OCCASIONAL PAPER

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Changing socioeconomic inequalities in child nutrition in the Indian states:

What the last two National Family Health Surveys say

Simantini Mukhopadhyay

Achin Chakraborty

July 2018

INSTITUTE OF DEVELOPMENT STUDIES KOLKATA

DD 27/D, Sector I, Salt Lake, Kolkata 700 064

Phone : +91 33 2321-3120/21 Fax : +91 33 2321-3119

E-mail : idsk@idskmail.com, Website: www.idsk.edu.in

Changing socioeconomic inequalities in child nutrition in the Indian states:

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Simantini Mukhopadhyay[1]

Achin Chakraborty[2]

Abstract

We find that the modest improvement in child undernutrition in the ten years between the last two rounds of the National Family Health Survey (NFHS) has been skewed against children in the poorest households. There is no evidence of convergence in the nutritional achievements of children across the states of India, which is due to the fact that the backward states with high average levels of undernutrition have also witnessed a rise in socio-economic inequalities in child nutrition. We use different indicators, ranging from the simple relative rate of decline in the bottom wealth quintile vis-à-vis the mean to the more sophisticated measures such as the extended concentration index to measure socioeconomic inequalities. While mapping the performance of states in reducing stunting inequalities to the economic indicators, we find that there is no generalisable pattern. Gujarat, which has had the second highest growth rate in per capita net state domestic product, has witnessed a rise in relative inequality in child stunting by all measures. At the other extreme, Uttarakhand, which has had the highest growth rate in PCNSDP and the second highest rate of poverty reduction, has also been successful in reducing wealth inequality in stunting, irrespective of the measure chosen.

JEL Classification:

Key words:

[1] Assistant Professor, Institute of Development Studies Kolkata. Email:simantinihalder@gmail.com

[2] Director and Professor, Institute of Development Studies Kolkata. Email: achinchak@gmail.com

1. Introduction

India has been infamous for its high child undernutrition figures that exceed those of many poorer and lower growth countries of Sub-Saharan Africa. India's high child undernutrition attracted a lot of attention, particularly after the results of the third National Family Health Survey (NFHS-3) conducted in 2005-06 were published. The fourth National Family Health Survey (NFHS-4) was carried out after a long gap of 10 years in 2015-16. Though the latest round shows a decline in child undernutrition(particularly in stunting and underweight), the figures are still quite high compared to other developing countries. While child stunting declined from 48 per cent to 38 per cent and child underweight fell from 43 per cent to 36 per cent, wasting among children below five years has disturbingly increased by one percentage point from 20 per cent (IIPS and ORC Macro 2017).

An overall decline in the average level often hides the fact that children in all socio-economic groups do not experience the same. In the context of such non-income dimension as nutritional status, group inequality deserves greater attention compared to interpersonal inequality. Interpersonal inequality (or what is often called 'pure' inequality) in indicators with a natural upper limit, such as anthropometric scores is expected to fall with an improvement in the average level. However, a low average level of undernutrition may be consistent with high between-group inequality if the few remaining undernourished children mostly belong to the lowest socio-economic strata. Much of the work on group inequalities in child nutrition has focused on the axis of economic status, proxied by household wealth, as available in the demographic and health surveys. Child undernutrition has been shown to be associated significantly with household wealth (Borooah 2005; Mukhopadhyay 2013) and wealth-related inequality in child nutrition varies considerably across the Indian states (Joe et al. 2008; Mukhopadhyay 2011). To quote the National Report of NFHS-3, "[c]hildren from households with a low standard of living are twice as likely to be undernourished as children from households with a high standard of living" (IIPS and ORC Macro 2007). Likewise, the NFHS-4 Report for India states that "[t]he prevalence of stunting decreases steadily with an increase in wealth quintiles, from 51 percent of children in households in the lowest wealth quintile to 22 percent of children in households in the highest wealth quintile” (IIPS and ORC Macro 2017).Moreover, when we look into the figures of child stunting across the wealth quintiles for the last two rounds of the NFHS, we find that the decline in child stunting in the bottom wealth quintile has been lower than the declines in the next three wealth quintiles. While overall child stunting fell by 21 percentage points between NFHS-3 and NFHS-4, the decline in child stunting in households comprising the poorest quintile has been only 15 percent. This tends to indicate that whatever little improvement in child nutrition has been achieved in the ten years following NFHS-3 has been skewed against children in the poorest households.

This paper attempts to look into the dynamics of socioeconomic inequality in child undernutrition in India. We also probe into how such inequality has evolved in the decade following NFHS-3 in each of the major states.We find no evidence of a convergence in the nutritional achievements of children across the states of India. Further probing indicates that the lack of convergence may be due to the fact that the backward states with high undernutrition averages have also witnessed a rise in socioeconomic inequalities in child nutrition. In other words, children from the poorest households in the backward states tend to suffer from the dual burden of a ‘state effect’ and a ‘class effect’. We use different indicators, ranging from the simple relative rate of decline in the bottom quintile vis-à-vis the mean to the more sophisticated measures such as the concentration index and the extended concentration index to measure socioeconomic inequalities and discuss how the substantive conclusions differ according to the choice of the measure. We also try to map these findings with the performance of the states in terms of two economic indicators, viz. the rate of growth of PCNSDP and poverty reduction.

In the next section we briefly discuss the literature on the concept and the measurement of health inequalities. We then describe the findings of some of the important studies on nutritional inequalities in India. The third section discusses the data sources and the methods used for the study. We present and discuss the results in Section 4, and conclude in Section 5.

2. Socioeconomic Inequality in Health

Socioeconomic inequality in health refers to the degree to which health status varies between groups with different levels of social and economic advantage. Pure health inequalities, on the other hand, refer to differences in health status between individuals. The individual is the unit of analysis and the distribution of health between individuals (not across social groups) is studied. Thus pure health inequalities refer to 'the variations in health status across individuals in a population' with individuals ranged along a continuum from 'best health to worst health' (Murray et al. 1999). It takes into account all covariates of health (Wagstaff and van Doorslaer 2004). A fundamental argument against restricting the analysis to pure health inequalities is that it is not meaningful 'to consider individuals stripped of their social relations' (Kawachi et al. 2003). It has been argued that inequality assumes significant political relevance when it corresponds to the group affiliation of individuals (Subramaniam 2010).

The indices of group inequality can be categorized into two broad classes: well-known statistical measures used to assess income inequalityand measures based on the ranking of certain social or socioeconomic variable (Regidor, 2004). Chakraborty (2001) discussed how simple statistical tools could be shown to have properties that conform to our normative judgment on group inequality. Among the measures based on the ranking of the socioeconomic variable, the most prominent is the concentration index (O'Donnell et al. 2008, Wagstaff et al. 1989, Kakwani et al. 1997, etc.). Since the latter class of measures accounts for the distribution of child undernutrition across the entire range of the socioeconomic variable, we feel that the adoption of a Rawlsian criterion, to judge the performance of states in reducing nutritional inequality between NFHS-3 and NFHS-4, would bring out more insightful findings. In his seminal work John Rawls derived the moral philosophical tenets of the concept of justice, understood as 'fairness' in the context of a constitutional democracy (Rawls 1990). Rawls's Difference Principle gives primacy to the condition of the representative man who is the worst off and hypothesizes that inequality is justifiable if it is to the advantage of the least advantaged individual(s). Adopting the Rawlsian position in the context of children's nutritional outcomes, we focus exclusively on children belonging to the poorest quintile of households. If the rate of decline in child stunting in Q1 in a state exceeds the national rate of decline in child stunting in Q1 (namely 15%), we conclude that the state's achievement has been laudable. Again, we bring in the notion of relative inequality and compare the decline in Q1 with the decline in average stunting in each of the major states.

Mukhopadhyay (2011) used the Rawlsian criterion to study the relative performance of states. The study shows that although state ranks according to average underwight and underweight in Q1 are highly correlated, there are some states (such as West Bengal, Haryana and Uttar Pradesh) which move up the league table when we consider the latter instead of the former as the ranking criterion. On the contrary, states like Maharashtra and Uttaranchal fare worse in terms of the Rawlsian criterion. Joe et al. (2008; 2009) studied socioeconomic inequality in child underweight in the Indian states using NFHS-3 data. They computed the concentration curves and the concentration indexes and found that there was no clear pattern between state level incomes (proxied by net state domestic product) and health inequality. However, there is a clear negative relationship between undernutrition levels and group inequality in undernutrition (Joe et al. 2009; Mukhopadhyay 2011). With a highly negative Spearman's rank correlation coefficient (between state ranks according to average undernutrition and the concentration index values), significant at 1% level, these studies found that low-average states like Kerala and Punjab had the highest levels of socioeconomic inequality.

3. Data and Methods

Following the Waterlow classification scheme, there are 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). The anthropometric indicators are usually expressed in standard deviation units (z-scores) from the median of the reference population. If the z-score is below minus two standard deviations (–2 SD) from the median of the reference population, the child is considered to be undernourished in that dimension. Children below minus three standard deviations (–3 SD) from the median of the reference population are considered to be severely undernourished. Stunting is a cumulative or long-term indicator of nutritional deprivation from conception. It is relatively independent of current conditions, and is an indicator of permanent or chronic undernutrition. Wasting, by contrast, measures body mass in relation to body length and describes current nutritional status; it is usually taken to be an indicator of short-term or temporary undernutrition. Underweight is a comprehensive measure, capturing both long-term and short-term dimensions. In this paper, we use stunting, the long term indicator of nutritional deprivation and analyse how wealth related inequalities in stunting among children has evolved in the states between 2005-06 and 2015-16.

3.1 The Data Source

The NFHS provides nation and state-level 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 (DHS Programme 2015). The urban and rural samples within each state were drawn separately and the sample within each state was allocated proportionally to the size of the state's urban and rural populations. A uniform sample design was adopted in all states. In each state, the rural sample was selected in two stages, with the selection of Primary Sampling Units (PSUs), which are villages, with probability proportional to population size (PPS) at the first stage, followed by the random selection of households within each PSU in the second stage. In urban areas, a three-stage procedure was followed. In the first stage, wards were selected with PPS sampling. In the next stage, one census enumeration block (CEB) was randomly selected from each sample ward. In the final stage, households were randomly selected within each selected CEB. The third round of the NFHS collected information from a nationally representative sample of 109,041 households, 124,385 women aged 15–49, and 74,369 men aged 15–54 living in all the 29 states of India. NFHS-3 enumerated a total of 515,507 individuals who stayed in the sample households the night before the interview. Anthropometric data were collected for 46,655 children, below five years of age, who stayed in the household the night before the interview (IIPS & ORC Macro, 2007).The NFHS-4 interviewed 6,01,509 households, 6,99,686 women, and 1,03,525 men from 28,583 primary sampling units composed of villages in rural areas and census enumeration blocks in urban areas spread across 640 districts of India. The sample size in NFHS-4 is almost six times that in NFHS-3. This is because, NFHS-4, for the first time, provides district-level estimates on important indicators. NFHS-4 provides anthropometric information on 225002 children below five years of age (NFHS-4 Research Collaborators, 2017).

While NFHS-4 unit level data provide the state-level classification of households into five wealth quintiles, NFHS-3 did not. Since national level cut-offs were used for demarcating the wealth quintiles in NFHS-3, 20 per cent of the household population of India was found in each quintile in the national level dataset. However, this was not true at the level of states. In a relatively poorer (richer) state, greater (lesser) proportion of the household population was found in the lower quintiles. For instance, as per NFHS-3 data, 36.9 per cent and one per cent of the household population were poorest according to the national standards in Madhya Pradesh and Kerala respectively (Mishra and Dilip 2008). We classify households into five quintiles using NFHS-3 unit level data for each of the major states. Next we divide the children into five groups, corresponding to the five household wealth quintiles in each state for each round. Thus, the bottom group of children in a state comprises those who belong to the poorest 20% of households in that state. The population shares of the groups of children differ by states, depending on state-level differences in the association between economic status and fertility. Following a logic similar to that of Mishra and Dilip (2008), we argue that it would be fundamentally wrong to group children into five equal groups based on the wealth index factor score, since the latter is calculated at the level of households and not at the child-level.

We use the acronym APT for the two states Andhra Pradesh and

Telengana. While NFHS-3 provided data on the undivided state Andhra Pradesh, NFHS-4 has carried out separate enumerations in the two states. We club data from the two states and consider the two states together as the APT region, for the purpose of comparability.

3.2 Methods

We first explore the dynamics of socioeconomic inequality in child stunting between 2005-06 and 2015-16, using simple descriptive statistics. We then calculate the concentration index (which is in turn based on the idea of the concentration curve) and the extended concentration indexes of child stunting for the last two rounds of the NFHS in the major Indian states. Before reporting the ranking-based measures that account for nutritional inequalities across the distribution of household wealth, we use the simple Rawlsian criterion to comment on the performance of a state. By the pure Rawlsian criterion, we laud a state's achievement if the rate of decline in child stunting in Q1 in the state exceeds the national rate of decline in Q1. We also comment on relative inequality by calculating the percentage decline in child stunting in the poorest households and the percentage decline in average rates of child stunting. If the former exceeds the latter, we conclude that the improvement in child stunting has been pro-poor in the respective state.

A discussion on inter-state divergences in outcomes in India would perhaps be incomplete without a focus on the BIMARU states, particularly in the light of the recent debate on the relevance of this metaphor (Ahluwalia 2010; Sharma 2015). Bose (1988) coined the term 'BIMARU' to depict the 'demographically sick' major states of Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh, and called for the attention of policy makers to bridge the gap in outcomes between these states and the better performing southern states. Some recent studies, however, have questioned the practice of clubbing these states as laggards, particularly in the post-reform period (Ahluwalia 2000; Dholakia 2003). Sharma (2015) has included the new states Chhattisgarh, Jharkhand and Uttarakhand in the group and has shown that these states still lag behind the national averages in most indicators.

3.2.1 The concentration curve

The concentration curve, conceptually similar to the Lorenz Curve that measures income-inequality, assesses the distribution of a health variable against a variable measuring income, wealth or living standards, using individual or group level data. The concentration curve plots the cumulative percentage of the health variable along the vertical axis and the cumulative percentage of the sample (ranked by income, wealth or living standards) along the horizontal axis.The 45° line, running from the bottom left-hand corner to the top right-hand corner, is the line of equality, along which all groups (starting from poorest to the richest) enjoy similar health status. If poorer groups are worse off in terms of a health outcome vis-à-vis richer groups, there are ‘pro-rich inequalities’ (Wagstaff and Watanabe 2000). If there are pro-rich inequalities in an ‘ill-health’ variable (e.g. malnutrition, mortality or morbidity rates), the concentration curve lies above the line of equality as in Figures A1 and A2. The further the curve is above the line of equality, the more concentrated the ill-health variable is amongst the poor.

3.2.2 The concentration index

A host of studies has used the concentration index in the context of different countries, a review of some of which is found in O’Donnell et al. (2008). Joe et al. (2008; 2009) and Mukhopadhyay (2011) have estimated wealth-related inequality in child undernutrition across the Indian states using the concentration index. The index is based on the moral philosophical premise that a match between cumulative proportions of a health outcome and cumulative proportions of population characterises a situation of health equity. For instance, if 20% of underweight children belong to each wealth quintile, there would be no inequality in child underweight across wealth classes. The point estimate of the concentration index can be calculated from grouped data using the formula:

$$CI=2 \ \mathrm{cov} \ (y_i, R_i) \ / \ \mu,$$

where y is the health variable whose inequality is measured, μ is its mean and R_i is the i-th individual’s rank in the socioeconomic distribution.

Here, the health variable may be denoted as a continuous variable measured on the ratio scale or as a dichotomous or binary variable typically assuming two values, zero and one. For instance, to measure inequality in nutritional status, the first approach would denote the anthropometric z-scores as y, while the second approach would define y as the binary outcome: undernourished or not (O'Donnell et al. 2008). Mukhopadhyay (2011) denotes the concentration index calculated by the first approach as CI_{CONT} and that by the second approach as CI_{BIN}.

3.2.3: The extended concentration index

Since the concentration index is calculated by attaching greater weights to the health status of the people in the bottom quintiles, it is intrinsically based on a set of value judgments about health-inequality. Wagstaff (2001) pointed out the need to generalize this index, so that it would be consistent with alternative sets of value judgments. He has thus formulated the extended concentration index (notionally similar to the 'ethical measures' of income-inequality) that allows an analyst to choose the degree of aversion to inequality in health outcomes across wealth (or level of living or income) classes. The extended concentration index allows the analyst to explicitly state how important inequalities are at different parts of the income (or wealth) distribution and is defined for grouped data as follows.

$$C(v)= 1 - v/\mu \sum f_t h_t (1-R_t)(v-1)$$

where t=1, 2, …, T; μ = the average level of health; f_t = sample proportion in the t-th group; h_t = average level of health in the t-th group; R_t = fractional rank, indicating the cumulative proportion of the population up to the midpoint of each group interval, defined as $R_t = \sum f_g + 1/2f_t$ for g = 1,2,...,T-1 (O'Donnell et al. 2008: 112). Here v is the inequality aversion parameter, the value of which is chosen according to one's ethical judgment. If the ethical position taken is that inequalities in health status are inconsequential, then v is chosen to be equal to one, such that people's health across all wealth classes is weighted equally. As v is raised above one, the weight attached to the health of the poorest group rises vis-à-vis that of the richer groups. When v = 2, we have the simple concentration index such that the poor receive a higher weight than the better-off, but the decrease in weight is the same for each one-step increase in rank, wherever in the income distribution one starts from. The concentration index is based on this assumption of equal ‘reduction-in-weight’. For greater aversion to wealth (or income) related inequality in health outcomes, we keep on raising v and approach the Rawlsian criterion that gives primacy only to the conditions of the least advantaged or poorest individuals. For instance, when v = 6, the weight attached to the health of persons in the top two quintiles is virtually zero, and when v = 8, the weight attached to those in the top half of the income distribution is virtually zero.

4 Results and Discussion

4.1 Descriptive Statistics

In Table 1 we show the decline in child stunting in India in each quintile in the 10 years following NFHS-3. Apart from the richest quintile, all the other quintiles have witnessed greater declines (both absolute and percentage) in stunting rates, as compared to children in the poorest wealth quintile. With the fourth quintile registering the highest decline, there is an indication of convergence in children’s long term health status at the upper end of the wealth scale. Since average stunting rate for the country has declined more than stunting rates in children from the poorest households, we can conclude that the improvement in child nutrition between 2005-06 and 2015-16 in India has not been pro-poor.

Table 1: Changes in stunting among children across wealth quintiles – all India

Wealth Quintiles	NFHS-3	NFHS-4	Change (%)
Poorest	60	50.9	9.1 (15)
Poorer	54.5	42.8	11.7 (22)
Middle	49	36	13 (27)
Richer	40.9	28.9	12 (29)
Richest	25.7	22.3	3.4 (13)
Total	48.5	38.1	10.4 (21)

Source:NFHS 3 and NFHS-4 Reports

4.1.1 Inter-State Divergences in Average Stunting and Stunting in Q1

The relative position of the states in terms of average stunting has been generally consistent over the last two rounds of the NFHS (Spearman's rank correlation coefficient being 0.85, significant at 1%). Kerala, Punjab, Tamil Nadu and APT have retained the first four positions and Bihar, Uttar Pradesh, Jharkhand, Madhya Pradesh and Gujarat have been among the six worst performing states in both rounds (Table 2). Two contrasting cases are Rajasthan and Chhattisgarh. While the former has slipped down the league table by eight places and is now among the worst six states, the latter has moved up by three places and now ranks 12^{th} among the 18 major states. Thus the group of worst-performing states now includes the BIMARU states (apart from Chhattisgarh and Uttarakhand) and Gujarat.

In terms of the Rawlsian criterion, Kerala, Punjab, Tamil Nadu and APT were the four best states in 2005-06. West Bengal has replaced APT (which has slipped down the league table by one position) and now has the fourth lowest stunting in Q1. The worst performing group again includes the BIMARU states (excluding Chhattisgarh and Uttarakhand) and Gujarat. It is noteworthy that in NFHS-3, most of the BIMARU states (namely Bihar, Madhya Pradesh, Rajasthan, Jharkhand and Chhattisgarh) were outside the group of worst states in terms of stunting rates in Q1. This indicates that wealth-related inequality in stunting status has increased over the years in these states. Gujarat has been the only non-BIMARU state that has retained its position in the group of worst-performing states, in terms of both average stunting and stunting in Q1 in both the rounds. We find that the state ranks according to the percentage change in average stunting and percentage change in stunting in Q1 are highly correlated (Spearman's rank correlation coefficient being 0.83, significant at 1% level).

4.1.2 Non-convergence in Average Stunting and Stunting in Q1

We find that the coefficient of variation in child stunting rates across the states has increased from 0.18 in NFHS-3 to 0.20 in NFHS-4. This rules out the possibility of a convergence in children's long term health outcomes across the states between 2005-06 and 2015-16. Furthermore, the coefficient of variation in stunting in Q1 has also increased between the last two rounds (from 0.14 to 0.17). Thus, we do not find evidence of convergence even among children from the poorest households in the states. This calls for a detailed discussion of the inter-state differences in the change in child stunting between 2005-06 and 2015-16.

4.1.3 Dynamics of Child Stunting across the States

Instead of appraising the change in child stunting by focusing exclusively on the difference in average (mean) rates, in Table 2, we use the Rawlsian criterion and consider the change in stunting among children in the poorest households (Q1). By the pure Rawlsian criterion, a state's achievement is commendable if its rate of decline in child stunting in Q1 exceeds the national rate of decline in Q1. We also calculate the percentage decline in child stunting in the poorest households and the percentage decline in average rates of child stunting between NFHS-3 and NFHS-4 in each major state. The decline in child stunting is pro-poor if the decline in average rate falls short of the decline in the stunting rate in Q1 in the respective state.

There have been huge inter-state variations in the change in child stunting at the bottom wealth quintile, ranging from a decline by 38% in Kerala to a rise by eight per cent in Bihar. By the pure Rawlsian criterion, Kerala, Punjab, Uttarakhand, Maharashtra, West Bengal, Haryana, Odisha and Gujarat have done well, with rates of decline in Q1 exceeding the national rate of 15%. However, of these states, Odisha and Gujarat have done worse in terms ofthe Rawlsian criterion ofrelative inequality, with the improvement in average stunting exceeding the improvement in stunting at Q1. The improvement in the remaining six states, however, has been pro-poor.

Table 2: Descriptive statistics on average stunting and stunting in Q1 in 2005-06 and 2015-16

State	Q1 NFHS-4	Mean NFHS-4	Q1 NFHS-3	Mean NFHS -3	Change in Q1	Change in Mean
Andhra Pradesh Region	41.6	31.4	47.6	36.2	6 (13)	4.8 (13)
Assam	48.5	36.3	56.8	46.5	8.3 (15)	19.4 (22)
Bihar	57.6	48.4	53.1	54	-4.5 (-8)	5.6 (10)
Chhattisgarh	43.2	37.6	53.1	51.3	9.9 (18.6)	15.6 (29)
Gujarat	50.9	38.2	65.8	51.3	14.9 (23)	13.1 (26)
Haryana	46	34	61.1	45.4	15.1(25)	11.4 (25)
Jharkhand	54.2	45.6	55.1	49.5	0.9 (2)	3.9 (8)
Karnataka	46.8	36.2	54.1	43.6	7.3 (13)	7.4 (17)
Kerala	27	20	43.4	24.6	16.4 (38)	4.6 (19)
Madhya Pradesh	49.6	42.9	54.4	49.9	4.8 (9)	7 (14)
Maharashtra	45	34.1	63.6	46.4	18.6 (29)	12.3 (27)
Odisha	47.7	34	63	45.1	15.3 (24)	11.1 (25)
Punjab	34.8	25.7	52.7	36.5	17.9 (34)	10.8 (30)
Rajasthan	49.5	39.1	53	44	3.5 (7)	4.9 (11)
Tamil Nadu	35.4	27.2	39.3	31.6	3.9 (10)	4.4 (14)
Uttar Pradesh	58.5	46.3	67.4	56.6	8.9 (13)	10.3 (18)
Uttarakhand	42.4	33.9	63.9	45.1	21.5 (34)	11.2 (25)
West Bengal	41.3	32.7	57.6	44.4	16.3 (28)	11.7 (26)
India	50.9	38.1	60.4	48.5	9.5 (15)	10.4 (21)

Source: Authors' calculations from NFHS-3 and NFHS-4 unit level datasets

% changes in parenthesis

On further probing, we find in Figure 1 and Figure 2 that there is no generalisable pattern of the change in child stunting in Q1 across the states, neither with respect to wealth levels nor with respect to average rates of child stunting.

Figure 1: Decline in Q1 stunting against median Wealth Index Factor Score (NFHS-3)

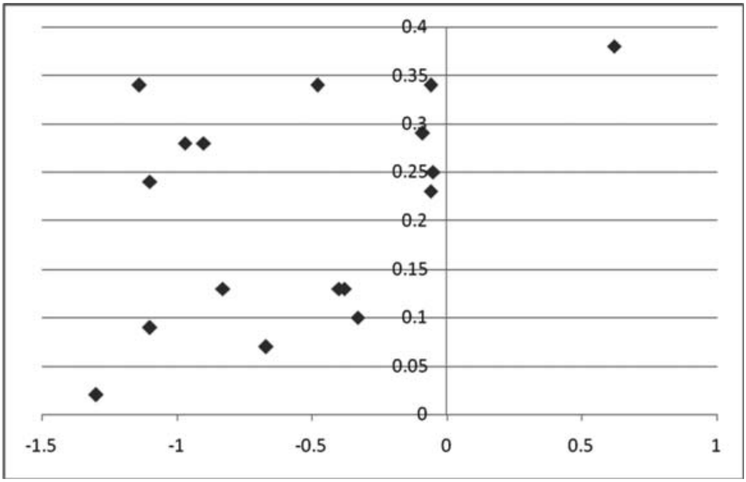
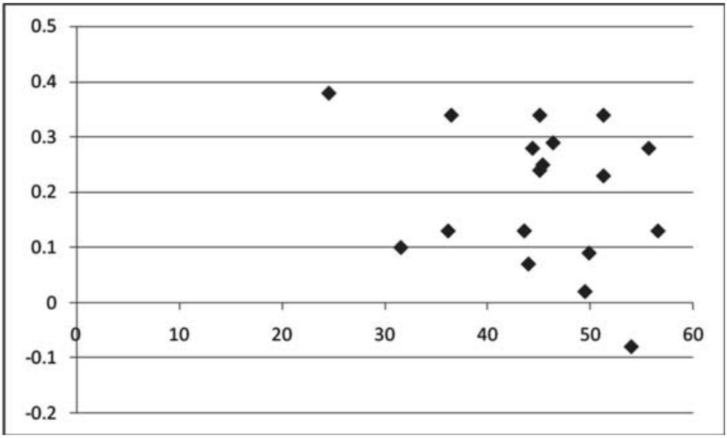


Figure 2: Decline in Q1 stunting against average stunting (NFHS-3)



Coming to the performance of the BIMARU states, our descriptive statistics on change in child stunting do not hint towards a convergence, with Bihar, Jharkhand, Rajasthan, Madhya Pradesh and Uttar Pradesh not only having the highest stunting rates but with them also having lower than national rates of decline in average stunting. Moreover, they have also been the laggards by the Rawlsian criterion and have done worse in terms of change in relative inequality, with decline rates in Q1 falling short of decline rates in average stunting. However, Uttarakhand and Chhattisgarh deserve special mention.Both these states have registered higher declines in average stunting compared to the national rate. Similar findings were noted by Khera and Dreze (2015) after the results of the Rapid Survey of Children (RSoC) were published. The authors computed a child development index (based on four indicators, namely proportion of children fully immunised; female literacy in the age group of 10-14 years; proportion of births preceded by an ante-natal checkup; and proportion of children who are not underweight) and noted that Chhattisgarh 'has detached itself from the rest as far as child development is concerned. Indeed, the child development index for Chhattisgarh is above the all-India average…Uttarakhand is doing even better.' However, while Uttarakhand has witnessed a reduction in relative inequality in stunting, with decline in Q1 exceeding decline in average stunting, Chhattisgarh has failed to do so. The case of Chhattisgarh is particularly interesting, because the baseline rates of stunting in the three higher wealth quintiles exceeded the stunting rate in the bottom wealth quintile (Table A1). In contrast, stunting is now systematically lower in the higher wealth classes.

Let us now focus on the better performing states (Kerala, Punjab, Tamil Nadu and Andhra Pradesh Region, the four states with lowest stunting rates in the last two rounds of NFHS). The case of Kerala is intriguing. While decline in stunting in Q1 has exceeded the national rate of decline in stunting in Q1, the rate of decline in average stunting has not only been lower than the rate of stunting in Q1 in Kerala, it has also fallen short of the national rate of decline in average stunting. This could be because of the relative difficulty in further improvement from the already low average in NFHS-3 (Chakraborty 2011). It is noteworthy that while none of the major states in 2015-16 had lower average stunting than average stunting in Kerala in 2005-06, six states in 2015-16 had lower rates of stunting in Q1 than the rate of stunting in Q1 in Kerala in 2005-06. Among the better-performing states Punjab had the highest stunting rate in Q1 in 2005-06. Punjab's performance in reducing the burden of stunting borne by children in the poorest households has been commendable, with decline in Q1 exceeding both the national rate of decline in Q1 and the decline in the state's average rate of stunting. However, Tamil Nadu, which had the lowest rate of stunting in Q1 in 2005-06, has witnessed a decline in Q1 that was lower than both the national average of decline in Q1 and the decline in the state's average rate of stunting. Tamil Nadu now has the third lowest rate of stunting in Q1. This might hint towards a convergence of undernutrition outcomesamong the poor in the better-performing states.

4.2 Concentration Index

While a comparison of stunting rate in the bottom quintile with the average rate of stunting satisfies the Rawlsian criterion of relative inequality, the concentration index represents the overall association between stunting status and the rank of the child in the scale of household wealth. Negative values of the concentration index for the ill-health variable of undernutrition in all states and in India in both the rounds imply that the burden of undernutrition is more concentrated among the poor across all major states and in the country as a whole. If the concentration index for a state has become more negative between NFHS-3 and NFHS-4, it implies that children from poorer households now bear an even greater burden of undernutrition in that state. Column 1 and Column 4 of Table 3 show that wealth related inequality in stunting has fallen in eight of the major states (namely Haryana, Karnataka, Kerala, Maharashtra, Odisha, Punjab, Tamil Nadu, Uttarakhand and West Bengal).

The concentration index has increased in all of the BIMARU states except Uttarakhand. The case of Chhattisgarh is again intriguing. Since the rate of stunting in Q1 was lower than the rates in the three higher wealth quintiles in 2005-06 and since the weights inherent in the concentration index decline in a step-wise fashion with increases in wealth, it assumed a lower value in 2005-06. Figures A1 and A2 illustrate the point. With the share of the children in Q1 in the total burden of stunting (percentage of total stunted children belonging to Q1) slightly exceeding their population share in Chhattisgarh in 2005-06, the concentration curve was slightly below the line of equality till the bottom quintile.The three other states that have witnessed a rise in wealth related inequality in stunting are APT, Assam and Gujarat. We observe a reverse trend in the concentration index in the three lowest average states of Kerala, Tamil Nadu and Punjab.

It is noteworthy that our simple descriptive statistics on relative inequality (based on a comparison of the decline in the bottom wealth quintile and that in the overall mean) and the concentration index give conflicting results in some cases. Though the concentration indexes for Odisha and Tamil Nadu have fallen, the relative declines in Q1 vis-à-vis the mean have been lower. Haryana and Karnataka, on the other hand, have witnessed declines in the concentration index, with declines in Q1 falling short of declines in their average stunting rates. The divergence in substantive conclusions from different measures indicates that depending on one's moral position on health inequality, one should choose the appropriate measure and measures focusing on Q1 should be used when one adopts a pure Rawlsian criterion.

4.3 Extended Concentration Index

Seven states (Karnataka, Kerala, Maharashtra, Odisha, Punjab, Uttarakhand and West Bengal) have witnessed declines in all three concentration indices. In contrast, the three measures have increased in all of the BIMARU states, excluding Uttarakhand. While the two low average states, Kerala and Punjab, have witnessed declines in all three concentration indexes, Tamil Nadu is a typical state, where though the standard concentration index has fallen between 2005-06 and 2015-16, the extended concentration indexes have increased. This mimics the descriptive finding of a greater decline in average stunting as compared to the decline in Q1 in Tamil Nadu. Haryana offers a similar picture where the standard concentration index has decreased and the extended concentration indexes have increased.However, the decline in average stunting was the same as the decline in Q1 in Haryana. That we can have different scenarios when we use different measures to judge how wealth related has evolved in the states is evident from Table 3. The situation in APT (where similar to Haryana, the decline in Q1 matches the decline in average stunting) is contrasting, with a rise in the standard concentration index, accompanied by increases in the extended concentration indexes. It is worth mentioning that Assam and Gujarat are the two non-BIMARU states where wealth related inequality in child nutrition has increased, irrespective of the chosen measure.

Table 3: Changes in concentration index values for child undernutrition across Indian states

State	NFHS 3			NFHS 4		
	CI	CI(6)	CI(8)	CI	CI(6)	CI(8)
Andhra Pradesh Region	-.1123	-.3579	-.3973	-.1642	-.3222*	-.3476*
Assam	-.1204	-.2109	-.2123	-.1635	-.3015	-.3219
Bihar	-.0937	-.1742	-.1881	-.1055	-.1883	-.1989
Chhattisgarh	-.0537	-.0490	-.0250	-.0925	-.1647	-.1755
Gujarat	-.1213	-.2416	-.2610	-.1676	-.2622	-.2776
Haryana	-.1598	-.2900	-.3117	-.1338*	-.3479	-.3960
Jharkhand	-.0871	-.1364	-.1337	-.1060	-.1733	-.1808
Karnataka	-.1393	-.2627	-.2873	-.1212*	-.2359*	-.2514*
Kerala	-.1741	-.5394	-.6372	-.1228*	-.3337*	-.3776*
Madhya Pradesh	-.0629	-.1703	-.1732	-.0953	-.1789	-.1899
Maharashtra	-.1518	-.3350	-.3774	-.1338*	-.2576*	-.2801*
Odisha	-.1924	-.4022	-.4384	-.1731*	-.3398*	-.3639*
Punjab	-.2238	-.4047	-.4198	-.1404*	-.3667*	-.4186*
Rajasthan	-.1098	-.1960	-.2051	-.1206	-.2414	-.2614
Tamil Nadu	-.1397	-.2414	-.2400	-.1154*	-.2619	-.2891
Uttar Pradesh	-.0882	-.2031	-.2226	-.1317	-.2509	-.2684
Uttarakhand	-.2055	-.4050	-.4394	-.1306*	-.2407*	-.2694*
West Bengal	-.1718	-.3771	-.3964	-.1374*	-.2704*	-.3058*
India	-.1289	-.2901	-.3073	-.1536	-.3113	-.3381

Source: Authors' calculations from NFHS-3 and NFHS-4 unit level datasets

4.4 Correspondence between change in stunting and change in economic indicators

Table 4 summarises our findings on the relative performance of states according to the three measures used in this paper, namely the Rawlsian criterion of relative inequality, the concentration index and the extended concentration index. We find that most of the states may be grouped into two broad categories. The first category comprises five states where the change in child stunting has been pro-poor according to all three measures and the second includes nine states where the change in child stunting has not been pro-poor. Substantive conclusions differ according to the measure chosen in the remaining five states.

In an attempt to map the nature of change in child stunting to that in economic indicators, we find that there is little correspondence between the two. We consider two indicators of economic change in the major states during the period under study, namely average annual growth rate in Per Capita Net State Domestic Product (PCNSDP) and rate of poverty reduction. While for the former we have data for all the years between 2005-06 and 2015-16, for the latter, we have data from the two rounds of the National Sample Survey on household consumption of various goods and services, conducted in 2004-05 and 2011-12.

We find no generalisable pattern in the correspondence between state ranks according to the indicators of stunting (changes in average stunting and stunting in Q1) and state ranks according to the economic indicators. In fact, Spearman's rank correlation coefficient is non-significant for all relevant pairs, i.e. (i) average annual growth rate in PCNSDP and change in average rate of stunting, (ii) average annual growth rate in PCNSDP and change in stunting in Q1, (iii) rate of poverty reduction and change in average rate of stunting, and (iv) rate of poverty reduction and change in stunting in Q1. It is noteworthy that Spearman's rank correlation coefficient between state ranks according to the two economic indicators is 0.65, significant at 1% level. In other words, even though there is an overall correlation between the growth rate in PCNSDP and decline in poverty (based on consumption expenditure) across states, there is no such relation between economic progress and decline in child stunting.

Considering the performance of the states according to the economic indicators, we re-examine the performance of the states in the two major groups and find that the respective cells in Table 4 are far from being homogenous. All the states in the first group (with pro-poor change in child stunting by all measures) except West Bengal, have been the better-performing states in terms of poverty reduction. The group is much more heterogenous with respect to average annual growth rate in PCNSDP. While Uttarakhand, Kerala and Maharashtra have been among the leaders, Punjab and West Bengal have been the laggards in terms of average annual growth rate in PCNSDP. The second block of states (with non-pro-poor change in child stunting by all measures), again have had mixed experiences with respect to the two economic indicators. While five of the BIMARU states (Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh and Uttar Pradesh) have performed poorly in terms of poverty reduction, APT, Rajasthan and Gujarat have been among the better performing states. In spite of having the second highest average annual

Table 4:Classification of states according to RC, CI and ECI*

Nature of Change in Child Stunting	States
Pro-Poor by all measures	Kerala, Punjab, Uttarakhand, Maharashtra, West Bengal
Non-Pro-Poor by all measures	Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Rajasthan, Uttar Pradesh, Gujarat, Assam, APT
Non-Pro-Poor by RC, Pro-Poor by CI and ECI	Karnataka, Odisha
Pro-Poor by by RC and CI, Non-Pro-Poor by ECI	Haryana
Non-Pro-Poor by RC and ECI, Pro-Poor by CI	Tamil Nadu

Source: Authors' Calculations from NFHS-3 and NFHS-4 unit level datasets
**RC: Rawlsian Criterion of Relative Inequality; CI: Concentration Index; ECI: Extended Concentration Index*

growth rate in PCNSDP, Gujarat's performance has not been as impressive with respect to poverty reduction. It has also failed to reduce inequality in child stunting. On the contrary, though APT has registered the highest decline in poverty, the change in child stunting in the state has not been pro-poor.

Table 5: Relative position of states according to economic indicators and stunting indicators

State	Average annual growth rate of PCNSDP	Rank by Growth	Poverty Reduction (%)	Rank by Poverty Reduction	Rank by % change in Mean Stunting	Rank by % change in Stunting in Q1
Andhra Pradesh	6.5	7	69	1	15	13
Assam	3.9	18	7	18	1	7
Bihar	6.2	9	38	12	17	18
Chhattisgarh	5.5	12	19	16	3	2
Gujarat	7.9	2	48	9	6	10
Haryana	6.6	6	54	8	7	8
Jharkhand	5.1	14	18	17	18	17
Karnataka	6.3	8	37	13	12	11
Kerala	6.9	5	64	3	10	1
Madhya Pradesh	5.6	11	35	14	13	15
Maharashtra	7	4	54	7	4	5
Odisha	4.9	15	43	10	9	9
Punjab	4.5	16	60	5	2	3
Rajasthan	6	10	57	6	16	16
Tamil Nadu	7.8	3	61	4	14	14
Uttar Pradesh	4.4	17	28	15	11	12
Uttarakhand	9.4	1	66	2	8	4
West Bengal	5.5	13	42	11	5	6

Source: Handbook of Statistics on the Indian States, RBI

5. Conclusion

Examining data on child stunting from the last two rounds of the NFHS, we do not find any evidence of convergence either across states or across economic classes. A close look into the inter-state differences in the reduction of undernutrition between the last two rounds of the NFHS reveals that the poorly performing states, particularly the BIMARU states (excluding Uttarakhand) not only have retained the last ranks in terms of average stunting, but they have also faltered in the reduction of stunting during the decade under study. These are the states which have also been the laggards according to the Rawlsian criterion. That is, children from the poorest quintile of households in these states have witnessed proportionately less improvement in stunting. Even when we use the more sophisticated health inequality measures, based on the ranking of the households' wealth scores, such as the concentration index and the extended concentration index, we find that inequality in stunting has increased in the backward states. This calls for immediate policy attention since children from the poorest households in the backward states seem to suffer from the dual burden of the state effect and the class effect. Assam, APT and Gujarat are the other states where relative inequality in stunting has increased unambiguously. Trying to map the performance of states in reducing stunting inequalities to the economic indicators, we find that there is no generalisable pattern. We have, at one extreme, a state like Gujarat, which has had the second highest growth rate in PCNSDP, but has failed to reduce poverty as impressively and has witnessed a rise in wealth-related relative inequality in child stunting by all measures. At the other extreme, we have a state like Uttarakhand, which has had the highest growth rate in PCNSDP and the second highest rate of poverty reduction and has also been successful in reducing wealth inequality in stunting, irrespective of the measure chosen.

Appendix

Table A1: Quintile-Specific Stunting rates in the Indian States in 2005-06 and 2015-16

State	NFHS 3					NFHS 4				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Andhra Pradesh Region	47.6	40.8	32.6	35.6	22.4	41.7	34.2	27.5	24.8	16.5
Assam	56.8	50.4	47.8	40.1	20.3	48.5	41.4	36.6	28.5	17.9
Bihar	66.6	58.9	57.6	56.7	33.4	57.6	54.2	49.3	43.8	29.7
Chhattisgarh	53.1	62.3	58.1	54.8	39.1	43.2	41.2	40.9	35.7	25.1
Gujarat	65.8	53.2	52.4	45.9	29.6	50.9	45.4	38.3	26.5	21.1
Haryana	61.1	49.7	48.7	40.7	23.3	46.0	35.6	33.6	27.1	23.3
Jharkhand	55.1	56.1	53.0	48.5	28.2	54.2	51.3	48.1	41.8	25.7
Karnataka	54.1	54.1	41.7	39.5	24.9	46.8	41.5	35.7	30.9	23.5
Kerala	43.4	23.9	23.6	15.7	20.4	27.0	22.5	20.3	14.6	14.9
Madhya Pradesh	54.4	56.3	49.7	48.5	35.6	49.6	46.5	43.1	38.4	28.3
Maharashtra	63.6	52.9	44.6	39.6	24.1	45.0	38.2	33.5	27.1	22.6
Odisha	63.0	58.2	43.7	38.1	18.5	47.7	39.6	34.6	26.4	19.1
Punjab	52.7	47.0	39.9	21.4	17.0	34.8	29.0	24.1	19.6	18.3
Rajasthan	53.0	48.6	45.9	41.5	24.8	49.5	43.4	39.0	31.5	27.0
Tamil Nadu	67.4	60.2	59.8	53.2	39.0	35.4	31.3	23.5	25.0	19.2
Uttar Pradesh	67.4	60.2	59.8	53.2	39.0	58.5	52.8	47.9	39.2	27.0
Uttarakhand	63.9	52.5	52.0	37.7	11.8	42.4	40.6	35.3	24.2	23.2
West Bengal	57.6	53.5	42.6	33.4	13.6	41.3	37.6	32.0	27.8	18.2

Source: Authors' Calculations from NFHS-3 and NFHS-4 unit level datasets

Figure A1: Concentration Curve for Chhattisgarh in 2005-06

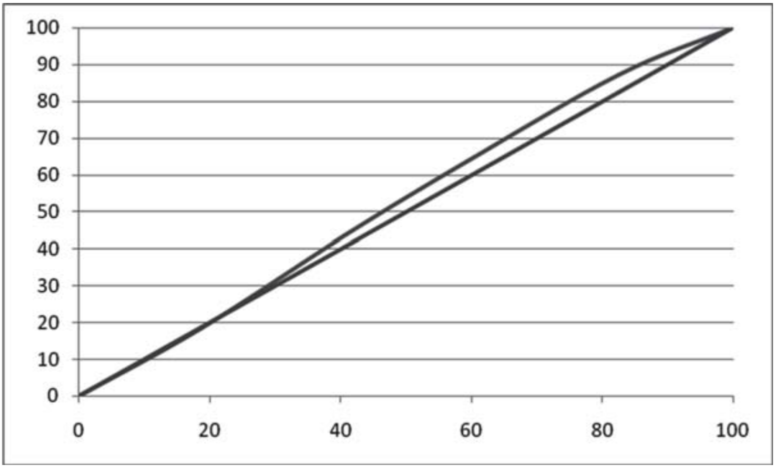
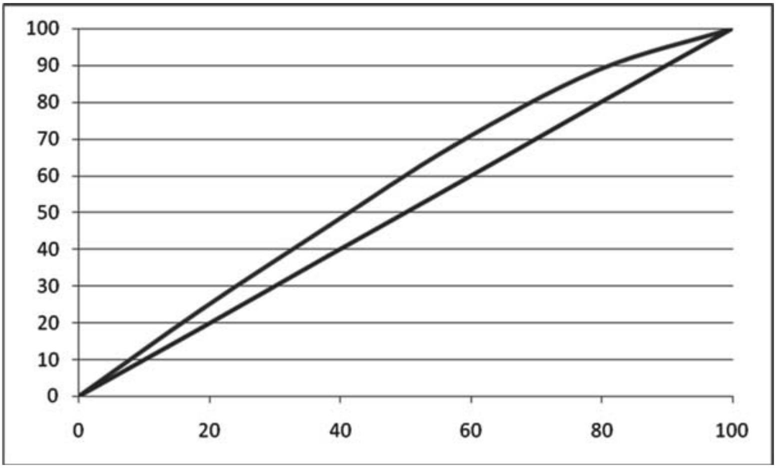


Figure A2: Concentration Curve for Chhattisgarh in 2015-16



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