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Changes in Socioeconomic Inequality in Nutritional Status Among Mothers in EAG States, India

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Abstract

Reduction of undernutrition is a major public health challenge for both developing and developed countries. Despite the impressive economic growth, India experienced pervasive and persistent child and mother malnourishment. According to NFHS-IV, Indian women Aged 15-49 years around 23% are below the normal BMI. Approximately 31% of women aged 15-49 are below the normal BMI in Jharkhand & Bihar. The nutritional status of women in such states as Madhya Pradesh, Rajasthan, Chhatisgarh, Odisha, and Uttar Pradesh is also below the national level. This indicates that in EAG states the nutritional status of the mothers is below the satisfactory level. The main objective of the study is to investigate the socioeconomic inequality in nutritional status among mothers in EAG states. The concentration Index method has been used to investigate socioeconomic inequality. Socioeconomic inequality among mothers has increased during the period. The causes of increasing inequality in undernutrition are poor economic status and the Education level. Some other causes are also immersed in the study's analysis, such as body mass index of mothers, caste, health care utilization, and household environment variables.

Keywords: Underweight, overweight, obesity, EAG States, Concentration Index

Introduction

Adolescent nutrition is essential to girls' health and is relevant to maternal nutrition. The period from pregnancy to 24 months of age is a crucial window of opportunity for reducing undernutrition and its adverse effects, so it should focus on this segment of the care continuum (Bryce, Coitinho et al. 2008). Worldwide 1.2 billion adolescent resides in different places, around 90% of whom live in low-middle-income countries (Cappa, Wardlaw et al. 2012). The adolescent is also a period of mental development, rapid growth, and maturation from childhood to adulthood. Some research study shows that adolescent is a period with some potential for height catch-up in children with stunting from early childhood (Prentice, Ward et al. 2013). Studies also found that adolescent fertility is three times higher in low middle-income countries. Among these nations, pregnancy in adolescents has a higher risk of complications and mortality in mothers and children and poorer birth outcomes than pregnancies in older women (UNICEF. 2008, Gibbs, Wendt et al. 2012, Kozuki, Lee et al. 2013). Maternal obesity during pregnancy increases the risk of childhood obesity that continues into adolescent and early childhood, potentiating the trans generational transmission of obesity (Catalano 2003, McGuire, Dyson et al. 2010). Maternal overweight and obesity are associated with maternal morbidity, preterm birth, and increased infant mortality (Black, Victora et al. 2013).

Maternal vitamin deficiencies

In, pregnancy vitamin and mineral deficiencies can also have negative implications in women and their children when they are not appropriately managed during and after pregnancy (Haider and Bhutta 2006, Peña-Rosas, De-Regil et al. 2012). The maternal and child undernutrition series indicates that maternal short stature and iron deficiency anaemia increases the mother's risk of death at delivery, accounting for at least 20% of maternal mortality (Black, Allen et al. 2008). Intrauterine growth restriction indicates constraints in fatal nutrition during a crucial period of brain development. In developing countries, intrauterine growth restriction is mainly due to poor maternal nutrition and infections (Blössner and Villar 1998).

Maternal undernutrition contributes to poor foetal and early childhood growth and increases infant morbidity and mortality with long-term adverse consequences for child development and life-long health (Black, Victora et al. 2013). Nevertheless, there is limited knowledge of the inequality among in mother's nutritional status. Given the striking prevalence of malnutrition and infant and child mortality in EAG

states, there is a strong need to study theeconomic inequality among mother's nutritional status. Hence, the present study Investigates the economic inequality among mothers nutritional status using large-scale population-based data in EAG states. The research will focus on the changes in socioeconomic inequality over the last two decades and whether it improved nutritional status in EAG states.

Data and Methods

The nationally represented data National Family and Health welfare NFHS-III and NFHS-IV round data has been used for this study.

The concentration Index

The concentration index is defined as twice the area between the concentration curve and the line of equality. The index bounded between -1 to +1. The concentration index is frequently used to measure inequality in one variable over the distribution of another. The concentration index, which is directly related to the concentration curve, does quantify the degree of socioeconomic-related difference in a health variable (Kakwani, Wagstaff et al. 1997). The concentration index summaries socio-economic inequality and compares demographic groups and over time (Zhang and Wang 2004). It has been used, for example, to measure and to compare the degree of socioeconomic-related inequality in child mortality (Wagstaff 2000), child immunisation (Gwatkin, Rustein et al. 2003), child malnutrition (Wagstaff, Van Doorslaer et al. 2003), adult health (Van Doorslaer, Wagstaff et al. 1997), health subsidies (O'Donnell, Van Doorslaer et al. 2007) and health care utilisation (O'Donnell, Van Doorslaer et al. 2007).

We used the concentration index to demonstrate the direction of a nutritional indicator across socio-economic groups. The household economic status is categorised into five quintiles. The household will be ranked according to their economic condition, starting with the poorest. The distribution of nutritional indicators was measured by plotting a concentration curve representing the cumulative proportion of nutritional indicators ranked by the households' socio-economic condition against cumulative proportions of the population in the corresponding groups of households. If the concentration index is zero, there is no socio-economic inequality in the nutritional indicator. The index takes a negative value when the curve lies above equality, indicating more nutritional indicators among the low socio-economic group. It takes a positive value when the index lies below equality if the nutrition indicator is more concentrated in high socio-economic groups. A negative value of the concentration index means malnutrition is higher among the poor.

Formally, the concentration index is defined as

$$C=1-2\int_0^1 L_h(p)dp$$

For a discrete living standards variable, it can be written as

$$C=\frac{2}{N\mu}\sum_{i=1}^{n} h_i r_i - 1 - \frac{1}{N}$$

Where, h_i is the nutritional status indicator, μ is the mean, and
$r_i = \frac{i}{N}$ is the rank of an individual in the living standards distribution, with i = 1 for the poorest and i=N for the richest.

Results

A summary of the result presented in ***Table 1*** shows the percentage age distribution of nutritional status among mothers in India's EAG states. Results reveal that in the adolescent age group 15-19 years, the prevalence of underweight and overweight was 42.2% and 2.73%. The prevalence of overweight/obesity was 24.44 in age 35-49 in 2015-16. Results also show that the prevalence of underweight decreases as the age of the mother increases. The prevalence of underweight was 39.89 and 4.18%, respectively, in never-married women. The underweight prevalence was highest, about 27.02%, in Illiterate women, followed by 25.95, 28.58, and 17.58% in Primary, secondary and higher levels. The prevalence of underweight and overweight/obesity was higher among women working in agriculture and professional jobs. Women who belong to the rural area reported about 29% prevalence in underweight. SC/ST women have a higher prevalence of underweight as compared to OBC and other categories. Poverty also affects the nutritional status among mothers and children in these states. The prevalence of underweight was highest among the poorest women, while overweight/obesity was among the wealthiest groups.

A summary of the result is presented in ***Table 2*** shows the decomposition for the two-period and changes. Entries in each column for elasticity, concentration index, and contribution to c derived from the equation given by Wagstaff, Van Doorslear and Watanable(Wagstaff, Doorslaer et al. 2001). The columns show the underweight elasticity for each factor, the concentration index for each factor, and each factor's total contribution to the Underweight concentration index. Each year, a factor related to mothers such as age, marital status, respondent education level, residence, caste, religion and wealth contributed to inequality in underweight. The last two columns under the heading' contribution to c' and percentage contribution make it clear that the bulk of inequality in underweight in both 2005 and 2015 was caused by inequality in many factors household economic condition, respondent's education, place of residence. Both sets of inequality disfavored the poor in both years. The negative concentration indices in the last row (contribution to c) show that inequality is underweight to the poor's disadvantage each year. The column 'contribution to c' clearly shows that inequality has been decreased over time. The large Elasticities of underweight for these factors are responsible for their enormous contribution to the underweight concentration index.

Inequality in the household's economic condition, respondent education, caste, and household environment variable all disfavored the poor in both years. The household's economic condition was reported highest contributor to inequality in childhood stunting under five years of age. The wealth index contribution to underweight inequalities accounted for -0.045 points of -0.049 in 2005 and -0.032 of -0.042 in 2015. The second highest contributor was the respondent's education level, but their contribution to malnutrition inequality was, accounting in

total for -0.006 points of -0.049 in 2005 and -0.006 of -0.042 in 2015. Inequalities in the caste also disfavored the poor, but their contribution is significantly 9% in 2005 to 6% in 2015, respectively.

A summary of the result is presented in ***Table 3*** shows the decomposition for the two-period and changes. Entries in each column for elasticity, concentration index, and contribution to c derived from the equation given by Wagstaff, Van Doorslear and Watanable(Wagstaff, Doorslaer et al. 2001). The columns show the overweight/obesity elasticity for each factor, the concentration index for each factor, and each factor's total contribution to the overweight/obesity concentration index. Each year, a factor related to mothers such as age, marital status, respondent education level, residence, caste, religion and wealth contributed to inequality in overweight/obesity. The last two columns under the heading' contribution to c' and percentage contribution make it clear that the bulk of inequality in overweight/obesity in both 2005 and 2015 was caused by inequality in many factors household economic condition, respondent's education, place of residence. Both sets of inequality favored the richer group in both years. The positive concentration indices in the last row (contribution to c) show that there was inequality in overweight/obesity to the richer group advantage each year. The column 'contribution to c' clearly shows that inequality has been increased over time. The large Elasticities of overweight/obesity for these factors are responsible for their enormous contribution to the underweight concentration index.

Inequality in the household's economic condition, respondent education, caste, and household environment variable all disfavored the poor in both years. The household's economic condition was reported highest contributor to inequality in childhood stunting under five years of age. The wealth index contribution to underweight inequalities accounted for 72% in 2005 and 70% in 2015. The second highest contributor was the respondent's education level, but their contribution to malnutrition inequality was, accounting in total for 12% in 2005 and 13% in 2015. Inequalities in the caste also favored the richer group, but their contribution was significantly by 7% in 2005 to 6% in 2015.

Table 1: Percentage distribution of underweight and overweight/obesity among mothers in EAG States, India, NFHS-IV (2015-16)

Background Characteristics	Underweight	Normal	Overweight/Obesity	Total
Age				
15-19	42.20	55.08	02.73	71488
20-24	29.46	63.48	07.06	64164
25-29	24.06	62.75	13.19	56165
30-34	21.23	60.06	18.71	46401
35-49	18.34	57.22	24.44	111128
Marital status				
Never married	39.89	55.93	04.18	86036
Currently married/ living with partner	22.17	60.33	17.49	252399
Widowed/Divorce/Separated	23.13	58.65	18.22	10911
Respondents education				
Illiterate	27.02	60.62	12.36	128952
Primary	25.95	59.68	14.37	44598
secondary	28.58	57.45	13.98	140809
Higher	17.58	60.40	22.03	34988
Respondent Occupation				
Not working	26.21	58.16	15.63	39822
professional job	16.06	60.27	23.67	1706
Agriculture	30.00	60.20	9.80	13424
Socio-economic variables				
Place of residence				
Urban	18.47	56.14	25.39	83432
Rural	29.11	60.16	10.74	265914
Caste				
SC/ST	31.24	60.02	08.75	104829
OBC	26.43	59.53	14.04	175921
others	19.44	57.03	23.53	64324
Religion				
Hindu	26.76	59.59	13.64	297457
Muslim	25.51	56.48	18.01	45203
Others	20.40	59.02	20.58	3923
Wealth Index				
Poorest	34.77	59.78	05.45	106492
Poorer	29.57	60.81	09.61	80753
Middle	24.78	60.26	14.97	61418
Richer	19.92	58.15	21.93	51250
Richest	13.11	55.05	31.84	49433
Total	**26.57**	**59.20**	**14.24**	**349346**

Note: - The sum of percentages may not reach 100% in some cases.

Table 2: Decompositions of concentration index for changes in inequality among underweight mothers by socioeconomic characteristics, EAG states, NFHS-III & NFHS-IV (2005-06 – 2015-16)

Background Characteristics	Elasticities		Concentration Index		Contribution to C			(%) Contribution	
	2005	2015	2005	2015	2005	2015	Change	2005	2015
Age(in months)									
15-19									
20-24	0.002	-0.011	0.037	0.054	0.000	-0.001	-0.001	-0.18	1.39
25-29	0.000	-0.016	-0.015	0.014	0.000	0.000	0.000	-0.01	0.54
30-34	0.002	-0.017	-0.050	-0.024	0.000	0.000	0.001	0.20	-0.98
35-49	-0.007	-0.052	0.006	0.001	0.000	0.000	0.000	0.09	0.09
Marital status								0.10	1.04
Never married									
Currently married/ living with partner	-0.109	-0.076	-0.032	-0.017	0.003	0.001	-0.002	-7.15	-3.08
Widowed/Divorce/Separated	-0.004	-0.003	-0.151	-0.102	0.001	0.000	0.000	-1.20	-0.63
Respondent's education								-8.35	-3.71
Illiterate									
Primary	-0.005	-0.003	0.019	-0.078	0.000	0.000	0.000	0.17	-0.57
secondary	-0.007	-0.014	0.347	0.143	-0.003	-0.002	0.001	5.26	4.80
Higher	-0.004	-0.007	0.797	0.589	-0.003	-0.004	-0.001	6.20	9.73
Socio-economic variables								11.63	13.96
Place of residence									
Urban									
Rural	-0.014	0.015	-0.174	-0.167	0.002	-0.003	-0.005	-5.06	6.08
Caste									
SC/ST									
OBC	-0.020	-0.009	-0.012	0.018	0.000	0.000	0.000	-0.48	0.38
others	-0.014	-0.007	0.342	0.354	-0.005	-0.003	0.002	9.52	6.02
Religion								9.04	6.40
Hindu									
Muslim	0.006	-0.001	0.051	0.107	0.000	0.000	0.000	-0.61	0.33
Others	0.000	0.000	0.445	0.217	0.000	0.000	0.000	0.27	0.16
Wealth Index								-0.34	0.49
Poorest									
Poorer	-0.010	-0.011	-0.223	-0.160	0.002	0.002	0.000	-4.43	-4.17
Middle	-0.019	-0.015	0.188	0.247	-0.004	-0.004	0.000	7.38	8.97
Richer	-0.025	-0.018	0.531	0.569	-0.013	-0.010	0.003	27.36	23.95
Richest	-0.036	-0.023	0.846	0.858	-0.031	-0.020	0.011	62.67	47.00
Total(N)					**-0.049**	**-0.042**	**0.007**	92.99	75.74

Table 3: Decompositions of concentration index for changes in inequality among overweight/obesity mothers by socioeconomic characteristics, EAG states, NFHS-III & NFHS-IV (2005-06 – 2015-16).

Background Characteristics	Elasticities		Concentration Index		Contribution to C			Percentage Contribution	
	2005	2015	2005	2015	2005	2015	Change	2005	2015
Age(in months)									
15-19									
20-24	-0.002	0.001	0.037	0.054	0.000	0.000	0.000	-0.24	0.06
25-29	0.003	0.010	-0.015	0.014	0.000	0.000	0.000	-0.12	0.28
30-34	0.006	0.016	-0.050	-0.024	0.000	0.000	0.000	-0.84	-0.78
35-49	0.026	0.059	0.006	0.001	0.000	0.000	0.000	0.48	0.08
Marital status									
Never married									
Currently married/ living with partner	0.041	0.047	-0.032	-0.017	-0.001	-0.001	0.001	-3.70	-1.64
Widowed/Divorce/Separated	0.001	0.001	-0.151	-0.102	0.000	0.000	0.000	-0.60	-0.27
Mother's education									
Illiterate									
Primary	0.003	0.005	0.019	-0.078	0.000	0.000	0.000	0.18	-0.77
secondary	0.008	0.025	0.347	0.143	0.003	0.004	0.001	7.75	7.28
Higher	0.002	0.006	0.797	0.589	0.002	0.004	0.002	4.28	7.21
Socio-economic variables									
Place of residence									
Urban									
Rural	-0.026	-0.031	-0.174	-0.167	0.005	0.005	0.001	12.91	10.40
Caste									
SC/ST									
OBC	0.004	0.007	-0.012	0.018	0.000	0.000	0.000	-0.13	0.26
others	0.007	0.009	0.342	0.354	0.002	0.003	0.001	7.06	6.28
Religion									
Hindu									
Muslim	0.001	0.005	0.051	0.107	0.000	0.001	0.000	0.20	1.03
Others	0.000	0.000	0.445	0.217	0.000	0.000	0.000	0.50	0.09
Wealth Index									
Poorest									
Poorer	0.002	0.007	-0.223	-0.160	0.000	-0.001	-0.001	-1.14	-2.35
Middle	0.004	0.012	0.188	0.247	0.001	0.003	0.002	2.18	6.23
Richer	0.009	0.018	0.531	0.569	0.005	0.010	0.005	13.80	20.28
Richest	0.024	0.027	0.846	0.858	0.020	0.023	0.002	57.41	46.33
Total(N)					**0.035**	**0.049**	**-0.014**		

Discussion and conclusion

This study was conducted in EAG states, India. Earlier it was known as BIMARU. Ashish Bose, a prominent Indian demographer, and economist coined the word BIMARU in a paper submitted to Prime Minister Rajiv Gandhi in the mid-80s. BIMARU has a resemblance to the Hindi word "Bimar," which means sick. These states are still facing a problem with infant mortality, bad nutritional condition for both mother and children, child mortality, maternal mortality, etc. Our main aim was to examine the causes of the health sector, socioeconomic inequality, and changes in mother's nutritional status over the period. The result shows statistically significant mother's undernutrition changes by wealth index, education level, BMI, residence, healthcare variables, caste, and household environment variables. Some literature found that many variables, such as the wealth of the household, antenatal care were the key contributor to declining the prevalence of undernutrition among mother's (Ukwuani and Suchindran 2003). Some research also supports the findings; the largest decline in the risk of malnutrition was observed in the rich wealth quintile, while the least decline occurred in the most deprived quintile in India and across the states(Pathak and Singh 2011). Reduction in undernutrition rates has been slow but steady and is likely to speed up because of socioeconomic status improvements (Sachdev 2003).

Decomposition analysis revealed that household economic status was the first contributor to Underweight inequality. Education was the second-highest contributor to the inequality in underweight among mothers. Many factors, such as toilet facility, type of house, and caste, contributed to the inequality in underweight. Some decomposition analysis also showed that household economic status and education were the most important contributor to the socioeconomic inequalities in mother's nutritional status (Chalasani 2012, Kia, Rezapour et al. 2017).

To the best of our knowledge, perhaps, our study is the first to examine socioeconomic inequality changes in mother's nutritional status in recent years, particularly in India's EAG states. We analyzed large-scale population-based cross-sectional, nationally representative NFHS series data. Our analysis indicated the decline in the prevalence of underweight did not result in a decline in socioeconomic inequality in indicators. Notably, the overall inequality in overweight remained unchanged while the underweight inequality decreased over the years in EAG states. Our analysis also indicated that socioeconomic inequality differed by state. The highest inequality in overweight/obesity and underweight was reported in Odisha, respectively. Similarly, Uttarakhand had the highest decrease in inequality in both indicators during 2005-2016.

India is committed to Sustainable Development Goals (SDG), and the second SDG seeks sustainable solutions to end hunger in all its forms by 2030 and achieve food security (United Nations 2020). Hence, India also set a national target of bringing down the prevalence of stunting and underweight up to 2.5% and 0.9%, respectively, by 2030 (NITI Aayog 2020). To SDG implementation, the Prime Minister of India launched the Prime Minister's Overarching Scheme for Holistic Nutrition (POSHAN) Abhiyaan (National Nutrition Mission (NNM)) in 2018. It is a multi-ministerial convergence program with the vision to ensure the attainment of malnutrition free India by 2022. The POSHAN Abhiyaan has a target of reducing stunting, under-nutrition, anaemia (among young children, women and adolescent girls), and low birth weight by 2%, 2%, 3%, and 2% per annum, respectively. It aims to ensure holistic development and adequate nutrition for pregnant women, mothers, and children (NITI Aayog 2020, NITI Aayog 2020). However, India State-Level Disease Burden Initiative Malnutrition Collaborators reported that the annualized percentage decline in stunting and underweight prevalence in children is sluggish among low Socio-demographic Index (SDI) state group (EAG states) compared to the high SDI state group in India in 2017. The study further added that most of these states require significantly higher rates of reduction for all forms of undernutrition to meet NNM 2022 and SDG 2030 targets (Swaminathan, Hemalatha et al. 2019).

The study gives the following crucial message based on analysis:
The proportion of underweight has declined from 2005 to 2015 in EAG states, but the prevalence is still not acceptable. The prevalence of underweighted mothers was concentrated among a vulnerable group in EAG states. Socioeconomic inequality in childhood undernutrition has increased during the period. The causes of increasing inequality in undernutrition are poor economic status and education level. Some other causes are also immersing from the study's analysis, such as caste, economic status, and household environment variables. The state-wise differences in inequality can also be noticed. Madhya Pradesh and Bihar had the highest inequality underweight, respectively, in 2015-16. The decomposition analysis indicates household wealth index, mother's education, and mother's nutritional status determine about 80% of the inequality in underweight among children in EAG states in India. The decomposition alerts us to a potential trade-off between improving the inequality and improving the mean of the variable of interest. A trade-off discussed by Contoyiannis and Foster and apparent in our empirical illustration (Contoyannis and Forster 1999).

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