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Socioeconomic inequality in child malnutrition in India: searching for a SES gradient

Abstract:

Background & Introduction: Hunger is synonymous with poverty and both are inseparably linked. Access to food and improved nutrition constitutes an undeniable basic human right and one of the central goals of development processes aiming reduction of poverty and inequality. Reducing malnutrition is thus central to the notion of reducing poverty itself. Malnutrition is a global public health and development concern with important health and socioeconomic consequences. The importance of reducing malnutrition has been acknowledged in the MDGs as well and constitutes one of the prime targets of development processes globally to ameliorate different dimensions of non-income poverty. From this perspective, this paper is an attempt to contribute to the growing empirical evidence on the linkage between malnutrition and poverty drawing on recent household survey data from India, a country plagued with widespread undernourishment among children.

Aims & Objectives: The main aim of the study is to examine the linkage between poverty and socioeconomic inequality and malnutrition among Indian children. Inequality in malnutrition at the state level is investigated to provide evidence on its pattern and association with overall socioeconomic inequality. We also aim to reveal the relative contribution of proximate and intermediary determinants of malnutrition towards inequality in malnutrition to reinforce the conjecture that poverty induces malnutrition and intensifies inequality.

Methods: The paper uses recent data on child nutrition from the latest wave of the Indian National Family Health Survey (Wave 3—2005-06). Clustering of malnutrition among its determinants as well the regional heterogeneity is observed using the weight-for-age (stunting), weight-for-height (wasting) and weight-for-age(underweight) z-scores providing standard deviations from the new WHO child growth standards. In the analysis of inequality, stunting was considered as the summary indicator of chronic undernourishment. This paper employs a concentration index to summarize inequality across the entire socioeconomic distribution, which is further decomposed, using the methodology suggested by Wagstaff et. al. (2001) to identify the factors associated with inequality in malnutrition.

Findings: According to the NFHS 3 data, nearly half the children (48%) under five years of age in India suffer from moderate stunting (below -2 SD from the reference population), nearly 43 percent suffer from underweight and a fifth from wasting. Malnutrition in both its chronic and acute forms is mainly concentrated in the eastern, central and northern regions. Prevalence of malnutrition is found to be clustered among the children aged 24-36 months, in higher birth orders and for birth interval of less than nine months. Mother's education is significantly related with child undernourishment as its prevalence progressively declines with increase in years of education. Underweight mothers are also more prone to have malnourished children, as are households belonging to the scheduled castes and tribes. Poverty, in terms of the wealth index, has considerable impact on average rates of malnutrition as evident from stark differentials between the poor and the rich. At the macroeconomic level, overall socioeconomic inequality correlates moderately with the inequality in malnutrition which highlights the role of other non-income dimensions towards alleviating undernourishment among children. Malnutrition also collates well with the poverty levels in the state, as, except outliers like Punjab, it is more pronounced in states with higher levels of income poverty.
The concentration index brings out the extent of inequality in malnourishment in a clearer way. The negative values of the index (-0.13 for stunting, -0.14 for underweight and -0.11 for wasting) indicates disproportional burden of malnutrition among the poor. On further disaggregation at the state and regional level it is evident that inequality in malnutrition is pervasive in the states of Punjab, Orissa, Gujarat, Maharashtra and Kerala and overall in the eastern and western region, having significantly higher extent of inequality than the national average. Decomposition analysis of inequality in malnutrition provides further evidence indicating how poverty deepens inequality in malnutrition. The wealth index, proxying household economic capabilities alone explains more than half the inequality which justifies the poverty-nutrition inequality linkage. Apart from the economic determinants, mother's years of education (12 percent), birth order (6 percent) and small size of the child at birth (10 percent) are the important contributors to overall inequality. Access to health facilities, incorporating both maternal and child health dimensions as well as presence of ICDS centre in the village also explains around nine percent of the observed heterogeneity. Age and sex of the child, as well as breastfeeding and women's decision-making power, cited in literature as important predictors of child malnutrition are *not* found to have significant influence on inequality, which asserts that similar set of determinants may not be responsible for the depth and relative distribution of undernourishment. Child-level determinants explain about 17 percent, parent-level determinants about 18 percent, household-level determinants, which includes the poverty dimensions, about 55 percent and region-level determinants about 12 percent of the inequality in malnutrition.
Conclusion: The paper highlights the influence of poverty in deepening malnutrition leading to unequal nutritional outcomes among children in India. It demonstrates that not the same set of factors is equally responsible for average malnutrition and socioeconomic inequality in malnutrition. It indicates that a uniform approach may not be successful in reducing malnutrition as well as inequality in its distribution. More importantly, it brings to the fore that child malnutrition in India is a multidimensional problem alike poverty itself which warrants proper policy mix and

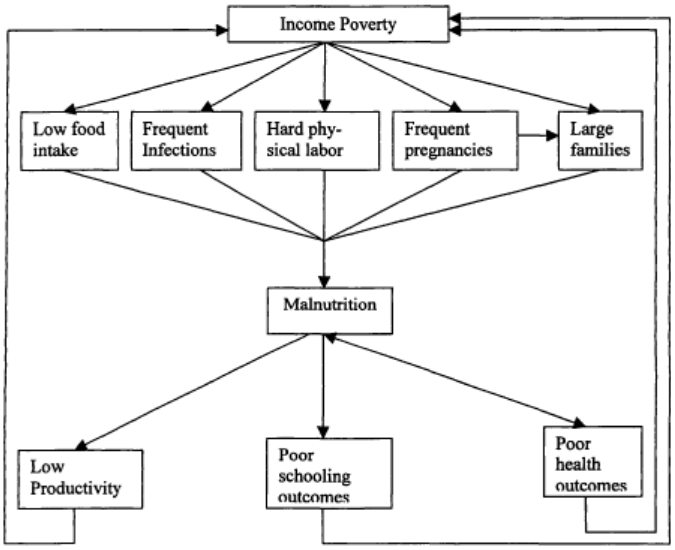
programme intervention to reduce the quantum of the problem and helping remove the scourge of nutritional deprivation among children reiterating the enshrined targets of the MDG.

Keywords: Non-income poverty, Poverty-malnutrition linkage, Concentration Index, Decomposition

Background:

Hunger is synonymous with poverty and both are inseparably linked. Access to food and improved nutrition constitutes an undeniable basic human right and one of the central goals of development processes aiming reduction of poverty and inequality. This stems from the premise that poverty is multi-dimensional and manifested in many other forms besides the inadequacy of income or consumption. The lack of access to basic services, illiteracy, and child malnutrition are all multi-faceted manifestations of poverty. This apart, malnutrition is also strongly related to income-poverty as well. Low incomes constrain the availability of adequate nutrient intake, which in turn causes malnutrition (Behrman and Deolalikar, 1988; Strauss and Thomas, 1995). On the other hand, income-poverty increases nutritional needs because of the income-poor expend more physical labour, are isolated from markets and services (and therefore expend more time and energy to access them) and have a high fertility rate (which places especially high demands on the mother's energy and health) (World Bank 2002) . This linkage is mapped in the flow-chart below.

Relationship Between Nutrition and Poverty



Source: World Bank 2002

Reducing malnutrition is thus central to the notion of reducing poverty itself. Malnutrition is a global public health and development concern with important health and socioeconomic consequences. Particularly important in this context is the aspect of child undernourishment or malnutrition. In the developing world, an estimated 230 million children under the age of five are chronically malnourished and more than half the deaths among children less than five years of age are attributable to malnutrition (Van de Poel et. al. 2007). Evidence abounds in literature citing that malnutrition in early childhood, apart from being an important proximate determinant of childhood mortality and morbidity, is associated with significant functional impairment in adult life involving reduced work capacity and economic productivity (Schroeder and Brown 1994). Malnourished children are also more likely to suffer from delayed mental and intellectual development and poor school performances, inhibiting their natural potentials. Chronic malnutrition, generally measured in terms of growth retardation thus serves not only as one of the best global indicators of child nutrition, but also provides an indirect assessment of the quality of life enjoyed by the entire population. Malnutrition among children is not only a consequence of underdevelopment, but also a contributory factor to it. The cumulative effects of malnutrition on health, education and productivity make it one of the main vehicles for intergenerational transmission of poverty and inequality. Recognizing the link between poverty and under nutrition, the first of the Millennium Development Goals clearly spells out the target to halve the

proportion of people who suffer from hunger between 1990 and 2015 specifically addressing the non-income dimension of poverty, and the prevalence of underweight children below five years of age has been decided as a key indicator in this regard (Shekhar and Young-Lee 2006). In fact, the sublime importance of malnutrition can be traced to almost all the MDGs, as outlined in the box below.

>> Box I: The Millennium Development Goals and their links to hunger and malnutrition

1. ERADICATE EXTREME POVERTY AND HUNGER
- ✔ Malnutrition erodes human capital through its intergenerational and irreversible effects on physical and cognitive development
- ✔ Poverty prevents people from producing or acquiring the food that they need

2. ACHIEVE UNIVERSAL PRIMARY EDUCATION
- ✔ Hunger reduces school attendance and impairs learning capacity
- ✔ Lack of education reduces income generation capacity and increases the risk of hunger

3. PROMOTE GENDER EQUALITY AND EMPOWER WOMEN
- ✔ Hunger reduces school attendance amongst girls more than boys
- ✔ Women lack the support of men in domestic tasks. They tend to subordinate their own nutritional health to benefit the rest of the family. Since malnourished women are more likely to give birth to underweight babies, this exacerbates nutritional vulnerability, which is transmitted from generation to generation

4. REDUCE CHILD MORTALITY
- ✔ Over half of all child deaths are directly or indirectly caused by hunger and malnutrition

5. IMPROVE MATERNAL HEALTH
- ✔ Malnutrition and micronutrient deficiencies significantly increase the risk of maternal death

6. COMBAT HIV/AIDS, MALARIA AND OTHER ILLNESSES
- ✔ Malnutrition can increase the risk of HIV transmission, reduce the effectiveness of antiretroviral therapy and speed up the onset of AIDS
- ✔ Undernourished children are twice as likely to die from malaria
- ✔ Malnutrition increases the risk of acquiring tuberculosis

7. ENSURE ENVIRONMENTAL SUSTAINABILITY
- ✔ Hunger increases the likelihood of an environmentally unsustainable use of resources
- ✔ Restoring and improving ecosystem functions is fundamental to reducing hunger amongst the rural poor
- ✔ Access to safe drinking water and basic sanitation is essential to ensuring that foods are safe for consumption

8. DEVELOP A GLOBAL PARTNERSHIP FOR DEVELOPMENT
- ✔ Greater international cooperation and a better allocation of resources could have positive effects on children's access to healthier and more balanced nutrition

Source: Based on the annual report of the UN Food and Agriculture Organization (FAO), "The State of Food Insecurity in the World," Rome, Italy, 2005.

Source: Martinez & Fernandez (2006)

However, nutrition is sidelined in the mainstream poverty agenda having a preemptive focus on income-poverty measures and consumption expenditures. Knowledge about malnutrition, its consequences and its links to poverty and other human development goals is fragmented and often inconsistently applied (Gillespie et. al. 2003).

This paper is an attempt to contribute to the growing empirical evidence on the linkage between malnutrition and poverty drawing on recent household survey data from India, a country plagued with widespread undernourishment among children. Apart from examining the depth of malnutrition and its clustering among the proximate and intermediate determinants disaggregated at the state level in India, we consider the relative distribution of malnutrition within the determinants aiming to unravel the inequality in nutritional deprivation. This paper employs a concentration index to summarize inequality across the entire socioeconomic distribution, which is further decomposed to identify the factors associated with inequality in malnutrition. Introducing economic inequality and its decomposition in the analysis of malnutrition and its causal factors enables further insight into the association of the determinants with malnutrition as well as their respective contribution to the overall level of inequality. Further, this paper employs the new child growth standards recently released by the World Health Organization (WHO) (WHO 2006) making the results amenable to cross-country comparisons.

From a policy perspective, the results of this paper have important implications in setting the program focus to reduce malnutrition as well as its disproportionate burden on the poor. Much of the results are believed to hold ground for South Asian and other developing countries as well. The effect of economic growth on reducing nutritional deprivation among the poor is also evident, which underscores the importance of the income distribution towards influencing nutrition outcomes. The paper is divided into six sections. In the next section, we briefly discuss the Indian scenario at the macroeconomic level and progress made in reducing malnutrition since the

last decade. The methods employed are outlined in the next section which includes a general description of the data. The fourth section presents the descriptive results and the decomposition model. The fifth section discusses the finding and consolidates the evidence emerging from the analysis. The final section concludes.

Child Malnutrition in India

India provides an interesting instance to investigate the poverty-undernourishment linkage on a number of counts. Even as, the country has achieved commendable achievements since her independence in population health manifest in significant reduction of total fertility rate, infant and child mortality and maternal mortality ratios, increase in life expectancy and improved coverage of vaccination and prevention against communicable diseases (Peters et. al. 2002) and simultaneously chartered a faster trajectory of economic growth, it has failed in achieving the desired targets in health outcomes. Rampant undernourishment among children remains an important hurdle impeding achievement of the millennium development goals (World Bank 2004). Estimates put the number of children below age three who are underweight at a staggering 37 million (Nair 2007). The successive waves of the Demographic and Health Survey in India (henceforth referred as the National Family Health Survey, following general convention) provide an opportunity to examine the progress made in reducing child malnutrition during the last decade and half. Figure 1 presents the comparative picture of malnutrition prevalence in India. In order to ensure comparability of reference standards and age of children surveyed in the three periods (1992-93, 1998-99 and 2005-06) we have only considered children below three years of age and malnutrition rates are calculated on the basis of the CDC standard deviation-derived growth reference curves using the NCHS/FELS/CDC reference population (IIPS 2000). It is evident that although there has been a progressive decline during the successive waves, it has been rather slow and still continues to be at a very high absolute level. In 2005-06, more than a third of the children under age three are stunted, while almost half are underweight. Further more than 15 percent of the children are severely stunted and underweight, one of the highest in the developing world.

Similar to countries in Sub-Saharan Africa, Protein-Energy Malnutrition (PEM) is the predominant form of malnutrition in India too (World Bank 1998), which primarily originates from calorie deprivation. Strongly linked to household food insecurity with its roots in poverty, the available estimates of nutritional intake in India in terms of the calorific requirement norms bear evidence to this fact. According to the latest available data on household nutrition and consumption, average daily calorie intake stands at 2047 kcal in rural areas and 2020 kcal in urban areas as against the prescribed norms of 2700 kcal. Further, 66 percent of the population in rural areas and 70 percent in urban areas are deprived of the above nutritional standard (NSSO 2007). This underscores the quantum of poverty which is responsible for such nutritional deprivation, which in turn breeds chronic undernourishment. Studies have evaluated the poverty-nutrition linkage from this viewpoint, which holds poverty as the primary cause of nutritional deprivation and food insecurity, which in turn is responsible for 'visible' undernutrition (Ramachandran 2007, Viswanathan and Meenakshi 2007, Sen 2005).

Several reasons have been forwarded to explain factors responsible for the unparalleled high levels of malnutrition in India (Mishra et. al. 1999). Ramalingaswamy et. al (1997) coined the term "South Asian enigma" and maintained that low birth weight, lower status and decision-making power of women and poor hygiene and sanitation standards are the primary causes behind such phenomenon. Research has traced patriarchal norms in Indian society responsible for low status of women resulting in a gender bias in intra-household allocation of food and health care (Smith et .al. 2003; Gragnolati et. al. 2005; World Bank 1998). Besides, socio-cultural norms of feeding practices also permeate undernutrition in India. Information barriers resulting from low awareness levels and lack of women's education affect breastfeeding and other child care practices leading to undernutrition among children. Evidence also suggests that disproportional burden of malnutrition falls on the poor (World Bank 1998, Mishra and Retherford 2000). However, studies are yet to be attempted to investigate the determinants and their relative contribution to the inequality in malnutrition and to what extent does economic status explain such disproportional outcomes (World Bank 1998). It is always possible that the most important determinants of malnutrition may not be equally important while explaining malnutrition inequality (Van de Poel et. al. 2007; Zere and McIntyre 2003). Understanding the determinants of malnutrition responsible for the heterogeneity in malnutrition prevalence across the population should form an important evidence base in order to target program intervention to the most disadvantaged and vulnerable groups.

Data and Methods

Measuring malnutrition

Undernutrition in young children is generally determined through measurement of height, weight, skin-fold thickness and age. The most commonly used indices derived from these measurements are stunting (low height for age), wasting (low weight for height) and underweight (low weight for age). Stunting is an indicator of chronic undernutrition, especially protein-energy malnutrition, the result of prolonged food deprivation and/or disease or illness; wasting is an indicator of acute undernutrition, the result of more recent food deprivation or illness; underweight is used as a composite indicator to reflect both acute and chronic undernutrition (WHO Working Group 1986). These indices are compared against an international reference population. Children whose measurements fall below –2 z-scores of the reference population median are considered undernourished, i.e. to have stunting, wasting or to be under-weight. Those children with measurements below –3 z-scores are considered to be severely undernourished. Until 2006 the most commonly used reference population, used in NFHS-1 and NFHS-2, was the U.S. National Center for Health Statistics (NCHS) standard, which was recommended at that time by the World Health Organization. However, for the NFHS 3, standardized z-scores provided based on a new international reference population released by WHO in April 2006 (WHO Multicenter Growth Reference Study Group, 2006, cited in IIPS, 2007). The new standard is based on children around the world (Brazil, Ghana, India, Norway, Oman, and the United States) who are raised in healthy environments, whose mothers do not smoke, and who are fed with recommended feeding practices (exclusive breastfeeding for the first 6 months and appropriate complementary feeding from 6 to 23 months) (IIPS 2007). In this paper, we have examined clustering of average malnutrition considering all three domains of malnutrition, viz., stunting, underweight and wasting. For the decomposition analysis and also for subsequent explanation, we have relied on the child's height-for-age (stunting) z-score as the summary indicator of malnutrition, based on the justification forwarded by Pradhan et. al. (2003). We have used the z-scores to compute a binary variable denoting whether or not the child is malnourished, using the -2 SD as the cut-off, which is used for inter-state comparisons and descriptive analysis. For the decomposition, we have relied on the negative of z-scores as dependent variable, making it amenable to regression analysis and easy interpretation of the coefficients, as mentioned in Wagstaff et. al. (2001).

Measuring socioeconomic inequality in malnutrition

In this paper following the approach outlined by O'Donnell et .al. (2008), inequality in malnutrition is represented in the form of concentration curves, and concentration index derived from it. Concentration curves displays the share of the variable of interest (malnutrition) accounted for by cumulative proportion of the population, ranked accordingly by appropriate living standards variable, from poorest to richest (O'Donnell et. al. 2008). In other words, it plots share of the variable against quintiles of living standards variable. If everyone, irrespective of his or her living standards, has exactly the same value of the health variable, the concentration curve will be a 45-degree line, known as the line of equality. On the other hand if malnutrition is higher among poorer people, the concentration curve will lie above the line of equality. The farther the curve is above the line of equality, the more concentrated malnutrition is among the poor.

The concentration index, C, is defined with reference to the concentration curve as twice the area between the concentration curve and the line of equality. In the absence of socioeconomic inequality, C is zero. When the concentration curve lies above the line of equality the index takes a negative value, indicating disproportionate concentration of malnutrition among the poor. C can be expressed as

$$C = 2/N\mu\,[\Sigma m_i r_i - 1 - (1/N)]$$

where m_i denotes malnutrition variable, is its mean, and $r_i = i/N$ is the fractional rank of ith child in the living standards distribution, with $i = 1$ for the poorest and $i = N$ for the richest. For computation purposes, the above expression is more conveniently expressed in terms of covariance between the malnutrition variable and fractional rank in the living standards distribution (cited in O'Donnell et. al. 2008). An equivalent estimate of the concentration index can be obtained from a regression of the transformed m_i on the fractional rank in the living standards distribution, as

$$2\sigma_r^2 (m_i / \mu) = a + \beta r_i + \varepsilon_i ,$$

where σ_r^2 is the variance of the fractional rank. The OLS estimate of β provides an estimate of the concentration index.

Decomposition of inequality in malnutrition

Wagstaff, van Doorslaer and Watanabe (2001) have decomposed malnutrition inequalities in Vietnam into the contributions of individual factors to inequality related to the living standards variable, where each contribution is the product of the sensitivity of malnutrition with respect to that factor and inequality. For linear representation of any regression model of the determinants of malnutrition as specified above, the concentration index, C, can be decomposed into its determinants as,

$$C = \sum_k (\beta_k x_k' / \mu) C_k + GC_\varepsilon / \mu$$

where μ is the mean of the malnutrition variable (m), x_k' is the mean of x_k, C_k is the concentration index for x_k (with respect to living standards) and GC_ε is the generalized concentration index for the error term (ε). The last term represents the residual, inequality in malnutrition that is not explained by the model. The above expression shows that C is a weighted sum of the k regressors, the weight being the elasticity of m with respect to x_k.

All the estimations were carried out using the STATA software (release 9). The concentration curves were computed using the glcurve7 command, specified with the Lorenz option. The negative of the standardized z-scores for height-for-age, weight-for-age and weight-for-height were used for easier representation. Calculations for the concentration index and its decomposition were done following the program originally written by O'Donnell et. al. (2008). All estimation takes account of the sample weights provided in the NFHS data.

Data

Data for this paper is from the Indian National Family Health Survey—Wave 3 and are restricted to children under the age of 5. NFHS 3 included the anthropometric measurement for all children less than 5 years of age listed in the household questionnaire. We have used the birth history recode file for analysis. After deleting flagged observations with unusual measures and those having incomplete/missing information, the final analysis was carried out for 41,306 children born within the five years preceding the survey. The standard deviation z-scores with the WHO reference standards were used to compute the standardized z-scores for all three measures.

NFHS 3 has included for the first time a household wealth status index estimated from several household characteristics and ownership of household assets using a principal component analysis[1]. However, we have excluded information on the type of toilet and source of drinking water as both these variables are considered to have a direct relation to children's nutritional status. The recalculated wealth index was used as a suitable proxy for economic status, as maintained in literature (Rutstein and Johnson 2004). In the absence of any direct income-related information, the wealth index was divided into five quintiles for descriptives. For the concentration index and its decomposition, the raw scores were used.

Results

Table 1 presents the prevalence of malnutrition in India, across the states and geographic regions. As seen, 48 percent of the children under the age of 5 in India are stunted, much higher than the average for other developing countries including Sub-Saharan Africa. Nearly 43 percent of the children are found underweight, while about a fifth (20 percent) is wasted. Further, nearly a quarter of the children are severely stunted and about 16 percent severely underweight, which underscores the magnitude of the problem.

[1] The NFHS-3 wealth index is based on the following 33 assets and housing characteristics: household electrification; type of windows; drinking water source; type of toilet facility; type of flooring; material of exterior walls; type of roofing; cooking fuel; house ownership; number of household members per sleeping room; ownership of a bank or post-office account; and ownership of a mattress, a pressure cooker, a chair, a cot/bed, a table, an electric fan, a radio/transistor, a black and white television, a colour television, a sewing machine, a mobile telephone, any other telephone, a computer, a refrigerator, a watch or clock, a bicycle, a motorcycle or scooter, an animal-drawn cart, a car, a water pump, a thresher, and a tractor. (IIPS 2007)

Among the geographic regions, malnutrition is relatively concentrated in the Central and Eastern region with nearly half the children suffering from stunting and underweight. Interstate variations are also observed with undernutrition mostly pronounced in Madhya Pradesh, Bihar, Gujarat, Chattisgarh and Jharkhand. Nutritional problems are also substantially higher than average in Meghalaya and for stunting in Uttar Pradesh. Kerala and Punjab are the major states where undernutrition is much lower than the national average.

It is tempting to examine the undernutrition situation in the states vis-à-vis economic development and poverty levels to gain insight on the possible correlation between the two. We have plotted the scatter of proportion of the population below the state specific poverty line (BPL) as defined by the Planning Commission, Government of India and per capita net state domestic product (NSDP) (at current prices) for all the states with average stunting denoting malnutrition (Figures 2a and 2b). Interestingly, both BPL and NSDP correlates significantly with malnutrition, having a coefficient of 0.538 and -0.501 respectively (significant at 99% level, 2-tailed t-test). As seen in the figures there is a visible pattern in the association of malnutrition with these two variables denoting poverty and level of economic development at the macroeconomic level. In Figure 2a, the states towards the north-east quadrant (Bihar, Uttar Pradesh, Chattisgarh, Madhya Pradesh and Jharkhand) are those with highest levels of malnutrition as well as highest proportion of population living in poverty. Similarly, states towards the south-west quadrant (Punjab, Himachal Pradesh and few north-eastern states) have lower levels of malnutrition and also lesser proportion below the poverty line, as compared to the national average. The outliers, Kerala and Gujarat for e.g., too present important policy issues. Although both these states have similar levels of poverty, yet they differ substantially in nutritional outcomes, Kerala having far lower malnutrition prevalence than Gujarat. The most plausible explanation in this regard is apparently the improved levels of human development, notably education among women, and better access to health care facilities in Kerala helping in attaining one of the lowest levels of malnutrition among children in the country (Ramachandran 1997). This underscores the importance of socioeconomic and human development in attaining reduced levels of undernutrition, distinct from poverty alleviation.

Figure 2b attempts to explain the possible connection between overall levels of economic development in the states with malnutrition intensity. The findings are very much along the expected lines. Again, the high-prevalent states are found to cluster towards the north-west quadrant and the concentration thins out as one moves south-east along the regression line. The cluster is most dense at malnutrition levels of around 45 percent and per capita NSDP of about Rs. 20,000, indicating that malnutrition refuses to wither away even at modest levels of economic development, which reiterates the importance of other proximate determinants apart from economic development in curbing malnutrition in the Indian context. We aim to isolate the relative importance of the different determinants in the analysis to follow.

In table 2 we have observed the various comfounding factors of malnutrition and how malnutrition clusters across these determinants. It can be seen that stunting and underweight are more common in children of higher ages, primarily due to the cushioning effect of breastfeeding during the first six months, a period stipulated by the Indian government as of exclusive breastfeeding to ward off early nutritional shortfalls (IIPS 2007). Stunting prevalence is about double in children of age two and above compared to those less than a year, presumably as relative food scarcity and dearth of supplementary nutrition initiates its influence in more intense forms. Wasting however is more prevalent in very young ages, which may be due to the effect of low weight at birth. There are no significant sex differentials in undernutrition among Indian children, which is a bit surprising owing to the fabled north-south divide in gendered norms, and evidence regarding unequal survival probabilities among Indian children based on gender (Arokiasamy 2004; Das Gupta 1987). Past studies have also failed to establish any significant differentials even at the state-level, particularly in areas known for greater degree of gender discrimination (Mishra et.al. 1999), but there is yet any acceptable explanation for this phenomenon. Children of higher birth order are also more undernourished. This effect is apparently due to the presence of more siblings in the household which affects intra-household food allocation, and owing to cultural norms about feeding practices, it is the youngest child in most cases, who suffers from nutrient deprivation. Shorter birth intervals also intensify malnutrition, with nearly two-thirds of the children born of birth intervals less than nine months suffering from stunting.

Mother's education has been suggested as one of the most important proximate determinants of child malnutrition (Smith and Haddad 1999; Mishra and Retherford 2000), as also of child survival (Mosley and Chen 1984). Prevalence of stunting and underweight is substantially higher in children having mothers with little or no education. It significantly declines with increase in mother's completed years of schooling. Underweight mothers are also found more likely to have malnourished children.

Along expected lines undernutrition is more concentrated in rural areas and among vulnerable social groups like the scheduled castes and tribes. While some maintain these differences to stem largely from higher socioeconomic status enjoyed by members from more advanced social groups ('general castes') (Mishra et. al. 1999), others explain such unequal prevalence caused by lower use and access to health care and educational facilities by these vulnerable groups and consequently lesser accrual of the positive benefits therein (van De Poel and Spybroeck undated).

Table 2 highlights that disproportionate burden of undernutrition is on the poor. From the unadjusted prevalence rates in the table, it is clear that malnutrition is clustered in the poorer quintiles, with a gap of about 35 percentage points between the poorest and richest quintiles. The effect is relatively less intense for wasting. The negative influence of wealth on undernutrition is further evident from the figure below which shows that except in northern India, where malnutrition prevalence increases marginally in the middle quintiles, there is a progressive decline with increase in household economic status.

Inequality in Malnutrition

The overall concentration indices for stunting, underweight and wasting respectively are -0.129, -0.128 and -0.121. The statistically significant inequalities indicate that children in lower socioeconomic strata have significantly higher burden of undernutrition. The scenario is summarily reflected in the concentration curves (Figure 4). The concentration curves largely overlap which suggests similar extent of inequality in all the three domains of malnutrition. The figures are comparable with the findings of van De Poel and others (2008). For stunting, inequality is less pronounced in India compared to the median concentration index for South and South-east Asia (-0.19) and for all developing countries combined (-0.23), while for wasting inequality is significantly higher in India. Table 3 presents the concentration indices for stunting, wasting and underweight along with the t-statistic and 95 percent confidence intervals.

As in average malnutrition, there are significant inter-state differentials in malnutrition inequality. Overall, inequality is sharper in Eastern and Western regions and lowest in Central region. Notably, reiterating the findings in Table 1, average malnutrition was found highest in Central, followed by Eastern region. The lower extent of inequality in Central region is indicative of relatively homogeneous distribution of undernutrition in the states of the region (Chattisgarh, Uttar Pradesh and Madhya Pradesh, all high prevalence states). Malnutrition in central region thus appears to be an endemic phenomenon spread throughout the population, not limiting itself only to the poorest stratum. The rich-poor divide appears to be strongest in the West for all the three domains. The concentration index is highest in Goa, followed by Gujarat in this region. Inequality is highest in Punjab, a state known for its relative prosperity. Inequality is also high in Orissa, Uttaranchal, and Kerala. High levels of the concentration index in Kerala is somewhat surprising, as the state is known for one of the best achievements in social and human development and health services in the country, and also has the lowest levels of average malnutrition among the major states. Table 3 interestingly indicates that inequality in malnutrition is equally severe in the extreme points of the distribution of average malnutrition, affecting states having lower and higher levels of undernutrition alike. In equality in wasting is relatively less pronounced in most of the states, which suggests that poverty and inequality in income distribution has greater effect on chronic nutritional deprivation than acute shortfalls, which may be attributable more to transient shocks in income flow. That all the concentration indices are statistically significant underscores that the tendency of poorer children across the states to have higher rates of stunting, underweight, and wasting to a certain extent is not merely random, but well-rooted in the overall levels of socioeconomic inequality (Wagstaff and Watanabe 2000)

To probe deeper into the probable cause of intra-state differentials and also to explain the possible effect of overall socioeconomic inequality on inequality in malnutrition, we have examined the scatter plots and bivariate regressions showing the relationship between inequality in malnutrition, measured by the concentration index and overall socioeconomic inequality, measured by the conventional Gini coefficient[2]. The results are presented in Figure 5a and 5b (Initially, similar plots for wasting was examined but it offers no clear pattern). The emerging pattern is not uniform for all three dimensions of malnutrition. For e.g., it is observed that states with highest values of the concentration index for underweight (Figure 5a) have relatively lower values for the Gini (the cluster towards

[2] The Gini coefficient was calculated for all the states based on the raw scores of the wealth index provided in the NFHS 3 data. For better comparability, the wealth index scores were normalized into a scale of 0 to 100 and Gini coefficient calculated in STATA with the command `ginidesc` available as an ado-program. The advantage of `ginidesc` over the conventional inequality ado-files like `inequal, ineqdeco` and `ineqerr` is in allowing for the –by- option, facilitating computation.

the northwest quadrant) and those having more unequal pattern in socioeconomic status (Bihar, Uttar Pradesh, Madhya Pradesh and Rajasthan) have relatively lower levels of inequality in underweight.

However, the pattern is quite reversed for stunting as the cluster is denser towards the southeast quadrant which indicates that the states having higher inequality in socioeconomic status also suffers from higher extent of the same for stunting. It thus appears that generally, states with unequal distribution of socioeconomic status also tend to have unequal distributions of malnutrition, much in line with the findings of Wagstaff and Watanabe (2000), where India was not considered. Notably, the regression fit does not justify expectation. A number of states disperse well away from the fit. Besides, as in Figure 2a and 2b, the paradoxes are also present here. Consider Punjab and Himachal Pradesh or Orissa and Madhya Pradesh for instance. Although having similar levels of socioeconomic inequality they have different levels of inequality in malnutrition, with much sharper levels in Punjab. This signifies that the linkage between poverty and malnutrition, or socioeconomic inequality and malnutrition is conditioned by other factors as well in a differential manner. The importance of contextual factors can be made in this regard. Examining them in detail is beyond the scope of the present paper and may be taken up as further research in the Indian context. Of particular interest can be the states of Punjab, Haryana and Kerala, for e.g., where inequality in malnutrition persists despite relatively lower levels of socioeconomic inequality.

From the policy perspective, it is essential to explore another dimension of the poverty-undernutrition linkage in India. Given the severity and depth in average malnutrition in India it needs to be examined in conjunction with the relative distribution of malnutrition across the states to enable classifying states having higher absolute levels of both. Again, we resort to scatterplots and regression fits to answer the question. Figures[3] 6a and 6b present average malnutrition and its association with the inequality and malnutrition.

In the figures above, in the first instance it is noted that the dispersion of the states, particularly for stunting is substantial making delineating definite patterns difficult. Yet it is discernable that there are a few states where average malnutrition as well as rich-poor divide is quite pronounced. We divide the scatter space to four somewhat related quadrants. For representative purposes, we have employed the national averages as the frontiers of the quadrants, the blue dotted line denoting average concentration index for malnutrition and the red, the average malnutrition levels. Region I stands for the 'pitfalls' marking high malnutrition rates coupled with high inequality (Gujarat and Bihar for stunting, and Gujarat yet again for underweight), Region II denotes the 'intensity' with high malnutrition prevalence but relatively low inequality (Jharkhand, Chattisgarh, Uttar Pradesh and Madhya Pradesh for stunting, Bihar and Meghalaya additionally for underweight), Region III are the 'do-gooders' representing lower levels of both average malnutrition and less pronounced inequality (Tamil Nadu, Rajasthan, Andhra Pradesh among the major states and a few northeastern states for stunting, Himachal Pradesh additionally for underweight) and Region IV standing for the 'disparity' having high inequality even at lower levels of malnutrition (Punjab, Kerala, Maharashtra, West Bengal, Karnataka and Orissa). However, we maintain that these clusters are purely representative and relative to the chosen frontier, the national average in our instance. A different frontier can change the constitution of the clusters. Again within the clusters the states are not homogenously, but scattered irregularly and a different approach can form different clubs of states.

Clearly, the situation is worse among the 'pitfalls', Gujarat being the foremost both in terms of deprivation and its disproportionate burden on the poor. It should be noted that both in terms of population below the poverty line and level of economic development (in terms of NSDP), the state is favourably placed than many others and held as one of the engines of future economic prosperity in the country. Dismal performance in nutritional outcomes along with the detrimental effect of inequality can seriously impede the development process in the state. Again, it reminds of the subtle importance of other human and social development parameters as well which needs to be adequately considered aiming alleviating hunger and

[3] Legend for the states:

AP –Andhra Pradesh	CG-Chattisgarh	GA-Goa	TR- Tripura
HR- Haryana	MZ- Mizoram	NL- Nagaland	HP-Himachal Pradesh
PB- Punjab	KL- Kerala	UT-Uttaranchal	BR- Bihar
JH-Jharkhand	MH- Maharashtra	GJ- Gujarat	MN- Manipur
AS- Assam	DL- Delhi	OR- Orissa	SK- Sikkim
J & K- Jammu & Kashmir	MP- Madhya Pradesh	UP-Uttar Pradesh	TN-Tamil Nadu
RJ- Rajasthan	KA- Karnataka	ARN- Arunachal Pradesh	ML - Meghalaya
WB- West Bengal			

nutritional deprivation and that not always economic growth translates into better outcomes in alleviating malnutrition. The second group of 'intensity' states is still faced with an uphill task of fighting higher levels of average malnutrition, although the rich-poor divide is not as stark as in the former case. Incidentally, these are also the poorest states in India and economically backward. Poverty thus has a visible linkage with the depth of malnutrition, although not equally clear for inequality in malnutrition. In the third region, the 'do-gooders' states closer to the y-axis represent the better performers, Tamil Nadu being the possible example. With relatively lower levels average undernutrition and lesser degree of inequality, Tamil Nadu is closer to the national average in terms of average poverty and economic development. The plausible explanation of its success seems to be the effective nutritional supplementation programme, ICDS, in the state stressing the importance of programme effort (Rajivan 2006). The last group, marking the 'disparity' has the highest inequality, even at low levels of average malnutrition and also comprises of the most number of states. Kerala and Punjab are interesting examples. Although these states, notably Kerala, have achieved better levels of malnutrition, yet the poor shoulders the disproportionate burden. This indicates that, although social and human development in Kerala and economic prosperity in Punjab might have initiated improvements in nutritional outcomes among children, the major part of the improvement has remained locked in the upper echelons of the income distribution, and relatively lesser benefits accruing to the poor. In these states, it must be emphasized, future programme thrust should be aimed at the socio-economically vulnerable groups specifically. This, to sum, is the extent of malnutrition problem in India. Sparing a few states having pervasive deprivation coupled with inequality in nutritional outcomes, which in turn pulls down the national aggregates (these are also the most populous states, hence, represents almost 60 percent of the national sample), and a few successes, most part of the country suffers from 'modest' (as per the national standard) undernutrition but marked by stark rich-poor divide in the outcomes. Since, sharp inequality in malnutrition characterizes a major part of the states, it deserves further analytical treatment. Decomposition analysis of malnutrition inequality addresses this perspective and enables isolating the factors responsible for such glaring inequality in undernutrition.

Decomposition of Malnutrition

Table 4 provides a brief description of the variables incorporated in the regression model and Table 5 the results of the decomposition. The latter also shows the concentration index and the relative contributions for each determinant to aggregate inequality in malnutrition. Additionally, the last column in Table 5 provides the relative contribution of each broad group of determinants to overall inequality. Higher value of the determinants' percentage contribution signifies intensification of inequality and vice-versa.

As evident from Table 5, household-level determinants are the prime determinants of socioeconomic inequality in malnutrition, with the wealth index alone explaining more than half the total inequality. This leads us to believe that in India, economic status of the household alone explains substantial part of the observed inequality in nutritional outcomes, with less pronounced effect of other comfounding factors. Wealth also affects inequality through indirect effects of other proximate determinants of inequality. Foremost among them include small size of child at birth (explaining about 10 percent of the variation), birth order (six percent), mother's years of education (12 percent), and another 12 percent attributable to region-level determinants. Although the composite index employed to reflect access to health facility explains about nine percent of observed inequality, a similar index for women's decision-making power relative to men does not offers much explanation to the inequality. The robustness of the decomposition model can be adjudged from the contribution of the residual which tends to zero (O'Donnell et. al. 2008).

Hence, socioeconomic inequalities in malnutrition are intensified primarily by household wealth, or in other words, the relative poverty status of the households. This is further corroborated by the very high value of the concentration index for the wealth variable (- 1.091).[4]The effect of other proximate determinants, mainly low birth weight of the child at delivery, mother's years of education, mother's nutritional status and access to health facility are also seemingly conditioned by socioeconomic status as the poor are more likely to

[4] As mentioned in Wagstaff et. al. (2008), "…….if the values of the health variable takes negative as well as positive vales, then its concentration index is not bounded within the range (-1, 1)."

have lower access to health facility, poorer maternal nutritional status, lower educational attainment and higher chances to have a low birth weight baby as a resultant.

In conjunction with the possible proximate determinants of average malnutrition, the determinants of inequality in nutritional outcomes underscore the centrality of economic capabilities of a household. However, a caveat needs to be maintained in this regard. Not the same determinants play equal role in determining average malnutrition and socioeconomic inequality in it. For e.g., relative poor status of women and lack of decision-making power at the household level has been maintained as one of the major reasons responsible for the inexplicable levels of malnutrition in the Indian sub-continent (Ramalingaswamy et. al. 1997, Smith et. al. 2002). Although the decision making index computed for regression analysis correlates well with the standardized z-scores and shows moderately strong evidence of lower prevalence of malnutrition as women's decision-making power increases, the variable accounts for insignificant amount of inequality in the decomposition analysis. On the other hand, as seen from the regression coefficients, birth order has rather weak effect on average malnutrition but significantly contributes to inequality in malnutrition. Another important proximate determinant of malnutrition among children is breastfeeding—the timing, duration and mode of supplementation (Madise and Mpoma 1997, World Bank 2004; IIPS 2007). Controlling for other random effects, we find that average malnutrition declines with increased duration of breastfeeding as well for exclusive breastfeeding up to six months. Also, average malnutrition declines if the child is put to breast within an hour after childbirth. Also increased duration of breastfeeding lessens inequality. It would be interesting to observe the effect of breastfeeding duration on malnutrition inequality, treating the variable as dichotomous instead, with 6 months as the cut-off. Inequality is expected to be higher for breastfeeding beyond 6 months as it indicates lesser availability of alternative supplementary nutrition and more likely to be poverty-induced. However, in the present form of analysis, the breastfeeding variables have marginal influence on inequality, suggesting that although instrumental in determining average undernutrition, breastfeeding in itself, is not an equally strong predictor of inequality in malnutrition.

Discussion

High levels of malnutrition among the children in India compared to other developing countries have been since long a much-debated issue in literature. The recent wave of the National Family Health Survey (NFHS-3) presents an opportunity to undertake a situational analysis of the current magnitude of the problem. Disaggregating the analysis at the state and regional level unearths significant disparities in nutritional outcomes among the children, mostly attributable to poverty and inequality in economic capacity.

Malnutrition is a nation-wide phenomenon in India with greater extent visible in the Eastern and Central regions. In the first place, there is a definite association of poverty and malnutrition at the aggregate level, with states having higher levels of average poverty, also found to suffer from higher extent of undernutrition among children. The level of economic development in the states also follows a similar pattern, the more developed states having a tendency to have lower levels of malnutrition. Nevertheless, higher extent of malnutrition in the developed states of Gujarat and Maharashtra for instance, highlights that economic development per se fails to ensure better nutritional outcomes unless effectively backed by improvements in social and human development as well as institutional coverage. Kerala and Tamil Nadu reaffirm the hypothesis that the ideal strategy to ensure reduction in malnutrition levels involves a coordination of collective action at the individual, household and community level.

Malnutrition among Indian children under five years of age rises steadily with age, similar to other developing country settings (Wagstaff and Watanabe 2000, Mishra et. al. 1999, Nair 2007). However, no significant sex differentials in malnutrition was noted, which, in a society known for gendered norms in household food allocation and care-practices for children, is surprising. This area warrants micro-level investigation to identify the reasons behind such observed paradox. Malnutrition is more common among children of higher birth order and shorter birth intervals, primarily due to unequal attention and nutritional shortfalls due to increased division of available resources in the household.

The socially vulnerable groups of the scheduled castes and tribes also suffer from higher malnutrition prevalence, which may be due to the economic disadvantages faced by these groups and lack of access to services like improved institutional healthcare. Mother's education is instrumental in ensuring better

nutritional outcomes of the children, mainly through positive linkages between enhanced better awareness, increased potential of income generation and consequent access to financial resources and other institutional services all influencing better child nutrition. Also through delayed age at marriage, which reduces high-risk pregnancies and probabilities of delivering low-birth weight babies, and better decision-making capabilities at the household level, maternal education has both direct and indirect effects on reducing risks of child malnutrition. It is evident that lower prevalence of malnutrition among the children of educated mothers in India, even after controlling for other variables signifies the importance of education among mothers. Also, it is indicative of the probable poverty-illiteracy nexus intensifying malnutrition.

Socioeconomic status of the household remains one of the most important predictors of child malnutrition in India. The rich-poor gap is substantial in all domains of malnutrition, with the disproportionate burden among the poor. For stunting and underweight, malnutrition prevalence in the poorest strata is about three times of the same in the richest groups. Controlling for all other determinants does not dilute the strong effect of wealth on malnutrition as visible through the statistically significant regression coefficient, which reiterates the poverty-nutrition linkage in India.

Apart from depth in average malnutrition, the distribution of undernutrition in India is also highly unequal as reflected by the concentration index. The concentration curves, which depict the extent of inequality in malnutrition, signify the extent of inequality at the aggregate national level. However, comparing the indices value with that of other developing countries and those in SE Asia (van De Poel et. al. 2008) suggest that inequality is less pronounced for India as a whole. However, inequality in acute undernutrition mainly resulting from temporary shocks in income and food security or morbidity patterns, is more severe in India. As suggested, average malnutrition and inequality in its distribution among the population does not necessarily moves in similar direction with equal intensity as each are more likely to be influenced by different set of factors (Wagstaff et. al. 2001). Inequality in malnutrition is most pronounced in the Eastern and Western regions, and lowest in the Central, the latter having highest average levels of the same.

We also find existence of a pattern in the association between overall socioeconomic inequality and inequality in malnutrition, particularly for stunting, which reflects chronic undernutrition. States with more unequal distribution of socioeconomic status also tend to have higher extent of inequality in malnutrition, even as the pattern is somewhat reversed for underweight. Nevertheless that some states jump the general trend signifies that socioeconomic inequalities in itself is not solely responsible for malnutrition inequality, and other determinants are also, if not equally important, as seen elsewhere (Haddad et. al. 2002). In a similar vein, the observed spatial association between average malnutrition and malnutrition inequality also suggests that there are some states, Gujarat being the foremost, having the dual burden of the depth and unequal distribution of malnutrition simultaneously. Being a relatively developed state, with lower than national levels of average poverty, such an outcome underscores the need of a complimentary strategy in alleviating malnutrition and reducing the extent of socioeconomic inequalities in undernutrition. The success of effective and properly targeted nutritional supplementation programme run under the Integrated Child Development Services (ICDS) in Tamil Nadu is discernible from the findings. Notably, a large cluster of states are found to have lower than national levels of malnutrition but at the cost of higher intensity in socioeconomic inequalities in malnutrition. On the other hand, the most populous states from the heartland are found to have severe levels of average malnutrition at less intense extent of inequality. Incidentally, the latter group of states also suffers from lower levels of economic development and higher levels of average poverty. This presents the multi-faceted nature of the child malnutrition problem in India, where poverty and inequality permeates undernutrition among children

Decomposing the absolute levels of malnutrition inequality into the relative contribution of the predictors also reiterates the central role of socioeconomic status in influencing differential extent of malnutrition. Such disparity is almost single-handedly explained by overall socioeconomic inequality, indicating that controlling for all other possible determinants it is the poor who shoulders the disproportionate burden of child malnutrition. Inequality in malnutrition is also explained significantly by mother's educational status and other demographic determinants like birth order, low weight at birth and birth interval. Lower access to healthcare facilities involving both preventive and curative aspects of maternal

and child health, as well as availability of ICDS centres is also responsible for observed heterogeneity in malnutrition. Poverty, can, with reason, be thought of as the instrumental variable in this regard too restricting access through interlinkages between other socioeconomic variables.

Limitations

The main limitation of the paper is in operationalizing economic status and household income. In the absence of a suitable economic variable in the data, which remains the major handicap for economic and poverty analysis using DHS data, we had to rely on the wealth index, arguable a close proxy to the economic capacity of a household (Rutstein 2004). Although information in NFHS 3 was collected on the possession of a Below Poverty Line (BPL) card, provided by the Indian government to the households officially recognized as poor it was not employed in the analysis for a number of reasons. Firstly, being dichotomous, the variable is not amenable to analytical approach adopted in the paper and secondly, there is some anomaly in the correlation of this variable with wealth index (may be due to data limitations, as ownership of such card was not physically verified during the survey).

As noted elsewhere (van De Poel et. al. 2007) economic analysis of child health outcomes suffers from endogeneity of much of the demographic determinants. But even for controlling for the individual effects of such comfounding predictors, the relative importance of socioeconomic status, and rich-poor disparity remains unaltered. Much of the state level analysis at the macroeconomic level is primarily aimed at illustrating the linkages between poverty, inequality and economic development with malnutrition and classification of states into groups are based on the reference standard, the national average in this case. Although this may lead to biasing the results, it is felt that much of the evident associations would be independent of such influences, which, if any, should be limited to the extremes of the distribution.

Conclusion and Policy Implications

This paper examines the extent of malnutrition among children under the age of five in India and the linkage between poverty and socioeconomic inequality and undernutrition. The results highlight the centrality of poverty in influencing nutritional outcomes and also in explaining the observed disparity in malnutrition among the population groups. That the poor and the vulnerable sections of the Indian population shoulders the disproportionate burden of child malnutrition in India is one of the key findings of the paper, arrived at by the application of concentration indices and decomposition techniques on the most recent household survey data in India. Additionally, the paper brings to the fore the disaggregated scenario among the states in the country with respect to nutritional deprivation among the children and its depth as well as distribution. India, as the findings indicate, is faced with the twin challenges of reducing the average malnutrition levels in the states, which also are the largest, most populous, relatively underdeveloped and plagued by high poverty levels and simultaneously reduce inequality and heterogeneity in the extent of malnutrition in a majority of states, having lower levels of malnutrition but higher extent of inequality, relative to the national average. Apart from poverty and socioeconomic inequality, the sublime importance of other proximate determinants and program outreach is underscored in the emerging results, notably maternal education and improved access to maternal and child health care reducing the incidence of low birth weight babies being born. The complementary nature of the determinants of malnutrition, as the findings of the paper suggests, calls for targeted interventions by the policy-makers aimed specifically at the vulnerable sections toward the cherished goals of reducing the scourge of hunger and nutritional deprivation among the children of India.

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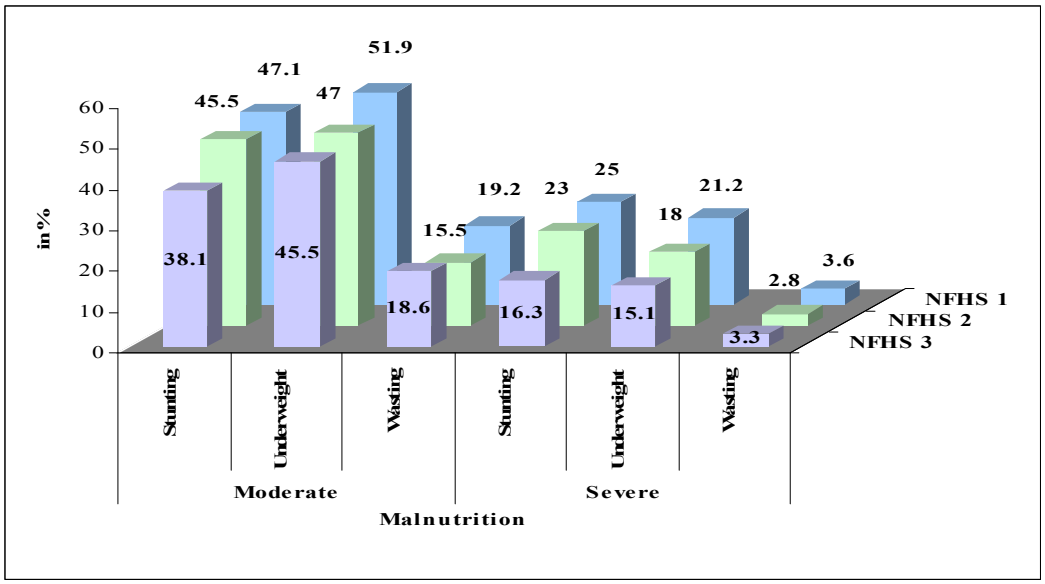
Figure 1: Malnutrition trends in India among children aged 0-35 months, 1992-93 –2005-06



Source: Malnutrition rates for NFHS 1 and NFHS 2 were obtained from *StatCompiler* online tool provided by the DHS (http://www.statcompiler.com/ accessed on 20th June, 2008. Estimates for NFHS-3 are based on authors' calculations from the NFHS 3 data using the CDC/NCHS international reference population.

Fig 2a: Child malnutrition and population below the poverty line in Indian states, 2005-06

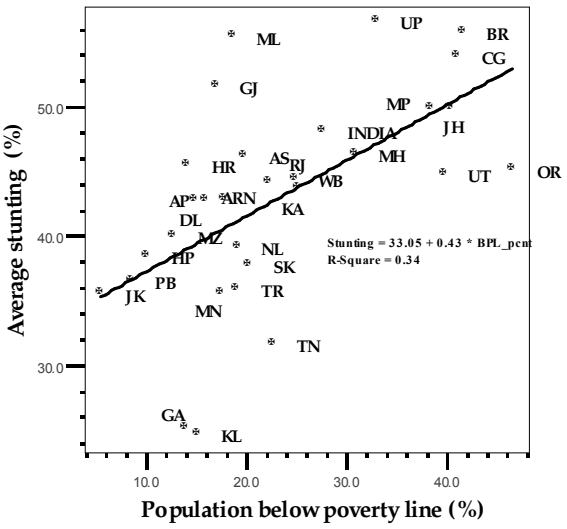
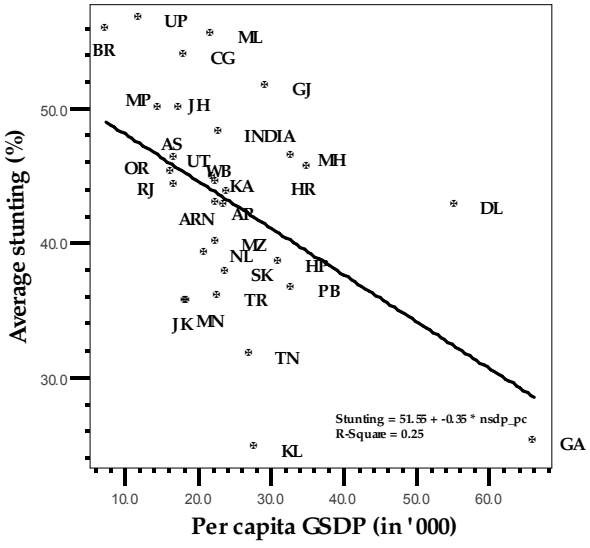


Fig 2b: Child malnutrition and per capita State Domestic Product in Indian states, 2005-06



Source: Average stunting figures are from NFHS 3 calculated by the authors. Population below poverty line for the states are based on Uniform Recall Period (2004-05) accessed from http://planningcommission.nic.in/news/prmar07.pdf on 21st June, 2008 Per capita Gross State Domestic Product (at current prices) is for 2004-05, (accessed from http://indiabudget.nic.in on 17th June, 2008.

Figure 3: Distribution of stunting across socioeconomic status quintiles for geographic regions, India

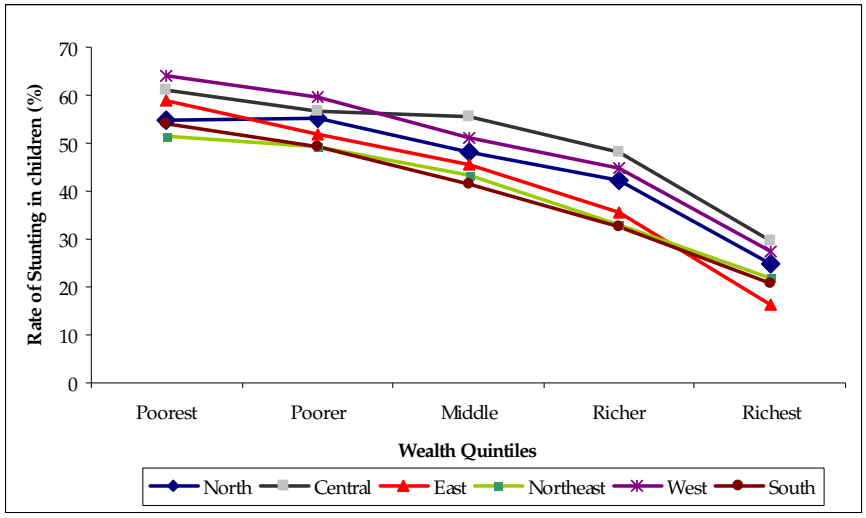
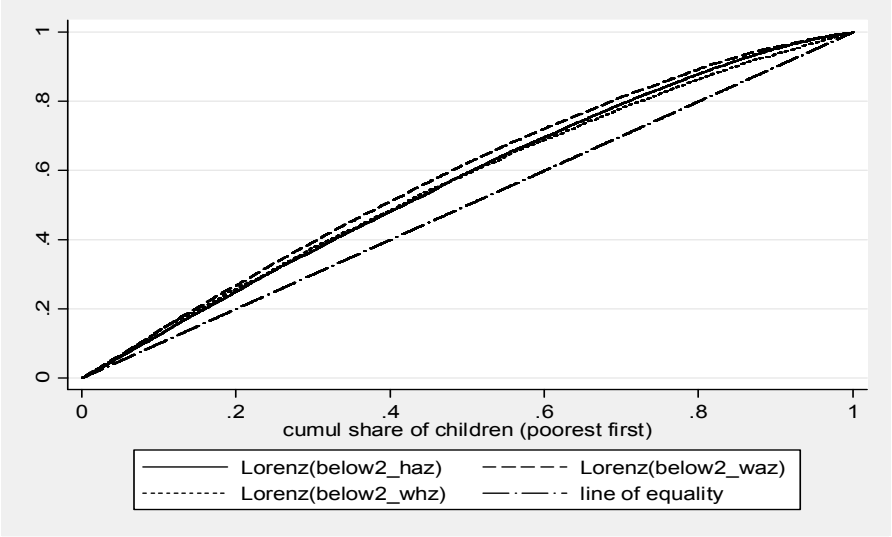


Figure 4: Malnutrition concentration curves for stunting, underweight and wasting, India



Note: Authors' calculations based on INHFS -3 data.
Abbreviations: below2_haz denotes proportion of children below -2 SD of the z-score for height-for-age, below2_whz and below2_waz denotes the same for weight-for-height and weight-for-age respectively

Figure 5a: Socioeconomic inequality and malnutrition in India—the interlinkages: Inequality in stunting versus overall socioeconomic inequality in under-five children in India

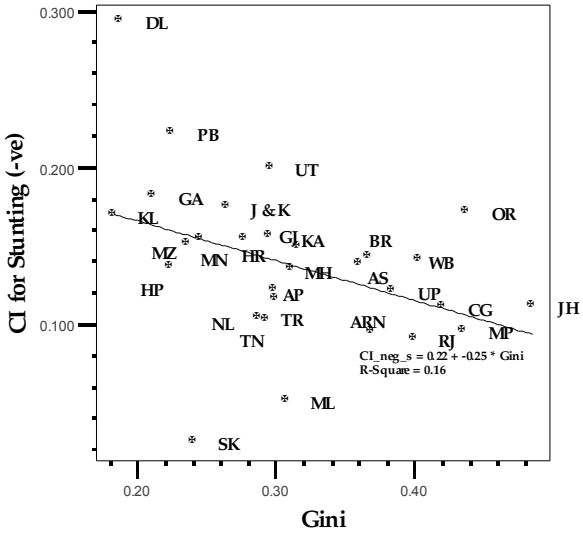
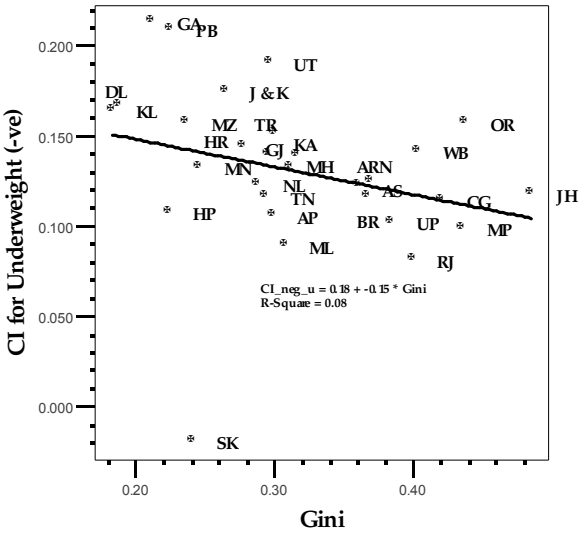


Figure 5b: Socioeconomic inequality and malnutrition in India—the interlinkages: Inequality in underweight versus overall socioeconomic inequality in under-five children in India



Source: Authors' calculations from NFHS-3 data

Figure 6a: Average underweight versus socioeconomic inequality in underweight in under-five children in India

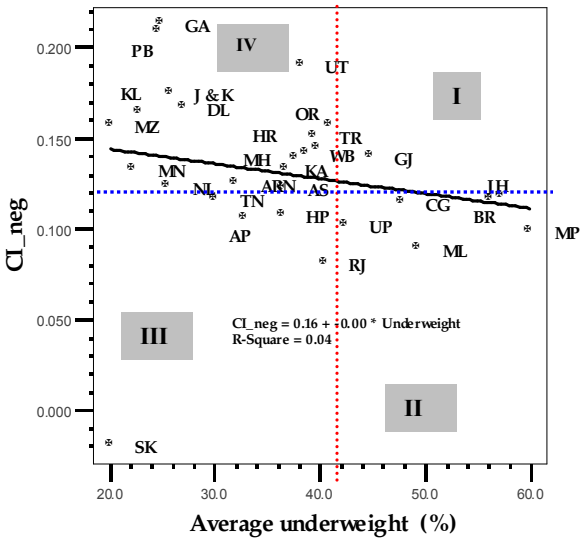
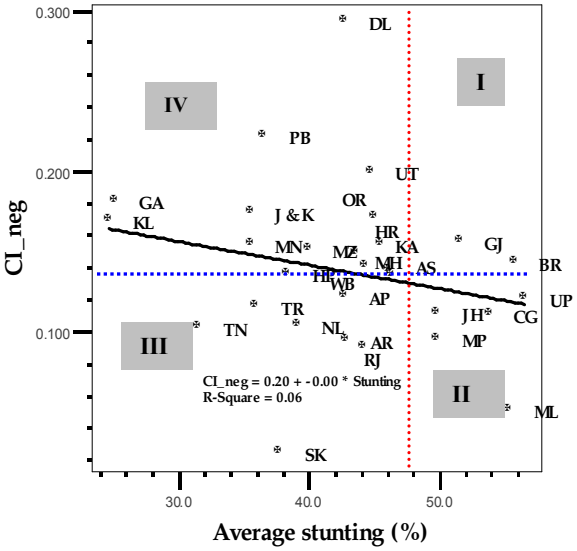


Figure 6b: Average stunting versus socioeconomic inequality in stunting in under-five children in India



Source: Authors' calculations from NFHS-3 data

Table 1: Prevalence of Malnutrition (stunting, underweight and wasting) among children (less than 5 years) in India and States, 2005-06

States	stunting		underweight		wasting	
	moderate	severe	moderate	severe	moderate	severe
North	**42.3**	**20.8**	**35.9**	**13.1**	**17.8**	**5.8**
Delhi	42.7	20.8	26.9	9.0	16.1	7.3
Haryana	45.4	19.2	39.7	14.2	19.5	5.1
Himachal Pradesh	38.3	16.3	36.3	11.4	19.5	5.5
Jammu & Kashmir	35.5	15.1	25.7	8.2	14.6	4.2
Punjab	36.5	17.3	24.6	7.7	8.9	2.1
Rajasthan	44.1	23.1	40.4	15.5	20.5	7.3
Uttaranchal	44.7	23.3	38.1	15.5	18.8	5.3
East	**50.1**	**24.1**	**48.9**	**19.0**	**23.8**	**7.2**
Bihar	55.7	29.1	56.1	24.0	27.3	8.3
Jharkhand	49.8	26.6	57.1	26.2	32.6	11.9
Orissa	45.0	19.8	40.9	13.4	19.6	5.2
West Bengal	44.3	17.5	38.6	11.1	16.8	4.4
North-East	**44.6**	**20.2**	**35.4**	**12.0**	**15.2**	**5.4**
Arunachal Pradesh	42.8	21.3	31.9	10.9	15.0	6.1
Assam	46.1	20.8	36.4	11.3	13.6	3.9
Manipur	35.5	12.8	22.2	4.6	9.0	2.2
Meghalaya	55.3	29.6	49.3	28.1	31.1	20.1
Mizoram	39.9	18.0	20.0	5.0	8.8	3.6
Nagaland	39.1	19.4	25.5	7.4	13.3	5.2
Sikkim	37.7	16.7	20.0	5.2	9.9	3.3
Tripura	35.9	14.6	39.4	15.8	25.0	8.9
Central	**54.6**	**30.3**	**47.1**	**19.2**	**20.5**	**7.1**
Chattisgarh	53.8	25.1	47.7	16.6	20.1	5.7
Madhya Pradesh	49.8	26.5	59.9	27.4	35.3	12.5
Uttar Pradesh	56.5	32.3	42.3	16.4	14.9	5.2
West	**48.2**	**21.6**	**39.9**	**13.4**	**17.2**	**5.5**
Goa	25.1	10.0	24.8	6.6	14.0	5.2
Gujarat	51.5	25.5	44.7	16.3	18.6	5.9
Maharashtra	46.3	19.1	36.7	11.5	16.3	5.2
South	**37.7**	**15.8**	**32.0**	**9.2**	**16.6**	**5.6**
Andhra Pradesh	42.7	19.0	32.7	10.2	12.3	3.5
Karnataka	43.6	20.7	37.6	12.9	17.8	6.0
Kerala	24.6	6.3	22.7	4.5	15.8	4.3
Tamil Nadu	31.5	11.1	30.0	6.5	21.7	8.6
India	**48.0**	**23.7**	**42.5**	**15.8**	**19.8**	**6.4**

Source: Authors' calculations from NFHS-3 data

Table 2: Prevalence of Malnutrition (stunting, underweight and wasting) among children (less than 5 years) according to select background socioeconomic and demographic variables

Background characteristics	stunting		underweight		wasting	
	moderate	severe	moderate	severe	moderate	severe
Age of the child (in months)						
< 6 months	20.4	8.5	29.5	10.9	30.3	13.0
6-12 months	28.6	11.8	35.5	13.8	29.0	10.4
12-24 months	52.4	26.0	43.1	16.8	22.8	7.5
24-36 months	55.9	29.0	44.8	17.8	16.6	5.0
36-60 months	52.5	26.1	45.4	15.9	15.5	4.3
Birth order						
1	40.9	17.9	36.0	11.9	17.8	5.4
2 & 3	47.7	22.3	41.3	14.3	19.5	6.3
3-5	54.3	30.5	49.7	21.1	21.7	7.5
6+	61.0	37.1	56.4	26.2	24.4	8.7
Gender						
female	48.0	23.4	43.0	16.3	6.0	19.1
male	48.1	24.0	42.0	15.4	6.8	20.5
Birth interval						
9 months	78.6	59.9	59.2	35.5	22.6	0.0
9-24 months	55.5	30.2	47.4	18.8	18.9	6.1
24-47 months	51.2	26.1	46.1	17.9	21.7	7.3
more than 48 months	42.2	18.9	37.3	12.8	18.6	5.9
Mother's completed years of education						
no education	57.1	31.6	51.9	22.0	22.7	7.9
less than 5 year	50.4	24.0	45.7	15.6	20.8	6.2
5-7 years	45.8	20.4	38.5	12.2	18.8	5.4
8-9 years	40.9	15.6	35.0	9.4	17.4	5.1
10-11 years	33.1	11.0	26.8	6.5	14.2	3.8
12 years or more	22.0	7.0	17.9	4.4	12.7	4.0
Mother's Body Mass Index						
underweight	53.5	27.3	51.9	20.9	25.1	7.8
normal	46.3	22.6	38.7	13.6	17.3	5.9
overweight	33.1	13.8	22.4	6.1	10.4	3.2
Place of residence						
urban	39.9	17.7	32.8	10.8	16.8	5.6
rural	50.7	25.7	45.7	17.5	20.8	6.7
Social Groups						
general caste	40.9	17.9	33.9	11.2	16.3	5.2
scheduled castes	53.9	27.6	47.9	18.4	21.0	6.6
scheduled tribes	54.2	29.5	55.0	25.3	27.8	9.4
other backward class	48.8	24.7	43.1	15.8	20.0	6.6
Religion						
hindu	48.0	23.5	43.3	16.1	20.3	6.5
muslim	50.2	26.1	41.7	15.6	18.5	6.1
christian	39.2	17.9	30.2	8.8	15.9	5.4
others	42.7	19.5	34.5	14.8	18.1	5.6
Wealth Quintiles						
poorest	59.9	34.4	56.7	24.9	25.1	8.6
poorer	54.4	28.1	49.4	19.5	22.1	6.8
middle	48.8	23.2	41.5	14.1	18.9	6.3
richer	40.8	16.5	33.6	9.5	16.5	4.9
richest	25.6	8.2	19.7	4.9	12.7	4.2
Possession of BPL card						
Household does not have BPL card	46.4	22.7	40.4	15.0	19.3	6.4
Household have BPL card	53.1	26.8	49.0	18.6	21.4	6.6

Source: Authors' calculations from NFHS 3 data

Table 3: Concentration Indices, Standard errors, t-ratios and 95% confidence interval for Stunting, Underweight and Wasting, India and States, 2005-06

States/ India	Stunting					Underweight					Wasting					Number of Observations
	C	Robust S.E.[C]	t[C]	95 % C.I. Lower	95 % C.I. Upper	C	Robust S.E.[C]	t[C]	95 % C.I. Lower	95 % C.I. Upper	C	Robust S.E.[C]	t[C]	95 % C.I. Lower	95 % C.I. Upper	
North	**-0.112**	**0.009**	**-12.020**	**-0.131**	**-0.094**	**-0.118**	**0.007**	**-17.070**	**-0.131**	**-0.104**	**-0.121**	**0.012**	**-9.780**	**-0.145**	**-0.097**	**7538**
Delhi	-0.293	0.037	-7.940	-0.366	-0.221	-0.166	0.030	-5.450	-0.226	-0.106	0.057	0.064	0.890	-0.069	0.182	729
Haryana	-0.153	0.020	-7.720	-0.192	-0.114	-0.144	0.016	-8.810	-0.176	-0.112	-0.130	0.029	-4.400	-0.187	-0.072	1106
Himachal Pradesh	-0.135	0.032	-4.170	-0.199	-0.071	-0.107	0.024	-4.470	-0.154	-0.060	-0.057	0.046	-1.240	-0.148	0.034	855
Jammu and Kashmir	-0.174	0.024	-7.160	-0.221	-0.126	-0.174	0.024	-7.160	-0.221	-0.126	-0.085	0.039	-2.190	-0.161	-0.009	986
Punjab	-0.221	0.021	-10.280	-0.263	-0.179	-0.208	0.018	-11.560	-0.243	-0.172	-0.182	0.032	-5.620	-0.246	-0.119	1133
Rajasthan	-0.090	0.014	-6.340	-0.118	-0.062	-0.081	0.011	-7.700	-0.102	-0.061	-0.062	0.019	-3.210	-0.100	-0.024	1704
Uttaranchal	-0.199	0.019	-10.710	-0.235	-0.162	-0.190	0.015	-12.540	-0.219	-0.160	-0.176	0.029	-6.000	-0.234	-0.118	1025
North-East	**-0.128**	**0.013**	**-10.050**	**-0.153**	**-0.103**	**-0.128**	**0.010**	**-13.010**	**-0.147**	**-0.108**	**-0.115**	**0.018**	**-6.580**	**-0.150**	**-0.081**	**7682**
Arunachal Pradesh	-0.094	0.023	-4.100	-0.140	-0.049	-0.124	0.018	-6.840	-0.160	-0.088	-0.160	0.035	-4.640	-0.228	-0.092	709
Assam	-0.137	0.018	-7.590	-0.172	-0.102	-0.122	0.014	-8.780	-0.150	-0.095	-0.088	0.025	-3.590	-0.136	-0.040	1232
Manipur	-0.153	0.020	-7.790	-0.192	-0.115	-0.132	0.015	-8.520	-0.162	-0.101	-0.094	0.027	-3.440	-0.148	-0.041	1636
Meghalaya	-0.050	0.028	-1.790	-0.105	0.005	-0.089	0.023	-3.830	-0.135	-0.044	-0.123	0.052	-2.360	-0.226	-0.021	657
Mizoram	-0.150	0.036	-4.160	-0.221	-0.079	-0.157	0.023	-6.720	-0.203	-0.111	-0.162	0.051	-3.200	-0.262	-0.063	738
Nagaland	-0.103	0.023	-4.540	-0.148	-0.059	-0.123	0.015	-7.970	-0.154	-0.093	-0.139	0.031	-4.480	-0.199	-0.078	1673
Sikkim	-0.024	0.046	-0.510	-0.115	0.068	0.020	0.034	0.570	-0.048	0.087	0.075	0.066	1.140	-0.054	0.205	490
Tripura	-0.115	0.031	-3.750	-0.176	-0.055	-0.151	0.027	-5.540	-0.205	-0.098	-0.204	0.047	-4.350	-0.296	-0.112	547
East	**-0.138**	**0.007**	**-19.660**	**-0.152**	**-0.124**	**-0.131**	**0.006**	**-22.840**	**-0.142**	**-0.120**	**-0.117**	**0.011**	**-10.630**	**-0.138**	**-0.095**	**6884**
Bihar	-0.142	0.013	-10.670	-0.169	-0.116	-0.116	0.010	-11.170	-0.137	-0.096	-0.076	0.019	-3.900	-0.114	-0.038	2000
Jharkhand	-0.111	0.014	-7.980	-0.139	-0.084	-0.117	0.010	-11.290	-0.137	-0.097	-0.120	0.020	-6.090	-0.159	-0.082	1326
Orissa	-0.171	0.012	-13.700	-0.195	-0.146	-0.157	0.010	-14.980	-0.178	-0.137	-0.129	0.021	-6.130	-0.170	-0.087	1530
West Bengal	-0.140	0.012	-11.290	-0.165	-0.116	-0.141	0.010	-13.740	-0.161	-0.121	-0.138	0.021	-6.660	-0.179	-0.097	2028
Central	**-0.107**	**0.007**	**-15.900**	**-0.120**	**-0.094**	**-0.107**	**0.005**	**-20.850**	**-0.117**	**-0.097**	**-0.106**	**0.010**	**-10.780**	**-0.126**	**-0.087**	**9217**
Chattisgarh	-0.110	0.015	-7.520	-0.138	-0.081	-0.114	0.011	-10.300	-0.136	-0.092	-0.118	0.024	-5.010	-0.164	-0.072	1388
Madhya Pradesh	-0.095	0.013	-7.120	-0.121	-0.069	-0.098	0.010	-10.000	-0.118	-0.079	-0.101	0.019	-5.420	-0.138	-0.065	2563
Uttar Pradesh	-0.120	0.009	-13.940	-0.137	-0.103	-0.102	0.007	-15.400	-0.115	-0.089	-0.072	0.012	-5.850	-0.096	-0.048	5266
West	**-0.143**	**0.011**	**-13.020**	**-0.164**	**-0.121**	**-0.136**	**0.008**	**-16.010**	**-0.152**	**-0.119**	**-0.115**	**0.017**	**-6.760**	**-0.148**	**-0.082**	**4363**
Goa	-0.181	0.025	-7.170	-0.230	-0.131	-0.213	0.022	-9.860	-0.255	-0.170	-0.266	0.048	-5.570	-0.360	-0.172	772
Gujarat	-0.155	0.017	-9.180	-0.188	-0.122	-0.139	0.012	-11.170	-0.164	-0.115	-0.099	0.024	-4.050	-0.146	-0.051	1357
Maharashtra	-0.134	0.014	-9.260	-0.162	-0.106	-0.132	0.011	-11.620	-0.155	-0.110	-0.124	0.023	-5.320	-0.169	-0.078	2234
South	**-0.136**	**0.011**	**-12.880**	**-0.157**	**-0.116**	**-0.123**	**0.008**	**-14.910**	**-0.139**	**-0.107**	**-0.092**	**0.015**	**-5.950**	**-0.122**	**-0.061**	**5622**
Andhra Pradesh	-0.121	0.020	-6.120	-0.160	-0.083	-0.105	0.016	-6.510	-0.136	-0.073	-0.065	0.029	-2.240	-0.121	-0.008	1797
Karnataka	-0.148	0.017	-8.610	-0.182	-0.114	-0.138	0.013	-10.530	-0.163	-0.112	-0.106	0.025	-4.180	-0.155	-0.056	1456
Kerala	-0.169	0.025	-6.790	-0.218	-0.120	-0.164	0.020	-8.220	-0.203	-0.125	-0.164	0.040	-4.090	-0.243	-0.085	896
Tamil Nadu	-0.102	0.023	-4.520	-0.146	-0.058	-0.116	0.018	-6.590	-0.150	-0.081	-0.136	0.034	-4.030	-0.202	-0.070	1473
India	**-0.129**	**0.003**	**-37.820**	**-0.135**	**-0.122**	**-0.128**	**0.003**	**-48.490**	**-0.133**	**-0.123**	**-0.121**	**0.005**	**-23.830**	**-0.131**	**-0.111**	**41306**

Table 4: Mean, standard deviation and description of all variables

Variable	Mean	Std. Dev.	Type	Description
Dependant Variables				
neghaz	1.71	1.67	continuous	Negative of height-for-age z-score (based on WHO)
Child-level variables				
hw1	30.11	16.95	continuous	Age of the child (in months)
age2	1194.15	1049.35	continuous	Square of child's age
largesize	0.23	0.42	dichotomous	Size of child at birth category dummy-large
normalsize	0.56	0.50	dichotomous	Size of child at birth category dummy-normal
smallsize	0.20	0.40	dichotomous	Size of child at birth category dummy-small
childsex	0.52	0.50	dichotomous	Sex of the child--male=1, female=0
bord	2.62	1.80	continuous	Birth order
b11	36.83	21.39	continuous	Birth interval
childmorbid	0.28	0.45	dichotomous	Child morbidity --(based on whether child suffered from any of the following illnesses, viz., diarrhoea, fever, difficult or fast breathing during the reference period)--yes=1, no=0)
Parent-level Variables				
mother_edu	5.16	5.09	continuous	Mother's years of education
father_edu	7.83	9.65	continuous	Father's years of education
birthage	24.74	5.23	continuous	Mother's age at childbirth
bf_months	8.84	10.94	continuous	Duration of breastfeeding (in months)
bf_time	0.23	0.42	dichotomous	Timing of initiation of breastfeeding--within 1 hour of childbirth = 1, later=0
bf_suppl	0.36	0.48	dichotomous	Mode of breastfeeding--exclusive breastfeeing =1, supplemented=0
mother_bmi	0.32	0.47	dichotomous	Mother's nutritional status (in BMI)--less than 18.5=1, >=18.5=0
dmw_index_norm	29.02	4.78	continuous	Women's decision-making index (estimated by principal component analysis. The indicator combines whether woman works for cash income, percentage age difference between woman and husband, woman's age at marriage and educational difference, in years, between woman and spouse, normalized to a scale of 0-100)[Smith et. al. 2002]
Household-level variables				
por	0.37	0.48	dichotomous	Place of residence--urban=1, rural=0
wealthindex	-0.21	0.95	continuous	Wealth Index Score of the household (provided in INFHS-3)[Reference]
drinkwater	0.77	0.42	dichotomous	Whether the household has access to safe drinking water (has access to safe drinking water=1, else=0). Classification based on INFHS-3 [IIPS 2007]
toilet	0.45	0.50	dichotomous	Whether household has a toilet --yes=1, no=0. Classification based on INFHS-3 [IIPS 2007]
access_ind_norm	67.23	26.17	continuous	Access to and use of health services index (estimated by principal component analysis. This index combines place of delivery, utilization of antenatal care, immunization of the child and whether the PSU is served by an ICDS centre, normalized to a scale of 0-100)
Region-level variables				
north	0.18	0.39	dichotomous	Geographic region dummy--north
central	0.22	0.42	dichotomous	Geographic region dummy--central
east	0.17	0.37	dichotomous	Geographic region dummy--east
northeast	0.19	0.39	dichotomous	Geographic region dummy--northeast
west	0.11	0.31	dichotomous	Geographic region dummy--west
south	0.14	0.34	dichotomous	Geographic region dummy--south

Table 5: Regression and decomposition results of inequality in malnutrition: coefficient, concentration index (C) and proportional contribution

Variables	Coefficients	Elasticity	C	Contribution	Contribution (in %)
Child-level determinants					**16.79**
Age-squared	-0.001	-0.803	-0.002	-0.002	-1.36
Age (in months)	0.103	1.656	-0.001	-0.001	0.90
Size of the child at birth					
large	-0.002	0.000	0.038	0.000	0.01
normal	0.018	0.005	0.011	0.000	-0.05
small	0.204	0.022	-0.062	-0.001	10.08
Sex of the child	0.022	0.006	0.009	0.000	-0.04
Birth order	0.043	0.063	-0.123	-0.008	6.01
Birth interval	-0.004	-0.083	0.020	-0.002	1.26
Child morbidity	0.035	0.005	0.007	0.000	-0.03
Parent-level determinants					**17.57**
Mother's years of education	-0.022	-0.048	0.419	-0.020	12.37
Father's years of education	-0.003	-0.124	0.207	-0.003	1.99
Mother's age at childbirth	-0.010	-0.127	-0.005	0.001	-0.50
Duration of breastfeeding (in months)	-0.011	-0.053	0.018	-0.001	0.76
Timing of initiation of breastfeeding	-0.054	-0.005	0.153	-0.001	0.59
Mode of breastfeeding	-0.127	-0.025	-0.013	0.000	-0.26
Mother's nutritional status	0.127	0.026	-0.148	-0.004	2.02
Women's decision-making index*	-0.004	-0.054	0.014	-0.001	0.59
Household-level determinants					**54.97**
Place of residence	0.094	0.012	0.490	0.006	-4.74
Wealth Index*	-0.247	0.060	-1.091	-0.066	51.21
Drinking water	0.094	0.040	0.033	0.001	-1.02
Toilet	-0.007	-0.001	0.542	-0.001	0.51
Access to health facility**	-0.003	-0.100	0.116	-0.012	9.00
Region-level determinants					**11.94**
North	0.056	0.004	0.217	0.001	-0.68
Central	0.282	0.043	-0.138	-0.006	4.64
East	0.101	0.015	-0.214	-0.003	2.42
Northeast*		0.000	-0.712	0.000	0.00
West	0.322	0.021	-0.284	0.006	4.61
South	-0.063	-0.005	0.238	-0.001	0.95
Residual			-0.435	-0.013	-1.30
Total			**-0.128**	**-0.129**	**100.00**

Note: Authors' calculations from INFHS-3 data.
* not significant
Dependant variable: negative of standardized z-scores fro height-for-age (stunting)