Socioeconomic inequality in malnutrition in India, 1992-2005

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Abstract: This paper examines the trends and patterns of socioeconomic inequality in child malnutrition by wealth status across major regions and states of India. The data from three rounds of National Family and Health Survey (NFHS) conducted during 1992-05 was analysed. Underweight children (measure of both acute and chronic malnutrition) have been used as dependent variable. The wealth index is estimated by principal component analysis using a set of household assets and living conditions variables for all three rounds. Bivariate analyses, poor-rich ratios (Q1/Q5), concentration curve and concentration index are used to understand the trends in socioeconomic inequality in childhood malnutrition. Result indicates disproportionately higher concentration of malnutrition among the poor over the years. In fact the poor-rich ratio and concentration index have shown an increasing trend during 1992-2005. Average decline in underweight has concealed larger socioeconomic inequality across space and time.

Introduction

The reduction of malnutrition is one of the biggest challenges that India faces in the 21st century. The prevalence of underweight children is amongst the highest in the world, and nearly double that of Sub-Saharan Africa. Nearly 60 million children are underweight in India (Gragnolati *et al*, 2005). India is committed towards-halving the prevalence of underweight children by 2015- as a key indicator for achieving the Millennium Development Goal (MDG) of eradicating extreme poverty and hunger (United Nations, 2000). However, the persistence of under-nutrition continues to pose a major impediment to human development, economic growth and reduction of child mortality in the country, especially among the poor and the vulnerable, where the prevalence of malnutrition is highest. Evidence also suggest that child malnutrition is not only associated with high child morbidity and mortality, but also reduces long term physical development, cognitive skills, and consequently negatively affects school enrolment, productive in later life and likelihood of developing chronic diseases (Tarozzi and Mahajan, 2007; Grantham-McGregor *et al*, 2007; Walker *et al*, 2007).

The prevalence of malnutrition has been estimated using several measures such as weight-for-age (underweight), height-for-age (stunting) and weight-for-height (wasting). According to the estimates of National Family Health Survey (IIPS and ORC Macro, 1992-93, 1998-99, 2005-06), the prevalence of underweight children has declined from 53 percent to 46 percent; stunting has declined from 52 percent to 38 percent and wasting has increased from 18 percent to 19 percent during 1992-2005 in India. This indicates that under-nutrition is a major problem in every part of India but it is most prevalent in states of Bihar, Uttar Pradesh, Madhya Pradesh and Rajasthan, where more than half of the children were underweight and stunted. In addition to these four states, about half of children were underweight in Orissa, Maharashtra and West Bengal. Similarly, about half of children are stunted in Assam and Haryana. States with the

lowest percentages of underweight and stunted children are Goa, Kerala, and all the small north-eastern states except Tripura and Meghalaya (Arnold, *et al.,* 2004).

Despite the increase in food production, disease control and economic and social development over the decades, the progress in reducing proportion of undernourished children has been sluggish (Pathak and Singh, 2009; Svedberg, 2006). While aggregate level of malnutrition in the country is already very high of late, the socioeconomic inequalities –gender inequality, rural-urban divide, rich-poor gap, social inequality, demographic and regional inequality etc. further exacerbate the magnitude of this problem as these inequalities seems to be increasing rather than narrowing. While efforts to reduce socioeconomic disparities are not lacking, achievements are disproportionately low.

Recently, there has been an spurt of interest in the socio-economic inequalities in health outcomes among researchers and policy makers (Mohanty and Pathak, 2009; Poel *et al*, 2008; Houweling *et al*, 2007; Lawn *et al*, 2006; Carr, 2004; Gwatkin *et al*, 2004; Oomann *et al*, 2003; Zere and McIntyre, 2003; Wagstaff, 2002; Wagstaff, 2000; Gwatkin 2000;). Evidences have shown the pervasiveness of socioeconomic inequalities in health both between and within counties at any stage of development. The relationship between socioeconomic status and illness and death has been found to be inverse, with morbidity and mortality are highly concentrated among those at the lowest spectrum of socioeconomic ladder. This clearly shows the seriousness of the emerging socioeconomic divide in the levels of demographic and socio-economic development, especially in country like India that is struggling to dent the vicious cycle of malnutrition which has not yet received the public attention it deserves.

Accordingly, using the rich data of three rounds of NFHS, this paper attempts to examine the trends and patterns of socioeconomic inequality in child malnutrition by wealth status household across major regions and states of India. It also examines the association

between socioeconomic inequality and average level of malnutrition in Indian context. Further, attempt has also been made to understand the salient socioeconomic and demographic correlates of child malnutrition in Indian context.

Data and Methods

The present study uses the data from the three rounds of National Family Health Survey (NFHS), the Indian version of Demographic Health Surveys (DHS) conducted during 1992-93, 1998-99 and 2005-06 respectively. Data on children below three years of age has been used uniformly for all three rounds of NFHS to measure underweight children (measure of both acute and chronic malnutrition). The term underweight is a measures of protein-energy under nutrition which are used to describe children, who have a weight-for-age measurements that is less than two standard deviations below the median value of NCHS(*National Centre for Health Statistics*)/WHO (*World health Organization*) international reference population. The nutritional status indicators are expressed in standard deviation units (Z-scores) from the median of the reference population. Children (below three years of age) whose weight-for-age was below minus two standard deviations from the median reference population were classified as underweight (*malnourished*) and those whose weight-for-age was below minus three standard deviations have been referred as severely underweight (malnourished).

To assess the nutritional status of children with respect to reference population, Z-scores (standard deviation scores) are employed. Z score is defined as:

Z-score = (observed individual value – median value of the reference population)/
(standard deviation of value in the reference population)

Since the availability of direct data on income or expenditure is a constraint in DHS, as they generally not collected such information and therefore, the wealth index based on the ownership of household assets has been largely used as a proxy for assessing the economic

status of the households (Montgomery et *al.*, 2000; Filmer & Pritchett, 2001; Vyas & Kumaranayake, 2006; O'Donnell, 2008). In the present study, the wealth index was estimated by principal component analysis using a set of household assets and consumer durables, size of landholding, housing quality, drinking water and sanitation facilities for all three rounds of NFHS in STATA 10.0, to make it comparable over the years. Wealth groups are so constructed such that each consists 20 percent of the surveyed population. Regions have been computed into six groups by combining group of states i.e. north region includes the state of Jammu and Kashmir, Himachal Pradesh, Punjab, Uttaranchal, Haryana, Delhi and Rajasthan. Central region comprises the states of Chhattisgarh, Madhya Pradesh and Uttar Pradesh. East region includes the states of Bihar, Jharkhand, Orissa and West Bengal. West region consists of the states, namely, Goa, Gujarat and Maharashtra. South region includes the state of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. The North east region includes the seven states i.e. Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Assam and Meghalaya.

Bivariate analyses, poor-rich ratio (Q1/Q5), concentration curve (CC) and concentration index (CI) were used to understand the trends in socioeconomic inequality in malnutrition. Bivariate analysis is carried out to understand the differentials in child malnutrition by wealth quintiles across major regions and states in India during the study period. Chi-square test has been used to assess the association between malnutrition and selected socio-demographic variables. The poor-rich ratio, defined as the ratio of the poorest to the richest wealth quintile is used to measure the gap in child malnutrition. The concentration index is used to measure the overall inequalities in malnutrition among the wealth quintiles (Kakwani *et al*, 1997; O'Donnell *et al*., 2008). It is defined as twice the area between the concentration curve and the line of equality and varies between -1 to +1. The

closer the value to 1 (absolute), the more unequal is the malnutrition and the closure the value to 0, more equal is the distribution of malnutrition. Multiple logistic regression models were used to assess individual effect of variables on child malnutrition while adjusting for potential confounding factors.

Results

Trends in child malnutrition

The prevalence of child malnutrition in India is amongst the highest in the world, with dire consequences for morbidity, mortality, productivity and economic growth. Evidence suggests that India has not made sufficient progress towards reducing under nutrition and hunger, especially among the poor and marginalised, in contrast with her economic success (8% GDP growth rate for past one decade) through the introduction of new economic reforms during early 1990's.

Table 1 presents the prevalence of underweight rates (weight-for-age, < -2 S.D.) among children below three years of age according to socioeconomic status of population across major regions and states in India during 1992-05. On average, the prevalence of malnutrition (weight-for-age below -2 S.D.) has declined from 53% to 47% during 1992-98 and further reduced to 41% during 1998-05 in India. However, it is also important to note that the prevalence of malnutrition among poorest quintile declined from 62% to 54% while it declined from 34% to 19% among the richest quintile in India during 1992-05. This shows that not only the levels of malnutrition are unfavourable to poor, but the decline in under nutrition has been much slower among the poor compared to non-poor over the years. This also indicates that the prevalence of malnutrition is negatively associated with the socioeconomic status of the population (see figure 1). The highest decline in prevalence of

malnutrition occurred in southern region (35%), followed by western region (28%) and least decline took place in the eastern region (19%), followed by central region (20%) during 1992-05 in India. Therefore, it is imperative to note that prevalence of malnutrition significantly varied across socioeconomic status of population in all the states and regions of India, for the peril of poor.

The poor-rich ratio has increased from 1.8 to 2.4 during 1992-98 and further increased to 2.9 during 1998-05 (see table 2). This result was also strengthened by upward trend in concentration index that increased from -0.10 to -0.14 during 1992-98 and again moved up to -0.16 during 1998-05 suggesting that in spite of falling malnutrition rate, the socioeconomic inequality in prevalence of malnutrition has increased in India towards the peril of poor during 1992-05. The socioeconomic inequality in prevalence of malnutrition predominates in southern, western and northern region/states (Tamil Nadu, Kerala, Punjab, Maharashtra) while opposite is true in case of central, eastern and north-eastern region/states (Madhya Pradesh, Chhattisgarh, Bihar, Uttar Pradesh) in India. For example (see figure 2), the concentration curve of north-east dominates the other region suggesting highest inequality in malnutrition in the region during 1992-93. However, exact measurement of inequality can be gauged through concentration index which shows the area between line of equality and concentration curve.

We examine the association between average malnutrition rates with concentration index during 1992-05 (see figure 3a, b, c). Result indicates negative relationship between average malnutrition and socioeconomic inequality quantified through concentration index during all three survey rounds (in fact strength of association improved from -0.68 to -0.81 during 1992-05). It is interesting to note that states and regions with low prevalence of malnutrition rates (like Punjab, Tamil Nadu, Maharashtra, Kerala, and southern region) have

higher socioeconomic inequality than states or regions having higher average malnutrition rates (like Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh and central region).

We found large regional disparities in prevalence of child malnutrition in India over past 15 years. The prevalence of malnutrition (>=50% malnutrition) occurred in 10 states and three regions (eastern, central & western) of India during 1992-93 while only Kerala (<=30% malnutrition) had less than 30% prevalence of malnutrition during the same period. In next six years, the number of state (>=50% malnutrition) reduced to eight and two regions (eastern & central) while the states with less malnutrition (<=30% malnutrition) increased to three in the country. During 2005-06, only three states (Madhya Pradesh, Bihar and Jharkhand) had more than 50% prevalence of malnutrition while seven states and one region (southern) had below 30% prevalence of malnutrition in the country.

The prevalence of severe malnutrition (weight-for-age < -3 S.D.) has consistently declined from an average of 22% to 18% during 1992-98 and further declined to 15% during 1998-05 in India (see table 3). Among poorest, the prevalence of severe malnutrition has declined from 31% to 24% while it declined from 11% to 5% among the better-off during 1992-05. Overall, there has been 27% decline in the prevalence of severe malnutrition in the country, mainly from the southern (Tamil Nadu (65%), Andhra Pradesh (46%)) and western (Maharashtra (50%)) region of India. The prevalence of severe malnutrition has increased in Haryana and Jharkhand during 1992-05. However, the socioeconomic inequality in severe malnourishment remained widespread against the favour of poor across all the region/sates in India.

Socioeconomic and demographic variations in child malnutrition

The prevalence of malnutrition considerably varies with various socioeconomic and demographic factors in a population. Table 4 presents the variation in malnutrition by selected socio-demographic variables in India. The prevalence of malnutrition sharply varies across wealth quintile i.e., 54% among poorest while 19% among richest quintile. Again, prevalence of malnutrition was higher among literate mothers (51%), living in rural areas (44%), Hindu mothers (42%), belong to SC/ST caste groups (49%), among older children (46% among 24-36 months old), male children (41%), high birth order (54% among five or above order birth), elder mothers (55%) and hailing from eastern (48%) or central (47%)region in India.

Using multiple logistic regression model (see table 4), we attempt to examine the effect of various socioeconomic and demographic factors on child malnutrition in India. After controlling for various confounding variables, it may be noted that wealth quintile, maternal education, birth order of child, religion, caste, age of mother, and region of residence significantly affects the likelihood of suffering from malnutrition in India. For example, children belonging to the richest wealth quintile had 65% significantly less likelihood of suffering from malnutrition relative to the children from poorest wealth quintile. Maternal education was also negatively associated with malnutrition as children belonging to highly educated mothers had 55% lower likelihood of being malnourished relative to children whose mothers were literates. Children of higher order births, belonging to relatively older mothers, living in eastern or central region in India had significantly higher odds of suffering from malnutrition than their counterparts. The role of caste and religion was also found significant suggesting that children belonging to relatively poor social groups (SC/ST) had higher odds of being malnourished than their counterparts.

Discussion and Conclusion

This paper examines the trends and patterns of socioeconomic inequality in child malnutrition by socioeconomic status of population across major regions and states of India. It reveals the disproportionately higher concentration of malnutrition among the poor across regions and states in India. The average prevalence rate of underweight in India has declined from 53 percent to 41 percent during 1992-05. However, this decline in average prevalence of malnutrition among children hides the enormous socioeconomic disparities across regions and states of India. The rising poor-rich ratio of 1.8 (1992-93), 2.4 (1998-99) and 2.9 (2005-06) and concentration index indicates increasing socioeconomic inequality in the prevalence of malnutrition in India. The socioeconomic inequality in the prevalence of malnutrition also varies considerably across most of the regions and states in India. This is evident through the changing pattern of rich-poor gap in prevalence of underweight children across regions of India over time. There appears a clear negative association between average underweight and socioeconomic inequality (Spearman coefficient= -0.81) in Indian context. A study by Wagstaff and Watanabe, 2000 also found inverse relationship between underweight and socioeconomic inequality.

We found that regions/states with lower prevalence of malnutrition had higher socioeconomic inequality contrary to the region/states with higher prevalence of malnutrition and low socioeconomic inequality. This suggests that region/states with higher prevalence of malnutrition need comprehensive strengthening of health system to focus on improving the overall nutritional and health status of population. However, in the second case, where state/region has low prevalence of malnutrition but high inequality, then there is a need to specially designed programmes to target the poor and marginalised, and assist them in improving their nutritional and health status. Apart from focussing on reducing

socioeconomic inequality in prevalence of malnutrition, there is a need to address the various socio-economic and demographic factors which influence malnutrition. Focus on reducing gender inequality, regional disparities, improving women education and reducing higher order births etc, to minimise the prevalence of malnutrition will be crucial.

Considering these widening socioeconomic inequality in prevalence of malnutrition in India, special focus is needed to target the poor. Otherwise, failure to tackle this rising inequality will impede the chances of achieving millennium declaration goals, mainly, reducing hunger, poverty and child mortality. If India has to achieve her MDG-1 i.e. reduction of hunger by two-third from the level of 1990, then policy should focus on reducing the under nutrition and hunger, especially among poor and marginalised, rather than taking care of average figures. Policies and programmes should, therefore, take into account the distribution of childhood malnutrition across all socioeconomic groups.

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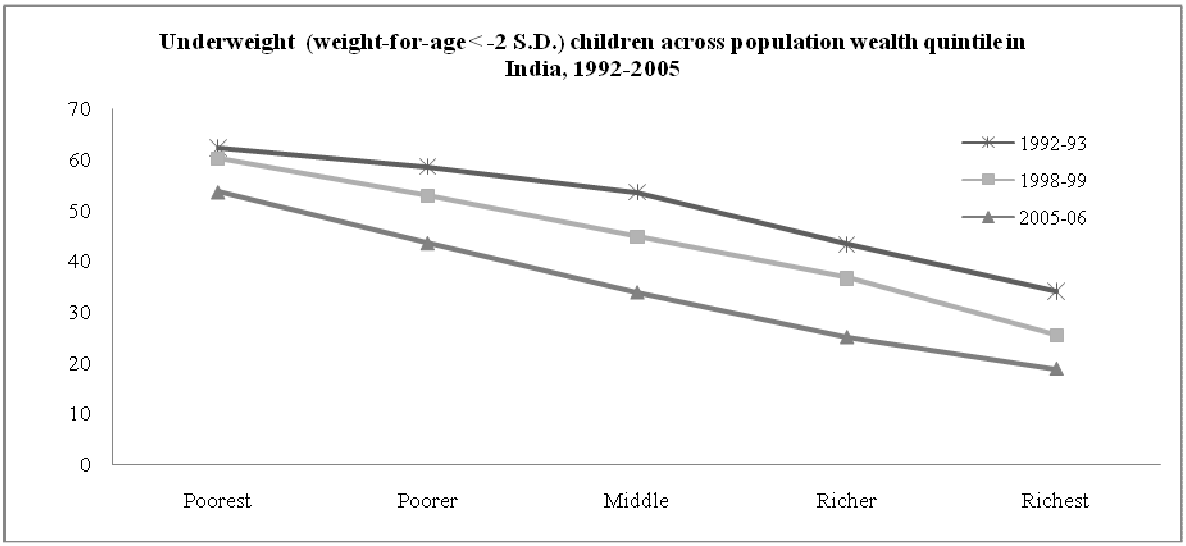
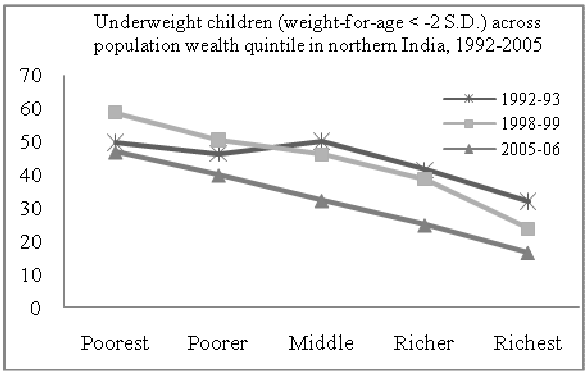
Table 1 - Estimated underweight rates (weight-for-age, < -2 S.D.) among children (0-3 years old) by economic status of population in India and states, 1992-2005

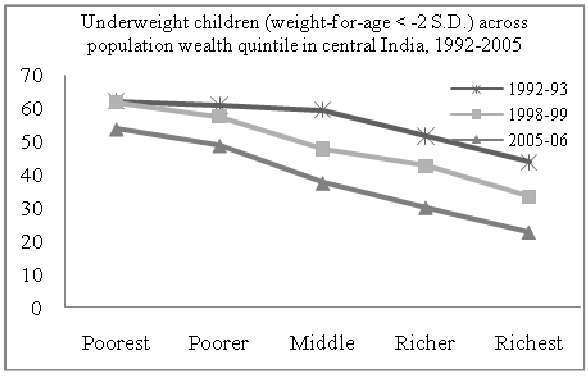
Region/State	NFHS-1 (1992-93)						NFHS-2 (1998-99)						NFHS-3 (2005-06)						
	Prevalence of underweight by population wealth quintile (in %)					Average under-weight	Prevalence of underweight by population wealth quintile (in %)					Average under-weight	Prevalence of underweight by population wealth quintile (in %)					Average under-weight	%[a] point change per year
	Poorest	Poorer	Middle	Richer	Richest		Poorest	Poorer	Middle	Richer	Richest		Poorest	Poorer	Middle	Richer	Richest		
India	**62.3**	**58.5**	**53.5**	**43.3**	**34.0**	**52.8**	**60.2**	**52.9**	**44.8**	**36.6**	**25.4**	**47.1**	**53.6**	**43.6**	**33.8**	**25.0**	**18.8**	**41.0**	**-0.79**
North	**49.8**	**46.5**	**50.3**	**41.5**	**32.0**	**43.5**	**58.6**	**50.4**	**46.0**	**38.5**	**23.7**	**42.9**	**46.9**	**39.9**	**32.2**	**24.8**	**16.4**	**33.5**	**-0.66**
J& K	61.1	42.1	52.4	42.0	25.1	42.3	62.0	45.9	38.8	23.0	21.2	34.9	46.6	28.0	22.3	18.7	14.7	25.1	-1.15
H.P.	47.9	55.4	49.3	42.6	25.0	46.3	74.8	52.5	48.8	43.8	26.1	44.5	56.5	34.2	33.9	30.1	13.6	32.0	-0.96
Punjab	58.3	55.7	57.9	44.8	31.8	46.2	46.2	51.5	36.5	30.7	13.5	29.2	48.5	40.4	29.2	20.0	11.3	24.4	-1.45
Uttaranchal	62.8	46.9	50.9	44.1	36.7	52.1	61.9	42.3	53.3	33.3	12.4	48.3	42.3	43.9	34.9	24.2	12.6	31.8	-1.36
Haryana	50.0	52.5	42.4	30.9	18.3	35.2	47.2	45.0	40.4	31.6	19.3	34.8	47.9	48.0	41.8	33.8	21.4	38.7	0.23
Delhi	71.4	26.7	51.9	51.8	34.2	41.0	50.0	41.7	57.7	46.1	28.7	34.6	29.4	55.6	30.7	25.2	19.9	25.5	-1.03
Rajasthan	45.3	42.7	51.1	44.0	41.6	45.2	58.5	53.1	51.5	49.2	30.6	51.0	46.9	39.0	30.4	23.1	18.2	37.1	-0.54
Central	**62.2**	**61.0**	**59.5**	**51.6**	**43.8**	**58.3**	**61.6**	**57.5**	**47.6**	**42.6**	**33.3**	**53.5**	**53.8**	**48.8**	**37.5**	**30.1**	**22.6**	**46.5**	**-0.79**
Chhattisgarh	71.6	74.4	63.4	40.1	44.1	66.9	65.5	61.3	61.6	57.0	31.7	59.7	54.6	53.3	35.6	30.9	17.6	48.5	-1.23
Madhya Pradesh	63.1	61.5	59.7	49.7	43.6	58.1	62.9	62.7	52.4	42.6	24.1	54.5	64.4	58.0	53.4	45.6	33.8	58.0	-0.01
Uttar Pradesh	60.8	59.4	59.3	52.1	43.9	57.6	60.7	54.3	44.0	41.6	39.7	52.3	50.1	43.2	32.8	24.6	19.0	42.2	-1.03
East	**66.4**	**61.7**	**59.5**	**47.2**	**33.2**	**59.6**	**62.0**	**53.3**	**48.4**	**35.5**	**22.9**	**53.0**	**56.9**	**44.5**	**33.4**	**25.7**	**23.3**	**48.3**	**-0.76**
Bihar	68.7	64.8	65.9	58.5	47.0	64.7	60.7	53.5	54.2	46.6	25.9	55.2	62.6	49.3	45.9	35.8	31.1	55.8	-0.60
Jharkhand	55.8	60.0	69.5	47.1	16.1	53.4	64.0	57.6	46.1	35.6	19.6	54.9	61.2	52.3	45.8	37.3	15.0	54.7	0.08
Orissa	59.5	57.4	43.6	44.6	21.4	52.9	64.3	56.4	42.5	39.4	22.9	54.9	49.5	39.4	23.2	15.2	30.2	39.7	-0.88
West Bengal	68.7	60.4	59.0	39.8	23.5	57.6	61.7	51.1	44.7	26.5	21.7	49.3	47.8	36.9	23.4	14.7	11.7	38.0	-1.31
West	**65.8**	**61.4**	**50.6**	**48.2**	**32.9**	**50.7**	**64.8**	**58.3**	**47.8**	**43.4**	**30.4**	**48.4**	**51.4**	**46.0**	**41.5**	**29.6**	**17.5**	**36.7**	**-0.93**
Goa	67.9	49.3	42.5	35.7	21.0	34.2	56.3	23.2	43.4	29.5	19.3	29.0	58.3	42.7	32.2	20.0	12.0	29.5	-0.31
Gujarat	60.0	60.3	48.3	46.7	32.4	48.6	61.1	58.9	49.7	38.2	27.4	44.8	54.3	49.8	47.3	32.7	24.3	42.0	-0.44
Maharashtra	68.8	62.0	51.8	49.0	33.5	51.9	65.8	58.1	46.8	45.3	32.6	50.1	49.4	42.6	37.5	27.9	13.9	33.3	-1.24
South	**58.7**	**54.4**	**47.1**	**33.4**	**28.5**	**45.6**	**51.8**	**46.7**	**40.1**	**29.4**	**18.1**	**37.7**	**45.8**	**37.1**	**29.1**	**19.0**	**14.9**	**29.5**	**-1.08**
Andhra Pradesh	58.7	52.6	42.8	33.8	33.1	47.2	46.3	46.9	40.4	24.3	22.5	37.8	46.2	36.4	27.0	23.8	13.4	31.1	-1.07
Karnataka	61.9	55.1	55.7	41.2	31.5	51.0	60.8	53.6	45.8	34.9	19.2	43.9	49.6	39.8	31.1	21.7	23.9	34.2	-1.12
Kerala	39.6	45.3	31.0	23.7	16.9	27.9	50.1	31.3	37.3	24.8	16.2	27.3	50.1	40.1	28.7	13.7	17.4	21.3	-0.44
Tamil Nadu	58.2	58.8	52.2	35.9	27.2	47.6	54.2	43.2	37.3	34.4	13.5	37.1	38.3	35.2	29.6	16.0	6.7	26.8	-1.39
North-East	**58.5**	**50.5**	**45.2**	**24.7**	**16.5**	**47.2**	**39.9**	**40.5**	**32.0**	**22.6**	**22.3**	**34.7**	**42.3**	**37.9**	**24.1**	**12.7**	**28.8**	**34.1**	-0.87

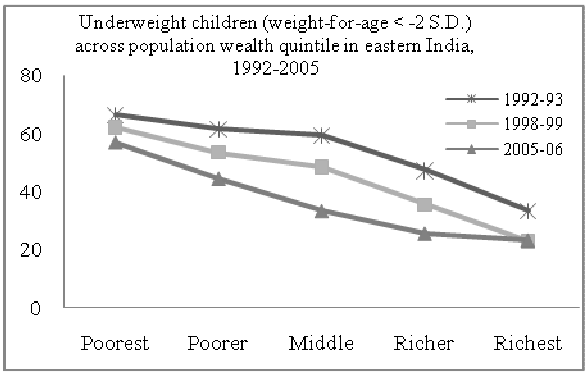
[a] Percentage point change per year calculated by dividing the difference between first and last data points and divided by the number of years (15) between the two surveys; HP-Himachal Pradesh.

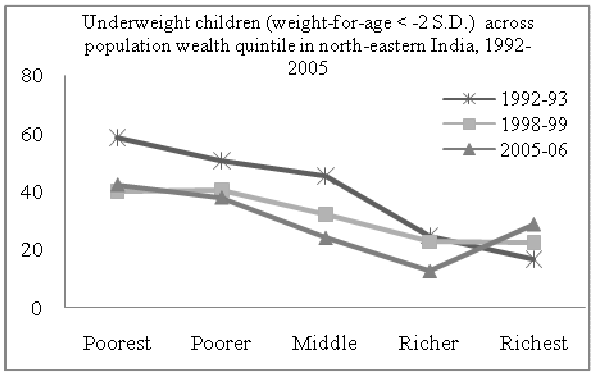
Figure 1- Trends in underweight children (weight-for-age < -2 S.D., 0-36 months) by economic status in regions of India, 1992-05.

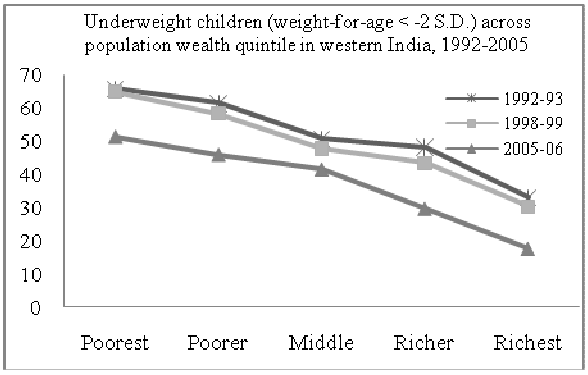












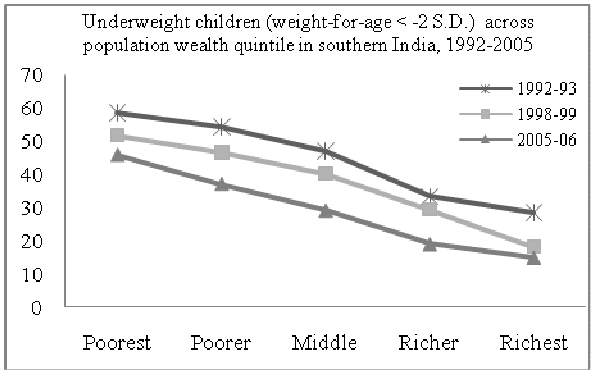


Table 2: Poor-rich ratio and concentration index depicting trends in inequality in child malnutrition (weight-for-age < -2 S.D.) in regions and states of India, 1992-2005.

	1992-93			1998-99			2005-06		
	PR-ratio[a]	**CI[b]**	**(SE)[c]**	**PR-ratio[a]**	**CI[b]**	**(SE)[c]**	**PR-ratio[a]**	**CI[b]**	**(SE)[c]**
India	**1.8**	**-0.10**	**0.003**	**2.4**	**-0.14**	**0.004**	**2.9**	**-0.16**	**0.003**
North	**1.6**	**-0.08**	**0.011**	**2.5**	**-0.15**	**0.011**	**2.9**	**-0.17**	**0.013**
Jammu and Kashmir	2.4	-0.12	0.056	2.9	-0.19	0.050	3.2	-0.17	0.062
Himachal Pradesh	1.9	-0.08	0.041	2.9	-0.12	0.052	4.1	-0.11	0.068
Punjab	1.8	-0.11	0.022	3.4	-0.21	0.035	4.3	-0.24	0.038
Uttaranchal	1.7	-0.08	0.032	5.0	-0.13	0.032	3.4	-0.20	0.052
Haryana	2.7	-0.17	0.027	2.4	-0.15	0.034	2.2	-0.13	0.029
Delhi	2.1	-0.10	0.032	1.7	-0.13	0.041	1.5	-0.15	0.070
Rajasthan	1.1	0.00	0.018	1.9	-0.08	0.014	2.6	-0.15	0.016
Central	**1.4**	**-0.04**	**0.005**	**1.9**	**-0.09**	**0.007**	**2.4**	**-0.10**	**0.007**
Chhattisgarh	1.6	-0.07	0.017	2.1	-0.06	0.023	3.1	-0.10	0.022
Madhya Pradesh	1.4	-0.06	0.010	2.6	-0.11	0.012	1.9	-0.07	0.011
Uttar Pradesh	1.4	-0.04	0.006	1.5	-0.08	0.009	2.6	-0.12	0.008
East	**2.0**	**-0.06**	**0.006**	**2.7**	**-0.10**	**0.007**	**2.4**	**-0.12**	**0.006**
Bihar	1.5	-0.04	0.008	2.3	-0.06	0.011	2.0	-0.08	0.008
Jharkhand	3.5	-0.06	0.024	3.3	-0.11	0.021	4.1	-0.09	0.015
Orissa	2.8	-0.08	0.017	2.8	-0.11	0.016	1.6	-0.15	0.020
West Bengal	2.9	-0.11	0.010	2.8	-0.14	0.012	4.1	-0.16	0.014
West	**2.0**	**-0.12**	**0.009**	**2.1**	**-0.13**	**0.010**	**2.9**	**-0.18**	**0.012**
Goa	3.2	-0.20	0.129	2.9	-0.18	0.172	4.9	-0.15	0.011
Gujarat	1.9	-0.12	0.016	2.2	-0.16	0.017	2.2	-0.14	0.018
Maharashtra	2.1	-0.13	0.011	2.0	-0.12	0.011	3.6	-0.20	0.017
South	**2.1**	**-0.14**	**0.008**	**2.9**	**-0.16**	**0.010**	**3.1**	**-0.19**	**0.013**
Andhra Pradesh	1.8	-0.12	0.013	2.1	-0.14	0.017	3.4	-0.16	0.021
Karnataka	2.0	-0.10	0.014	3.2	-0.17	0.018	2.1	-0.16	0.023
Kerala	2.3	-0.16	0.032	3.1	-0.14	0.034	2.9	-0.19	0.047
Tamil Nadu	2.1	-0.14	0.015	4.0	-0.16	0.018	5.7	-0.21	0.026
North East	**3.5**	**-0.13**	**0.017**	**1.8**	**-0.10**	**0.028**	**1.5**	**-0.13**	**0.023**

[a] Poor-rich ratio; [b] Concentration index; [c] Standard error

Table 3 - Estimated severe underweight rates (weight-for-age, < -3 S.D.) among children aged less than three years by economic status of population in India and states, 1992-2005

Region/State	NFHS-1 (1992-93)						NFHS-2 (1998-99)						NFHS-3 (2005-06)						
	Prevalence of underweight by population wealth quintile (in %)					Average under-weight	Prevalence of underweight by population wealth quintile (in %)					Average under-weight	Prevalence of underweight by population wealth quintile (in %)					Average under-weight	% [a] point change per year
	Poorest	Poorer	Middle	Richer	Richest		Poorest	Poorer	Middle	Richer	Richest		Poorest	Poorer	Middle	Richer	Richest		
India	**30.6**	**24.6**	**20.0**	**14.0**	**10.6**	**21.8**	**27.5**	**21.4**	**15.0**	**10.3**	**5.1**	**17.9**	**24.4**	**15.9**	**10.1**	**7.6**	**4.5**	**16.0**	**-0.38**
North	**26.6**	**17.4**	**19.2**	**12.5**	**9.1**	**16.0**	**30.1**	**19.4**	**16.3**	**11.2**	**4.9**	**15.9**	**21.8**	**13.4**	**10.9**	**6.9**	**4.1**	**12.2**	**-0.25**
J&K	30.0	18.1	17.6	10.5	5.3	13.4	15.1	10.4	11.2	4.2	5.4	8.6	20.7	9.4	8.8	2.6	3.8	8.7	-0.31
H.P.	22.6	25.7	16.1	8.7	3.2	14.7	37.3	16.6	11.8	11.9	4.5	12.1	17.4	10.9	9.8	9.5	2.4	9.5	-0.34
Punjab	16.7	16.4	22.4	13.2	8.5	14.8	18.7	23.1	8.9	10.1	2.5	8.9	22.6	16.0	11.5	3.1	2.4	7.9	-0.46
Uttaranchal	29.7	17.9	20.2	8.0	0.0	20.2	32.3	21.7	20.0	14.7	0.0	22.6	19.1	20.2	14.5	8.7	0.8	12.7	-0.50
Haryana	14.2	12.4	11.0	7.1	2.1	8.2	14.7	15.0	15.7	6.3	0.6	9.9	29.6	19.4	16.9	7.3	5.9	14.8	0.44
Delhi	28.6	6.7	20.3	17.8	9.9	13.1	0.0	21.6	22.5	15.0	7.6	10.4	0.0	16.2	12.8	8.2	6.3	8.5	-0.31
Rajasthan	26.9	17.7	24.8	17.3	16.9	21.4	31.2	20.6	20.1	14.5	6.9	20.9	21.4	11.1	7.7	9.6	4.8	13.8	-0.51
Central	**31.3**	**27.2**	**24.1**	**18.7**	**14.0**	**25.6**	**29.3**	**26.0**	**18.4**	**15.7**	**7.7**	**23.1**	**24.5**	**19.5**	**13.4**	**11.1**	**6.3**	**19.7**	**-0.40**
Chhattisgarh	40.6	38.8	42.8	16.7	8.1	35.7	28.4	25.8	23.4	14.1	5.4	23.5	22.6	17.5	11.4	6.1	4.4	17.7	-1.20
M.P.	36.8	29.0	24.6	22.0	11.7	28.2	32.7	28.6	21.5	15.0	7.0	24.9	33.6	25.9	18.7	17.8	7.7	26.9	-0.09
U.P.	27.8	25.4	23.0	17.5	15.5	23.8	27.8	24.7	16.5	16.1	8.5	22.2	21.6	17.1	12.0	9.2	6.0	17.3	-0.43
East	**34.4**	**26.7**	**25.4**	**16.1**	**12.2**	**27.3**	**28.5**	**19.9**	**17.4**	**10.3**	**6.6**	**21.6**	**26.3**	**16.8**	**7.1**	**6.2**	**9.0**	**20.1**	**-0.48**
Bihar	38.1	31.5	34.9	24.7	22.5	33.5	32.2	22.9	20.5	14.7	6.1	25.3	30.9	20.8	9.6	6.3	16.2	25.0	-0.57
Jharkhand	32.5	27.5	8.3	11.7	2.7	24.1	35.3	22.3	24.6	8.7	9.8	27.1	32.9	21.6	12.4	7.3	6.4	26.4	0.15
Orissa	27.4	25.8	16.1	15.0	6.0	22.7	26.2	21.9	12.5	12.3	5.0	20.9	22.0	13.3	4.2	2.8	7.1	15.1	-0.51
West Bengal	32.6	22.2	21.9	10.6	3.3	22.7	23.2	15.7	13.0	6.9	6.7	16.6	16.6	10.8	4.7	7.2	3.9	12.4	-0.69
West	**33.4**	**25.6**	**17.2**	**16.0**	**10.3**	**19.6**	**31.2**	**24.3**	**15.7**	**11.4**	**5.1**	**17.0**	**20.9**	**18.2**	**12.1**	**10.3**	**3.1**	**12.7**	**-0.46**
Goa	25.0	21.1	15.0	5.8	2.5	8.6	18.8	6.0	12.4	1.2	1.6	4.7	9.0	7.3	8.7	3.9	3.8	5.2	-0.23
Gujarat	28.6	22.6	16.6	15.7	6.2	17.2	32.9	24.7	19.1	7.8	3.8	15.5	26.0	23.2	13.5	12.6	3.0	16.0	-0.08
Maharashtra	35.9	27.2	17.5	16.2	12.6	21.0	30.8	24.2	13.9	12.8	6.0	17.8	17.5	13.8	11.1	9.0	3.1	10.5	-0.69
South	**24.0**	**20.7**	**14.6**	**9.0**	**8.4**	**15.9**	**18.1**	**17.4**	**10.5**	**6.4**	**2.6**	**11.1**	**19.7**	**9.7**	**7.9**	**4.6**	**1.7**	**8.5**	**-0.49**
AP	24.5	22.7	14.0	8.8	11.6	18.1	15.4	14.5	7.3	5.3	3.9	9.9	20.3	10.7	8.1	5.7	2.4	9.8	-0.55
Karnataka	28.1	20.7	19.4	12.4	9.4	18.8	25.6	25.2	18.0	10.0	0.7	16.7	23.5	11.2	11.2	7.7	1.4	11.9	-0.45
Kerala	20.8	11.0	6.0	4.7	3.3	6.3	37.4	8.6	7.1	3.2	1.1	4.7	20.0	8.6	6.1	2.7	2.6	4.4	-0.13
Tamil Nadu	19.9	21.3	14.8	10.3	6.8	15.1	15.6	15.6	10.4	7.6	3.4	10.9	12.0	7.0	5.4	2.2	0.4	5.4	-0.65
North-East	**22.9**	**20.0**	**13.3**	**5.4**	**3.0**	**17.0**	**13.9**	**15.5**	**9.4**	**5.7**	**4.9**	**11.6**	**17.8**	**12.7**	**5.9**	**5.0**	**6.1**	**11.9**	-0.34

Note: [a] Percentage point change per year calculated by dividing the difference between first and last data points and divided by the number of years (15) between the two surveys; J&K- Jammu and Kashmir, HP-Himachal Pradesh, M.P.-Madhya Pradesh, U.P.-Uttar Pradesh, A.P.-Andhra Pradesh.

Figure 2: Trends in concentration curve showing inequality in underweight (weight-for-age < -2 S.D.) by wealth status of population across major regions and states, India, 1992-2005.

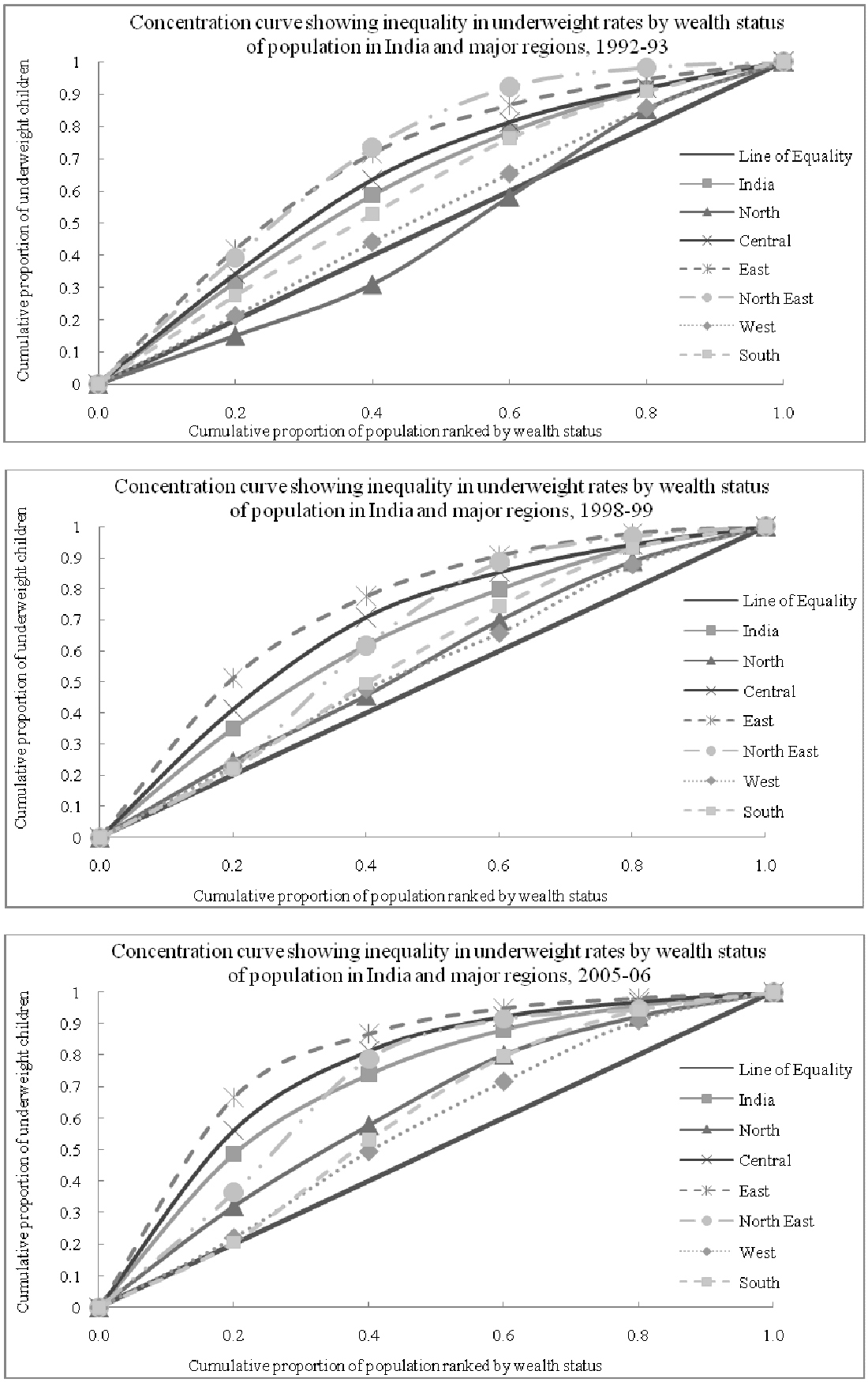
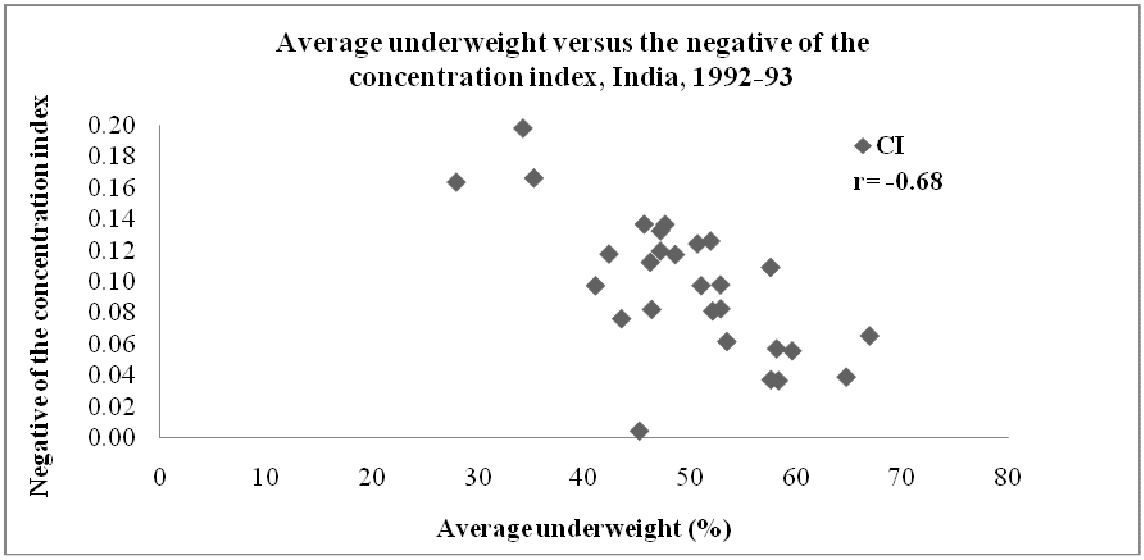
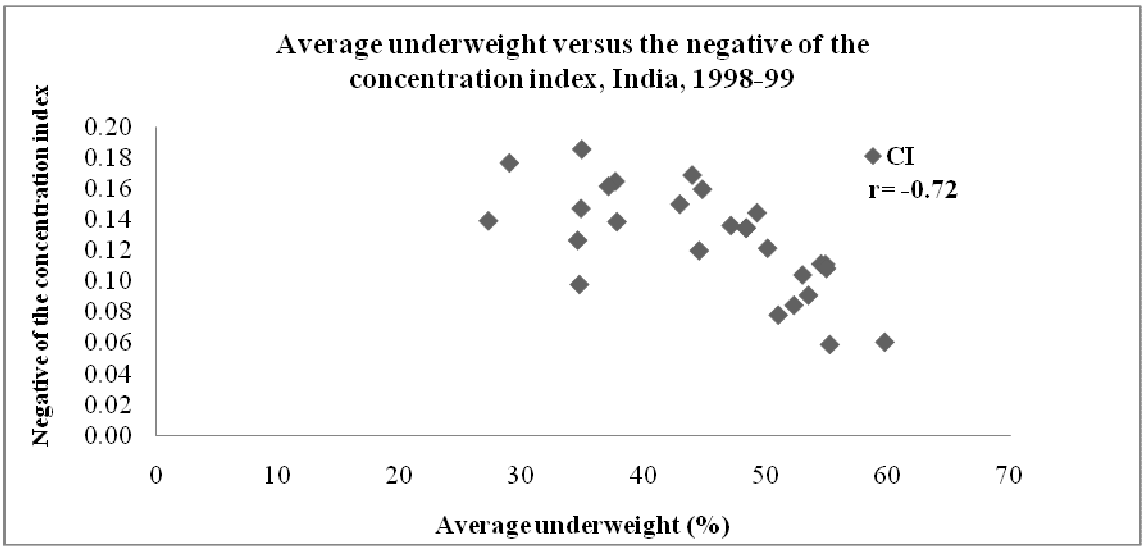


Figure 3 a,b,c- Average underweight children (weight-for-age < -2 S.D. , 0-36 months) versus concentration index across major Indian states, 1992-2005





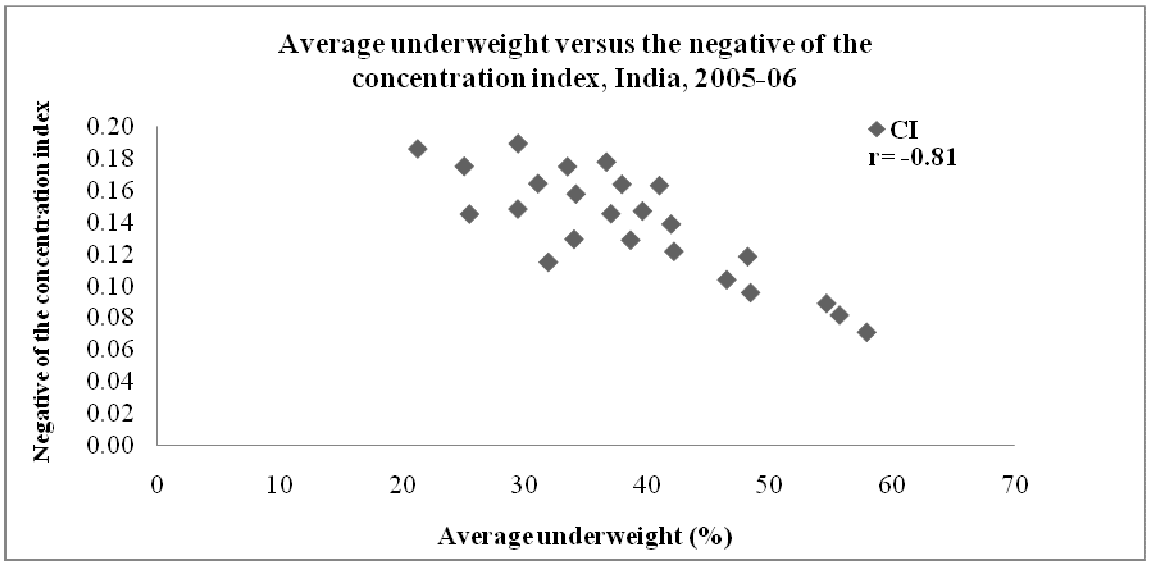


Table 4: Determinants of child malnutrition[$] (weight-for-age < -2 S.D.,0-36 months) in India, 2005-06

Characteristics (N=24969)	% under-weight	P-values[a]	Univariate analysis[b] OR	(95% CI)	Multivariate analysis[c] OR	(95% CI)
Population wealth quintile						
Poorest ®	53.6		1.00		1.00	
Poor	43.6		0.62***	(0.58, 0.67)	0.82***	(0.76, 0.89)
Middle	33.8		0.43***	(0.39, 0.46)	0.62***	(0.56, 0.68)
Richer	25.0		0.29***	(0.27, 0.32)	0.46***	(0.41, 0.52)
Richest	18.8	0.00	0.19***	(0.18, 0.22)	0.35***	(0.31, 0.41)
Maternal education						
No®	50.7		1.00		1.00	
Primary	41.8		0.71***	(0.65, 0.76)	0.90**	(0.82, 0.98)
Secondary	30.9		0.41***	(0.39, 0.44)	0.72***	(0.67, 0.78)
Higher	15.1	0.00	0.17***	(0.15, 0.20)	0.45***	(0.38, 0.53)
Place of residence						
Urban®	30.8		1.00		1.00	(0.34, 0.72)
Rural	44.3	0.00	1.69***	(1.60, 1.79)	0.94	(0.87, 1.01)
Religion				(0.76, 1.38)	1.06	(0.76, 1.47)
Hindu®	41.8		1.00		1.00	
Muslim	39.9		0.95	(0.88, 1.02)	1.03	(0.95, 1.12)
Others	32.3	0.00	0.56***	(0.51, 0.61)	0.77***	(0.69, 0.85)
Caste						
SC/ST®	48.7		1.00		1.00	
OBC	41.7		0.94**	(0.88, 1.00)	0.86***	(0.80, 0.92)
General	32.1	0.00	0.58***	(0.54, 0.62)	0.72***	(0.67, 0.78)
Age of child (in months)						
0-5®	29.6		1.00		1.00	
6-11	36.0		1.23***	(1.11, 1.36)	1.35***	(1.21, 1.50)
12-23	43.5		1.70***	(1.55, 1.86)	1.97***	(1.79, 2.17)
24-36	45.5	0.00	1.89***	(1.73, 2.06)	2.21***	(2.00, 2.44)
Sex of child						
Male ®	41.4		1.00		1.00	
Female	40.7	0.00	0.93**	(0.89, 0.98)	0.91	(0.86, 0.97)
Birth order						
First ®	34.6		1.00		1.00	
Second	37.4		1.14***	(1.06, 1.22)	1.20***	(1.05, 1.37)
Third	43.2		1.48***	(1.37, 1.61)	1.33***	(1.15, 1.53)
Fourth	48.0		1.68***	(1.52, 1.85)	1.56***	(1.19, 2.05)
Five plus	53.9	0.00	2.18***	(2.01, 2.37)	1.76***	(1.34, 2.31)
Age of mother (in years)						
<20®	43.5		1.00		1.00	
20-29	39.3		0.78***	(0.70, 0.86)	0.81***	(0.72, 0.91)
30-39	45.5		0.81***	(0.72, 0.90)	0.77***	(0.67, 0.88)
40+	55.3	0.00	1.20***	(0.97, 1.49)	0.86	(0.67, 1.10)
Region						
Northern®	33.5		1.00		1.00	
Central	46.5		1.77***	(1.63, 1.92)	1.28***	(1.16, 1.40)
Eastern	48.3		1.74***	(1.60, 1.90)	1.23***	(1.11, 1.35)
North Eastern	34.1		0.76***	(0.70, 0.83)	0.64***	(0.57, 0.71)
Western	36.7		1.14**	(1.02, 1.26)	1.28***	(1.15, 1.43)
Southern	29.5	0.00	0.82***	(0.75, 0.91)	0.84***	(0.76, 0.94)

[$] Dependent variable is dichotomous, Malnourished children (1), Non malnourished children (0);[a] P-values are from chi-square tests for differences by survey, adjusted for survey clustering; [b] Univariate analysis shows the unadjusted odds ratio for confounding variables; [c] Multivariate analysis shows adjusted odds ratio for confounding variables; OR- Odds ratio; ®- Reference category; ***Significant at 1% level of significance, **Significant at 5% level of significance,*Significant at 10% level of significance.