Evaluating Changes in Determinants of Stunting among Children Under 2 Years and Assessing Their Contribution to Socioeconomic Disparity in Child Nutritional Status across India

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Abstract

Background: Despite concentrated global efforts to bring about reduction in malnutrition among children, it continues to remain a public health concern, especially in developing countries such as India. While substantial reduction in the levels of stunting has taken place over the years, high levels of variation exist in distribution of stunting across the country. **Objective:** The study aimed to identify the determinants of stunting in early childhood and their contribution to change in levels of stunting across India. It also compared the socioeconomic disparity in the levels of stunting and changes therein over the last decade. **Methods:** The study utilizes data from the National Family Health Survey (NFHS-3 and NFHS-4) on children aged under-2 years. Bivariate and multivariate logistic regression identified determinants of early childhood stunting followed by Oaxaca decomposition model to assess the contribution of each of the factors to reduction in levels of stunting over the years. Concentration index was used to study the socioeconomic disparity in early childhood stunting. **Results:** Nearly 19% decrease in early childhood stunting can be attributed to increase in institutional deliveries, 14% to increase in maternal schooling, and 10% to improvement in maternal body mass index. In spite of an overall decrease, very little change is seen in socioeconomic disparity of childhood stunting. **Conclusions:** The study identifies institutional deliveries, maternal schooling, and maternal health as major contributors of decrease in early childhood stunting. It identifies persisting socioeconomic disparity in childhood stunting over the last decade.

Keywords: Concentration index, malnutrition, nutrition, Oaxaca decomposition, stunting

INTRODUCTION

Malnutrition together in all its forms continues to affect every country on earth and is considered a major impediment to achieving global food security, adequate nutrition, and sustainable development.[1] Global statistics for malnutrition among under-5 children reported 156 million children to be stunted, 93 million as underweight, and 50 million as wasted.[2] However, this burden is not distributed evenly around the world, and nearly 80% of the world's stunted children reside in just 14 countries.[3] Various efforts have been made over the years to bring about a reduction in child malnutrition; the latest among them involves Goal 2 of the Sustainable Development Goals. The SDG Target 2.2 recognizes the nutritional issues worldwide and aims to finish every form of malnutrition by 2030, including achieving the internationally agreed targets on reduction in stunting and wasting in under-5 children by 2050.[4] Despite all efforts at various levels, the prevalence of malnutrition continues to remain high in developing countries, especially in sub-Saharan Africa and South Asia. Even with sustained economic growth and reduced poverty levels in India over the last decade, a reduction in stunting has not been observed on the same scale.[2] High variation in the prevalence of stunting across India in terms of economy and geography

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indicates a need for further investigation into the determinants of early childhood nutrition. The present study attempts not only to quantify the contribution of various early child care practices to the change in prevalence of childhood stunting over the last 10 years but also to identify key point of focus that can lead to further decline in the levels of childhood stunting in India. The study also investigates weather the decline in level of early childhood stunting has been uniform across all socioeconomic groups of society.

MATERIALS AND METHODS

Ethics

The study is based on the data available in the public domain with no identifiers on the survey participants; hence, no ethical statement is required for this work.

Data source

The present study utilizes data from the last two rounds of the National Family Health Survey (NFHS), NFHS-3 in 2005–2006 and NFHS-4 in 2015–2016. It gives consistent and reliable estimates of fertility, mortality, birth control, utilization of maternal and child healthcare services, and other such indicators at the national, state, and regional level.[5-7]

Study sample

The final study sample consists of the youngest child aged 6–23 months, for whom data on height-for-age are available along with information on breastfeeding from last two rounds of the NFHS. After applying these criteria, the final sample size came out to be 10,153 and 55,896 children for NFHS-3 and NFHS-4, respectively.

Outcome and exposure variables

Height-for-age z-score which is the summary index for childhood stunting is taken to be the outcome variable. Children with height-for-age z-score below minus two standard deviations (−2 SD) of the mean WHO Child Growth Standards are categorized as stunted.[8]

Exposure variables can broadly be categorized into four groups, child factors such as sex, age, birth order, size at birth, place of delivery, diet diversity (children consuming at least four food groups), meal frequency (twice for breastfed infants aged 6–8 months and thrice for breastfed children aged 9–23 months), child's acceptable diet (children receiving minimum diet diversity and minimum meal frequency), and early initiation of breastfeeding; maternal factors such as maternal education, media exposure, daily consumption of green leafy vegetables and protein-rich food, and mother's body mass index (BMI) were taken into account; healthcare utilization such as complete antenatal care (antenatal care [ANC] in the first trimester, at least four antenatal visits, at least one tetanus toxoid injection, iron-folic acid tablets or syrup taken for at least 100 days); and socioeconomic characteristics of religion, caste, wealth index, place of residence, and geographical region were considered.

Statistical analysis

All analysis for the study was done using software package STATA version 14.0. Chi-square test was used to analyze the association of various factors with early childhood stunting followed by a t-test to assess the changes in prevalence by each factor. Bivariate and multivariate logistic analysis was also used to study the effect of various factors on childhood stunting. At last, Oaxaca decomposition was carried out to examine the contribution of the determinants of childhood stunting toward changes in its prevalence over the last 10 years. The Oaxaca–Blinder regression-based decomposition divides the gap in the outcome variable into two parts, "explained" and "unexplained."[9] The "explained" portion is that difference within the outcome due to group differences in levels of a group of measured exposure variables between "advantaged" and "disadvantaged" groups. The "unexplained" part is derived from the difference in how the predictor variables are related to the outcomes for the two groups. This portion would persist even if the disadvantaged group manages to achieve equivalent average levels of measured exposure variables of the advantaged group.

To examine the disparity in early childhood stunting across India for both rounds of the NFHS, concentration index was calculated for each of the states for both survey rounds. The predictive probabilities were calculated for each category of the wealth index after fitting a logistic model to control for other determinants of early childhood stunting to assess the change in prevalence of stunting across each socioeconomic group in the past 10 years.

RESULTS

Changes in factors associated with early childhood stunting over the last 10 years

The results of Chi-square tests for association of maternal and child characteristics to early childhood stunting indicate a significant association of stunting with the sex of the child, child's age, size at birth, place of delivery, early initiation of breastfeeding, mother's school attendance, mother's media exposure, mother's daily consumption of green leafy vegetables and protein-rich diet, and mother's BMI and complete ANC for both periods [Table 1]. Prevalence of stunting also comes out to be associated with caste, wealth index, place of residence, and geographical regions. The table indicates a significant association of child's diet diversity and minimum acceptable diet for 2005–2006. A significant decline in the prevalence of stunting is observed for all factors over the last decade.

The odds of early childhood stunting by maternal and child characteristics indicate that girls are less likely to be stunted as compared to boys [Table 2]. Children are more likely to be stunted at older ages and of higher birth orders. Children having the minimum diet diversity, consuming the minimum meal frequency, and having the minimum acceptable diet are less likely to be stunted as compared to their counterparts. However, on taking adjusted odds, the results show a higher

Table 1: Descriptive statistics of stunting among children aged 6-23 months by selected background characteristics during National Family Health Survey-3 (2005-2006) and National Family Health Survey-4 (2015-2016), India

Characteristics	NFHS-3 (2005-2006)			NFHS-4 (2015-2016)			Difference* (P)
	n=10,153 (unweighted)			n=55,896 (unweighted)			
	Percentage	95% CI	χ^2 (P)	Percentage	95% CI	χ^2 (P)	
Sex of child							
Male	44.8	43.0-46.6	4.7 (0.093)	37.8	37.0-38.7	118.1 (0.000)	−7.0 (0.000)
Female	42.7	40.7-44.6		33.4	32.6-34.3		−9.3 (0.000)
Age of child (months)							
6-11	28.3	26.4-30.2	702.4 (0.000)	22.9	22.1-23.7	2894.2 (0.000)	−5.4 (0.019)
12-17	47.7	45.5-49.8		38.9	37.9-39.9		−8.8 (0.000)
18-23	60.1	57.6-62.4		49.4	48.2-50.6		−10.7 (0.000)
Birth order of child							
First	38.6	36.3-40.9	103.2 (0.000)	31.1	30.2-32.1	645.4 (0.000)	−7.5 (0.000)
Second	41.2	38.8-43.6		34.5	33.5-35.6		−6.6 (0.010)
Third	46.2	43.0-49.3		39.4	38.1-40.9		−6.7 (0.038)
Fourth and above	51.3	48.6-53.9		46.5	45.1-47.9		−4.8 (0.002)
Size of child							
Small	51.1	48.4-53.8	61.1 (0.000)	44.4	42.7-46.0	287.9 (0.000)	−6.7 (0.002)
Average	42.2	40.4-44.0		35.3	34.7-36.1		−6.9 (0.000)
Large	40.9	38.1-43.7		31.9	30.4-33.3		−9.0 (0.010)
Place of delivery							
Noninstitutional	50.0	48.2-51.7	254.5 (0.000)	45.0	43.7-46.3	472.6 (0.000)	−4.9 (0.000)
Institutional	33.8	31.8-35.7		33.6	33.0-34.3		−0.1 (0.000)
Child's minimum diet diversity							
Not consumed	44.5	43.1-46.0	14.7 (0.002)	35.6	34.9-36.3	1.4 (0.465)	−8.9 (0.000)
Consumed	38.9	35.7-42.3		36.2	34.7-37.8		−2.7 (0.789)
Child's minimum meal frequency							
Not consumed	44.0	42.3-45.8	0.3 (0.681)	35.7	35.0-36.4	0.1 (0.817)	−8.4 (0.000)
Consumed	43.5	41.5-45.5		35.8	34.8-36.9		−7.7 (0.000)
Child's minimum acceptable diet							
Not consumed	44.2	42.7-45.6	6.0 (0.051)	35.6	35.0-36.2	5.3 (0.140)	−8.6 (0.000)
Consumed	40.0	36.0-44.1		37.3	35.1-39.5		−2.7 (0.623)
Early initiation of breastfeeding							
Not initiated	44.8	43.2-46.4	13.1 (0.004)	36.6	35.8-37.4	22.5 (0.001)	−8.2 (0.000)
Initiated within 1 h	40.6	38.2-43.1		34.6	33.7-35.6		−6.0 (0.002)
Mother's school attendance							
Not attended	52.6	50.6-54.5	301.9 (0.000)	46.4	45.4-47.5	1096.3 (0.000)	−6.1 (0.000)
Attended	35.4	33.8-37.1		31.5	30.8-32.2		−3.9 (0.049)
Mother's media exposure							
Not exposed	52.6	50.2-54.9	150.5 (0.000)	45.5	44.4-46.5	853.4 (0.000)	−7.1 (0.000)
Exposed	39.6	38.1-41.2		32.1	31.4-32.9		−7.5 (0.000)
Mother's daily consumption of green leafy vegetables							
Not consumed	46.1	44.0-48.3	14.0 (0.005)	36.4	35.6-37.3	13.4 (0.012)	−9.7 (0.000)
Consumed	42.3	40.7-44.0		34.9	34.1-35.8		−7.4 (0.000)
Mother's daily consumption of protein-rich food							
Not consumed	46.5	44.5-48.5	23.4 (0.000)	36.8	35.9-37.7	23.9 (0.001)	−9.7 (0.000)
Consumed	41.7	39.9-43.5		34.8	34.0-35.7		−6.9 (0.000)
Mother's BMI							
Low	49.1	47.1-51.1	142.7 (0.000)	41.1	40.0-42.1	483.6 (0.000)	−8.1 (0.000)
Normal	40.8	39.0-42.7		34.8	34.1-35.6		−6.0 (0.000)
Overweight	24.2	20.2-28.8		25.9	24.1-2.7		1.6 (0.311)
Complete antenatal care							

Contd...

Table 1: Contd...

Characteristics	NFHS-3 (2005-2006)			NFHS-4 (2015-2016)			Difference* (P)
	n=10,153 (unweighted)			n=55,896 (unweighted)			
	Percentage	95% CI	χ² (P)	Percentage	95% CI	χ² (P)	
Not completed	45.3	43.8-46.8	94.8 (0.000)	37.2	36.6-37.9	279.9 (0.000)	−8.1 (0.000)
Completed	28.5	25.1-32.3		28.1	26.6-29.6		−0.5 (0.054)
Religion							
Hindu	44.7	43.1-46.3	12.8 (0.007)	35.8	35.1-36.5	0.3 (0.730)	−8.9 (0.000)
Others	40.4	37.7-43.1		35.5	34.2-36.9		−4.9 (0.000)
Caste							
SC/ST	51.1	48.8-53.4	159.9 (0.000)	40.1	39.0-41.1	423.4 (0.000)	−11.0 (0.000)
OBC	44.4	42.1-46.7		36.1	35.3-37.0		−8.3 (0.000)
Others	35.1	32.9-37.4		28.8	27.4-30.2		−6.3 (0.000)
Wealth index							
Poorest	55.8	53.0-58.5	464.1 (0.000)	46.6	45.5-47.7	1719.6 (0.000)	−9.2 (0.000)
Poorer	48.7	46.0-51.4		39.5	38.3-40.6		−9.3 (0.000)
Middle	43.3	40.6-46.0		33.2	32.0-34.6		−10.0 (0.000)
Richer	35.0	32.3-37.8		27.8	26.4-29.3		−7.2 (0.000)
Richest	22.9	20.4-25.6		22.1	20.5-23.7		−0.8 (0.525)
Place of residence							
Urban	35.9	33.4-38.4	72.4 (0.000)	30.3	28.9-31.8	244.6 (0.000)	−5.6 (0.000)
Rural	46.0	44.4-47.6		37.6	36.9-38.3		−8.4 (0.000)
Geographical regions							
North	39.5	36.3-42.8	104.7 (0.000)	32.6	31.3-34.0	420.7 (0.000)	−6.9 (0.000)
Central	48.8	46.3-51.3		39.5	38.5-40.4		−9.3 (0.000)
East	45.4	42.4-48.5		39.1	37.9-40.3		−6.4 (0.026)
Northeast	36.5	32.1-41.1		32.6	31.0-34.3		−3.9 (0.015)
West	46.0	42.2-49.8		32.8	30.4-35.3		−13.2 (0.000)
South	34.2	31.0-37.6		28.8	27.1-30.5		−5.4 (0.101)
Total	43.8	42.4-45.2		35.7	35.1-36.4		−8.1 (0.000)

*NFHS-4 – NFHS-3. NFHS: National Family Health Survey, CI: Confidence interval, BMI: Body mass index

likelihood of stunting among children consuming the minimum acceptable diet during 2015–2016. We observe a substantial change in odds of stunting among children having institutional deliveries, those having early initiation of breastfeeding, and those whose mothers received complete ANC during pregnancy over the last 10 years. While mother's media exposure does not show significant association with stunting during 2005–2006, the tables indicate that mothers with media exposure are 9% less likely to have stunted children in 2015–2016. The geographical distribution of early childhood stunting indicates the prevalence of early childhood stunting in central, northeastern, and western region is higher compared to northern region of India according to NFHS-4 (2015–2016).

Contribution of maternal and child covariates toward changes in the prevalence of stunting over the last decade

The result of Oaxaca decomposition shows that maternal and child characteristics explained 56% of the difference in early childhood stunting during the last 10 years [Table 3]. The increase in institutional delivery, maternal education, and improvement in maternal BMI were responsible for a major decline in the prevalence of early childhood stunting. On the other hand, a child's diet diversity, caste, and place of residence contributed negatively to the decline in stunting.

Changes in the levels of stunting across socioeconomic groups during 2005–2016

The values of predictive probabilities indicate a nearly 45% probability of stunting among children belonging to the poorest section of the population in 2005–2006, whereas the probability is about 26% in the richest section [Table 4]. Here, we see that in 2005–2006, there does not seem to be much difference in the probability of stunting between the two lowest groups of the wealth quintile, but we observe a difference of more than three-point percent in 2015–2016. The highest level of change in predictive probability is observed in the poorer and middle group of the wealth quintile of nearly five-point percent over the last decade. A gap of nearly twenty-point percent is observed between the richest and the poorest wealth quintiles in both periods.

Discussion

The study attempts to examine various aspects of change that have taken place in the prevalence of stunting among children aged 6-23 months during the last 10 years. It analyzes the changes in the determinants of early childhood stunting across the last two rounds of the NFHS and the contribution

Table 2: Unadjusted and adjusted odds of stunting among youngest children aged 6–23 months by selected background characteristics for National Family Health Survey 3 and National Family Health Survey 4, India

| Characteristics | NFHS-3 (2005–2006) | | | | NFHS-4 (2015–2016) | | | |
| | n=10,153 (Un-weighted) | | | | n=55,896 (Un-weighted) | | | |
	OR (P)	95% CI	AOR (P)	95% CI	OR (P)	95% CI	AOR (P)	95% CI
Sex of child								
Male®								
Female	0.89 (0.003)	0.82-0.96	0.84 (0.000)	0.77-0.92	0.80 (0.000)	0.77-0.83	0.78 (0.000)	0.75-0.81
Age of child (months)								
6-11®								
12-17	2.30 (0.000)	2.08-2.54	2.40 (0.000)	2.17-2.67	2.06 (0.000)	1.97-2.15	2.12 (0.000)	2.03-2.22
18-23	3.62 (0.000)	3.26-4.02	4.03 (0.000)	3.60-4.51	3.00 (0.000)	2.87-3.14	3.16 (0.000)	3.02-3.32
Birth order of child								
First®								
Second	1.10 (0.064)	0.99-1.23	1.02 (0.698)	0.91-1.15	1.17 (0.000)	1.12-1.22	1.01 (0.000)	1.05-1.15
Third	1.35 (0.000)	1.20-1.53	1.03 (0.633)	0.90-1.18	1.43 (0.000)	1.36-1.50	1.18 (0.000)	1.12-1.25
Fourth and above	1.74 (0.000)	1.56-1.94	1.14 (0.038)	1.01-1.30	1.77 (0.000)	1.68-1.86	1.28 (0.000)	1.21-1.36
Size of child								
Small®								
Average	0.70 (0.000)	0.64-0.78	0.73 (0.000)	0.65-0.81	0.71 (0.000)	0.67-0.74	0.73 (0.000)	0.69-0.77
Large	0.60 (0.000)	0.53-0.68	0.65 (0.000)	0.57-0.74	0.62 (0.000)	0.58-0.66	0.67 (0.000)	0.62-0.71
Place of delivery								
Noninstitutional®								
Institutional	0.51 (0.000)	0.47-0.55	0.80 (0.000)	0.72-0.89	0.67 (0.000)	0.65-0.70	0.90 (0.000)	0.86-95
Child's minimum diet diversity								
Not consumed®								
Consumed	0.80 (0.000)	0.71-0.89	0.76 (0.009)	0.62-0.93	1.00 (0.847)	0.95-1.04	0.89 (0.000)	0.83-0.95
Child's minimum meal frequency								
Not consumed®								
Consumed	0.91 (0.019)	0.84-0.98	0.92 (0.072)	0.83-1.01	0.97 (0.166)	0.94-1.01	0.92 (0.000)	0.88-0.96
Child's minimum acceptable diet								
Not consumed®								
Consumed	0.79 (0.000)	0.70-0.90	1.11 (0.398)	0.87-1.43	1.00 (0.899)	0.94-1.06	1.12 (0.016)	1.02-1.23
Early initiation of breastfeeding								
Not initiated®								
Initiated within 1 h	0.87 (0.001)	0.80-0.95	1.06 (0.251)	0.96-1.17	0.93 (0.000)	0.89-0.96	0.99 (0.680)	0.96-1.03
Mother's school attendance								
Not attended®								
Attended	0.49 (0.000)	0.45-0.53	0.84 (0.001)	0.75-0.93	0.55 (0.000)	0.53-0.57	0.82 (0.000)	0.78-0.86
Mother's media exposure								
Not exposed®								
Exposed	0.55 (0.000)	0.50-0.60	0.95 (0.378)	0.85-1.06	0.57 (0.000)	0.55-0.59	0.91 (0.000)	0.87-0.96
Mother's daily consumption of green leafy vegetables								
Not consumed®								
Consumed	0.87 (0.001)	0.80-0.94	0.99 (0.892)	0.91-1.09	0.89 (0.000)	0.85-0.92	1.00 (0.856)	0.96-1.04
Mother's daily consumption of protein-rich food								
Not consumed®								
Consumed	0.80 (0.000)	0.74-0.87	1.01 (0.844)	0.92-1.11	0.88 (0.000)	0.88-0.95	0.99 (0.599)	0.95-1.03
Mother's BMI								
Low®								
Normal	0.69 (0.000)	0.63-0.75	0.84 (0.000)	0.77-0.92	0.72 (0.000)	0.69-0.74	0.82 (0.000)	0.78-0.85
Overweight	0.36 (0.000)	0.30-0.43	0.75 (0.005)	0.61-0.92	0.46 (0.000)	0.43-0.50	0.68 (0.000)	0.63-0.73
Complete antenatal care								

Contd...

Table 2: Contd...

| Characteristics | NFHS-3 (2005–2006) | | | | NFHS-4 (2015–2016) | | | |
| | n=10,153 (Un-weighted) | | | | n=55,896 (Un-weighted) | | | |
	OR (*P*)	95% CI	AOR (*P*)	95% CI	OR (*P*)	95% CI	AOR (*P*)	95% CI
No®								
Yes	0.49 (0.000)	0.42-0.56	0.85 (0.051)	0.72-1.00	0.68 (0.000)	0.64-0.71	0.94 (0.030)	0.89-0.99
Religion								
Hindu®								
Others	0.83 (0.000)	0.76-0.90	1.00 (0.986)	0.90-1.11	0.85 (0.000)	0.82-0.88	1.00 (0.926)	0.95-1.05
Caste								
SC/ST®								
OBC	0.90 (0.035)	0.82-0.99	0.94 (0.225)	0.84-1.04	0.94 (0.001)	0.90-0.98	0.97 (0.167)	0.93-1.01
Others	0.58 (0.000)	0.53-0.65	0.74 (0.000)	0.67-0.83	0.66 (0.000)	0.63-0.69	0.81 (0.000)	0.77-0.85
Wealth index								
Poorest®								
Poorer	0.79 (0.000)	0.70-0.89	0.93 (0.269)	0.81-1.06	0.72 (0.000)	0.69-0.76	0.87 (0.000)	0.82-0.92
Middle	0.59 (0.000)	0.52-0.67	0.77 (0.001)	0.66-0.89	0.56 (0.000)	0.53-0.59	0.73 (0.000)	0.68-0.77
Richer	0.42 (0.000)	0.37-0.48	0.61 (0.000)	0.51-0.72	0.43 (0.000)	0.41-0.46	0.59 (0.000)	0.55-0.64
Richest	0.25 (0.000)	0.22-0.29	0.40 (0.000)	0.33-0.49	0.32 (0.000)	0.30-0.34	0.48 (0.000)	0.44-0.52
Place of residence								
Urban®								
Rural	1.51 (0.000)	1.38-1.64	0.89 (0.031)	0.80-0.99	1.42 (0.000)	1.36-1.49	0.96 (0.141)	0.92-1.01
Geographical regions								
North®								
Central	1.43 (0.000)	1.26-1.62	1.06 (0.452)	0.92-1.22	1.39 (0.000)	1.32-1.47	1.06 (0.043)	1.00-1.13
East	1.24 (0.001)	1.09-1.42	0.92 (0.262)	0.79-1.07	1.49 (0.000)	1.42-1.58	1.01 (0.873)	0.94-1.07
Northeast	0.77 (0.000)	0.67-0.88	0.68 (0.000)	0.58-0.80	0.91 (0.003)	0.85-0.97	0.76 (0.000)	0.71-0.82
West	1.15 (0.074)	0.99-1.35	1.35 (0.001)	1.13-1.60	1.13 (0.003)	1.04-1.22	1.13 (0.006)	1.04-1.23
South	0.78 (0.001)	0.67-0.91	0.97 (0.707)	0.81-1.15	0.94 (0.091)	0.87-1.01	1.08 (0.056)	1.00-1.18

OR: Odds ratio; AOR: Adjusted OR; CI: Confidence interval; ®: Reference category; BMI: Body mass index

Table 3: Contribution of select background characteristics toward changes in prevalence of early childhood stunting across India from 2005-2016

| Characteristics | Difference due to characteristics (E) | | |
	Coefficient	Percentage*	*P*
Birth order of child	0.00520	6.45033	0.00000
Size of child	0.00633	7.85272	0.00000
Place of delivery	0.01533	19.02478	0.00000
Child's diet diversity	−0.00188	−2.32991	0.00700
Child's meal frequency	−0.00004	−0.05360	0.95900
Child's minimum acceptable diet	0.00009	0.11664	0.41600
Mother's school attendance	0.01204	14.93563	0.00000
Mother's media exposure	0.00107	1.32558	0.00900
Mother's BMI	0.00840	10.42149	0.00000
Complete antenatal care	0.00179	2.22034	0.01000
Caste	−0.00316	−3.91556	0.00000
Wealth index	0.00074	0.92417	0.58000
Place of residence	−0.00097	−1.20050	0.02400
Geographical regions	0.00034	0.42250	0.51000
Constant			
Total	0.04529	56.19485	0.00000

*Percent out of the total gap between NFHS-3 and NFHS-4. NFHS: National Family Health Survey; BMI: Body mass index

of these factors toward changes in the nutritional status of children aged 6–23 months. At last, it examines the levels of disparity in the prevalence of stunting among children by various economic groups in society and the changes in their levels over the last decade.

The study reveals an overall decline in the prevalence of early childhood stunting across India over the last 10 years from 2005 to 2016. However, high levels of variation continue to exist across all the states in India. Various studies in the past have shown a significant association of children undernutrition with the place of residence, however; here, we did not observe much difference in the prevalence of stunting between rural and urban areas.[10,11] This might indicate an improvement in the nutritional status of children in rural India. The study reveals institutional delivery as the highest contributing factor for this decline. Maternal education, BMI, and complete ANC during pregnancy also contribute significantly to the improvement in childhood stunting. The study also indicates a negative effect of the change in complementary feeding practices among children over the last 10 years. This could be due to the decline in the percentage of children receiving the minimum number of meals and the minimum acceptable diet over the last decade. Previously, studies have shown diet inadequacy as a critical indicator of child undernutrition and have been

Table 4: Predicted probability of being stunted from logistic regression analysis for different categories of wealth quintile, India, 2005-2016

Wealth status and time	Predicted probability*	95% CI	P
2005-2006			
Poorest	0.450	0.427-0.473	0.000
Poorer	0.433	0.412-0.455	0.000
Middle	0.393	0.373-0.414	0.000
Richer	0.344	0.325-0.364	0.000
Richest	0.265	0.244-0.286	0.000
2015-2016			
Poorest	0.416	0.407-0.425	0.000
Poorer	0.384	0.376-0.393	0.000
Middle	0.346	0.337-0.354	0.000
Richer	0.304	0.294-0.314	0.000
Richest	0.261	0.250-0.273	0.000
Change 2005-2016			
Poorest	−0.034		
Poorer	−0.049		
Middle	−0.047		
Richer	−0.04		
Richest	−0.004		

*Predicted probabilities adjusted for sex of child, age of child, birth order, size of child, place of delivery, diet diversity, meal frequency, minimum acceptable diet, early initiation of breastfeeding, mother's school attendance, mother's media exposure, mother's diet, mother's BMI, complete ANC, religion, caste, wealth index, place of residence, and geographical region. BMI: Body mass index, ANC: Antenatal care, CI: Confidence interval

known to be associated with illness, poor health, and mortality among infants and young children aged less than 2 years.[12] Studies carried out on complementary breastfeeding practices in India have shown high levels of variations and are found to be associated significantly with modifiable factors such as maternal education, wealth index, skilled assisted delivery, and frequent antenatal visits.[13]

Pieces of evidence from various studies show the omnipresence of socioeconomic inequalities in health both within and between countries at any stage of development.[14-17] While the prevalence of stunting across India has decreased, the nutritional gap between the richest and the poorest section of society remains almost unchanged. While macroeconomic growth is often treated as a critical factor for improvement in childhood stunting by policymakers, evidence from India shows no direct association of reduction in childhood stunting to economic growth. An increase in economic growth can lead to improved nutritional status only if the nature of growth is pro-poor and consequences of the growth include increased investment in public health infrastructure that directly affect child health.[18]

To maintain comparability, the study has been done on the youngest currently breastfeeding child in the household aged 6–23 months as NFHS-3 does not provide data on the meal frequency of children of nonbreastfed children. Previously,

studies have suggested the measure of childhood stunting in large-scale surveys to be sensitive to over-dispersion and have lower measurement precision.[19] However, more recent studies on quality of data collected on child anthropometric measures in the NFHS round 2005–2006 and 2015–2016 indicated the data to be of sufficiently high quality for the estimation of prevalence of stunting and underweight among children.[20]

The findings from the present study suggest a need for effective implementation of various constituents of maternal and childcare such as preconception care, antenatal checkups, and readiness for complications as stipulated by the Reproductive, Maternal, Neonatal, and Child Health + Adolescents Program in India. Although the program is intended to provide a continuum of care from conception to early childhood, certain stages of the process continue to remain neglected.[21,22] Recent reports have shown that nearly 20% of the existing burden of stunting can be prevented if nutrition specific interventions in the country can be scaled up to cover 90% of the target population; studies also suggest that wider dissemination of information on nutrition in an easy and understandable manner to vulnerable groups of population could help promote child health.[22] At last, the study indicates maternal education as one of the major factors for improvement in early childhood stunting emphasizing the importance of universal primary and secondary education. The programs to improve school education in the country should be effectively monitored, and opportunities should also be provided for school dropouts to re-enter the schooling system to complete their education.

CONCLUSION

The study illustrates changes in prevalence of stunting among children aged 6–23 months over the last decade and brings out the existing socioeconomic disparity in distribution of early childhood stunting in India. It identifies major contributors of change in the prevalence of childhood stunting over the last decade. It identifies persisting inequality in nutritional status among children by socioeconomic group despite significant reduction in levels of stunting among children across India.

Conflicts of interest

There are no conflicts of interest.

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