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The Changing Pattern of Undernutrition in India

A Comparative Analysis across Regions

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Abstract

This study analyses the changes in prevalence of undernutrition between the 1980s and 1990s at the national and sub-national levels in India and focuses on the rural-urban comparisons. The study exploits the demographic information available in household surveys to derive a household-specific norm as the calorie cutoff point to measure undernutrition, instead of the single per capita norm used in most other studies. The main findings of the study are: There has been an apparent increase in the prevalence of undernutrition over time in rural India, while in urban areas, the prevalence has remained unchanged, or has declined. Also, over time, average intakes in urban areas have surpassed those in rural India in most states. At the same time, there appears to be a decline in the within-state inequalities in energy intakes between 1983 and 1993/94, but an increase (especially in urban areas) between 1993/94 and 1999/2000. Income

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Keywords: calories, consumption, poverty, India

JEL classification: I12, I31, O10, R11

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elasticities of energy demand, estimated using household-level data, are large and significant, especially among the poor. There is some evidence that, despite declining energy intakes in rural areas, there has also been some dietary diversification. However, in comparison with other developing nations, the prevalence of undernutrition is high and the level of dietary diversification is low in India.

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1 Introduction

The proportion of population that is undernourished has been used as one of the main indicators of poverty. Quoting Osmani (1992: 1):

> Being poor almost always means being deprived of full nutritional capabilities, i.e., the capabilities to avoid premature mortality, to live a life free of avoidable morbidity, and to have the energy for work and leisure. The study of poverty is, therefore, very much a study of the people's state of nutrition.

The study of the 'state of nutrition' is attracting increasing attention precisely because undernutrition is not a problem of low incomes alone, although most undernourished people live in poorer countries. However, not all the variation in undernutrition can be explained by income. Indeed, trends in the prevalence of undernutrition may even move in a direction opposite to that suggested by income poverty; a good case in point is India, as elaborated in this study. This is despite the fact that in India, as in many other countries, the poverty lines established to quantify income poverty were initially anchored to a caloric norm.

The early contributions to the literature were in the form of estimates of the calorie-income elasticity: for instance, for India, household level data have been used to estimate the calorie-income elasticity by Behrman and Deolalikar (1987); Subramanian and Deaton (1996); Roy (2001); and Viswanathan and Meenakshi (2003). However, most studies do not explicitly focus on the relationship between the prevalence of undernutrition and income. Our own earlier work was among the first to focus on this issue for the rural sector in India (Meenakshi and Viswanathan 2005). The present study extends this work to include related aspects such as income inequality and dietary diversification; further, it extends the comparison to include urban households.[1]

The present study attempts to describe the pattern of undernutrition in India, disaggregated by state and rural/urban sector, and in the factors associated with these changes. It also attempts to contextualize undernutrition in India in comparison with that in other countries. The underlying objective is to understand the level of and trends in food insecurity in India, at a time when the country has experienced higher economic growth and an improvement in various social indicators.

In measuring undernutrition, we use a household-specific calorie norm, which takes into account the age and gender composition of the household. We believe this to be a superior means of measuring the prevalence of undernutrition, when food intake data are available at the household- (but not individual-) level.

The paper is organized as follows. Section 2 describes the dataset and methodology and section 3 compares undernutrition in India with that found across other developing countries. Section 4 presents evidence on the prevalence of undernutrition and on how

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1 There is other literature that considers the relationship between incomes and nutritional outcomes, which encompass a broader measure of development. It is the focus of studies such as those by Osmani (1997); Haddad *et al*. (2003); and Svedberg (2004). These studies suggest that some reduction in adverse outcomes can be brought about at lower levels of income growth; and highlight the role of environmental pollution, sanitation, female literacy and presence of a well functioning primary health care system under well targeted schemes in achieving improvement in nutritional outcomes.

sensitive the magnitudes are to the alternative measures that we propose. Section 5 focuses on inequality in energy intakes and how these have changed over time. Section 6 considers the relationship between intakes and income, while section 7 discusses whether there may be a tradeoff between the intake levels and dietary quality. Section 8 provides the conclusions.

2 Data and methodology

2.1 Data

The analysis is based on Indian household level (unit record) data on consumer expenditure surveys of the National Sample Survey Organization (NSSO) for the years 1983 (38th round), 1993/94 (50th round) and 1999/2000 (55th round). For two of the years, 1983 and 1999/2000, the unit record data reported energy intakes at the household level. For 1993/94, we computed these following the same procedure as used by the NSSO: that is, by multiplying food intakes with their calorie content using food composition tables as given in GOI (1996).[2] The study focuses on 16 major states in rural and urban India and compares the variations between the states and sectors over time.

Where comparisons across countries are made, we use the dietary energy supply as reported by the Food and Agricultural Organization (FAO) using food balance sheets (FBS). For the more detailed analysis of Indian data, however, we use the NSSO's consumer expenditure surveys. This is because the FBS data are not disaggregated by rural/urban residence, by state, or by income group. The FBS data reflect energy availability (and, as the name implies, are calculated as disappearance from production), whereas the NSSO data capture consumption at the household level. The household surveys do not, however, canvass intakes of individuals within the household, although details of the demographic composition of the household are available.

2.2 Methodology

The prevalence of undernutrition (henceforth POU) is simply the headcount percentage of persons whose energy intakes are below a pre-specified norm. That is, given reported caloric intake (C_h) and the recommended intake level, or norm (Z),

$$POU = \frac{1}{N}\sum_{h=1}^{n} I_h \, w_h \qquad (1)$$

where, $I_h = 1$ if $C_h < Z$ and zero otherwise; n is the number of households sampled, and $N = \sum_{h=1}^{n} w_h$ is the estimated population; w_h is the sampling weight associated with the hth household.[3]

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2 As a consistency check, we replicated results for a subset of states in 1999/2000.

3 Note that for household-level data, w_h is defined as the household-level multiplier × household size.

In computing these headcount ratios, we follow two approaches. The first is to use the familiar per capita norm—with a 2400 calories per day cutoff recommended by the Indian Council of Medical Research (ICMR) for rural India, and a lower 2100 norm that is recommended for urban India. Thus, C_h is defined in per capita terms as household caloric intakes divided by the household size, and Z is either the 2400 or 2100 norm, depending on whether the household is located in a rural or an urban area. We term this the ICMR POU.

We propose and use a second approach, one that recognizes that there are gender and age specificities to energy requirements, and exploits the demographic information contained in the NSSO household surveys. In this alternative computation, Z is replaced by Z_h in (1) above. That is, we first compute household-specific norm (Z_h) and compare *household* intakes (rather than per capita intakes) with this norm (for more details, see Meenakshi and Viswanathan 2005). Thus $I_h = 1$ if $C_h < Z_h$ and zero otherwise. As in the earlier case, h indexes households. The sampling weight (w_h) (as mentioned before) is used to calculate the percentage of *persons* living in households with insufficient intakes, thereby enabling a direct comparison of the two POUs. This modification, necessitated by the absence of data on consumption by individuals within the households, represents an attempt to capture the impact of demographic composition, and changes in this structure, on the prevalence of undernutrition. We term this the DMG POU.

The age- and gender-norms used in this computation are taken from Gopalan, Ramasastri and Balasubramanian (2000) and are as follows for urban areas:

$$Z_h = n_{1h}*713 + n_{2h}*1240 + n_{3h}*1690 + n_{4h}*1950 + b_{1h}*2190 + b_{2h}*2450 + b_{3h}*2640 \quad (2)$$
$$+ g_{1h}*1970 + g_{2h}*2060 + g_{3h}*2060 + am_h*2425\ (2875) + af_h*1875\ (2225).$$

Where the variables represent the number of members in different gender and age groups for a given household h:

n_1 = number of children below 1 year;

n_2 = number of children between 1 and 3 years;

n_3 = number of children between 4 and 6 years;

n_4 = number of children between 7 and 9 years;

$b_1(g_1)$ = number of boys (girls) between 10 and 12 years;

$b_2(g_2)$ = number of boys (girls) between 13 and 15 years;

$b_3(g_3)$ = number of boys (girls) between 16 and 18 years, and

am (af) = number of men (women) above 18 years.

This formulation uses the assumption of *sedentary* life styles in urban areas; for the rural formulation we use the recommended dietary intake levels for *moderate* activity status (as indicated within parenthesis). Note that this affects the coefficients associated with adult males and females only.

It may be noted that this alternative DMG POU approach is related to—but different from—the use of adult-equivalent units to scale consumption. The practice with using adult equivalents is to compute the number of consumer units in each household (for example, an adult man is assigned a weight of 1, an adult woman: 0.77, and so on), and to divide household energy intake by the number of consumer units. This per consumer unit intake (which is by construction higher than the per capita intake) is then compared with a norm of 2700 (for India). The approach being followed in this paper is different: it computes a household-specific norm; i.e., the norm itself varies from household to household. We believe this to be a more sensitive measure of the numbers who have inadequate energy intakes.

In computing the household-specific norm, we use the recommended dietary allowance (RDA). This is in contrast to the recent literature that has argued for a change in the way that the prevalence of undernutrition is measured. It is now argued that the use of RDA to measure population prevalence is likely to overstate the number of malnourished, as the RDA is defined to be the level at which there is 97.5 per cent probability that an *individual*'s nutrient requirements are met. Instead, the use of estimated energy requirement (EER) is recommended; this is typically 20 per cent lower than the RDA (see Barr *et al.* 2003 and Murphy, Barr and Poos 2002).

While this may be applicable for the ICMR POU approach, for the alternative method that we propose above, which compares a household's energy intake with the household's requirement—we continue to use the RDA, as this is the more appropriate measure given the level of disaggregation used in the computation. We also continue to use the RDA-based cutoffs for the ICMR POU, in order to maintain comparability across measures. We also note here (but do not discuss) the parallel literature that focuses on the methodological issues related to measurement of insufficiency in energy intakes; see Kakwani (1992); Palmer-Jones and Sen (2001); and Vaidyanathan (2002).

3 Comparing India with other developing nations

Before examining in detail the pattern of change in energy intakes in India, it is useful to compare the prevalence of undernutrition in India with that in other developing countries. The food balance sheets (FBS) of the FAO provide the basis for such a comparison. As indicated in Table 1 which provides evidence for selected countries, in 1999/2000 average caloric intakes in India ranked 67th among 173 countries, and were about four-fifths the levels found in China, Argentina or the countries in transition. That is, more than half the developing countries had prevalence rates of undernutrition that were lower than those of India.

Not only are rates of undernutrition high in India relative to other countries, the Indian NSS data suggest that average caloric intake in India has been declining over time as we elaborate later (although this is not borne out by the FBS data).[4] Note however that this decrease in intakes is not unique to India; the FAO country-profiles data suggest declining intakes for other countries as well, although these surveys are relatively few in number. The limited evidence from the country nutrition profiles of FAO suggests a similar pattern for several countries. For instance, based on consumption expenditure surveys, the average energy intake declined from 2480 (2160) kcal in 1984/85 to 2380 (2140) in 1987/88 in rural (urban) Pakistan. Similarly based on the national nutritional surveys the per capita average energy intake declined from 2651 (2446) in 1982 to 2294 (2395) in 1992 in rural (urban) China. It is to be noted again that these trends are different from the dietary energy supply values as given in the FBS of FAO. That this decline in caloric intakes in India should have happened when average incomes were increasing reinforces the need to study the Indian situation in greater detail. In fact, even in a cross-country comparison, the correlation between per capita GDP (adjusted for PPP in US dollars for countries with values below US$8000) and POU is not very high (see Figure 1). Also, many developing countries have lower POUs but much higher levels of income poverty than India.[5]

A decline in intakes need not necessarily be indicative of worsening nutritional wellbeing, provided the fewer calories are compensated by ‘better quality’ calories. A crude indicator of dietary quality is the share of calories derived from cereals and tubers; the lower the proportion of these starchy staples in the diet, the better its quality. According to FBS data, a decline in this ratio—indicative of an improvement in diet quality—can be seen in over 85 countries worldwide, with the exception of countries in Sub-Saharan Africa. (Note that Table 1 presents figures for only a subset of countries, not all countries are reported there). This decline in the starchy staple ratio between the early 1980s and 1999/2000 is the steepest in some of the newly industrialized economies (NIEs), but is also indicated in all the South Asian countries. The NSS intake data for India also indicate that the percentage of calories derived from cereals is declining systematically over time, as we note later.

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4 As indicated below, there is a divergence in the mean energy intake figures as reported by the NSSO and the FBS: in the 1970s and 1980s the FBS values are lower than the NSS values, but in the 1990s, the NSS estimates are lower.

Energy intake per capita per day in India, FBS and NSSO estimates

	1971/72	1977/78	1983	1993/94	1999/2000
Dietary energy supply (FBS)[a]	2072	2085	2144	2330	2494
Caloric intake (NSSO)[b]	2170	2370	2190	2132	2283

Sources: [a] FBS (FAO website); [b] cited in Vaidyanathan (2002).

While given the differences in methodology the magnitude of the difference between the two sources may not be considered as very large, the FBS data point to a steady increase in caloric intakes over time, where as the NSS data indicate an almost secular decline in intakes over time. Svedberg (2000: ch. 7), among others, based on pre 1980s consumption survey data for a few countries, notes that FBS data are usually higher (varying between 10 to 40 per cent) than the consumption surveys and the variation increases with the per capita income of the country. However, this work does not compare trends for a particular country.

5 We attempted alternative scatter plots relating income and the proportion of underweight children. The correlation is not very high; and is lower still if one considers countries with GDP below PPP US$2000 per capita. Scatter plots of the prevalence of undernutrition with the proportion of underweight children indicate a higher correlation, but also exhibit a considerable amount of variability across countries. Figures are available from the authors on request.

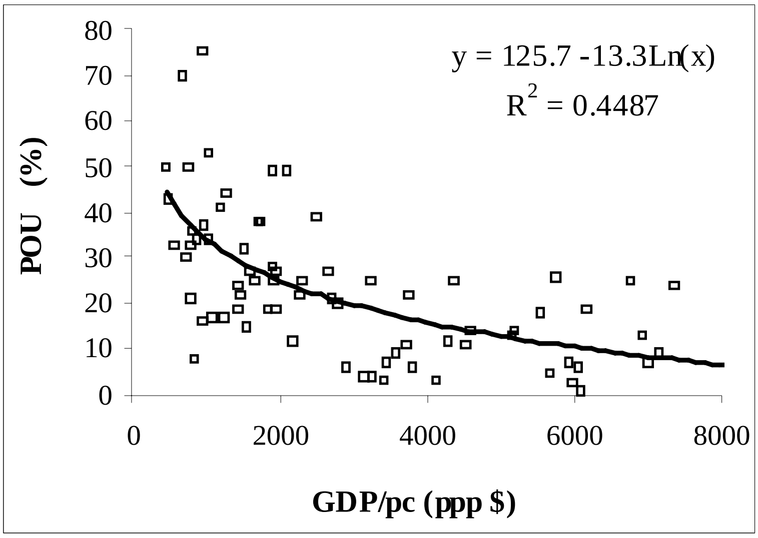
Table 1
Energy intakes per capita, and share of cereals in energy intakes, in select developing countries 1983/84 to 1999/2000

Country	1983/84 Total calories	1983/84 Share (%) of cereal and tubers	1993/94 Total calories	1993/94 Share (%) of cereal and tubers	1999/2000 Total calories	1999/2000 Share (%) of cereal and tubers	Rank in 1999/2000	Country intake as proportion of India's intake in 1999/2000
Argentina	3048	34.7	3149	33.1	3181	35.0	143	1.28
Bangladesh	2017	85.2	2021	85.1	2140	83.2	26	0.86
Brazil	2623	43.5	2849	37.9	3001	34.2	130	1.20
China	2590	78.5	2792	67.3	2979	60.0	127	1.19
Ghana	1762	65.3	2401	72.7	2597	71.4	79	1.04
India	2206	65.8	2328	63.4	2494	60.6	67	1.00
Indonesia	2367	72.6	2826	69.3	2903	69.5	113	1.16
Korea, DPR	2061	59.4	2230	65.0	2164	67.3	29	0.87
Korea, Rep. of	2949	66.0	2967	52.7	3083	50.0	134	1.24
Malaysia	2705	47.9	2853	43.8	2910	45.7	115	1.17
Mexico	3183	48.9	3141	47.2	3147	47.1	139	1.26
Nepal	2075	81.3	2390	79.6	2434	76.7	61	0.98
Nigeria	1914	58.0	2759	67.2	2779	65.9	103	1.11
Pakistan	2208	57.9	2363	55.4	2459	51.1	64	0.99
Philippines	2130	58.4	2229	56.2	2374	55.4	55	0.95
Rwanda	2260	49.5	2087	48.5	1945	48.2	11	0.78
Sri Lanka	2377	60.6	2218	59.1	2356	56.3	51	0.94
Thailand	2320	65.5	2325	52.9	2456	51.6	63	0.98
Turkey	3314	55.5	3481	53.0	3364	52.9	157	1.35
Viet Nam	2282	82.9	2381	79.2	2486	73.6	65	1.00

Note: Each column is the average for the two years under consideration.

Source: Computed from FBS data of FAOSTAT database, available at www://faostat.fao.org

Figure 1
Income-POU for 1999/2000 across developing countries



Source: Authors' computations based on FBS data from FAOSTAT database, available at www://faostat.fao.org. GDP data are from World Bank (2003).

4 Trends in the prevalence of undernutrition in India

Since the beginning of 1980s, the per capita gross domestic product (GDP) in India has grown at an annual rate of 3 per cent. However there were regional differences in terms of both the rate of growth of the state domestic product, as well as the structural composition of growth. Some regions showed larger growth in industry in the 1980s, a pattern which transformed into stagnation in the 1990s, while for other states, the services sector picked up as the manufacturing sector growth showed a decline. Very few states retained agriculture as the largest component of the states' domestic product by 2000 (Shetty 2003), even though per capita food production increased, as did real agricultural wages with inflation rates at fairly low levels. India's human development index (HDI) improved marginally; at the same time, however, inter-state variations in components of HDI seem to have widened (GOI 2001). The states which were growing faster were able to control population growth, improve literacy rates, and reduce infant mortality rates and the proportion of children severely malnourished.

Consider, first, changes in the ICMR POU (Table 2). Note that this measure indicates a high prevalence of undernutrition in the country, much higher indeed than income-based poverty measures would suggest. The ICMR POU is greater than 50 per cent in nearly all states, with undernutrition in urban areas being much lower than in rural areas in most states. Over time, however, the ICMR POU has increased in rural areas, but has declined marginally in the urban areas of most states; this is in contrast to the trends in income poverty, which declined over the same period.[6]

To what extent might the incorporation of a demographically-adjusted norm change these results? The results of this alternative approach, which we term the DMG POU, are also set out in Table 2. The simple demographic adjustment that we propose results in DMG POUs that are much lower than the ICMR POUs, especially in rural areas, where the differences often amount to nearly 10 percentage points. In urban areas, the difference appears to be much smaller, although even here, the difference in some states is as high as 5 percentage points. However, the DMG POU figures continue to be larger than what is indicated by income poverty. Further, both measures yield the same the direction of change in the prevalence of undernutrition.

In an alternative formulation, we use the same sedentary activity RDA in computing the household norms for rural areas (results available on request). Not surprisingly, the impact of this change is to reduce prevalence rates in rural areas dramatically, so much so that there is little difference in the prevalence of undernutrition between rural and urban areas. Indeed, if this procedure is adopted, urban undernutrition is higher in many states. Thus the DMG POU is sensitive to the assumption made regarding moderate or sedentary activities in calculating the household norm. Once again, however, there is no change in the trend in the prevalence of undernutrition over time.

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6 As we show in Meenakshi and Viswanathan (2005, 2003), there is considerable sensitivity of the ICMR POU to the choice of norm used, especially in rural areas, on account of the fact that a considerable mass of the energy intake probability density function is located at around the norm. Indeed, a choice of a cutoff other than the 2400 (rural) not only affects the magnitude but also the direction of change in the prevalence of *depth of deprivation*.

Table 2
Prevalence of undernutrition and poverty, alternative norms
1983, 1993/94, and 1999/2000 (%)

	2400 kcal Norm			Demographically-adjusted norm[a]			Income poverty[b]		
	1983	1993/94	1999/2000	1983	1993/94	1999/2000	1983	1993/94	1999/2000
					RURAL				
Andhra Pradesh	68.4	78.2	80.6	54.5	71.9	74.7	35.9	29.8	10.5
Bihar	67.5	72.4	74.8	52.1	61.8	63.1	71.1	65.6	43.2
Gujarat	72.6	80.0	80.5	61.3	72.7	75.2	39.1	30.6	12.4
Haryana	54.1	57.6	55.1	41.8	44.0	46.7	27.6	28.3	7.4
Himachal Pradesh	44.4	62.1	56.1	30.9	50.9	46.8	23.9	34.0	7.9
Karnataka	63.9	73.9	78.9	52.6	66.8	74.2	39.8	36.9	16.8
Kerala	81.5	79.8	81.2	72.4	75.8	77.2	48.5	33.4	9.4
Madhya Pradesh	62.5	70.5	78.4	46.4	61.1	70.5	53.8	36.3	37.4
Maharashtra	73.1	83.6	83.3	60.3	77.7	76.2	54.5	50.9	23.3
Orissa	70.8	67.5	74.6	57.6	57.5	67.3	66.1	56.8	48.0
Punjab	46.2	57.8	62.8	35.0	48.0	53.4	18.5	15.7	6.0
Rajasthan	54.1	51.7	56.7	40.4	38.1	41.5	46.7	26.2	13.5
Tamil Nadu	80.5	83.7	86.5	72.8	81.2	85.2	59.1	42.7	20.0
Uttar Pradesh	58.4	63.2	64.4	43.4	48.0	50.8	50.8	41.3	31.0
West Bengal	76.0	69.7	75.6	65.6	58.2	69.0	66.7	52.4	34.3

	2100 kcal Norm			Demographically-adjusted norm(a			Income poverty(b		
	1983	1993/94	1999/2000	1983	1993/94	1999/2000	1983	1993/94	1999/2000
					URBAN				
Andhra Pradesh	63.2	62.4	61.1	59.4	58.8	57.8	36.5	36.1	27.4
Bihar	52.3	48.1	51.9	47.3	42.3	47.1	51.9	44.4	34.0
Gujarat	62.4	60.9	61.4	58.8	55.5	60.1	39.0	29.5	14.7
Haryana	51.4	54.9	55.3	48.1	46.8	50.8	28.1	12.3	10.0
Himachal Pradesh	36.1	31.5	27.1	44.6	27.4	24.9	9.6	5.6	4.6
Karnataka	55.9	59.9	60.9	53.6	56.7	60.0	46.3	34.3	24.7
Kerala	66.1	65.8	63.2	64.8	63.1	60.2	27.1	32.1	19.8
Madhya Pradesh	56.1	56.7	58.8	50.2	50.8	53.8	52.8	46.6	38.5
Maharashtra	65.4	63.9	62.3	65.3	61.2	61.2	40.7	33.3	26.7
Orissa	48.3	41.5	41.8	39.0	38.3	38.9	52.9	39.7	43.3
Punjab	58.8	57.8	51.8	52.2	53.4	51.3	22.1	7.2	5.5
Rajasthan	49.9	48.4	45.4	45.4	42.0	40.1	37.8	33.1	19.4
Tamil Nadu	72.9	67.9	66.8	69.6	65.5	64.3	48.0	39.8	22.2
Uttar Pradesh	61.7	55.5	56.3	56.4	49.0	52.0	48.2	36.5	30.8
West Bengal	61.2	53.0	58.3	60.1	51.2	58.8	28.9	21.4	14.7

Notes: [a] This is based on the household specific norm as discussed in section 2.
[b] The income poverty rates are calculated using the official poverty lines

Source: Computed from NSS unit record data for the 38th, 50th and 55th rounds.

Table 3
Spearman's rank correlation between DMG-POU and select variables

	Child to adult ratio	ICMR-POU	Prop of income poor	Per capita total expenditure	Cereal share
			RURAL		
1983	-0.58 (0.02)	0.99 (0.00)	0.56 (0.03)	-0.35 (0.21)	0.34 (0.21)
1993/94	-0.64 (0.009)	0.99 (0.00)	0.36 (0.18)	-0.24 (0.58)	0.08 (0.75)
1999/2000	-0.68 (0.005)	0.97 (0.00)	0.18 (0.52)	-0.08 (0.79)	0.13 (0.71)
			URBAN		
1983	-0.41 (0.12)	0.96 (0.00)	-0.10 (0.72)	0.19 (0.49)	0.003 (0.98)
1993/94	-0.29 (0.28)	0.97 (0.00)	0.11 (0.70)	0.24 (0.39)	-0.18 (0.52)
1999/2000	-0.40 (0.14)	0.96 (0.00)	0.04 (0.88)	0.39 (0.14)	-0.17 (0.55)

Note: Values in parentheses are p-values.

To examine whether more generally the ranking of states differs significantly by measure of deprivation used, Table 3 presents the rank correlation coefficients between the two measures of POU, income poverty, and related statistics. The rank correlation between the ICMR POU and the DMG POU is above 0.9 in all the three years. Thus while the use of the DMG POU dramatically lowers the headcount per cent of insufficient intakes, the ranking of states is unaltered. Also noteworthy is the lack of correlation between the DMG POU and income poverty, and between the DMG POU and per capita income. As indicated in Table 3, while the rank correlation coefficient is positive, it is insignificant except for rural India in 1983. We return to this lack of correlation between income poverty and the POU subsequently.

Interestingly, the DMG POUs are larger in states where there are fewer children relative to adults. As shown in Table 3, the rank correlation between DMG-POU and proportion of children to adults is negative. This is somewhat puzzling since *cet. par.* one would expect the per capita energy intakes to be higher in households with a higher proportion of adults. This suggests that the sensitivity of the household energy intakes to changes in demographic structure is much lower than the sensitivity of the household norm; that is, with more adults, household-level intakes increase less than the household's energy requirements.[7]

The increase in the POU over time in rural areas is consistent with a decrease in the mean per capita energy intake that is seen in several states, as indicated in Table 4. Similarly, the reduction in the POU in urban areas is consistent with increased urban intakes. There are, of course, state-specific trends in that not all the states show the same secular trend as the all India pattern: the terminal period mean intake values are lower than those in initial period for 12 rural states; in urban areas, however, only four states show a similar pattern as all India.

[7] We are grateful to a referee for pointing this out, who further notes that the energy requirements for adult males are quite high relative to that of other members of the household (except boys in the age group of 13-15 and 16-18 years).

A comparison of the initial and last periods glosses over the interesting changes that appear to have occurred in the intervening years. For example, in some states, while average intakes have declined between 1983 and 1993/94, they appear to have recovered by 1999/2000. This is especially evident in urban areas—among the states which exhibited a decline between 1983 and 1993/94, subsequently, in six states intakes recovered enough to equal or surpass the intake levels of 1983.

Table 4
Mean and distribution of per capita calorie intakes across states in rural and urban India, 1983, 1993/94 and 1999/2000

	Mean (kcal)			Coefficient of variation		
States	1983	1993/94	1999/2000	1983	1993/94	1999/2000
			RURAL			
Andhra Pradesh	2204	2052	2021	0.387	0.321	0.354
Bihar	2190	2115	2121	0.370	0.298	0.629
Gujarat	2110	1994	1986	0.389	0.319	0.297
Haryana	2538	2491	2455	0.462	0.616	0.440
Himachal Pradesh	2613	2325	2454	0.384	0.301	0.533
Karnataka	2260	2073	2028	0.466	0.320	0.460
Kerala	1885	1966	1982	0.450	0.336	0.332
Madhya Pradesh	2324	2165	2062	0.435	0.331	0.463
Maharashtra	2143	1940	2012	0.357	0.482	0.433
Orissa	2103	2199	2119	0.358	0.300	0.281
Punjab	2672	2418	2381	0.464	0.351	0.368
Rajasthan	2434	2470	2425	0.635	0.298	0.364
Tamil Nadu	1861	1884	1826	1.054	0.471	0.396
Uttar Pradesh	2399	2307	2327	0.414	0.343	0.582
West Bengal	2027	2211	2095	0.505	0.284	0.349
All India	2222	2153	2130	0.500	0.359	0.479
			URBAN			
Andhra Pradesh	2010	1993	2052	0.411	0.298	0.525
Bihar	2133	2188	2169	0.328	0.279	0.369
Gujarat	2000	2028	2058	0.346	0.285	0.533
Haryana	2242	2141	2172	0.458	0.301	0.624
Himachal Pradesh	2430	2416	2655	0.432	0.272	0.652
Karnataka	2124	2026	2046	0.491	0.309	0.328
Kerala	2050	1966	1995	1.041	0.333	0.335
Madhya Pradesh	2139	2083	2132	0.346	0.358	1.383
Maharashtra	2030	1990	2039	1.416	0.286	0.476
Orissa	2220	2262	2302	0.313	0.270	0.452
Punjab	2101	2090	2198	0.482	0.296	0.355
Rajasthan	2255	2185	2337	0.459	0.283	0.881
Tamil Nadu	2140	1923	2032	1.000	0.357	0.663
Uttar Pradesh	2044	2142	2131	0.357	0.302	0.604
West Bengal	2040	2131	2135	0.389	0.272	0.642
All India	2090	2058	2106	1.590	0.479	0.665

Source: Computed from NSS unit record data for the 38th, 50th and 55th rounds.

Also interesting are the rural-urban comparisons: mean urban intakes were lower in most states in 1983, a result consistent with the largely sedentary urban lifestyles, although the difference was nowhere close to the 300 calorie rural-urban difference in the ICMR norm. Over time, the gap between rural and urban intakes declined; in fact, by 1999/2000 urban intakes were larger than the rural in a majority of the states. This phenomenon itself merits a separate investigation; suffice it to note here that this may be one indication that urban India is headed for the 'double' burden of malnutrition with conditions of overnutrition and undernutrition coexisting. Among the states that continued to have a larger rural intake than urban were the ones with larger share of agriculture in their domestic product compared to the other states.[8]

5 Trends in inequality

A simple and widely-used measure of the inequality in nutrient intakes is the coefficient of variation (CV). Table 4 also presents changes in the CV for each of the 16 states and for rural and urban areas separately.[9] The CV values range between 0.3 to 0.5 in rural areas in all the three years. This is also true in urban states, except in 1999/2000 when the CV was substantially higher. Over time, for both rural and urban sectors, the CV declined in 1993/94 as compared to 1983 in a large number of states. In rural India, this decline reflects a decline in standard deviation, given that declining mean intakes should have been reflected in higher CVs.[10] Between 1993/94 and 1999/2000, the CV increased for nine rural states; in six of these mean intakes had declined. In urban areas, however, the CV increased in all states, despite higher intakes.

Also of note is the fact that the CV of intakes in urban areas is higher than that in rural areas in 1999/2000. This is somewhat unexpected since it is widely perceived that a food safety-net, in the form of the public distribution system, caters primarily to the urban areas in India, and contributes to the increased intakes of the poor. Indeed in Kerala and Tamil Nadu, states where the public distribution system is acknowledged to work better than in other states, the CV has declined over time. This is also true in the case of rural Andhra Pradesh, another state where the reach of the food-safety net is demonstrably better (see for example, Dutta and Ramaswami 2001).

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8 When the mean intakes are adjusted for demographic changes, the reversal in trend is observed in 1993/94 itself, and in 1999/2000 only two states, Harayana and Punjab, have higher values in rural. These were the only two states which not only have a higher than average share of agriculture in their domestic product but were also among those few states where the growth rates in agriculture were large during the past decade.

9 Related measures like the Gini coefficient or the ratio of mean intakes of the richest quintile to the lowest quintile are also discussed elsewhere (Meenakshi and Viswanathan 2003; Viswanathan and Meenakshi 2004).

10 This is consistent with our earlier results that demonstrated the 'pinching-in' of both tails of the probability density of energy intakes over time (Viswanathan and Meenakshi 2003).

6 Changes in income elasticities of nutrient demand

As discussed in section 4 above, the rank correlation of the POU with per capita total expenditure is insignificant. Also, the income poverty rates are much lower than both the ICMR and DMG based measures of the POU.[11] One implication is that a large number of people above the poverty line also have insufficient energy intakes, which is clearly an inappropriate inference, especially if there is a substitution of dietary

Table 5
Calorie income elasticities in rural and urban India

	Rural			Urban		
	Q1	Q5	All	Q1	Q5	All
Andhra Pr.	0.771 (0.11)	0.223 (0.06)	0.487 (0.03)	0.429 (0.02)	0.258 (0.02)	0.337 (0.01)
Bihar	0.709 (0.04)	0.390 (0.02)	0.544 (0.01)	0.654 (0.05)	0.167 (0.04)	0.400 (0.02)
Gujarat	0.573 (0.04)	0.294 (0.03)	0.423 (0.02)	0.469 (0.03)	0.125 (0.02)	0.287 (0.01)
Haryana	0.555 (0.05)	0.445 (0.07)	0.496 (0.03)	0.492 (0.04)	0.229 (0.04)	0.345 (0.02)
Himachal Pr.	0.373 (0.06)	0.347 (0.07)	0.360 (0.03)	0.365 (0.06)	0.180 (0.05)	0.263 (0.03)
Karnataka	0.638 (0.04)	0.345 (0.03)	0.485 (0.02)	0.514 (0.03)	0.145 (0.03)	0.310 (0.02)
Kerala	0.609 (0.03)	0.267 (0.02)	0.430 (0.01)	0.596 (0.03)	0.175 (0.02)	0.363 (0.01)
Madhya Pradesh	0.551 (0.04)	0.394 (0.03)	0.469) (0.02)	0.490 (0.03)	0.212 (0.03)	0.341 (0.01)
Maharashtra	0.556 (0.04)	0.242 (0.04)	0.388 (0.02)	0.383 (0.02)	0.133 (0.01)	0.244 (0.01)
Orissa	0.587 (0.02)	0.301 (0.02)	0.435 (0.01)	0.551	0.229	0.379
Punjab	0.622 (0.04)	0.352 (0.02)	0.480 (0.02)	0.504 (0.05)	0.283 (0.05)	0.388 (0.02)
Rajasthan	0.537 (0.03)	0.505 (0.03)	0.520 (0.01)	0.530 (0.04)	0.206 (0.03)	0.358 (0.02)
Tamil Nadu	0.592 (0.03)	0.270 (0.03)	0.422 (0.02)	0.614 (0.03)	0.234 (0.02)	0.409 (0.02)
Uttar Pradesh	0.595 (0.05)	0.330 (0.03)	0.458 (0.02)	0.540 (0.03)	0.225 (0.03)	0.372 (0.01)
West Bengal	0.643 (0.02)	0.366 (0.02)	0.496 (0.02)	0.337 (0.06)	0.276 (0.07)	0.304 (0.02)

Note: Values in parentheses are standard errors;
Q1 = Lowest income quintile; Q5 = Richest income quintile.

Source: Computed from NSS unit record data for the 38th, 50th and 55th rounds.

[11] Though the difference between income poverty and POU persists with alternative measures such as the poverty gap ratio and the squared poverty gap, the difference declines with the power of the FGT measure used (results not reported here).

quality for caloric quantity. Further, the POU across states in rural India has increased, despite increases in real incomes over time. Does this imply that energy intakes are only weakly affected by income? In order to explore this linkage further we look at the relationship between income and calories at the household level using the unit record data.

In particular, Table 5 sets out the expenditure elasticity of demand for energy intakes in 1999/2000. We estimate these separately for the poor (first quintile) and the rich (fifth quintile) (Meenakshi and Viswanathan 2005; 2003). The income elasticities of energy demand are significant but magnitudes decline with the level of income. This is evident in several ways: first, states with lower per capita total expenditures exhibit higher elasticities than those with larger incomes; second, rural income elasticities are higher than those in urban areas. Finally, in any particular state, the poorer income quintiles have more elastic income elasticities of calorie demand than richer income quintiles. The decline in magnitude of the elasticities across income quintiles is greater in rural areas than in urban. Rural households in Himachal Pradesh are the only exception to this, with an elasticity of 0.3 across all the quintiles. Thus there is a positive association between expenditure levels and the level of energy intakes, especially among the poor, and among poorer regions.

Increases in real incomes are likely to result in declining food shares by Engel's Law and a more diversified diet by Bennett's Law, and each implies higher welfare. The next section tries to understand how the changes in dietary patterns can explain the trends in mean energy intakes observed in rural and urban areas.

7 Diet quality

One 'explanation' for declining mean intakes is that dietary quality is improving, in that there is a tradeoff between the quantity of calories and the quality of its composition. It is suggested that nutritional wellbeing need not be compromised if fewer calories are compensated by 'better' calories. One indicator of dietary quality is the share of calories derived from cereals and tubers; the lower the proportion of starchy staples in the diet, the better its quality. The NSS intake data for India do indicate that the percentage of calories derived from cereals is declining systematically over time (Table 6).

While diets continue to be cereal-based, that is, cereals account for the bulk of energy intakes but over time, this proportion has declined (Table 6). The cereal share in total calories declined in all states between 1983 and 1999/2000 in both rural and urban India. The decline in the urban sector was more modest; urban diets were more diversified than the rural even in 1983. However, with very little variation across states in any given period or sector, the rank correlation of POU with cereal share is not significant as shown in Table 3.

The declining cereal share in calories reflects a secular decline in the intake of cereals, especially in rural areas, where the per capita per month cereal intake declined from 14.9 kg to 13.4 kg to 12.7 kg over the two decades, i.e., about 1 kg in the first ten-year period and about the same amount in the next five years. The decline in urban areas was rather marginal (perhaps due to the initial level itself being lower). Similar changes have been noticed in China with per capita monthly consumption (for adults in the age 20 to

45) declining from 22.2 (16.5) kg to 17.4 (14.7) kg in rural (urban) areas between 1989 and 1997 (Popkin 2003).

In turn, this decline in cereal intake is associated with a decline in coarse cereals intake. Thus, even within cereals, there has been a switch away from coarse cereals (which often have negative income elasticities of demand) toward the more ‘superior’ rice and wheat. The average per capita per day intake of cereals other than rice and wheat declined from 130 (40) grams in 1983 to 50 (50) grams in 1999/2000 for rural (urban) India. In a few states the decline in coarse cereals is compensated to some extent by the increase in refined cereals, thereby reducing the overall decline in cereal intake. In some states, coarse cereals are not preferred and hence there is either no decline in cereal intake or the decline is mainly from the refined ones. This phenomenon is not unique to India and has also been noted in other parts of the world including China. A part of the explanation may also have to do with the decline in the availability of coarse cereals—from 83 grams to 61 grams per day over this period (GOI 2003).

The declining dependence on cereals is a more widespread phenomenon, and can be found in many other developing countries. While a detailed examination of the constituents of the non-cereal foods and of their implications for the nutrition transition is the subject of a separate paper; suffice it to note that these trends can be discerned even among the poorest two quintiles in both rural and urban areas. These are, all in all, consistent with improvements in dietary quality.

Table 6
Share of cereals in energy intake (per cent)

	Rural		Urban	
	1983	1999/2000	1983	1999/2000
Andhra Pradesh	84.2	72.1	68.6	62.5
Bihar	83.7	74.3	73.3	67.4
Gujarat	67.1	56.7	53.9	47.1
Haryana	66.6	52.6	58.6	48.9
Himachal Pradesh	71.6	59.8	53.9	47.9
Jammu & Kashmir	79.4	63.5	69.0	29.7
Karnataka	80.2	64.9	64.7	57.8
Kerala	71.4	57.4	62.8	54.2
Madhya Pradesh	80.0	71.6	66.0	59.5
Maharashtra	76.1	63.8	58.7	53.0
Orissa	88.0	81.8	74.8	73.1
Punjab	60.0	50.5	52.9	48.0
Rajasthan	77.1	65.3	64.6	56.3
Tamil Nadu	83.0	67.1	67.1	55.8
Uttar Pradesh	75.2	66.7	65.6	57.6
West Bengal	83.1	74.4	67.1	60.3

Source: computed from NSS unit record data for the 38th, 50th and 55th rounds.

8 Summary and conclusions

There were about 800 million undernourished people in the developing world in 1999/2000 out of which the largest number lived in India, accounting for 26.7 per cent followed by China with 17 per cent (FAO 2003). While China made significant progress during the decade of the 1990s, reducing the POU from 17 per cent to 11 per cent, the decline in India in comparison was much more modest. Nevertheless, as many as half the developing countries have POUs that are lower than that India; only in Sub-Saharan Africa are these prevalences higher.

Given such a scenario, and the concern that many countries, including India, may not be in a position to meet the millennium development goals (MDGs), this paper examines the pattern of undernutrition across states in India over the two decades ending in 1999/2000, based on large-scale household level data which have information on caloric intakes.

In doing so, we propose and implement an alternative measure of the prevalence of undernutrition, the DMG-POU, that explicitly factors in the demographic composition of the household, even though individual-level intakes are not available. We suggest that this is a superior method for calculating the prevalence of undernutrition; the resulting estimates are much lower than what is suggested by the more traditional methods for calculating the POU.

Our analysis suggests that rural India has seen a decline in energy intakes, while urban India has seen a small increase, although there are substantial state-specific variations. This has led to a reversal in the observed pattern of urban caloric intakes which were lower than the rural in the early 1980s compared to the late 1990s for most states except two agriculturally dominant states.

The results on the proportion of undernourished are not in consonance with changes in income poverty rates. For both rural and urban states the percentage of undernourishment is far higher than the income poverty rates. Further, over time in rural India the POU has increased, while income poverty rates have declined. Interestingly, a decline in inequality in caloric intakes is observed in both rural and urban between 1983 and 1993/94. However, between 1993/94 and 1999/2000, inequalities appear to have increased in urban areas.

Thus, at an aggregate level, the relationship between income and undernutrition is weak, in that the rank-order correlations across states between measures of income/income poverty and prevalence of undernutrition are statistically insignificant, however, results based on household-level data reverse this conclusion. Income elasticity estimates for the poorer households are high, and certainly not close to zero; this indicates that improvements in income would still play a role in improving energy intakes, especially among the poor.

There is some evidence to suggest that despite declining intakes, attributed almost entirely to lower cereal intakes, there is some improvement in dietary quality, as reflected by the decreasing reliance on cereals and tubers as the principal energy source. There is need for further analyses to understand this change, and look at the contribution of other foods like meat, egg, fruits and vegetables. The extent to which the greater intakes of other components of the food basket, which tend to be important sources of proteins and micronutrients, perhaps compensate for the decline in calories is yet to be studied. The increase in urban energy intakes also needs separate analysis, given the recent concerns related to the problem of overnutrition in developing countries.

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