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Dynamics of Child Undernutrition in India: An Analysis beyond the Headcount Ratio

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Abstract

India's GNP at factor cost registered an increase of almost 60 percent during the period from 2001-02 to 2005-06. In the face of that, the proportion of underweight children under three years of age decreased marginally from 43 per cent to 40 per cent between 1998-99 and 2005-06. This paper argues that in order to delve deeper into the puzzle of high and almost stagnant child undernutrition, we need to look beyond the simple headcount ratio and understand the dynamics of depth and severity of undernutrition as well. For that we examine the changes in the headcount ratio and the Mean of Squared Deprivation Gaps (MSDG) of child underweight in the major states of India between 1998-99 and 2005-06. We classify the states into four zones according to the changes in headcount ratio and MSDG and find that while the headcount ratio has improved in certain states, the situation of the worst affected children has worsened further.

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1. Introduction

UNICEF's report on the situation of India's children has imploringly argued that the achievement of the Millennium Development Goals with respect to the world's children crucially depends on what happens to the children of India (UNICEF 2011). Child undernutrition is a dimension of non-monetary poverty and ability to be well-nourished is one of the most relevant capabilities, particularly for very young children (Mukhopadhyay 2013). Nutritional status is an outcome indicator in the space of child functionings (defined, following Sen (1992) as the actual beings and doings of a child) as opposed to income or expenditures. Undernutrition levels in India are higher than those of some poorer and lower-growth countries of Sub-Saharan Africa, such as Ethiopia, Botswana and Tanzania (UNICEF 2015). According to the third National Family Health Survey (NFHS-3) Report, 48 per cent of Indian children below five years of age are stunted, 43 per cent underweight and 20 percent wasted. 24, 16 and 6 per cent of children below five years of age respectively suffer from severe forms of stunting, underweight and wasting (IIPS and ORC Macro 2007).

India's GNP at factor cost registered an increase of almost 60 percent during the period from 2001-02 to 2005-06. In the face of that, the proportion of underweight and severely underweight children under three years of age decreased marginally from 43 per cent to 40 per cent and from 18 per cent to 16 per cent respectively between NFHS-2 (1998-99) and NFHS-3 (2005-06) (Svedberg 2008). Debates and discussions continue to ask if the 'peculiar and ahistoric' growth process experienced by India (Papola 2005) is feeding on and breeding further inequality. On the other side of the debate, growth enthusiasts such as Panagariya have started to question if the undernutrition figures for India are exaggerated and based on faulty international yardsticks (Panagariya 2013). The author has argued that genetics has a crucial role to play and that children from Sub-Saharan Africa are in reality not better nourished than their Indian counterparts. Scathing criticism of his arguments followed in a series of six articles by noted nutritionists and economists in a later issue of the journal. These articles slated the methodology, analysis and findings of Panagariya's paper and accused him of trying to manipulate measurement standards that would 'conveniently underestimate the burden of child undernutrition' (Wable 2013).

Studies dealing with the measurement of undernutrition have argued that measuring undernutrition as the headcount ratio of those failing to achieve a cut-off level of nutritional status is loaded with problems similar to those associated with the headcount ratio of poverty. Studies have suggested the use of measures that go beyond that level and capture other important dimensions of undernutrition, namely depth and severity (Sen and Sengupta 1983; Sahn and Stifel 2002; Swain 2008; Mishra and Mishra 2009). Mukhopadhyay (2011) has argued why the Mean of Squared Deprivation Gaps (MSDG) seems to be the ideal measure of undernutrition. The intuitive interpretation of the measure, applied in the context of undernutrition, entirely differs from the 'relativist view' of poverty. Explaining the relativist view of poverty, Sen (1976) has referred to the 'greater sense of poverty' of a person lower in the welfare scale. The use of greater weights attached to lower levels of nutritional status in MSDG is based on the biomedical finding that as nutritional shortfall increases the physiological risk increases at an increasing rate (Scrimshaw *et al*. 1968; Pelletier *et al*. 1994; Blossner and de Onis 2005; Black *et al*. 2008). The MSDG measures undernutrition as a weighted sum of the nutritional shortfalls of the undernourished (in terms of anthropometric scores), the weights equalling the very shortfalls, to capture the magnitude of biological and functional hazards. Thus, the MSDG captures all three dimensions: level, depth and severity.

Mukhopadhyay (2011) has found out the MSDG of child underweight in the Indian states and has shown that figures of average undernutrition mask the peculiarities of the distribution of the undernourished and do not shed light on how the undernourished are dispersed below the cut-off level. Thus, state ranks according to average figures of child underweight often differ from those according to MSDG of child underweight. Mukhopadhyay (2015) compares the relative performance of states with respect to average underweight and MSDG of underweight among children below five years of age.

This paper argues that in order to delve deeper into the puzzle of high and almost stagnant child undernutrition (particularly underweight), we need to understand the dynamics at the state level. The aim of this paper is to study the relative performance of the Indian states in reducing child undernutrition, not only with respect to the headcount ratio, but also in terms of the MSDG, since the latter incorporates the dimensions of depth and severity. The paper argues that the headcount ratio and the MSDG may move in different directions and accordingly we may have different situations. For instance, a fall in average undernutrition may be accompanied with a rise in MSDG, a measure that attaches increasing weights to increasing shortfalls. This would mean an improvement only for marginally undernourished children (those near the cut-off), with a worsening of the condition of children who are severely undernourished. We argue that such possibilities deserve policy attention. In the following section, we will describe the data source and the methods used. While the third section will state and discuss the results, the fourth section will summarize the findings and conclude the paper.

2. Data and Methods

2.1 Calculating the MSDG

Foster *et al.* (1984) devised a new class of poverty measures (commonly called the Foster Greer Thorbecke (FGT) measures) that were additively decomposable across population subgroups. The MSDG is one such FGT measure that has been extensively used in applied work on poverty and deprivation. The underweight MSDG may be defined as:

$M(y; z) = 1/ nz^2 \Sigma gi^2$

where i =1, 2, . . ., q, $y = (y_1, y_2, \ldots, y_n)$ is a vector of child weight for age z-scores in increasing order, z is the cut-off z-score, (-2 for underweight), gi =(z – yi) is the nutrition shortfall of the ith child, n and q are the total number of children and the number of underweight children respectively. The class of FGT measures of undernutrition may be likewise defined as $M_\alpha (y; z) = 1/n\Sigma (gi / z)^\alpha$, where i = 1, 2, . . ., q and $\alpha \geq 0$ is the undernutrition aversion parameter. By proposing the MSDG as a measure of undernutrition, we are assuming that $\alpha = 2$, the least integral value needed to ensure increasing weights for increasing shortfalls. For a description of the axiomatic framework behind the formulation of the MSDG, see the Appendix to the paper.

While in the analysis of monetary poverty, identification of the poor is a complicated step (since we may use several poverty lines), the cut-offs for undernutrition are universally fixed. Following the Waterlow classification scheme, we have three measures of undernutrition, namely stunting or low height-for-age, underweight or low weight-for-age, and wasting or low weight-for-height (Waterlow *et al.* 1977). Weight-for-age is a composite index of height-for-age and weight-for-height. It takes into account both acute and chronic malnutrition (IIPS and ORC Macro 2007).The anthropometric indicators are expressed in standard deviation units (z-scores) from the median of the World Health Organization (WHO) reference population. Children whose weight-for-age is below minus two standard deviations from the median of the reference population (with a weight-for-age z-score below -2) are classified as underweight (Garza and de Onis 2004). Children with weight-for-age z-score above -2 are not underweight, those between -2 and -3 are moderately underweight and those below -3 are severely underweight. Since the MSDG is a weighted average of the squared nutrition deficits of only the underweight children, this paper analyses children with weight-for-age z-score below -2.

We calculate and compare the underweight MSDG for children below three years in the major states of India in 1998-99 and 2005-06. The states of Madhya Pradesh, Bihar and Uttar Pradesh, were divided into two states each in November 2000. For reasons of comparability, we consider the undivided regions as our units of analysis. For instance, Madhya Pradesh and Chhattisgarh (the two states formed out of the partition of the state of Madhya Pradesh in 2000) both comprise 'Madhya Pradesh Region' as our unit of analysis in 2005-06.

2.2 Data

This paper uses the NFHS-2 and NFHS-3 data. The National Family Health Surveys are nationwide surveys conducted with a representative sample of households throughout the country. Until now, three such surveys have been conducted: NFHS-1 (1992-93), NFHS-2 (1998-99) and NFHS-3 (2005-06). These surveys were organized by the Ministry of Health and Family Welfare of the Government of India to develop a demographic and health database for the country. These surveys provide national and state estimates of fertility, family planning, infant and child mortality, reproductive and child health, nutrition of women and children, the quality of health and family welfare services, and socioeconomic conditions. Standardized questionnaires, sample designs, and field procedures are used, following the general format of Demographic and Health Surveys. The urban and rural samples within each state were drawn separately using a multi-stage, systematic, stratified sampling design. The primary sampling units (villages in rural areas and wards in urban areas) were selected with probability proportional to population sampling. National and state-level sampling weights were generated to reflect the sampling design. NFHS-3 collected information from a nationally representative sample of 109 041 households, 124 385 women age 15–49, and 74 369 men age 15–54 living in all the 29 states of India. Anthropometric data have been collected for 46 655 children who stayed in the household the night before the interview (IIPS and ORC Macro 2007). National and state-level sampling weights were generated to reflect the sampling design. NFHS-3 collected information from a nationally representative sample of 109 041 households, 124 385 women age 15–49, and 74 369 men age 15–54 living in all the 29 states of India. Anthropometric data have been collected for 46 655 children who stayed in the household the night before the interview (IIPS and ORC Macro 2007). For comparability, we restrict our analysis to of children under age three years born to ever-married women, since the NFHS-2 collected anthropometric information of the latter.

3. Results and Discussion

We can classify the states into four zones depending on the changes in headcount ratio and MSDG of underweight among children between the last two rounds of the NFHS, as depicted in Table 1. Table 2 shows that Zone 1 comprises states where both headcount ratio and MSDG have either increased or remained stagnant. Clearly these are the states which have the worst situation. Zone 2 includes states with no improvement in the headcount ratio but some progress in terms of MSDG. Thus, inclusion in Zone 2 would indicate an improvement of the lot of the severely undernourished children, coupled with a failure to reduce overall undernutrition. This could be a result schemes targeted for children at the lower end of the distribution of undernutrition. Zone 3 characterises the situation that is exactly reverse of the situation in Zone 2. That is, inclusion in Zone 3 indicates a fall in average underweight coupled with a rise in MSDG. This would mean an improvement near the threshold of undernutrition and a further worsening of nutritional status of children who were already at the lower end of the nutritional distribution. An inclusion in Zone 3 may be the result of nutritional policies that focus on children who are only marginally undernourished. Zone 4 characterizes the best situation possible, where both headcount ratio and MSDG of undernutrition decline over the period. Our analysis reveals that in Haryana, Madhya Pradesh Region and Gujarat, the headcount ratio of underweight children has increased during the period. Among these states, the situation is particularly alarming in Haryana. Belonging to Zone 1, the relatively richer state of Haryana records an increase in both headcount ratio and MSDG of child underweight during the last two rounds of the NFHS. With a rise in headcount ratio, coupled with a fall in MSDG, Gujarat (a rich state) and Madhya Pradesh Region (now comprising the poor and backward states of Madhya Pradesh and Chhattisgarh) are included in Zone 2. We find that even some of the relatively developed states such as Kerala and Punjab, are located in Zone 3, an improvement in the headcount ratio has been accompanied by a worsening of the MSDG. This indicates a worsening of the situation of children who were already worse-off in terms of nutritional status at the beginning of the period. Zone 3 also includes Assam (a state with a relatively low headcount ratio of underweight) and Bihar Region (now comprising the poor and backward states of Bihar and Jharkhand). Zone 4 includes eight states, namely Tamil Nadu, Andhra Pradesh, Maharashtra, Karnataka, Rajasthan, West Bengal, Orissa and Uttar Pradesh Region (now comprising the poor and backward states of Uttar Pradesh and Uttaranchal), where the progress in reducing undernutrition has been along desirable lines.

4. Summary and Conclusion

Trying to explain the poor progress in reducing child undernutrition in India, previous studies have shown that the placement of nutrition related programmes in India is regressive across states (Lokshin *et al*., 2005). The states with the greatest need for the programme have the lowest programme coverage and the lowest budgetary allocations from the central government. We argue that to examine the puzzle of stagnant undernutrition we need to look beyond the level of undernutrition and pay heed to the dimensions of depth and severity of undernutrition. Using measures such as the MSDG, we can find out what has happened, over time, to the children at the lower end of the nutritional distribution. It may so happen that though the average figures of undernutrition in a state has declined, the situation of the worst affected children has worsened further (the states in Zone 3, for instance). Looking at the four zones, we can understand the dynamics of undernutrition, not only in terms of level or average figures, but also in terms of the other important dimensions of the undernutrition problem, namely depth and severity.

However, our analysis does not take into account the magnitude of improvement, either in headcount or in MSDG. More research is needed to rigorously rank states not only in terms of the current status of nutrition (both headcount ratio and MSDG), but also in terms of the magnitude of improvement in headcount ratio and MSDG.

Table 1: Average and MSDG of child underweight in the Indian states during 1998-99 and 2005-06

State	NFHS-2		NFHS-3	
	Average	MSDG	Average	MSDG
Andhra Pradesh	34.2	0.10	29.8	0.07
Assam	19	0.10	16.7	0.10
Bihar Region	54.9	0.21	52.2	0.22
Gujarat	41.1	0.14	41.6	0.13
Haryana	29.9	0.09	38.2	0.13
Karnataka	38.6	0.13	33.3	0.10
Kerala	21.7	0.03	21.2	0.04
Madhya Pradesh Region	50.8	0.21	57.9	0.20
Maharashtra	44.8	0.12	32.7	0.08
Orissa	50.3	0.17	39.5	0.11
Punjab	24.7	0.06	23.6	0.06
Rajasthan	46.7	0.18	36.8	0.12
Tamil nadu	31.5	0.09	25.9	0.05
Uttar Pradesh Region	48.1	0.19	41.6	0.14
West Bengal	45.3	0.13	37.6	0.08

Table 2: Change in average and MSDG of child underweight in the Indian states between 1998-99 and 2005-06

Average	MSDG	
	↑/–	↓
↑/–	Zone 1: Haryana	Zone 2: Gujarat, Madhya Pradesh Region
↓	Zone 3: Kerala, Punjab, Assam, Bihar Region	Zone 4: Tamil Nadu, Andhra Pradesh, Maharashtra, Karnataka, Rajasthan, West Bengal, Orissa, Uttar Pradesh region

References

Black, R.E., Allen, L.H., Bhutta, Z.A., Caulfield, L.E., de Onis, M., Ezzati, M., Mathers, C., Rivera, J., (2008) "Maternal and child undernutrition: global and regional exposures and health consequences", *The Lancet* **371**(9608), 243–260.

Blössner, M. and de Onis, M. (2005): "Malnutrition: quantifying the health impact at national and local levels" (WHO Environmental Burden of Disease Series, No. 12), http://www.who.int/quantifying_ehimpacts/publications/eb12/en/ accessed on 30 August 2013

Chakraborty, A., Pattanaik, P. And Xu, Y. (2008) "On the mean of squared deprivation gaps", *Economic Theory* **34,** 181–187

Foster, J.E., Greer, J. and Thorbecke, E. (1984) "A Class of Decomposable Poverty Measures", *Econometrica* **52**(3), 761-766.

Garza, C. and de Onis, M. (2004) "Rationale for developing a new international growth reference", *Food and Nutrition Bulletin* **25**(1) (supplement 'i'), The United Nations University.

IIPS and ORC Macro (2007) *National Family Health Survey 2005-06 (NFHS-3):India,:* IIPS, Mumbai.

Kakwani (1980) "On a Class of Poverty Measures", *Econometrica* **48,** 437-446.

Lokshin, M., Das Gupta, M., Gragnolati, M. and Ivaschenko, O. (2005) "Improving Child Nutrition? The Integrated Child Development Services in India", *Development and Change* **36** (4), 613–640.

Mishra, U.S. and Mishra, R.N. (2009) "On comparison of nutritional deprivation: an illustration using Foster Greer Thorbecke criterion", *Applied Economics Letters* **16**(10), 1021 – 1024.

Mukhopadhyay, S. (2011) "Using the Mean of Squared Deprivation Gaps to Measure Undernutrition and Related Socioeconomic Inequalities", *Journal of Human Development and Capabilities,* **12**(4), 535-556.

Mukhopadhyay, S. (2013) "Do Public Services Reach the Worst Affected Children in Rural India? An Investigation Applying the Quantile Regression Method", *Child Indicators* **6**(3):527-546.

Mukhopadhyay, S. (2015) *Aspects of Child Undernutrition in India*, Unpublished Ph.D. Dissertation.

Panagariya, A. (2013) "Does India really suffer from worse child malnutrition than Sub-Saharan Africa?", *Economic and Political Weekly,* **48**(18), 98-111.

Papola, T.S. (2005) "Emerging Structure of Indian Economy", Presidential Address at the 88th Annual Conference, The Indian Economic Association.

Pelletier, D.L., Frongillo, E.A. Jr., Shroeder, D.G. and Habicht, J-P (1994) "A Methodology for Estimating the Contribution of Malnutrition to Child Mortality in Developing Countries", *Journal of Nutrition*, **124**(10), 2106S–2122S.

Sahn, E.D. and Stifel, D.C. (2002) "Parental Preferences for Nutrition of Boys and Girls: Evidence from Africa", *The Journal of Development Studies*, **39**(1): 21-45.

Sen, A. (1992) *Inequality Re-Examined*, Oxford: Clarendon Press.

Scrimshaw, N.S., Taylor, C.E. and Gordon, J.E. (1968) "Interaction of Nutrition and Infection", World Health Organization, Monograph Series No.57.

Sen A. and Sengupta S. (1983) "Malnutrition of Rural Children and the Sex Bias", *Economic and Political Weekly*, **18,** 855-864.

Sen, A.K. (1976) "Poverty: An Ordinal Approach to Measurement", *Econometrica* **44,** 219-231.

Svedberg, P. (2008) "Why malnutrition in shining India persists", paper presented at 4th Annual Conference on Economic Growth and Development, Indian Statistical Institute, New Delhi, December 17-18, 2008.

Swain, S.C. (2008) "Nutritional Deprivation of Children in Orissa", *Economic and Political Weekly*, **43**(37), 49-57.

UNICEF (2011) "The Situation of Children in India: A Profile", New Delhi: UNICEF.

UNICEF (2015) "State of the World's Children 2015: Country Statistical Tables". Available Online. http://www.unicef.org/statistics/index_countrystats.html Accessed on 22 December 2015.

Waterlow, J. C. Buzina, R. Keller, W. Lane, J. M., Nichaman, M. Z. and Tanner, J. M. (1977) "The presentation and use of height and weight data for comparing the nutritional status of groups ot children under the age of 10 years", Bulletin of the World Health Organization, **55**(4): 489-98.

Appendix: The Axioms of Poverty Measurement

Sen (1976) formulated two axioms that a poverty measure must satisfy namely the monotonicity axiom and the transfer axiom, spelt out as follows:

Monotonicity Axiom: Given other things, a reduction in income of a person below the poverty line must increase the poverty measure.

Transfer Axiom: Given other things, a pure transfer of income from a person below the poverty line to anyone who is richer must increase the poverty measure.

Kakwani (1980) formulated another axiom that focuses on transfers among the poorest poor:

Transfer Sensitivity Axiom: If a transfer $t > 0$ of income takes place from a poor household with income y_i to a poor household with income $y_i + d$ ($d > 0$), then the magnitude of the increase in poverty must be smaller for larger y_i.

Foster *et al*. (1984) formulated a fourth axiom for the analysis of poverty by population subgroups:

Subgroup Monotonicity Axiom: Let y^ be a vector of incomes obtained from y by changing the incomes in subgroup j from $y^{(j)}$ to $y\wedge^{(j),}$ where n_j is unchanged. If $y\wedge^{(j)}$ has more poverty than $y^{(j)}$, then y^ must also have a higher level of poverty than y. (Where n_j is the population size of the jth subgroup.)

Chakraborty *et al*. (2008) axiomatically characterised the MSDG and showed that a deprivation measure satisfies eight properties, namely, continuity, normalization, anonymity, monotonicity, independence; uniform scale invariance, transfer axiom and equivalent transfer if and only if it is the MSDG. A deprivation measure for the society has been defined as a function, $f : [0, 1]^n \rightarrow R+$. For all $x, y \in [0, 1]^n$, $f(x) \geq f(y)$ is interpreted as indicating that the degree of deprivation in situation x is at least as great as the degree of deprivation in situation y. The eight properties of f that the MSDG satisfies have been mathematically expressed as follows:

Continuity: $f(x)$ is continuous at $x^0 \in (0, 1)^n$.

Normalization: $f(0^{[n]}) = 0$, $f(1^{[n]}) = 1$.

Anonymity: Let σ be a one-to-one function from N to N. Then, for all $x \in [0, 1]$ n, $f(x) = f(x\sigma(1),..., x\sigma(n))$. (iv) Monotonicity (MON). For all $x \in [0, 1]^n$, all $i \in N$, and all $x_{i'} \in [0, 1]$, if $x_{i'} > x_i$ then $f(x_{-i}, x_i') > f(x)$.

Independence: For all $x, y \in [0, 1]^n$, all $i \in N$, and all $t \geq 0$, if $x_i + t \in [0, 1]$, then

$$f(x_{-i}, x_i+t) - f(x_{-i}, x_i) = f(y_{-i}, x_i+t) - f(y_{-i}, x_i).$$

Uniform scale-invariance: Let $x, y, x', y' \in [0, 1]^n$. Suppose $f(x) - f(y) = f(x') - f(y')$. Then $f(kx) - f(ky) = f(kx') - f(ky')$ for every $k > 0$, such that $kx, ky, kx', ky' \in [0, 1]^n$.

Transfer axiom: For all x, y ∈ $[0, 1]^n$, all distinct i, j ∈ N, and all δ ∈ (0, 1], if [x and y are {i, j} − variants], [$x_i > x_j$], [$y_i = x_i + \delta$], and [$y_j = x_j - \delta$], then f (y) > f (x).

Equivalent transfer: Let x, y, w ∈ (0, 1]n, i, j, i', j' ∈ N, and t ∈ [0, 1] be such that [$x_i - x_j = x_i' - x_j'$], [x and y are {i, j}− variants and x and w are {i', j'} − variants], [$y_i = x_i - t$ and $y_j = x_j + t$], and [$w_i' = x_i' - t$ and $w_j' = x_j' + t$]. Then f (y) = f (w).

It must be mentioned here that though the MSDG does not satisfy the transfer sensitivity axiom (that the higher order FGT measures do), it is one of the very few deprivation measures in the FGT class which satisfy equivalent transfer.