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Food Consumption and Nutritional Status in India: Emerging Trends and Perspectives

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Abstract

The paper reviews the trends over three decades in the consumption of cereals, calories and micronutrients and nutritional status based on anthropometric measures using the data sets of NSS, NNMB and NFHS. It provides an explanation for the slow growth of nutrient intake and slow reduction in malnutrition. The paper demonstrates that multiple factors influence the nutritional well-being of a child and argues that besides improving the income of a household, there is a need to improve the health and educational status of mothers.

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This paper proposes to review the trends in food/nutrient intake, nutritional gaps and nutritional well-being in India using a wide range of input and outcome measures. The multidimensionality of nutritional well-being necessitates the use of multiple indicators for nutritional assessment. The inadequacy of most popularly used measures based on food intake for nutritional assessment has now been widely recognised. Various factors like non-nutrient food attributes, privately and publicly provided inputs and health status of the individual also affect nutritional status (Martorell and Ho, 1984). Sukhatme, in his pioneering studies on malnutrition, explained that the conversion efficiency of food into energy of an individual depends on his/her access to safe drinking water, health care and environmental hygiene. In the case of outcome measures, anthropometric measurements, clinical signs of malnutrition, biochemical indicators, and physical activity are suggested indicators of nutritional well-being. Among these, anthropometric measurements should be preferred since body measurements are highly sensitive to even minor levels of malnutrition whereas biochemical and clinical indicators are useful only when the level of malnutrition is extreme. This paper analyses the consumption of cereals, calories and micronutritents and nutritional status based on outcome measures such as incidence of under nutrition among children and chronic energy deficiency among adults. It also analyses the proximate determinants of food consumption and malnutrition.

Trends in Cereal Consumption

The NSS data reveal that the per capita cereal consumption has been declining since the early seventies despite a significant increase in per capita cereal production (Radhakrishna and Ravi, 1992; Rao, 2000). The cereal consumption declined in rural areas from 15.35 kg/per capita/month in 1970-71 to 12.7 kg in 1999-00 and from 11.4 to 10.4 kg in urban areas. The declining trend is discernible in most of the states particularly in Punjab and Haryana where the decline is as much as 6 kgs per capita per month between 1970-71 and 1999-00. What is most conspicuous is the low per capita intake of cereals in a prosperous state like Punjab (10.58 kg. per day in rural and 9.21 kg. per day in urban areas in 1999-00) and higher intake in a backward state like Orissa (15.09 kg. per day in rural and 14.51 kg. per day in urban areas). The sharp fall in cereal consumption has been attributed to changes in consumer preferences from food to non-food items, and within the food group from cereals to non-cereal food items and from ‘coarse’ to

'fine' cereals (Radhakrishna and Ravi, 1992). More recently, Rao (ibid.) has shown that the decline in cereal consumption was greater in the rural areas, where improvement in rural infrastructure made other food and non-food items available to the rural households. Rao further observes that a reduction in the intake of cereals on this account should not be taken as deterioration in biological welfare and argues that reduction in hard manual work in agriculture due to farm mechanization might have put downward pressure on the nutritional requirements. The structural factors underlying the changing preferences and their implications for nutritional well-being are little researched and there are severe knowledge gaps.

Household Food Consumption and Calorie Intake

The per capita cereal expenditure at constant prices declined in rural and urban areas during the 70's and 80's, but the decline was greater in rural areas than in urban areas (Table 1). However, the fall in cereal consumption was more than compensated by the increased consumption of non-cereal food items and as a result per capita calorie intake increased at a moderate rate during the 70's and 80's in rural and urban areas (Table 2). However, this did not continue in the 90's when the per capita calorie intake tended to stagnate. The slow down of non-cereal food intake growth in the 90's should be a matter of concern. This is due to changing food preferences towards non-food items in the 90's as well as adverse cereal price movements. These tendencies may lead to demand deficiency in the agricultural sector.

In the case of the bottom 30 per cent of the population, there was some improvement in the calorie intake in the rural and urban areas in the seventies, however not commensurate with the increase in their per capita total expenditure. In the eighties and nineties the per capita intake of calories nearly levelled off despite a moderate improvement in their real per capita expenditure. There has been a substantial diversification of the consumption basket in favour of non-cereal food items as well as non-food items. These tendencies would not be a major cause of concern if the intake levels were nutritionally adequate. From a nutritional perspective, one can justify diet diversification only if it enhances nutritional status by increasing the intake of micro nutrients, even though it may not add much calories to the diet. Given the state of knowledge, it is extremely difficult to infer about the impact of dietary diversification on the nutritional status. However, what is worrisome is the low per capita calorie intake (1600-1700 k.cal/day) of the bottom 30 per cent which falls short of even a conservative norm. What is still worse, intra-family distribution of food is inequitable in the poor households and the pre-school children get much less than their physiological needs as compared to adult males and females (NNMB 2000).

Table 1: Annual Compound Growth Rate in Per Capita Real Consumption Expenditure (%)

(at 1990-91 prices)

	Bottom 30%	Middle 40%	Top 30%	All classes
Rural				
Cereals				
1970-1989	0.10	-0.55	-1.26	-0.67
1990-2000	-1.38	-2.30	-2.30	-2.06
1990-2001	-1.38	-2.04	-2.26	-2.04
Non-cereals				
1970-1989	2.81	2.24	1.88	2.13
1990-2000	0.42	0.42	0.10	0.26
1990-2001	0.95	0.77	0.54	0.68
Total Food				
1970-1989	1.11	0.72	0.58	0.73
1990-2000	-0.55	-0.78	-0.68	-0.69
1990-2001	-0.29	-0.56	-0.36	-0.42
Total Expenditure				
1970-1989	1.73	1.48	1.65	1.60
1990-2000	1.11	1.03	1.11	1.08
1990-2001	1.48	1.31	1.03	1.20
Urban				
Cereals				
1970-1989	0.08	-0.32	-0.18	-0.17
1990-2000	-0.77	-0.80	-0.06	-0.53
1990-2001	-0.93	-0.91	-0.34	-0.72
Non-cereals				
1970-1989	2.17	1.91	0.85	1.38
1990-2000	0.75	0.59	0.28	0.46
1990-2001	0.93	0.72	0.39	0.58
Total Food				
1970-1989	1.15	1.05	0.60	0.86
1990-2000	0.13	0.16	0.22	0.18
1990-2001	0.18	0.21	0.24	0.22
Total Expenditure				
1970-1989	1.75	1.88	1.99	1.92
1990-2000	2.09	2.71	3.55	3.08
1990-2001	2.32	2.83	3.29	3.01

Note: Growth rates are from semi-log trend equations estimated from the NSS data.
Source: Radhakrishna et al (2004).

Table 2: Average Per Capita Calorie Intake and its Growth Rate in India

Decile Classes	**K. Cal./day**				
Rural	**1972-73**	**1977-78**	**1993-94**	**1999-2000**	**1972-2000 Percentage Annual Growth Rate**
Bottom 30%	1504	1630	1678	1696	0.6
Middle 40%	2170	2296	2119	2116	-0.1
Top 30%	3161	3190	2672	2646	-0.8
All groups	2268	2364	2152	2149	-0.3
Urban					
Bottom 30%	1579	1701	1701	1715	0.4
Middle 40%	2154	2154	2438	2136	-0.0
Top 30%	2572	2979	2405	2622	0.1
All groups	2107	2379	2071	2156	0.1

Source: Radhakrishna et al (2004).

Child Food and Nutrient Intake

National Nutrition Monitoring Bureau (NNMB) carried out individual repetitive diet surveys in rural areas of Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat and Orissa in the same villages in 1975-79, 1988-90 and 1996-97. Table 3 presents the food and nutrient intakes based on these surveys in the age groups 1-3 years and 4-6 years. The NNMB had also carried out diet and surveys for children in the integrated tribal areas of the above states in 1988-89 and 1998-99. These are analysed in Radhakrishna and Ravi (2005).

Table 3 indicates that in rural areas, nutrient intake of children improved between the periods 1975-79 and 1988-90, but deteriorated between 1988-89 and 1996-97. The consumption of food items other than vegetables and oil and fats declined in both the age groups. The consumption of vegetables and edible oils either stagnated or marginally improved. In 1996-97, for 1 – 3 years age group children in rural areas, the intake gap from recommended dietary allowance was as high as 22 per cent for cereals and 78 per cent for milk and milk products. The gap was equally worse for other food items. It needs to be highlighted that in percentage terms, the gap in the consumption of milk, fats and oils, and sugar was much larger than that of cereals. These food gaps are associated with micronutrient deficiencies.

The calorie intake dropped by 11 per cent between 1988-90 and 1996-97 in the age group 1-3 years and 4 per cent in the age group 4 – 6 years (Table 3). The decline in calorie intake could be attributed to the reduction in the cereal consumption. In 1996-97, the calorie intake of the 1-3 year old children fell short from the RDA by as much as 35 per cent. There was no perceptible improvement in the intake of micronutrients. However, intake of Vitamin-A

and Vitamin-C improved between 1988-90 and 1996-97, but restored at best to the level of 1975-79.

Table 3: Average Intake of Selected Food Items (g/day) and Nutrient Intake (per day) among Rural
(Children in the NNMB Sample States)

Food Items (gm/day)

	1 - 3 years				4 - 6 years			
	1975-79	**1988-90**	**1996-97**	**RDA**	**1975-79**	**1988-90**	**1996-97**	**RDA**
Cereals and millets	158.0	176.0	135.3 (22%)	175.0 *	228.0	263.0	243.0 (10%)	270.0 *
Pulses	14.0	14.0	13.0 (37%)	35.0 +	14.0	14.0	13.0 (63%)	35.0 +
Vegetables	35.0	35.0	35.0 (42%)	60.0 ++	52.0	51.0	64.0 (20%)	80.0 ++
Milk and milk Products	74.0	68.0	66.0 (78%)	300.0	57.0	62.0	59.0 (76%)	250.0
Fats and oils	5.0	5.0	5.0 (67%)	15.0	6.0	7.0	8.0 (68%)	25.0
Sugar and jaggery	12.0	16.0	15.0 (50%)	30.0	14.0	18.0	17.0 (57%)	40.0

* For cereals, + pulses and legumes and ++ leafy and other vegetables.

Nutrient Intake (per day)

	1 - 3 years				4 - 6 years			
	1975-79	**1988-90**	**1996-97**	**RDA**	**1975-79**	**1988-90**	**1996-97**	**RDA**
Calorie (K.cal.)	834.00	908.00	807.00 (35%)	1240.00	1118.00	1260.00	1213.00 (28%)	1690.00
Protein (g)	22.80	23.70	20.90 (5%)	22.00	30.20	33.90	31.20 (- 4%)	30.00
Calcium (mg)	304.00	258.00	239.00 (52%)	500.00	359.00	147.00	298.00 (25%)	400.00
Iron (mg)	10.20	10.20	8.70 (28%)	12.00	15.00	15.30	20.50 (- 14%)	18.00
Vitamin A (mg)	136.00	117.00	133.00 (67%)	400.00	159.00	153.00	205.00 (49%)	400.00
Thiamin (mg)	0.50	0.52	0.40 (33%)	0.60	0.76	0.83	0.70 (22%)	0.90
Riboflavin	0.38	0.37	0.40 (43%)	0.70	0.48	0.52	0.60 (40%)	1.00
Niacin (mg)	5.08	5.56	4.60 (43%	8.00	7.09	8.40	7.40 (33%)	11.00
Vitamin C (mg)	15.00	14.00	15.00 (50%)	30.00	20.00	23.00	25.00 (37%)	40.00

Figures in the parenthesis are percentage shortfall of nutrient intake from Recommended Dietary Allowance (RDA).
Source: Radhakrishna and Ravi (2005)

The average nutrient intake was substantially below the recommended level for all nutrients other than proteins, especially Calcium, Iron, Vitamin-A, Thiamin, Riboflavin, Niacin and Vitamin-C. The picture would be much more disquieting had we considered the distribution rather than average intake. According to NNMB (2002), in the eight NNMB sample states in 2000-01, 38 per cent children consumed calories less than 50 per cent of the RDA; 70 per cent of children consumed

calcium less than 50 per cent of RDA; 72 per cent of children consumed iron less than 50 per cent of RDA, 88 per cent consumed Vitamin-A less than 50 per cent of RDA and 66 per cent consumed Vitamin-C less than 50 per cent of RDA. The calorie deficiency of the malnourished children can be met without creating much pressure on the present supply of calories. Radhakrishna and Ravi (2005) show that about 1 million tonne of cereals per year would be enough to meet the calorie deficiency of the malnourished children. It is far more difficult to eliminate micronutrient malnutrition than protein-calorie malnutrition since micronutrient deficiency is wide spread and maladies require concerted effort for implementation. The micronutrient malnutrition would not only increase the risk of infant and child mortality but also affect their functioning in their adulthood (Mahalanobis, 2005).

Sources And Determinants Of Nutrient Intake

Cereals accounted for 83 per cent of calorie intake of very poor households in rural areas, 76 per cent of very poor households in urban areas; 73 per cent for all groups in rural areas and 62 per cent for all groups in urban areas (Table 4). As one moves from very poor to non poor higher group, the sources of food energy tend to diversify particularly in the urban areas. Non-cereal food accounted for 35 per cent of the calorie intake of the rural higher income households and 45 per cent of the urban higher income households.

The food consumption elasticity with respect to prices and per capita total expenditure is numerically large for the poor groups (Table 5). The expenditure elasticity of food is close to one for very poor households in both rural and urban areas and declines significantly between very poor and non-poor higher groups, more strikingly in the urban areas. The calorie elasticity also exhibits similar pattern across expenditure groups but its value is lower than that of food. The calorie (food) elasticity for all groups is estimated to be 0.48 (0.67) in rural areas and 0.37 (0.56) in urban areas. The calorie elasticity is smaller than the food elasticity; which could be due to dietary diversification with income improvement. Similar dietary diversification also takes place with urbanization.

Calorie elasticities with respect to food prices are numerically higher particularly for poor groups. Cereal as well as non-cereal food prices affects the calorie intake of all classes. In rural areas a 10 per cent increase in cereal price would result in a 2.4 per cent cut in food consumption intake of an average consumer and 2.9 per cent cut in calorie intake in rural areas; and the corresponding figures in urban areas are 1.2 and 1.6 per cent. A 10 per cent rise in non-cereal food price would reduce food consumption of an average consumer by 5.6 per cent in both rural

and urban areas and calorie intake by 2.6 per cent in rural areas and 2.9 per cent in urban areas. The policy advice that flows from these empirical results is straight forward: from the perspective of nutritional well being of the population, it is not only necessary to maintain cereal price stability but also non-cereal food price stability.

Towards an explanation for the slow growth of calorie intake

With the significant growth in the income of the bottom segment of population and favourable cereal price movements, one would have expected significant improvement in the cereal and food consumption of the poor during 1970-90. But no such marked improvement had taken place. Was it due to changing demographic composition of the population or due to changing preferences? Demographic change may not explain the reduction in per capita cereal intake since the change in the former was rather slow and the shift in demographic composition in favour of adults should have increased the per capita cereal consumption. Even in the case of children, average intake declined between 1988-90 and 1996-97 (Table 3).

Table 4: Percentage Distribution of Calorie intake by Source in 1998

Commodity Group	Very Poor	Moderately Poor	Non Poor Lower	Non Poor Higher	ALL
Rural					
Cereals & cereal subst.	83	78	73	65	73
Milk & milk Products	1.4	3.0	5.0	8.8	4.8
Meat, Fish & Eggs	4.7	5.5	6.4	7.1	6.2
Edible oils	0.0	0.0	0.01	0.01	0.01
Sugar & Gur	2.1	2.8	3.5	4.8	3.6
Other Food	8	10	11	1.3	11
Total	100	100	100	100	100
Total Calorie intake (K.cal/day)	(1551)	(1795)	(2026)	(2488)	(2019)
	Very Poor	Moderately Poor	Non Poor Lower	Non Poor Higher	ALL
Urban					
Cereals & cereal subst.	76	70	66	55	62
Milk & milk Products	2.1	3.6	5.2	7.9	6.2
Meat, Fish & Eggs	7.6	8.2	8.5	9.3	8.8
Edible oils	0.0	0.01	0.01	0.01	0.01
Sugar & Gur	3.8	4.3	4.5	4.7	4.6
Other Food	11	13	15	22	18
Total Calorie intake (K.Cal/day)	(1445)	(1624)	(1855)	(2350)	(1997)

Notes: Figures in the parentheses are per person total calorie intake(k.cal/day) derived from various food items. Persons below 75 per cent of the poverty line are defined as very poor; persons between 75 per cent of the poverty line and the poverty line as moderately poor; persons between the poverty line and 150 per cent of the poverty line as non-poor lower, and above 150 per cent of the poverty line as non-poor higher.
Source: Ravi (2000)

During 1970-89, the bottom 30 per cent of the rural population experienced 1.7 per cent per annum growth in real per capita expenditure, 0.7 per cent per annum decline in real cereal price, 1.1 per cent per annum increase in non-cereal food price and 0.3 per cent per annum decline in non-food

price and the corresponding figures for urban bottom 30 per cent population are 1.7, 0.8, 1.0 and 0.5. Using the elasticities (computed controlling for changes in preferences) given in Table 5, it can be shown that given the scale of preferences, the per capita calorie intake of the bottom group in rural areas would have increased by about 1.5 per cent per annum (1.3 per cent due to real per capita expenditure growth and 0.2 due to favourable price changes) and in urban areas, by 1.1 per cent (1.0 per cent increase was due to income growth). These figures are much higher than the observed increases given in Table 2; between 1972-73 and 1993-94, the per capita calorie intake of the bottom group increased at an annual rate of 0.5 per cent in rural areas and 0.3 per cent in urban areas. The unaccounted gap could be attributed to changes in the scale of preferences (tastes). Thus, the changing preference might have resulted in 1.0 per cent per annum decline in rural areas and 0.6 per cent per annum decline in urban areas.

Table 5: Price and Expenditure Elasticities of Calorie intake

	Elasticity with respect to price of				
	Cereals	Non-cereal food	All Food	Non-food	Total Expenditure Elasticity
Rural					
Commodity/Expenditure group			Food		
Very Poor	-0.51	-0.47	-0.98	-0.01	0.99
Moderately Poor	-0.36	-0.52	-0.87	0.01	0.86
Non-poor lower	-0.24	-0.54	-0.78	0.01	0.77
Non-poor high	-0.12	-0.74	-0.86	0.35	0.51
All groups	-0.24	-0.56	-0.81	0.14	0.67
			Calories		
Very Poor	-0.74	-0.16	-0.90	-0.01	0.91
Moderately Poor	-0.40	-0.20	-0.60	0.01	0.59
Non-poor lower	-0.22	-0.24	-0.45	0.01	0.45
Non-poor high	-0.16	-0.36	-0.51	0.21	0.31
All groups	-0.29	-0.26	-0.55	0.08	0.48
Urban					
			Food		
Very Poor	-0.37	-0.59	-0.96	0.01	0.95
Moderately Poor	-0.20	-0.57	-0.76	0.14	0.62
Non-poor lower	-0.13	-0.62	-0.75	0.14	0.61
Non-poor high	-0.07	-0.58	-0.65	0.13	0.52
All groups	-0.12	-0.56	-0.68	0.12	0.56
			Calories		
Very Poor	-0.57	-0.22	-0.79	0.01	0.78
Moderately Poor	-0.20	-0.27	-0.47	0.09	0.38
Non-poor lower	-0.11	-0.27	-0.38	0.07	0.31
Non-poor high	-0.10	-0.31	-0.41	0.08	0.33
All groups	-0.16	-0.29	-0.44	0.08	0.37

Source: Ravi (2000).

From a nutritional perspective, the period of 1990s was adverse. The bottom 30 per cent of the rural population experienced a slower growth in real per capita expenditure at 1.1 per cent per annum, and an increase of 0.9 per cent per annum in real cereal price. However, the favourable factor

witnessed was a decline in real non-cereal food price at 0.4 per cent per annum, and a decline in non-food prices at 0.5 per cent per annum. The corresponding figures for urban areas are 1.5, 0.9, 1.1 and 0.6 respectively. Had there been no change in scale of preferences, the per capita calorie intake would have increased in the 1990s at 0.4 per cent per annum in rural areas and 0.8 per cent per annum instead of stagnating.

Child Undernutrition

The NNMB reports provide undernutrition (or malnutrition) estimates based on Gomez classification for children and bio-mass index (BMI) classification for adults. The NNMB data show that the incidence of undernutrition among rural children, even though slowly declining was alarmingly high and its incidence at 47.7 per cent in 2000-01 was substantially higher than that of income poverty (Table 6). The incidence of malnutrition in 1998-99 was as high as 60 per cent among tribal children in the states covered by NNMB surveys. NFHS data show that in 1998-99 in rural areas, 50.5 per cent of

Table 6: Trends in under-nutrition (%) among children in Rural areas of selected states: NNMB Estimates

	KER	TN	KAR	AP	MR	GJ	MP	OR	WB	Pooled
Rural Population – NNMB Repeat Surveys										
1975-79	56.8	59.6	64.3	61.5	71.4	68.1	68.1	56.6	60.6	62.5*
1988-90	34.9	50.0	57.1	51.8	55.3	58.8	52.5	57.3		52.5*
1996-97	27.1	36.4	51.6	54.7	57.2	63.7	n.a.	54.5		50.5*
* Pooled estimate of Kerala (KER), Tamil Nadu (TN), Karnataka (KAR), Andhra Pradesh (AP), Maharashtra (MR), Gujarat (GJ) and Orissa (OR). n.a.: not available.										
Rural Population – NNMB Surveys based on NSS Sample Design										
	KER	TN	KAR	AP	MR	GJ	MP	OR	WB	Pooled
1991-92	35.6	52.4	62.8	50.8	62.2	62.7	n.a.	55.8	60.6	56.2*
2000-01	28.8	39.0	47.6	39.9	52.2	48.9	63.9	54.4	49.6	47.7+
*Pooled estimate of KER, TN, KAR, AP, MR, GJ, OR and WB. +Pooled estimate of the nine states										
Tribal Population										
	KER	TN	KAR	AP	MR	GJ	OR	WB	Pooled	
1985-87	71.8	60.7	82.6	72.3	74.2	73.7	68.1	68.2	71.8	
1998-99	55.2	62.6	45.5	56.9	73.6	61.1	62.8	53.8	60.2	

Note: Undernutrition estimates were based on Gomez Classification. Children whose weight was less than 75 per cent of the National Centre for Health Statistic Standards were treated as undernourished.

Source: National Nutritional Monitoring Bureau (1991, 1993, 1999, 2000 and 2002).

children were undernourished, and in urban areas 39 per cent of children were under nourished (Table 7). Hence, half of the children of India might not have reached their physical or mental

potential and a sizeable section of them might be functionally impaired. It is obvious that India faces the problem of child undernutrition despite progress in food production, disease control and economic and social development.

There are substantial inter-state variations in the undernutrition levels of children as well as in their reduction over time. The percentage of undernourished children in 1997-98 varied between 27.4 in Kerala and 55.7 in Madhya Pradesh (Table 7). In terms of nutritional status of children, middle-income

Table 7: Percent of underweight children under age of 3 years

	Undernutrition in 1998 – 99		
	Rural	Urban	All
Andhra Pradesh	42.0	28.7	38.7
Assam	37.2	27.3	36.6
Bihar	55.8	47.7	55.0
Goa	30.4	27.1	29.3
Gujarat	50.1	39.4	46.0
Haryana	36.5	31.3	35.3
Himachal Pradesh	46.2	30.4	45.0
Jammu & Kashmir	37.7	21.3	35.0
Karnataka	47.2	39.0	44.6
Kerala	28.6	22.4	27.4
Madhya Pradesh	59.0	44.8	55.7
Maharashta	54.6	44.9	50.7
Manipur	28.6	27.3	28.2
Meghalaya	38.9	37.6	38.7
Mizoram	32.7	21.9	27.5
Nagaland	25.6	18.1	24.3
Orissa	56.4	45.5	55.2
Punjab	32.8	19.1	29.6
Rajasthan	52.5	46.6	51.2
Sikkim	20.6	23.5	20.9
Tamil Nadu	39.4	34.6	37.2
West Bengal	53.5	33.0	49.7
Uttar Pradesh	54.5	43.3	42.6
New Delhi	52.6	32.8	34.7
Arunachal Pradesh	26.8	19.5	24.7
All India	50.5	39.0	47.8
Notes: Children with weight below 2 Standard Deviations from median value of the international reference population were treated as undernourished.			
Source: Radhakrishna et al (2004).			

states such as Kerala (27.4%), Tamil Nadu (37.7%) and Andhra Pradesh (38.7%) performed better than states with higher per capita SDP, such as Maharashtra (50.7%) and West Bengal (49.7%). It is also noteworthy that in spite of higher per capita SDP, calorie intake level of the

children was comparatively lower in Maharashtra (NNMB, 1993) which might partly explain its high incidence of malnutrition. Not surprisingly, poorer states such as Madhya Pradesh, Bihar and Orissa showed the worst performance. These states also have higher proportions of disadvantaged groups – SC and ST. Despite low calorie consumption, undernutrition among children was low in Kerala and Tamil Nadu (ibid.). The better nutrition status at a comparatively lower level of consumption of food energy could be due to better health care and nutritional intervention programmes. Surprisingly, in Orissa and West Bengal, children consume comparatively higher levels of calories. Yet, their malnutrition level was high in 1991-92 (ibid.) This could be due to deficiencies in health care and environmental hygiene and weak nutrition intervention programmes. North-Eastern states showed better performance in terms of nutritional status. In fact, Sikkim (20.9%), Nagaland (24.3%) and Arunachal Pradesh (24.7%) performed better than Kerala and the performance of Mizoram and Manipur was very close to that of Kerala (Table 7). Among the eight NNMB sample states, the record of Kerala and Tamil Nadu in undernutrition reduction between 1975-79 and 1996-97 was better (Table 6). All states except Orissa, performed better in the 1990s than in the earlier period.

Chronic Energy Deficiency among Adults

Despite some improvement in the nutritional status of adults over the past two decades, incidence of chronic energy deficiency remains high (Table 8). NNMB data show that 37.4 per cent of adult males and 39.4 of adult females in 2000-01 suffered from Chronic Energy Deficiency (CED) in rural areas of the nine sample states. A major factor determining adult malnutrition is poor diets in their childhood as well as exposure to infections (Gillespie and Mc Neill, 1994). The interstate variations in CED are similar to those of malnutrition among the children. The incidence of CED was found to be lower in Kerala (22.4 per cent for males and 18.7 per cent for females) and Tamil Nadu (26.7 per cent for males and 38.7 per cent for females) and higher in Madhya Pradesh, Maharashtra and West Bengal (above 40 per cent). Gender differences did exist in some states; the incidence of malnutrition among adult females was higher than in men in Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Orissa and West Bengal and lower in Kerala and Gujarat. The decline in the incidence of chronic energy deficiency was slower for females (Table 8).

Table 8: NNMB Estimates of Chronic Energy Deficiency (CED) among Adults in Rural Areas in Selected States
Percentage of adults with Body Mass Index (BMI) less than 18.5

	Rural Areas 2000-01	
	Males	Females
Kerala	22.4	18.7
Tamil Nadu	26.7	38.2
Karnataka	36.2	41.7
Andhra Pradesh	37.4	42.0
Maharashtra	41.3	45.1
Gujarat	37.1	33.3
Madhya Pradesh	42.8	41.9
Orissa	38.6	46.0
West Bengal	40.5	45.9
Pooled	37.4	39.4
Trends in BMI for Rural Population*		
	Males	Females
1975-79	55.6	51.8
1988-90	49.0	49.3
1996-97	45.5	47.7
*Average BMI of 7 states -- Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat and Orissa.		
Source: Radhakrishna et al (2004).		

Determinants of Malnutrition in Rural areas

The NFHS data is analyzed to identify the determinants of malnutrition in rural areas by estimating logit regression model using the maximum likelihood method (Table 9). The dependent variable is assigned the value one if the child is malnourished and zero otherwise. The model is estimated separately for underweight (too thin for age), stunted (too short for age) and wasted (too thin for height) categories of malnutrition. The standard of living index, one of the independent variables, is chosen as a proxy for income level of the household. The other independent variables specific to the child are: sex of the child, birth order, place of delivery and leafy vegetable consumption; specific to the mother are mother's age, employment status, education and ante-natal care; specific to the household are household size, caste and consumption of nutritious food and specific to the village are existence of drainage, fair price shop, *anganwadi, mahilamandal*, health and education facilities.

In the case of child-specific variables, coefficients of birth order and leafy vegetable consumption are significant. They show that the risk of malnutrition decreases with the consumption of leafy vegetables and increases with the birth order. It appears, sex of the child has no effect on malnutrition since its coefficient is not significant. In the case of mother specific variables, education of the mother, age and working status of mother have significant effect on malnutrition. Probability of malnutrition decreases with mother's age and her ante-natal visits, but on the other hand, increases when the mother is working. Perhaps, child care suffers in poor households with working women. This needs further probing.

The coefficients of all household level variables are statistically significant and are in conformity with our understanding that risk of malnutrition decreases with income (standard of living) of the household and increases with household size. However, contrary to our understanding, scheduled tribes have lower probability of malnutrition, which may be due to the low incidence of malnutrition in North-Eastern States/Union territories where ST population is high. None of the coefficients of village level variables, with the exception of drainage, are significant. Most of the coefficients of the state dummies are significant and reveal meaningful patterns. Himachal Pradesh, Maharashtra, Madhya Pradesh, Orissa, Bihar and Uttar Pradesh have higher incidence of child malnutrition attributable to state specific factors. Assam and other states (which consists of mostly north eastern states) have lower incidence of malnutrition. Existence of fair price shops, *anganwadi*, and health facility have no effect on malnutrition. This is not in conformity with our understanding and needs further analysis.

To summarize, the logit regression analysis demonstrates that multiple factors influence the nutritional well-being of a child. Besides, improving the income of a household, there is a need to improve the health and educational status of mothers. The factors associated with a working mother that contribute to the risk of child malnutrition need to be understood and proper institutional mechanisms be created to mitigate their adverse effect.

Table 9: Parameter Estimates of Logit Regression

Variables	Underweight	Stunted	Wasted
Standard of Living Index	-0.0107*	-0.0073*	-0.0298
Square of Standard of Living Index	-0.0003*	-0.0004*	0.0003
Household Size	0.0093*	0.0144*	0.0034
Frequency of Consumption of Nutritious Food	-0.0317*	-0.0157*	-0.0075
Caste			
Other Caste (Reference)			
Scheduled caste	0.2435*	0.1977*	0.0613
Scheduled tribe	0.0818	0.1525*	0.1741*
Other Backward Castes	0.2764*	0.1242*	0.1137*
Mother's Body Mass Index	-0.0012*	-0.0004*	-0.0010*
Highest Education Level of Mother			
No education (Reference)			
Primary	-0.0494	-0.0600	-0.0424
Secondary	-0.2599*	-0.2653*	-0.1749*
Higher	-0.6161*	-0.6301*	-0.3483*
Place of Delivery			
Home			
Institution	-0.0999*	-0.1060*	0.0191
Number of ANC visits	-0.0157*	-0.0312*	0.0030
Working Status of Mother			
Not Working (Reference)			
Working	0.1088*	0.0546	0.1522*
Age of Mother at First Birth	-0.0961*	-0.1071*	-0.0190
Square of Age of Mother at First Birth	0.0019*	0.0021*	0.0004
Age of Child (Months)	0.0727*	0.0703*	0.0088*
Birth Order	0.0250*	0.0053	0.0079
Gender of Child			
Female (Reference)			
Male	-0.0772*	-0.0212	0.0251
Gave Child Green, Leafy Vegetables and Fruits			
No (Reference)			
Yes	-0.0909*	-0.0724*	0.0269
Type of Drainage Facility			
No Drainage (Reference)			
Underground	0.2984*	0.0821	0.2199
Open	-0.0339	-0.0827*	0.1322*
Health Facility in Village			
No (Reference)			
Yes	0.0332	0.0262	0.0077
Education Facility in Village			
No (Reference)			
Yes	-0.1252*	0.0990	-0.1727*
DWCRA beneficiaries in Village/100 population	-0.0245*	-0.0037	-0.0522

Table 9: Parameter Estimates of Logit Regression (Contd.)

Anganwadi Facility in Village	Underweight	Stunted	Wasted
No (Reference)			
Yeas	0.0038	-0.0253	-0.0350
Mahilamandal in Village			
No (Reference)			
Yes	0.0240	0.0429	-0.0920
Fair Price Shop in Village			
No (Reference)			
Yes	-0.0067	-0.0488	-0.0016
State			
Andhra Pradesh (Reference)			
Assam	-0.5646*	0.0328	0.3262
Bihar	0.4194*	0.2865*	0.9269*
Gujarat	0.3470*	0.0993	0.9340*
Haryana	-0.0235	0.6298*	-0.4328*
Himachal Pradesh	0.6347*	0.3324*	1.0803*
Jammu and Kashmir	0.0231	0.0448	0.5312*
Karnataka	0.1688	-0.2043	0.9655*
Kerala	-0.0038	-0.3627*	0.6327*
Madhya Pradesh	0.5094*	0.1831	0.9146*
Maharashtra	0.5094*	-0.0524	1.2236*
Orissa	0.4597*	-0.1488	1.1643*
Punjab	0.0302	0.3294*	0.1197
Rajasthan	0.3245*	0.3008	0.3861*
Tamil Nadu	-0.0524	-0.4724*	1.0833*
West Bengal	0.3708*	-0.1156	0.5761*
Uttar Pradesh	0.4034*	0.4594*	0.2111
Other States	-0.3676*	-0.3952*	0.3092*
Constant	1.7428*	0.4878	-0.0802
Number of Observations	16218	16218	16305
% of Malnourished in Sample	47.16	47.08	16.17
Log likelihood	19060.32	19608.30	13682.60
R2	0.25	0.213	0.076

Note: ANC: Antenatal Check up

* *Indicates statistical significance at 5 per cent, level.*

* *Source: Radhakrishna et al (2004).*

Concluding Observations

The consumption basket of the poor is getting diversified and calorie intake is levelling off even before the food energy needs are met. Micronutrient deficiencies are severe in the diets of the children causing high incidence of diseases. NNMB Surveys indicate that a majority of Indian children consume micronutrients less than half of the recommended dietary allowance. Early childhood micronutrient deficiencies will have adverse consequences in adulthood and may lead to inter-generational transmission of malnutrition. The problem of micronutrient deficiency will remain a major challenge for some more time.

The most important problem to be attended to is to increase the calorie intake of the bottom 30 per cent of the population and at the same time facilitate diet diversification to meet the micronutrient malnutrition. The food gap of the bottom 30 per cent of the population (400 k.cal. per person per day or 0.12 kg cereal equivalent per person per day) works out to about 13 million tonnes of cereal equivalent per year. According to World Development Indicators (2003), the per capita food supply was higher than the norm of 2100 k.cal per person per day by 10 per cent in 1990 and 17 per cent in 2002. It is clear that the food gap of the poor is more a question of distribution and is not unsurmountable.

Food inflation would affect the nutritional well-being of the population. Both cereal price and non-food cereal price are negatively associated with the consumption of food and calories. Needless to say, from nutritional welfare perspective, price stability of non-cereal food is as important as that of cereals. With economic growth and urbanization, the supply source of calories is likely to diversify and non-cereal food may emerge as a major source of supply.

India's record in reducing malnutrition is disappointing. Nearly 40 per cent of the malnourished children of the world are in India, although India's share in the world population is less than 20 per cent. Along with improving their diet, it is necessary to improve the health and educational status of mothers. India has put in place a number of nutrition intervention programmes to reduce the incidence of malnutrition but their impact so far seems to be marginal. They need to be scaled up and their governance requires substantial improvement. What is more, it needs to be recognised that for eradication of malnutrition one has to go beyond meeting the calorie gap and ensure the provision of safe drinking water, health care facilities and proper environmental hygiene.

[The paper draws on Radhakrishna (2005) and Radhakrishna and Ravi (2005)].

References

Gillespie, S., and G. McNeill. (1994) *Food Health and Survival in India and Developing Countries*, Oxford University Press.

International Institute of Population Studies (IIPS) and ORC Macro (2000) *National Family Health Survey (NFHS-2), 1998-99*, Mumbai.

Mahalanobis, D. (2005) *"Micronutrient Malnutrition: Some Public Health Concerns"*, in A.K. Bagchi and Krishna Soman (ed.) *Maladies, Preventives and Curatives, Debates In Public Health in India*, Tulika Books.

National Nutrition Monitoring Bureau (1991) *Report of NNMB Repeat Surveys (1988-90)*, National Institute of Nutrition, Hyderabad.

National Nutrition Monitoring Bureau (1993) *Report of NNMB Repeat Surveys (1991-92)*, National Institute of Nutrition, Hyderabad.

National Nutrition Monitoring Bureau (1999) *Report of Second Repeat Survey, Rural NNMB Technical Report No.18,* National Institute of Nutrition, Hyderabad.

National Nutrition Monitoring Bureau (2000) *Diet and Nutritional Status of Tribal Population, Report of First Repeat Survey NNMB Technical Report No.19*, National Institute of Nutrition, Hyderabad.

National Institute of Nutrition (2002) *Diet and Nutritional Status of Rural Population, NNMB Technical Report No.21*, National Institute of Nutrition, Hyderabad.

Martorell, R., and T.J.Ho (1984) "Malnutrition, Morbidity and Mortality", *Population and Development Review*, A Supplement to Vol. 10, pp. 49-68.

Radhakrishna, R., (2005). "Food and Nutrition Security of the Poor: Emerging Perspectives and Policy Issues, *Economic and Political Weekly*, April 30.

Radhakrishna, R., and C. Ravi (1992), "Effects of Growth, Relative Price and Preference on Food and Nutrition", *Indian Economic Review*, 27 (Special Number), 303-323.

Radhakrishna, R., K. Hanumantha Rao, C. Ravi and B. Sambi Reddy (2004) *Chronic Poverty and Malnutrition in India*, Working paper 11, Chronic Poverty Research Centre, Indian Institute of Public Administration, New Delhi.

Radhakrishna, R., and C. Ravi (2005) "Emerging Nutritional Trends and Their Implications" in A.K. Bagchi and Krishna Soman (ed) *Maladies, Preventives and Curatives*: *Debates in Public Health in India*, Tulika Books.

Rao, C.H.H., and R. Radhakrishna (1997) "National Food Security: A Policy Perspective for India" in G.H. Peter and J.V. Braun (eds.) *Food Security, Diversification and Resource Management: Re-focusing the Role of Agriculture*, Ashgate, 1999.

Rao, C.H.H. (2000) "Declining Demand for Foodgrains in Rural India: Causes and Implications", *Economic and Political Weekly*, January 2.

Ravi, C. (2000), *Complete Demand Systems, Welfare and Nutrition: An Application to Indian Consumption Data,* Centre for Economic and Social Studies, Hyderabad.