Malnourishment among Children in India: A Regional Analysis

This paper analyses inter-state differentials in malnourishment among children in India on the basis of the National Family Health Survey, 1992-93, 1998-99 and 2005-06. It brings out the prevalence of widespread disparities and indicates that these differentials are increasing over time. The study clearly reveals that such differentials do not always vary with the extent of poverty prevalent among the people of the state. Also the higher the age at which women have their first child and the earlier the start of breast feeding of newborn children, the less is the prevalence of child malnourishment. It finds the Integrated Child Development Services suited to tackle these aspects and makes a plea to extend it and make it more oriented towards reducing child malnourishment.

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The hearts of most grown-ups melt at the sight of small infants who constitute one of the most vulnerable sections of society. Children need extra care because they are our supreme assets as the children of today form the human resource of tomorrow. This is all the more so because the role of the human element is becoming more and more crucial in this age, which has witnessed sky-rocketing progress in robotics and electronic convergence. The provision of adequate facilities for children to realise their full potential in both mental and physical development is therefore the least that the world can do to assure not only a good present but also a good future for its people. Hence, it is hardly surprising that one of the millennium development goals (MDGs), agreed upon by countries of the world is to reduce the proportion of underweight children by half by the year 2015.[1]

India has creditable achievements to trumpet on a number of counts. These include high rates of economic growth lasting over a decade, reduction in infant mortality rates and increase in life expectancy at birth. But her position in terms of taking proper care of her children is, however, nothing to write home about.[2] Actually, India has the highest proportion of undernourished children in the world along with Nepal, Ethiopia and Bangladesh.[3] The number of Indian children below the age of three who are underweight is a mind-boggling one of 37 million. This is despite official claims that the well-being of children has been a priority and an integral part of the country's development planning since 1951 [Planning Commission 2002b]. A recent study of malnourished children in India by Gragnolati et al (2006) is of the view that without a major shake up in policy and an improvement in the effectiveness of its implementation, the attainment of the MDGs in this regard by India looks extremely unlikely.

It is interesting to note the repeated finding in earlier studies, including the one by Gragnolati et al (2006) and Shiva Kumar (2007), is that economic growth alone is insufficient to bring about significant reductions in the prevalence of malnourishment among children. Ramalingaswami et al (1997) carried out international comparisons in this regard and even coined a term "south Asian enigma" to describe how economic growth has not been accompanied by commensurate reduction in the extent of child malnourishment in south Asian countries including India in contrast with a number of other countries of the world. Gragnolati et al (2006) have pointed out that this enigma is possibly due to differences in the percentage of babies born with low birth weight, sociological conditions affecting the status and decision-making power of women, and hygiene and sanitation standards.

In the light of all this and also in view of the fact that the different regions of India are at different levels of economic and social development, it would be of considerable interest to carry out a detailed analysis of inter-regional differences in malnourishment among children in India.[4] The paper here is an exploratory exercise in this regard. It attempts to give an idea about the extent of these inter-regional differences, also examining the manner of inter-temporal changes in these. It further goes on to decipher possible factors, which can explain these observed inter-regional differences. It contains, besides this introductory part, four more parts. Section I gives details regarding the scope, sources of data and methodology used. The second section gives an idea of the extent of inter-regional disparities and manner in which these are changing over time. Section III looks at possible factors, which can help explain these observed inter-regional differences in malnourishment among children in India. The concluding section brings together the main findings of the study to draw some policy inferences.

I
Scope, Methodology and Sources of Data

The states of India are taken as regions for this study. It is true that the different states differ from each other widely in terms of area, population, agro-climatic conditions and socio-economic characteristics. Nor can any Indian state be looked upon as an entirely homogeneous region from any point of view. No Indian state would also strictly qualify as a nodal region, in the sense of having all its linkages within the region. But the states are the politico-administrative units of the Indian republic. They are also, to a considerable extent, planning and data-collecting units. Further, the reorganisation of the Indian states in the mid-1950s and subsequent changes in the boundaries and numbers of Indian states have resulted in considerable linguistic and socio-cultural homogeneity within each state. In view of all this and also of the prevalent view held by many including Isard et al (1959) that there are no ideal regions for the purpose of regional analysis, we look upon the states as regions.[5]

The first thing that comes to one's mind when one considers nourishment is that of overcoming "raw hunger" or the overt need

for macronutrients – calories and proteins – to fill the belly. The other type of nourishment needed is of micronutrients like vitamins, iron, iodine, zinc, calcium, etc, required in very small quantities. Since this type of requirement is not overtly voiced by children or even by their parents, it is often referred to as "hidden hunger". The paper here confines itself to issues related to "raw hunger", examining nourishment in terms only of macronutrients.[6] The findings of many including Martorell and Habicht (1986) that well nourished children in all population groups, for which data are available, follow somewhat similar growth patterns is often used to analyse malnourishment of this type and the same procedure will be followed here. On this basis, to have an idea of malnourishment, anthropometric measurements of children of a country are taken and compared to those of an international reference population. If a child in the concerned country has an anthropometric measurement that is too far below the average value for the reference population, that child is looked upon as undernourished.[7] Three anthropometric measurements are generally used in this regard. These are height-for-age, weight-for-height and weight-for-age. Height-for-age is taken as indicative of long-term or chronic undernourishment, which does not vary with short-term changes in the level of nourishment. Similarly, weight-for-height gives body mass in relation to body length and indicates acute but short-term undernourishment due to failure to receive adequate nourishment immediately before measurement. In contrast to these two measures, weight-for-age reflects both the long-term and short-term effects of nourishment and is considered indicative of both chronic and acute undernourishment. The study hence, focuses on the anthropometric measurement of weight-for-age to analyse child malnourishment at the state level in India.

State-wise data on child malnourishment in India are available from two major sources.[8] One is the National Nutrition Monitoring Bureau (NNMB) set up by the Indian Council of Medical Research in 1972 in 10 Indian states to carry out annual surveys of nutrition. Besides the problem of inter-temporal comparability by a change in the scientific procedure used by the NNMB in 1982, NNMB data suffer from the serious limitation of incomplete coverage since all the 29 states that exist in India are simply not covered by such surveys. It is true that an attempt was made by the department of women and child development of the ministry of human resource development of the government of India to bring out somewhat comparable data in this regard for the year 1995-96 for the states not covered by the NNMB. But such an exercise was not repeated and so an inter-temporal study of the extent of undernutrition among all the Indian states cannot be carried out with NNMB data and supplements to those by the other departments of the government.

The other source is the National Family Health Survey (NFHS) that was launched in 1991 by the ministry of health and family welfare of the government of India and coordinated by the International Institute of Population Sciences. This has a much wider coverage in terms of inclusion of the states. There have so far been three rounds of such surveys – NFHS-1 for 1992-93, NFHS-2 for 1998-99 and NFHS-3 for 2005-06. While detailed final results of NFHS-1 and NFHS-2 have already been published, provisional results of NFHS-3 have now become available.[9] In view of all this, the analysis of child malnourishment is based on NFHS data.[10] The paper thus examines the extent of malnourishment of children below three years of age on the basis of the anthropometric measurement of weight-for-age as given in the three rounds of the NFHS.[11] Children, whose measurements, in this regard, are more than twice the standard deviations below the corresponding median value of the international reference population, are considered to be suffering from malnutrition of both chronic and acute natures. It is usual to look upon children whose anthropometric measurement is less than three standard deviation times below the median value for the standard reference population as severely malnourished and those whose measurements fall between two and three standard deviation times less than the median value for the reference population as moderately malnourished. In this paper malnourishment thus includes both severe and moderate malnourishment.

The study is carried out with three objectives in view. The first intention is to have a detailed picture of the extent of disparities in malnourishment among children in the different states of India. We define MN, the extent of malnourishment among children, as the degree of malnourishment among children as shown by per cent children under three years who are underweight as per NFHS data.

We then find the state relatives RMN in the degree of malnourishment among children, the state relative RMN_s for state "s" being defined as follows:

$$RMN_s = 100 \times (MN_s/MN_n)$$

with sub-scripts s and n standing for states and the nation as a whole respectively.

Secondly, an analysis of the manner of change in these disparities over time is carried out. It is first done by examining the signs of change of the state relatives between the three points of time. In view of the fact that during periods of regional convergence, the value of the state relative in the base year and the percentage change in it over time will move in opposite directions, the coefficients of correlation are calculated between the initial year value of the state relative and the percentage change in it between the three points of time to have a clearer idea about the manner of inter-temporal changes in regional disparities. Further, light is sought to be thrown in this regard by calculating unweighted and weighted inter-state coefficients of variation of the prevalence of malnourishment; weights being the populations of the concerned states, and by comparing these values between the three points of time.

The paper also attempts to explain the observed inter-state differences in the extent of malnourishment among children. In doing so, it seems logical to consider an indicator of the level of living of the people as a possible explanatory variable. It would be interesting to examine whether the finding in cross-country comparisons that differences in per capita income do not move much in tandem with similar differences in the extent of child malnourishment, is true at the state level in India. Such an enquiry however is not possible due to data limitations. We have, at the state level in India, estimates of income originating and not of income accruing.[12] In view of this and also of the fact that there are widespread inequalities in the income distribution in each state, the prevalence of poverty in the state is taken as the relevant variable. It is indicated by BPL defined as the percentage of people below the poverty line as estimated by the Planning Commission (2002a, 2007).[13]

Further, in light of the findings of Ramalingaswami et al (1997) and Gragnolati et al (2006), variables indicative of awareness among women about factors affecting health, social conditions children and women are also taken into account. It is true that data are available from the NFHS on a large number of variables of this kind, though the problem of getting data for exactly identical variables that cover the same states remains a somewhat formidable one. Despite this, three sets of variables, for all of which data are available from the NFHS, though not always in an inter-temporally comparable form, are considered. One set is indicative of awareness among women about factors affecting health. The three variables of this kind taken into account in this regard are

the complete absence of education in the case of women, completion of primary education by women and non-exposure of women to media. The other set relates to social practices and the variables considered in this regard are the age of mother at the birth of the first child, age of wife at first cohabitation with husband and extent of the prevalence of early breast feeding of new born children.[14] The third relates more directly to women's health; the variables considered in this regard being the percentage of women whose body mass index is below normal and the extent of antenatal care.

As a result, mainly of data difficulties, the analysis of possible explanatory factors is carried out in two parts. A preliminary idea of the relationship is first sought to be obtained by an analysis of the coefficients of correlation of these possible explanatory variables with the extent of child malnourishment in the state. On the basis of the availability of comparable data and the largeness of the magnitudes of the coefficients of correlation, three of these explanatory variables are chosen for regression analysis. Multiple regression equations are fitted with these three as possible independent variables and the extent of malnourishment among children as the dependent variable. The significance of all the correlation and regression coefficients is tested at the 5 per cent level on the basis of a two-tailed t-test. An attempt is then made to explain inter-state disparities in the extent of child malnourishment among children in the different states of India on the basis of these equations.

II
Regional Disparities in Child Malnourishment

Even a mere perusal of Appendix Tables 1 and 2 that show the extent of malnourishment among children in the different states throw up some interesting regional facets of the issue. The economic giants from among the Indian states – Gujarat, Haryana, Maharashtra and Punjab – do not figure among the top five states in terms of the absence of child malnourishment in both tables, nor do the emerging economic powers of the south India like Andhra Pradesh and Karnataka. Besides the famous outlier – Kerala – it is the small north-eastern states such as Nagaland, Manipur and Mizoram, which occupy very high positions in the child nourishment ladder at all the three points of time considered here. Among the so-called Bimaru states, Bihar consistently holds the fort of being among the top five in terms of child malnourishment with Madhya Pradesh experiencing continuous worsening of its position on this front over time. In order to examine the position of the different states in comparison to that of the nation as a whole with regard to the extent of malnourishment of children, we now work out RMN, the state relative in the extent of malnourishment among children, and compare this over time.

Table 1 gives the values of RMN for the 24 states of India in years 1992-93 and 1998-99. It also gives the percentage change in RMN in each state between the two points of time. Manipur is the better off among the Indian states in terms of child nourishment in the year 1992-93. The percentage of malnourished children in the state in 1992-93 is almost half that for the nation as a whole. Nagaland overtakes Manipur in this regard in 1998-99.

The worst relative position in terms of child nourishment in 1992-93 is that of Bihar where the percentage of malnourished children is 20 per cent more than that for India as a whole. Madhya Pradesh replaces Bihar on this count in 1998-99. Actually, while Bihar, Orissa and West Bengal are the only three states with values of RMN higher than 100 and are thus worse off than the nation as a whole in 1992-93, the number increases to six with Madhya Pradesh, Rajasthan and Uttar Pradesh joining this group, with the largest relative deterioration taking place in Rajasthan, closely followed by Madhya Pradesh and Uttar Pradesh. The biggest improvement in the relative position took place in Punjab with Arunachal Pradesh on its heels. No clear evidence emerges from the signs of change in RMN between the two points of time in Table 1 regarding the manner of inter-temporal regional changes. It is true that the coefficient of correlation between RMN in 1992-93 and the per cent change in it between 1992-93 and 1998-99 is negative. This can, however not be taken as indicative of a reduction in inter-regional disparities in this regard between the two points of time. This is so because the coefficient has a value only of -0.07 and is hence too small to be considered significant of a reduction in regional disparities in child malnourishment.

Table 2 gives the values of RMN for the 29 states of India in the years 1998-99 and 2005-06. It also gives the percentage change in RMN in each state between the two points of time. Sikkim is the better off state of these 29 states in terms of child nourishment in 1998-99; the value of its RNM being as low as 43.84 – the lowest value for RNM in Tables 1 and 2 together. The relative position of Sikkim, however, is taken up by Mizoram in 2005-06. The worst relative position is that of Chhattisgarh in 1998-99, which has a value of RNM of 129.38. Madhya Pradesh replaces Chhattisgarh in this regard in 2005-06 and has a value of 131.39 for RMN – the highest in these two tables. Nine of the 29 states had values of RMN higher than 100 in 1998-99, while only seven belonged to that category in 2005-06. Actually, Orissa, Maharashtra, Rajasthan and West Bengal with values of RMN greater than 100 in 1998-99 improved their relative status to have values of RMN less than 100 in 2005-06. In fact, the three largest improvements took place in Mizoram, Maharashtra and Orissa (in that order). If we consider relative deteriorations, Arunachal Pradesh, Nagaland and Meghalaya are among the first three (in that order) with Haryana very close behind. As regards the change in regional disparities between the two points of time, it is true that the coefficient of correlation between RMN in 1998-99 and

Table 1: State Relatives, RMN Child Malnourishment in India, 1992-93 and 1998-99

(Per cent)

S No	State	Value of RMN		Per Cent Change in RMN
		1992-93	1998-99	
1	Manipur	52.05	58.52	12.43
2	Kerala	52.43	57.24	9.17
3	Nagaland	53.41	51.28	–3.99
4	Mizoram	55.15	58.95	6.89
5	Goa	66.22	60.86	–8.09
6	Haryana	67.19	73.63	9.58
7	Arunachal Pradesh	74.57	51.71	–30.66
8	Delhi	79.43	73.84	–7.04
9	Himachal Pradesh	84.87	92.78	9.32
10	Rajasthan	86.03	107.68	25.17
11	Meghalaya	86.22	80.65	–6.46
12	Andhra Pradesh	87.39	80.23	–8.19
13	Tripura	87.78	90.65	3.27
14	Tamil Nadu	88.75	78.10	–12.00
15	Punjab	89.33	61.07	–31.64
16	Uttar Pradesh	91.66	110.02	20.03
17	Gujarat	93.41	95.97	2.74
18	Madhya Pradesh	94.19	117.25	24.48
19	Assam	95.55	76.61	–19.82
20	Karnataka	98.27	93.42	–4.94
21	Maharashtra	99.82	105.55	5.74
22	Orissa	101.76	115.76	13.76
23	West Bengal	106.42	103.63	–2.62
24	Bihar	121.38	115.76	-4.63

Note: The states are arranged in ascending order of RMN in 1992-93.
Source: NFHS-1 and NFHS-2.

the per cent change in it between 1998-99 and 2005-06 is negative and higher than that obtained from evidence in Table 1. But the value of the coefficient is still too small – only -0.36 – to be considered significant. It has to be admitted that no clear evidence emerges from the table regarding the manner of regional change in inter-state disparities in child malnourishment between 1998-99 and 2005-06.

A clearer picture about the manner of change in inter-regional disparities emerges if we examine inter-state coefficients of variation. Table 3 gives the unweighted and weighted inter-state coefficients of variation of percentage of child malnourishment in India at the three points of time. Inter-state disparities seem much less if we consider the weighted coefficients of variation than if we take into account unweighted coefficients. Both, the weighted and unweighted coefficients of variation experience increase between 1992-93 and 1998-99 indicating an increase in inter-state disparities. The evidence regarding the direction of regional change is however, not so clear if we consider the change between 1998-99 and 2005-06. While the unweighted coefficient of variation undergoes a very slight decline of 0.67 or by about 2.4 per cent, the weighted coefficient of variation goes up by 2.06 or by about 12 per cent.

III
Attempt at Explanation

To facilitate the analysis, the possible explanatory variables considered from the NFHS are now indicated by symbols and given precise definitions as follows:

FIL = percentage of women respondents between the ages 15 and 49 years with no education.

FPE = percentage of women who completed primary school among ever-married women respondents between the ages 15 and 49 years.

FNM = percentage of women aged between 15 and 49 years not exposed to radio, TV or newspapers at least once a week.

COA = Median age at first co-habitation with husband of married women between 25 and 49 years of age.

AFB = median age at first birth for women aged 25-49 years.

BF1 = percentage of children who started breast feeding within one hour of birth.

BF2 = percentage of children, whose mothers squeezed out first milk from breast before breast feeding.

BMI = percentage of ever married women between the ages 15 and 49 years, whose body mass index was below normal.

AN = percentage of mothers who received antenatal care.[15]

The coefficients of correlation of MN, the extent of child malnourishment, with the possible explanatory variables considered, are given in Table 4.

The signs of the coefficients are along expected lines and indicate that while prevalence of poverty, lack of awareness among women about factors affecting health, age of first co-habitation with husband and first child birth at an early age for women go hand-in-hand with a high degree of malnourishment among children, the reverse is true when breast feeding starts early; the mothers are healthy in terms of body mass index and mothers receive antenatal care. But if we consider the magnitude and significance of the coefficients, some interesting facts also come to light. The highest value of the coefficient of correlation with MN is not for BPL at all the three points of time considered, with the coefficient not being significant in 1998-99. Of the three variables considered indicative of awareness among women of factors affecting health, FIL is the only one that has a significant coefficient of correlation with MN at all the three points of time, though the corresponding coefficient for FNM is higher in absolute magnitude and is also significant at two points of time. All available coefficients of correlation of MN with COA, AFB and BF1 are significant, though the only available coefficient in this regard with BF2 is too small and not significant. As regards BMI, coefficients of correlation with MN are available for two points of time and both these values are not only significant but also have the highest magnitudes among coefficients of correlation in Table 4 for the particular years. The coefficient of correlation of ANC with MN, though available for all three points of time, is significant only in 1992-93. For an exactly corresponding definition of ANC in 2005-06, the value of the coefficient, however, has the lowest magnitude among coefficients in that column related to the particular year and is not significant. Further, even for a more stringent definition of ANC for which data are available for 1998-99, the coefficient of correlation with MN is not significant. All these give an indication that it is the overall long-term health condition of the mother and not just ante-natal care, which has an impact on child health and hence, child malnourishment.

Table 2: State Relatives, RMN Child Malnourishment in India, 1998-99 and 2005-06

(Per cent)

S No	State	Value of RMN		Per Cent Change in RMN
		1998-99	2005-06	
1	Sikkim	43.84	49.25	12.34
2	Nagaland	51.28	64.72	26.21
3	Arunachal Pradesh	51.71	80.41	55.50
4	Kerala	57.24	62.76	9.64
5	Manipur	58.52	51.86	-11.38
6	Mizoram	58.95	47.07	-20.15
7	Goa	60.86	63.84	4.90
8	Punjab	61.07	58.83	-3.67
9	Jammu and Kashmir	73.42	64.06	-12.75
10	Haryana	73.63	91.30	24.00
11	Delhi	73.84	72.12	-2.33
12	Assam	76.61	88.03	14.91
13	Tamil Nadu	78.10	72.34	-7.38
14	Andhra Pradesh	80.23	79.53	-0.87
15	Meghalaya	80.65	100.89	25.10
16	Uttarakhand	88.95	82.80	-6.91
17	Tripura	90.65	84.98	-6.25
18	Himachal Pradesh	92.78	78.88	-14.98
19	Karnataka	93.42	89.56	-4.13
20	Gujarat	95.97	103.28	7.62
21	West Bengal	103.63	94.79	-8.53
22	Maharashtra	105.55	86.51	-18.04
23	Rajasthan	107.68	95.88	-10.96
24	Uttar Pradesh	110.23	103.07	-6.50
25	Madhya Pradesh	113.85	131.39	15.41
26	Bihar	115.55	127.25	10.13
27	Jharkhand	115.55	129.00	11.64
28	Orissa	115.76	95.88	-17.17
29	Chhattisgarh	129.38	113.53	-12.25

Note: The states are arranged in ascending order of RMN in 1998-99.
Source: NFHS-2 and NFHS-3.

Table 3: Inter-State Coefficients of Variation of Child Malnourishment in India, 1992-93,1998-99 and 2005-06*

S No	Year	Coefficients of Variation of Child Malnourishment	
		Unweighted	Weighted
1	1992-93	24.05	14.73
2	1998-99	26.90	17.03
3**	1998-99	27.76	17.44
4**	2005-06	27.09	19.50

*Notes:** The weights used are the state populations from the 2001 population census. Rows 1 and 2 are for the 24 states for which data on malnourishment were available earlier and are given in Appendix Table 1.
** Rows 3 and 4 are for the 29 states for which such data are available from the 3rd round of the NFHS and are given in Appendix Table 2.
Source: NFHS data.

For six of the 10 possible explanatory variables considered here, data are available for all three points of time. Of these six, three – FIL, AFB and BF1 – are such that their coefficients of correlation with MN are not only along expected lines but are also significant. Moreover, the three belong to different sets indicative of awareness of factors affecting health, social conditions regarding marriage and breast feeding practices respectively. In view of this, an attempt is now made to explain the observed inter-state differences in MN with the help of these three variables on the basis of multiple regression analysis. Linear, semi-log and log-linear regression equations are tried. Some of these results shown in Appendix Table 3 indicate that there is hardly any difference between these three. Hence, the log-linear regression has been used in the study. Further, instead of carrying out the analysis separately for each of the three sets of cross-sectional data, the study pools these data over the three points of time.[16] As the coefficients of correlation between the three possible explanatory variables are significant and lead to problems of multicollinearity, a regression equation is also tried with just two independent variables – AFB and BF1 – the coefficient of correlation between which two variables is the least in magnitude of these three coefficients.[17]

Some relevant details of the two regression equations tested are given in Table 5. The values of R^2 and adjusted R^2 are not low in the equations. The signs of all the regression coefficients are also along expected lines. Further, the regression coefficients of four of the five explanatory variables in Table 5 are significant. In view of all this, these equations are used here to explain inter-state disparities in the extent of child malnourishment in India. The results thus indicate that while both the age at which women have their first child and early breast feeding practice have a clear negative impact on child malnourishment, the former variable appears to be much more important than the latter.

IV
Inferences

This detailed state-wise analysis of the prevalence of child malnourishment in India on the basis of available NFHS data has clearly revealed the existence of considerable inter-state disparities on this count. At all the three points of time considered here – 1992-93, 1998-99 and 2005-06, these actually seem more pronounced if we consider unweighted inter-state coefficients of variation in child malnourishment than if we use weighted coefficients, with the weight being the population of the state in question. These disparities seem to have experienced an increase between 1992-93 and 1998-99, irrespective of the measure of disparity considered. Between 1998-99 and 2005-06, while there has been a slight decline in the unweighted coefficient of variation, the weighted coefficient has continued to increase, the increase in it being almost as substantial between 1998-99 and 2005-06 as it was between 1992-93 and 1998-99. The continuous increase in the weighted coefficient of variation should cause considerable concern because it under-estimates results for the economically less developed states of India like Uttar Pradesh and Bihar, which are the more populous ones. It is these states which have, by and large, experienced a relative increase in the prevalence of malnourishment among children. The fact that over time, the less economically developed regions of India are becoming concentrated pockets of malnourished children is bound to stand in the way of sustainable development of the nation. To overcome this vital issue, efforts to promote inclusive economic growth that would result also in the reduction of poverty are now on. It is assumed that with such measures, malnourishment among children would simply wither away.

The results of the study question this very assumption that suggests that poverty reduction would ensure the lessening of the prevalence of malnourishment among children. It does not seem, from the analysis here, that inclusive economic growth per se would automatically lead to a reduction in the extent of malnourishment among children.[18] In fact, in the three more economically developed states of India – Gujarat, Haryana and Maharashtra –substantial reductions in the extent of poverty between 1993-94 and 1999-2000 were not accompanied by similar reductions in the extent of child malnourishment between NFHS-1 and NFHS-2, with there being actually no change at all in the extent of child malnourishment in Haryana.[19] This is hardly surprising because the study has shown that factors other than poverty like the age of marriage/age of women at first child birth, prevalence of early breast feeding of children and awareness among women about factors affecting health, which are being increasingly recognised as having a strong impact on child malnourishment, are important in this regard at the regional level. The study thus stresses the need for additional measures to ensure the reduction of the prevalence of malnourishment among children in India.

The regression results suggest that the more important of these are steps to increase the age at which women have their first child. This becomes all the more so if we consider additional evidence from NFHS-2 and NFHS-3 that the lower the age of women at the time of their first child birth, the greater the percentage of women with below normal body mass index, which is the variable with the largest positive coefficient of correlation with the percentage of malnourished children.[20] Such a finding is not surprising if we consider the fact, stressed by many including Gragnolati et al (2006), that around one-third of the children born in India are underweight at the time of birth and an important reason for this is early teenage pregnancies. Measures to increase the age of women at the time of their first child birth would thus help

Table 4: Coefficients of Correlation of Malnutrition with Possible Explanatory Variables Considered**

Coefficient of Correlation of MN With	In the Year		
	1992-93	1998-99	2005-06
BPL	0.47*	0.28	0.70*
FIL	0.63*	0.60*	0.76*
FPE	-0.39	-0.37	-0.22
FNM	0.39	0.66*	0.82*
COA	-0.77*	-0.76*	NA
AFB	-0.76*	-0.77*	-0.75*
BF1	-0.52*	-0.56*	-0.58*
BF2	NA	0.14	NA
BMI	NA	0.88*	0.82*
ANC	-0.56*	-0.40	-0.19

Note: ** Variables are as defined and sources of data, as mentioned, in the text. Single asterisk indicates significance and NA indicates non- availability due to data for the concerned explanatory variable not being there.

Table 5: Some Relevant Regression Results

S No	Equation	R^2	Adj R^2
1	ln MN = 10.51 + 0.05 ln FIL – 2.29 ln AFB* – 0.05 ln BF1* (1.24) (0.05) (0.38) (0.03) [8.50] [1.07] [-6.00] [-1.85]	0.59	0.58
2	ln MN = 11.35 – 2.49 ln AFB* – 0.07 ln BF1* (0.96) (0.33) (0.03) [11.87] [-7.56] [-2.48]	0.59	0.58

*Note:** The number of observations is 79 and the sources of data and the definitions of variables are as given in the text. Round and square brackets show standard errors and t-values respectively. Single asterisk indicates significance of the coefficient at the 5 per cent level of significance.

in lessening this intergenerational transfer of malnourishment from the mother to child. Next in importance, as shown by the regression results, is early breast feeding of new born children, which has a clear negative impact on the extent of child malnourishment.[21] As regards the variables showing awareness among women about factors affecting health, while illiteracy among women seems important at all the three points of time; in later years, the lack of exposure of women to media is emerging as the more important variable from this group affecting the extent of child malnourishment.

It might appear, at first sight, that increase in women's age at the time of first child birth, adoption of early breast feeding practices and improved awareness among women about factors affecting health, all of which appear to reduce the extent of child malnourishment, are outside the realm of possibility in India in the near future. A closer look, however, would give us second thoughts on this count. An important reason for this is that, as pointed out by Gragnolati et al (2006), child malnourishment is concentrated in a few districts of India and scarce resources and energy in this regard do not have to be spread too thinly over the entire nation for achieving results. Further, with the information revolution and spread of infrastructure, there have been some success stories on the health front of social marketing and attempts can be made to repeat these in the case of child malnourishment too. There exist strong possibilities of replicating these particularly since exposure of women to media seems to move in the same direction as reduction in child malnourishment. All this is further facilitated by the fact that there is already in (somewhat successful) operation for over three decades in a few parts of India the Integrated Child Development Services (ICDS) with prevention of malnourishment among children as one of its mandates. The ICDS has, as pointed out by many including Sinha (2006), Ghosh (2006), Gupta (2006), Rajivan (2006) and Garg (2006), become a mere dole-giving agency out just to cure malnourishment among children by giving some "podi" or powder with hardly any public involvement. If the ICDS is made more efficient by overcoming these drawbacks and is at least spread to all pockets of child malnourishment, it is possible to ensure that the serious problem of child malnourishment is prevented and hence considerably lessened, if not wiped out from the face of India. EPW

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Appendix Table 1: Malnourishment among Children in the States of India, 1992-93 and 1998-99

State	Malnourished Children (Per Cent) 1992-93	1998-99
Manipur	26.8	27.5
Kerala	27	26.9
Nagaland	27.5	24.1
Mizoram	28.4	27.7
Goa	34.1	28.6
Haryana	34.6	34.6
Arunachal Pradesh	38.4	24.3
Delhi	40.9	34.7
Himachal Pradesh	43.7	43.6
Rajasthan	44.3	50.6
Meghalaya	44.4	37.9
Andhra Pradesh	45	37.7
Tripura	45.2	42.6
Tamil Nadu	45.7	36.7
Punjab	46	28.7
Uttar Pradesh	47.2	51.7
Gujarat	48.1	45.1
Madhya Pradesh	48.5	55.1
Assam	49.2	36
Karnataka	50.6	43.9
Maharashtra	51.4	49.6
Orissa	52.4	54.4
West Bengal	54.8	48.7
Bihar	62.5	54.4
India	51.5	47

Note: The states are arranged in ascending order of per cent malnourishment among children in 1992-93.
Source: NFHS-1 and NFHS-2.

Appendix Table 2: Child Malnourishment in Indian States, 1998-99 and 2005-06

State	Malnourished Children (Per Cent) 1998-99	2005-06
Sikkim	20.6	22.6
Nagaland	24.1	29.7
Arunachal Pradesh	24.3	36.9
Kerala	26.9	28.8
Manipur	27.5	23.8
Mizoram	27.7	21.6
Goa	28.6	29.3
Punjab	28.7	27
Jammu and Kashmir	34.5	29.4
Haryana	34.6	41.9
Delhi	34.7	33.1
Assam	36	40.4
Tamil Nadu	36.7	33.2
Andhra Pradesh	37.7	36.5
Meghalaya	37.9	46.3
Uattarakhand	41.8	38
Tripura	42.6	39
Himachal Pradesh	43.6	36.2
Karnataka	43.9	41.1
Gujarat	45.1	47.4
West Bengal	48.7	43.5
Maharashtra	49.6	39.7
Rajasthan	50.6	44
Uttar Pradesh	51.8	47.3
Madhya Pradesh	53.5	60.3
Bihar	54.3	58.4
Jharkhand	54.3	59.2
Orissa	54.4	44
Chhattisgarh	60.8	52.1
India	47	45.9

Note: The states are arranged in ascending order of per cent malnourishment among children in 1998-99.
Source: NFHS-2 and NFHS-3.

Notes

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Appendix Table 3: Regression Results

S No	Equation				R^2	Adj R^2
1	MN =	134.58	-4.49 AFB	-0.11 BF1		
		(11.84)	(0.61)	(0.05)	0.59	0.58
		[11.36]	[-7.35]	[-2.28]		
2	MN =	325.02	-91.80 ln AFB	-2.87 ln BF1		
		(35.93)	(12.38)	(1.01)	0.59	0.58
		[9.05]	[-7.41]	[-2.86]		
3	ln MN =	11.35	-2.49 ln AFB	-0.07 ln BF1		
		(0.96)	(0.33)	(0.03)	0.59	0.58
		[11.87]	[-7.56]	[-2.48]		

Note: The sources of data and the definition of variables are as given in the text. The results are on the basis of pooled data with 79 observations. The regression coefficients of all the independent variables in the table are significant at 5 per cent level of significance.

1 Three of the 10 MDGs set by the 191 member states of the United Nations – the reduction of the prevalence of extreme poverty and hunger by half, of child mortality rates by two-thirds and of maternal mortality rate by three-fourths by 2015 – are relevant with regard to child development and care. The first of the MDGs is the eradication of poverty and hunger and the target with regard to hunger is to halve the proportion of the population suffering from hunger in which connection, one of the two indictors used is the proportion of children below the age of five who are underweight.

2 See in this regard, among others, Radhakrishna and Ravi (2004), Council for Social Development (CSD) (2006) and Gragnolati et al (2006).

3 For further details see among others Dreze (2006).

4 For socio-economic differences between the states of India, see among others Planning Commission (2002a).

5 According to Isard et al (1959), "it is well known that for a long time economists, geographers, sociologists, political scientists, city and regional planners and other social scientists have been concerned with the concept of a region. After much heated discussion and protracted writing, they have generally come to subscribe to a procedure that considers the region as a meaningful areal unit varying with the problem to be studied, the inclination of the investigator and other features of a given situation" (pp 5-6).

6 For a recent discussion on hidden hunger in India, see Gopaldas (2006).

7 The World Health Organisation has suggested such a reference population and, as pointed out by Agarwal et al (1991) on the basis of a study for the Nutrition Foundation of India, the WHO standard seems applicable, in general, to Indian children.

8 For further details in this regard, see among others Radhakrishna and Ravi (2004) and Department of Women and Child Development (1998).

9 For a discussion on the limitations of the NFHS data, see among others Shiva Kumar (2007).

10 The creation of three new states-Chhattisgarh, Jharkand and Uttarakhand initially created as Uttaranchal between the second and the third rounds of the NFHS creates the problem of comparability of data between the third and the earlier rounds of the NFHS.

11 Children below the age of three are taken into account because of the finding in global research that 85 per cent of the core brain structure is already formed by that age. For details please see among others Gupta (2006).

12 See in this regard, among others Nair (2005).

13 Planning Commission (2002a) gives these estimates for 1993-94 and 1999-2000, whereas Planning Commission (2007) gives such estimates for 2004-05.

14 Marriages in many parts of India often take place when both the bride and groom are still children. The couple, whose child marriage is conducted by the concerned families, however, start staying together as man and wife only after they attain puberty and hence, the data on first cohabitation after marriage becomes more relevant than merely the age of marriage.

15 It has to be pointed out that data on the possible explanatory variables considered here are not available on a strictly comparable basis from the NFHS for the three points of time considered. In the case of FIL, FPE and FNM, while 1992-93 data refer to ever-married women between 13 and 49 years of age, the 1998-99 and 2005-06 data are for ever-married women between 15 and 49 years of age. Further NFHS-3 data used as indicative of FPE actually are, in the absence yet of comparable data, of those who have completed less than eight years of education. Data on COA are as yet available only for NFHS-1 and NFHS-2. But while the reference group for COA is ever-married women between 20 and 49 years of age in 1992-93, it is such for women between 25 and 49 years of age in 1998-99. Further, in the case of data on COA for 1992-93 for the tribal states where child marriages are not common, the data on median age at first marriage is taken as indicative of COA. For BF2, since data are not yet available for NFHS-3 and have not been collected for five states in NFHS-1, the variable is used only for the year 1998-99. Data on BMI are not available from NFHS-1. Similarly data on antenatal care are also not available on a comparative basis for all the three years. Hence for 1992-93 and 2005-06, we use the data on percentage of mothers who had at least three antenatal visits for their last birth, while for 1998-99, the data relate to women who had all recommended forms of antenatal care including the taking of iron/folic acid tablets during pregnancy in 1-47 months before the survey.

16 Such a procedure seems statistically warranted because the F-statistic with degrees of freedom (8,67) calculated on the basis of the residual sum of squares for log-linear regressions using pooled and "unpooled" data has a value 1.032, much below the critical value at 5 per cent level of significance, giving little ground to reject the hypothesis that the data can be pooled. Further details in this regard and about the regression results can be obtained from the author on request.

17 The coefficient of correlation of FIL with AFB and BF1 are 0.71 and 0.64 respectively while that between AFB and BF1 is 0.54.

18 More or less similar findings at the regional level in India were arrived at in earlier studies by Radhakrishna and Ravi (2004) on the basis of NFHS-2 data and by Shiva Kumar (2007) with the help of data from NFHS-2 and NFHS-3.

19 In Haryana, while the percentage of people below poverty line declined from 25.04 in 1993-94 to 8.74 in 1999-2000, the percentage of malnourished children remained the same at 34.6. For Gujarat, while the prevalence of poverty declined from 24.21 in 1993-94 to 14.07 in 1999-2000, the percentage of child malnourishment declined only very slightly from 48.1 to 45.1 between NFHS-1 and NFHS-2. For corresponding periods and data for Maharashtra, the decline in the prevalence of poverty was high – from 36.86 to 25.02, while the percentage of child malnourishment declined only very slightly from 51.4 to 49.6. Only in the case of a developed state like Punjab did both percentage of poverty and child malnourishment undergo considerable declines over time.

20 The coefficients of correlation of BMI with AFB are – 0.76 and – 0.70 for 1992-93 and 1998-99 respectively.

21 For detailed discussions on the positive impacts of early breast feeding on child nourishment and development, see among others Ghosh (2006) and Gupta (2006).

References

Agarwal, K N, D K Agarwal, D G Benakappa, S M Gupta, P C Khanduja, S P Khatua, K Ramachandran, P M Udani and C Gopalan (1991): *Performance of Affluent Indian Children (Under Fives): Growth Standard for Indian Children*, Nutrition Foundation of India, New Delhi.

Council for Social Development (2006): *India: Social Development Report*, Oxford University Press, New Delhi.

Department of Women and Child Development (1998): 'India: Nutrition Profile', Ministry of Human Rresource Development, Government of India, New Delhi.

Dreze, Jean (2006): 'Universalisation with Quality: ICDS in a Rights Perspective', *Economic and Political Weekly,* Vol XLV, No 34, August 26, pp 3706-15.

Garg, Samir (2006): 'Chhattisgarh: Grassroot Mobilisation of Children, Nutrition Rights', *Economic and Political Weekly*, Vol XLV, No 34, August 26, pp 3694-3700.

Ghosh, Shanti (2006): 'Food Dole or Health, Nutrition and Development Programme', *Economic and Political Weekly*, Vol XLV, No 34, August 26, pp 3364-65.

Gopaladas, Tarun (2006): 'Hidden Hunger: The Problem and Possible Interventions', *Economic and Political Weekly*, Vol XLV, No 34, August 26, pp 3666-70.

Gragnolati, Michele, Caryn Boedenkamp, Meera Sekhar, Monica Dasgupta and Yi Kyong Lee (2006): *India's Malnourished Children: A Call for Reform and Action*, The World Bank, Washington.

Gupta, Arun (2006): 'Infant and Young Child Feeding: An Optimal Approach', *Economic and Political Weekly,* Vol XLV, No 34, August 26, pp 3666-70.

IIPS (1995): *National Family Health Survey 1: India, 1992-1993*, International Insitute for Population Sciences, Mumbai.

– (2000): *National Family Health Survey 2: India, 1998-1999*, International Insitute for Population Sciences, Mumbai.

– (2007): *National Family Health Survey 3: Fact Sheets: India and 29 States,* International Insitute for Population Sciences, Mumbai.

Isard, W, E W Schooler and T Vietorisz (1959): *Industrial Complex Analysis and Regional Development*, Massachusetts Institute of Technology, Cambridge.

Martorell, R and J P Habicht (1986): 'Growth in Early Childhood in Developing Countries' in F Falkner and J M Tanner (eds), *Human Growth: A Comprehensive Treatise*, 3, Plenum Press, New York, pp 241-62.

Nair, K R G (2005): 'Economic Reforms and Regional Disparities in Economic and Social Development in India', report of a research study submitted to the Social and Economic Research Division of the Planning Commission, Government of India (mimeographed).

Planning Commission (2002a): *National Human Development Report*, Government of India, New Delhi.

– (2002b): *Tenth Five Year Plan*, Government of India, New Delhi.

– (2007): *Poverty Estimates for 2004-2005*, Government of India, New Delhi (press release, March 21).

Radhakrishna, R and C Ravi (2004): 'Malnutrition in India: Trends and Determinants', *Economic and Political Weekly*, Vol 39, No 7, February 14, pp 671-76.

Ramalingaswami, V, U Jonson and J Rohde (1997): 'The Asian Enigma' in *The Progress of Nations*, UNICEF, New York.

Rajivan, Anuradha Khati (2006): 'Tamil Nadu: ICDS with a Difference', *Economic and Political Weekly*, Vol XLV, No 34, August 26, pp 3684-88.

Sinha, Dipa (2006): 'Rethinking ICDS: A Rights Based Perspective', *Economic and Political Weekly*, Vol XLV, No 34, August 26, pp 3689-93.

Shiva Kumar, A K (2007): 'Why Are Levels of Child Malnutrition Not Improving?', *Economic and Political Weekly*, Vol XLII, No 15, April 14, pp 1337-45.