 0.68, 95% CI: 0.46-0.99, p<0.05) to offer their children the minimum dietary diversity. Also, children of mothers not involved in decision making about household purchases (AOR = 0.79, 95% CI: 0.63-0.99, p<0.05) were at increased risk of inadequate dietary diversity. However, mothers who are Christians (AOR =1.73, 95% CI: 1.08-2.75, p<0.05) have significantly higher rates of offering a varied diet than Hindu mothers.

Determinants of minimum meal frequency

Mothers with children aged 9-11 were significantly at greater risk (AOR = 0.67, 95% CI: 0.49-0.90, p<0.01) of not meeting the minimum meal frequency, compared to those with children in the youngest age bracket (6 to 8 months). Those still breastfeeding are 3.90 times more likely to achieve adequate meal frequency (AOR = 3.90, 95% CI: 3.07-4.97, p<0.01) compared to children not presently breastfed. Also, mothers that had four or more antenatal clinic visits (AOR = 1.80, 95% CI: 1.41-2.31, p< 0.01) and those who had between one and three visits (AOR = 1.47, 95% CI: 1.16-1.86, p<0.01) were more likely to achieve minimum meal frequency, compared to those without antenatal visits. Children with normal birth weights (AOR =0.68, 95% CI: 0.52-0.89, p<0.01) and those living in Western region of India (AOR = 0.67, 95% CI: 0.49-0.92, p<0.05) as opposed to those in the Northern region, were more likely at risk of suboptimal meal frequency.

Determinants of minimum acceptable diet

Children in the 12-17 (AOR = 2.21, 95% CI: 1.76-2.77, p<0.01) and 18-23 (AOR = 2.62, 95% CI: 2.09-3.28, p < 0.01) months age brackets were at 2.21 and 2.62 times higher odds to meet minimum acceptable diets, as opposed to those in the youngest age group (6 to 8 months). Compared with uneducated mothers, those with secondary education were 1.22 times more likely to offer the minimum acceptable diet (AOR = 1.22, 95% CI: 1.01-1.47, p<0.05). Mothers who were Christians (AOR =1.54, 95% CI: 1.19-2.01, p<0.01) and Muslims (AOR = 1.38, 95% CI: 1.16-1.64, p<0.01) have significantly higher rates of feeding children the minimum acceptable diet than Hindu mothers. As compared with mothers living in the Northern region of India, the Southern (AOR = 2.17, 95% CI: 1.76-2.67, p<0.01), North-Eastern (AOR = 1.32, 95% CI: 1.03-1.68, p<0.05) and Eastern (AOR = 1.23, 95% CI: 1.01-1.51, p<0.05) regions of India had higher rates of meeting the recommended minimum, whereas the Western (AOR = 0.46, 95% CI: 0.35-0.61, p<0.01) region of India were less likely to meet this minimum. Having a child with normal weight at birth (AOR =0.80, 95% CI: 0.66-0.98, p<0.05), working (AOR = 0.76, 95% CI:0.64-0.90, p<0.01) and living in rural areas (AOR = 0.83, 95% CI: 0.70-0.98, p< .05) were significant risk factors for suboptimal diet. Mothers currently breastfeeding their children (AOR = 1.21, 95% CI: 1.02-1.43, p<0.05), not involved in decision making about household purchases (AOR = 1.18, 95% CI: 1.02-1.37, p<0.05), those that delivered child in health centre rather than at home (AOR = 1.26, 95% CI: 1.05-1.52, p<0.05) and those who met the minimum four or more antenatal visits compared with those who had none (AOR = 1.94, 95% CI: 1.58-2.38, p<0.01) had higher odds of achieving minimum acceptable diets.

DISCUSSION

Findings from this study have demonstrated that almost half of children in the 6 to 8-month age bracket had been introduced to solid and semi-solid foods. About two-fifths of the children met minimum meal frequency while one-fifths of them had minimum dietary diversity and one out of ten of the children satisfied the minimum acceptable diet

requirement. Apart from being alarmingly low, these rates indicate a decline in trend for the proportion of infants and young children that received adequate complementary feeding in India. Specifically, the rate of achieving timely introduction to complementary foods was reduced from 54.6% in 2006 to 45.1% in 2016; minimum meal frequency satisfaction rate reduced from 41.5% in 2006 to 36% in 2016; minimum acceptable diet satisfaction rate reduced only slightly from 9.2% in 2006 to 9.1% in 2016. Only the minimum dietary diversity indicator had improved satisfaction rate, increasing from 15.2% to 21%, over the ten-year period between the two national surveys [13, 22].

The poor rates of meeting minimum recommended complementary feeding practice indicators were reflected in the physical condition of children in India over the same period. For example, wasting increased slightly from 20% in 2006 to 21% in 2016**.** Also, it could have been expected that incidences of underweight would have reduced drastically over the ten-year period, given the huge efforts made by the Indian government to promote optimal feeding practices [7, 19]. Rather, the condition reduced only by 7% over the ten-year period [13, 22].

Results from the multivariate analyses show (among the child-related factors) that child age was significantly associated with minimum dietary diversity (MDD), minimum meal frequency (MMF) and minimum acceptable diet (MAD), with infants in the youngest age group at highest risk of poor complementary feeding. The negative impact of a child being in the youngest age bracket on maternal complementary feeding practices was also reported by [4, 14]. Inadequate complementary feeding in the youngest age group may be because mothers of these infants consider them too young to receive the minimum recommended complementary feeding. Breastfeeding status was also associated with feeding practices. Breastfed children are less likely to receive a varied diet when compared to non-breastfed children. However, the reverse is the case for achieving MAD and MMF, with non-breastfed children less likely to receive the minimum recommendations.

Consistent with previous studies, results from this study show that maternal factors are significantly associated with complementary feeding indicators [10, 17]. Mothers with secondary education have a higher odd of meeting the minimum acceptable diet, compared to mothers with no education. Similar to results from the secondary analyses of the 2006 IDHS of India, [22] mothers who were Christians in the present study were more likely to introduce their child to complementary foods at the right age, achieving MDD, and achieving MAD, respectively, compared with those who were Hindus. Muslim mothers were also more likely to meet MAD than those of the Hindu religion. Working mothers are at risk of not meeting the minimum acceptable diet for their children. A study in Lebanon by *Batal* et al. [1] also found that women in employment were almost twice as likely than those who were unemployed, to introduce semi solid or solid foods before their infants reached four months of age [1]. Timely introduction by working mothers may be because of the need to leave the children in the care of other persons while they are away at work.

Watching television at least once a week or almost every day was significantly related to higher odds of meeting the minimum dietary diversity. The association between watching television and achieving a varied diet could be attributed to a better standard of living and the increased awareness among mothers who had access to a television set. This is corroborated by findings from a study by *Paul* et al. [23] which showed that a significant proportion of mothers received advice on complementary feeding from watching television.

Household wealth index was not significantly associated with complementary feeding indicators, except the timely introduction to complementary feeding. Those in the poorer households were found to be at higher risk of delaying complementary feeding than those in the poorest households. This result suggests that, apart from food insecurity, cultural barriers may contribute to late introduction to complementary food in India. Mothers not involved in decision making about household purchases were less likely to meet minimum dietary diversity, but more likely to meet minimum acceptable diets. A previous study found that mother's increased decision-making autonomy generally had a positive impact on their feeding practices [27].

Several studies had provided indication that maternal access to healthcare services would augment desirable feeding practices [9, 18, 25]. This was confirmed by results from this study, which shows that meeting the recommended minimum of four or more antenatal visits, compared with no antenatal, is predictive of timely introduction to complementary foods, achieving minimum dietary diversity, meal frequency and acceptable diets. Likewise, mothers who gave birth to their children in health facilities rather than at home were more likely to achieve minimum acceptable diets. There is considerable evidence that receiving nutrition counselling on infant and young child feeding (IYCF) practices from trained health workers can effectively improve complementary feeding practices, and consequently the child's nutritional status [11, 26, 28, 32].

Furthermore, we found that mothers living in rural areas were 74 % and 83% less likely than those living in urban areas to achieve timely introduction to complementary foods and minimum acceptable

diets, respectively. Mothers from the Southern, North-Eastern and Eastern regions had higher rates of achieving the minimum recommended practices compared to mothers living in the Northern region of India, whereas mothers living in the Western region are at a higher risk of not meeting minimum meal frequency and minimum acceptable diets. These findings are consistent with those from the secondary analysis of the 2006 IDHS in India [22] indicating that the disparity between regions in India concerning complementary feeding practices has not changed over the last decade. Finally, mother's age and BMI, stunting, and occurrence of diarrhoea in the last two weeks' prior interviews, were not found to be significantly associated with complementary feeding practices in the multivariate analyses of India IDHS.

Data from DHS are considered one of the most reliable on mother and child's health in developing countries [8]. However, being a cross sectional survey, causal relationships between variables of interest cannot be assessed. Also, because the data were self-reported, there is the possibility of social desirability bias and recall bias. Mothers' 24-hour recall of the types of food and number of times given may not correctly reflect their actual feeding practices. The possibility of residual confounding factors can also not be ruled out. Despite these limitations, a major strength of this study is the fact that it used a large, nationally representative sample, thereby providing useful evidence for policy makers and researchers to develop appropriate interventions to improve complementary feeding practices in all of India. Additionally, this study used a more accurate estimate of minimum acceptable diets, as it included data for non-breastfed children in its statistical computations, unlike previous studies which did not take into account the non-breastfed children [17, 22].

CONCLUSIONS

The rate of compliance with optimal complementary feeding practices remains abysmally low in India. This study showed that multiple factors including child age, birth weight, maternal education, breastfeeding, antenatal care uptake, place of delivery, maternal involvement in decision-making, access to media, religion, employment, household wealth index, place of residence, and region are driving complementary feeding practices in India. Findings from this study will serve as vital information for health policymakers and health program implementers for developing and deploying interventions and health policies to optimize complementary feeding practices in India.

Ethical approval

Not required. This study was based on the analysis of a publicly available survey data from the Demographic Health Survey (DHS), with all the identifier information removed. Biomarkers and questionnaire information were collected in the survey only with informed consent from respondents and all information was collected confidentially.

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Competing interests

The authors have no competing interests.

REFERENCES

1. *Batal M, Boulghourjian C, Akik C.* Complementary feeding patterns in a developing country: a cross sectional study across Lebanon. East Mediterr Health J 2010;16(2):180–186.
2. *Bhanderi D, Choudhary* S. A community-based study of feeding and weaning practices in under five children in semi urban community of Gujarat. Natl J Community Med 2011;2:277–283.
3. *Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J; Maternal and Child Undernutrition Study Group.* Maternal and child undernutrition: global and regional exposures and health consequences. Lancet. 2008Jan19;371(9608):243-60. doi: 10.1016/S0140-6736(07)61690-0.
4. *Dangura D, Gebremedhin S.*: Dietary diversity and associated factors among children 6-23 months of age in Gorche district, southern Ethiopia: cross sectional study. BMC Pediatric 2017;17(1):6, doi: 10.1186/s12887-016-0764-x.
5. *Dewey KG, Adu-Afarwuah S.* Systematic review of the efficacy and effectiveness of complementary feeding interventions in developing countries. Matern Child Nutr 2008;4Suppl1:24–85, doi: 10.1111/j.1740-8709.2007.00124.x.
6. *Dewey KG, Begum K.* Long-term consequences of stunting in early life. Matern Child Nutr. 2011:Suppl 3:5-18. doi: 10.1111/j.1740-8709.2011.00349.x.
7. *Dubowitz T, Levinson D, Peterman JN, Verma G, Jacob S, Schultink W.*: Intensifying efforts to reduce child malnutrition in India: an evaluation of the Dular program in Jharkhand, India. Food Nutr Bull 2007;28(3):266-273.
8. *Ghosh S, Shah D.* Nutritional problems in the urban slums. Indian Pediatrics 2004;41(7):682–696.
9. *Goswami M, Dash B, Dash NC.* Maternal care and childrearing practices: a micro level study among the Bhumija tribe of Northern Orissa, India. South Asian Anthropology 2012;12:51–59.
10. *Ickes SB, Hurst TE, Flax VL.* Maternal literacy, facility birth, and education are positively associated with better infant and young child feeding practices and

nutritional status among Ugandan children. J Nutr 2015;145(11):2578–2586, doi: 10.3945/jn.115.214346.
11. *Imdad A, Yakoob MY, Bhutta ZA*. Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. BMC Publ Health 2011;11(3):S25. https://doi.org/10.1186/1471-2458-11-S3-S25.
12. International Food Policy Research Institute. Global nutrition report. Washington, DC: Actions and Accountability to Accelerate the World's Progress on Nutrition; 2014.
13. International Institute for Population Sciences (IIPS) and ICF. National Family Health Survey (NFHS-4), 2015–2016: *India.* Mumbai: International Institute for Population Sciences; 2017.
14. *Issaka A, Agho K, Page A, Burns P, Stevens G, Dibley M*. Determinants of suboptimal complementary feeding practices among children aged 6-23 months in four Anglophone West African countries. Matern Child Nutr 2015;11(1):14-30.
15. *Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS.;Bellagio Child Survival Study Group.* How many child deaths can we prevent this year? The Lancet 2003;362(9377):65-71, doi: 10.1016/S0140-6736(03)13811-1.
16. *Krebs NF, Hambidge KM, Mazariegos M, Westcott J, Goco N, Wright LL,* et al. Complementary feeding: a global network cluster randomized controlled trial. BMC Pediatric 2011;11(4):4.
17. *Menon P, Bamezai A, Subandoro A.* Age appropriate infant and young child feeding practices are associated with child nutrition in India: insights from nationally representative data. Matern Child Nutr 2015;11:73–87.
18. *Michaelson K, Weaver L, Branca F, Robertson A*. Feeding and Nutrition of Infants and Young Children. Guidelines for the WHO European Region, with emphasis on the former Soviet countries. In European Series. [e-book] Denmark: World Health Organisation*;* 2003.
19. *Narayan J, John D, Ramadas N*. Malnutrition in India: status and government initiatives. J Publ Health Policy 2019;40(1):126-141.
20. *Ogbo F, Page A, Idoko J, Claudio F, Agho K*. Trends in complementary feeding indicators in Nigeria, 2003–2013. British Med J 2015;5(10):e008467.
21. *Olatona F, Adenihun J, Aderibigbe S, Adeniyi O.* Complementary Feeding Knowledge, Practices, and Dietary Diversity among Mothers of Under-Five Children in an Urban Community in Lagos State, Nigeria. Int J of MCH and AIDS 2017;6(1):46-59.
22. *Patel A, Pusdekar Y, Badhoniya N, Borkar J, Agho KE, Dibley MJ.* Determinants of inappropriate complementary feeding practices in young children in India: secondary analysis of National Family Health Survey 2005–2006. Matern Child Nutr 2012;8(1):28–44.
23. *Paul S, Islam Q, Roy S, Pranab K*. Complimentary feeding practices in under 2 children. Chattagram Maa-O-Shishu Hospital Medical College Journal 2014;13:35–41.
24. *Plessis LM, Kruger HS, Sweet* L. Complementary feeding: a critical window of opportunity from six months onwards. South Afr J Clin Nutri 2013;26(3):129–140.
25. *Rasania S, Sachdev T.* Nutritional status and feeding practices of children attending MCH Centre. Indian J Community Med 2001;26:145–150.
26. *Shi L, Zhang J.* Recent evidence of the effectiveness of educational interventions for improving complementary feeding practices in developing countries. J Tropical Pediatrics 2010;57:91–98.
27. *Shroff MR, Griffiths PL, Suchindran C.* Does maternal autonomy influence feeding practices and infant growth in rural India? Social Sci Med 2011;73:447–455.
28. *Sunguya B, Poudel K, Mlunde L, Shakya P, Urassa D, Jimba M, Yasuoka J.* Effectiveness of nutrition training of health workers toward improving caregivers' feeding practices for children aged six months to two years: a systematic review. Nutr J. 2013;12(1):66.
29. United Nation Children's Fund (UNICEF)-Nigeria. Maternal and Child Health. 2016.
30. World Health Organisation. Indicators for assessing infant and young child feeding practice. Part 1: definition. Geneva: World Health Organisation; 2008.
31. World Health Organization (WHO*).* Indicators for Assessing Infant and Young Child Feeding Practices Part 2: Measurement. Geneva: World Health Organization; 2010.
32. *Zaman S, Ashraf RN, Martines J.* Training in complementary feeding counselling of healthcare workers and its influence on maternal behaviours and child growth: a cluster-randomized controlled trial in Lahore, Pakistan. J Health Popul Nutr 2008;26:210–222.

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