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Review Article

Dynamics of Food Consumption and Nutrient Insecurity in India

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The dynamics of food consumption and nutrient intake of Indian households was investigated over the past three decades based on nationally representative sample survey data obtained from the NSSO. Disparities arising out of income differentials of the households were subject to in-depth analysis to discern the underlying patterns. The results suggest a gradual diversification of the dietary basket towards high-value commodities, irrespective of the income affiliations of the households. Nutritional assessments based on observed pattern of food consumption revealed a general trend of declining intake of nutrients such as calories, proteins and iron. On the contrary, intake levels of fats, calcium, zinc and Vitamin A improved over time, suggesting compositional changes of nutrient intake of people with changes in their diet pattern.

Keywords: Food Consumption Pattern; Nutrition; India

Introduction

Over the past few decades, Indian economy has made impressive progress on multiple counts. First, the average annual growth in per capita real income has been over 4 percent during 1980-2012 which contributed to strengthening of the purchasing power of people. Second, agricultural sector has grown by over 3 percent per annum,which has raised food grain production of the country from nearly 130 million tons in 1980-81 to over 255 million tons by 2012-13. The production of other food commodities has also grown significantly during the period; oilseeds by 3.3 percent, sugarcane by 2.2 percent, fruits and vegetables by 4.8 percent (pertains to the period 1987-88 to 2012-13), milk by 4.3 percent, eggs by 5.9 percent, fish by 4.3 percent and so on. Third, improvements in per capita income and per capita availability of food commodities have led to an appreciable increase in real per capita expenditure on food.The real per head expenditures (at 1993-94 prices) in rural areas has increased from Rs. 167.50 in 1983 to Rs. 181.50 by 1993-94, and further to Rs. 184.3 in 1999-00 and has remained more or less stagnant at Rs. 184.10 by 2004-05 (Deaton and Dreze, 2009). Coupled with a general increase in consumption expenditure, there have been changes over time in the variety and diversity of food consumed by people, as revealed by several recent studies. The consumption of cereals, particularly of coarse cereals has been declining with time and this decline is being compensated by increasing consumption of high-value commodities, such as milk, vegetables, fruits, meat, fish, eggs, etc. (Kumar *et al.*, 2007). Radhakrishna (2005) has argued, that the decline in cereal consumption has been attributed to the changes in consumers tastes—from food to non-food items and, within the food group, from cereals to non-cereals food items, and from 'coarse' to 'fine' cereals. Mittal (2006) has also acknowledged growing demand for non-food grain, high-value commodities and has called for a shift in focus needed in production technology, as well as resource allocation, so as to meet the growing demand for high-value crops and livestock products.

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In the above context, a pertinent question that arises is: how the changing dietary pattern has influenced the nutrients intake of people in India? Deaton and Dreze (2009) had reported a sustained decline in per capita calorie consumption during the past two decades or so by examining NSSO data of several rounds on food consumption. They have also reported decreasing intake levels of proteins and many other nutrients except, fat. They have attributed this decline in calorie and nutrient intake to a general reduction in calorie/nutrient requirements of people due to better health, as well as lower activity levels. However, a more important aspect is; how various sections of the economy, particularly the low income households, are being affected by the changing food consumption and nutrient intake pattern? Kumar *et al.* (2007) have noted that the decline in per capita consumption of cereals, particularly coarse cereals, has worsened the nutritional status of the rural poor. This indicates that though at the aggregate level, the decline in calorie intake from cereals was to a certain extent compensated by higher intake of calories from milk, vegetables, fruits, meat, etc., it may not be true for all the sections of society. Probably, it is reflected in the continuing prevalence of under-nutrition in India as assessed based on not only dietary nutrient intake but by several anthropometric indicators also. The National Family Health Survey (NFHS) III (2005-06) that reports the key facts related to health and nutritional status of the sample households in the country has estimated that nearly 40.4 percent of children under three are underweight and 44.9 percent are stunted; 36 percent of adult women and 34 percent of adult men suffer from chronic energy deficiency; and 79 percent of children and 56 percent of women are anaemic (IIPS and Macro International, 2007). Consequently, India ranks 63rd among 120 countries covered in the Global Hunger Index 2013, with the food security status designated as 'alarming' (IFPRI/ Welthungerhilfe/Concern Worldwide, 2013).

It is well known that, a wide range of nutrients such as proteins, fat, carbohydrates, vitamins and minerals are needed to maintain normal activities of human body. These nutrients are present in most foods consumed daily in various proportions. However, some foods provide only a few nutrients like sugar, edible oils, etc. Vitamins and minerals do not supply energy but they play an important role in the metabolic activity of the body. Thus, our diet must be well-balanced, to provide all the nutrients in proper proportions. Dietary habits of people in different regions of the country are determined mainly by the local availability of foods and traditional practices followed by them. With available information on major foods and food groups which form part of human diet, their nature and chemical composition, it is possible to assess the contribution of various food items to the intake of calories and essential nutrients. Against this backdrop, this study has analysed the long-term trends in food consumption and nutrients intake of households belonging to various demographic areas and income status in India and has investigated the dynamics of nutrition across households over time with the following specific objectives:

1. To study diversification in food consumption and construct dietary diversify index for different income groups and rural and urban households during past three decades.
2. To examine the changing dietary intake of calories, protein, fat, iron, zinc, vitamin A and calcium over time for different income groups and rural and urban households with time.
3. To estimate the population with less than the recommended levels of intake of above mentioned nutrients.

Data and Methodology

This study is based on the household unit level data on food consumption and consumer expenditures collected by the National Sample Survey Organization (NSSO), Government of India under the 38th and 68th rounds of surveys, covering the years 1983-84 and 2011-12, respectively. The data pertain to the average per-capita consumption of all the food and non-food commodities in the sample households. The dynamics in per-capita consumption of major food items were examined to understand the process of dietary diversification unfolding in India. The intake of calorie and nutrients by the sample households was computed on the basis of consumption of various food commodities reported by them. The standard nutrient chart provided by the National Sample Survey Organization in its 'Report on Nutrition Intake in India' (NSSO, 2012), as well as, the detailed chart on nutritive value of Indian foods available in Gopalan *et al.*(1989) were used for converting the quantity of each

consumed food item to its equivalent calorie and other nutrients. Further, the study makes no distinction between calorie intake and calorie absorption, which again is a simplification that cannot be avoided in a socio-economic study like this. Further, the calories and nutrient-intake gap of a household was computed based on the actual nutrients intake of the members of a household and the Recommended Dietary Allowances (RDA), prescribed by the Indian Council of Medical Research (ICMR) for individuals belonging to different age groups, sex, body weight and activity levels (ICMR, 2009). However, it is to be noted that, the body weight criteria were disregarded in the present computations assuming that the respondents' body weights were consistent with the specifications at an aggregate level. Table 1 presents a summary of RDA, based on which the calculations were undertaken. Thus, the intake norms for households vary depending on their family composition (number of adult men and women of particular activity status, male and female children of different age groups, as well as, infants). More specifically, the average per capita calorie/nutrient requirement (norm) of a household was obtained by summing the RDA for each member of the household and then dividing it with total number of members of the family. The household was subsequently assessed for its nutrient gap status by comparing the estimated average actual intake of calorie/nutrients against the computed norms. Further, the share of sample population with under-intake of calorie, as well as, dietary nutrients was estimated. The analysis was carried out for households belonging to different income groups and demographic areas (rural and urban). Assuming per-capita expenditure as the proxy for per-capita income, the sample households were categorized into following three expenditure/income groups: 'Poor' [below poverty line], 'Middle income' group [income level between poverty line (PL) and 150 percent of PL] and 'Rich' [above 150 percent of PL]. The poverty

Table 1: Summary of Recommended Dietary (RDA) Allowance of selected nutrients for Indians, 2010

Group	Particulars	Body wt kg	Net energy kcal/d	Protein g/d	Visible Fat g/d	Iron mg/d	Calcium mg/d	Zinc mg/d	Vitamin A	
									Retinol µg/d	β-Carotene µg/d
Man	Sedentary work	60	2320	60.0	25	17	600	12	600	4800
	Moderate work		2730		30					
	Heavy work		3490		40					
Woman	Sedentary work	55	1900	55.0	20	21	600	10	600	4800
	Moderate work		2230		25					
	Heavy work		2850		30					
	Pregnant woman		+350	82.2	30	35	1200	12	800	6400
	Lactation 0-6 m		+600	77.9	30	25	1200		950	7600
	6-12m		+520	70.2	30					
Infants	0-6 months	5.4	92 kcal/kg/d	1.16g/kg/d	__	46g/kg/d	500	__	350	2800
	6-12 months	8.4	80 kcal/kg/d	1.69g/kg/d	19	05		__		
Children	1-3 years	12.9	1060	16.7	27	09	600	5	400	3200
	4-6 years	18.0	1350	20.1	25	13		7		
	7-9 years	25.1	1690	29.5	30	16		8	600	4800
Boys	10-12 Years	34.3	2190	39.9	35	21	800	9	600	4800
Girls	10-12 years	35.0	2010	40.4	35	27	800	9		
Boys	13-15 years	47.6	2750	54.3	45	32	800	11		
Girls	13-15 years	46.6	2330	51.9	40	27	800	11		
Boys	16-17 years	55.4	3020	61.5	50	28	800	12		
Girls	16-17 years	52.1	2440	55.5	35	26	800	12		

Source: ICMR (2009).

line for rural and urban areas in different states corresponding to various NSS rounds, as defined and adopted by the Planning Commission, Government of India was used to define the income groups.

Measure of Dietary Diversification

The Simpson Index of Diversity (SID) was used to measure the diversity in food consumption of the households. It is a widely used index originally put forward by Edward H. Simpson in 1949 for measuring species diversity in the field of ecology (Simpson, (1949). Subsequently, it was modified by Orris C. Hefindahl for use in economic studies (Herfindahl, 1950). In the present context, it was estimated using equation (1) as follows:

$$SID_k = 1 - \sum_{i=1}^{k} P_{ik}^2 \quad (1)$$

where, SID_k is the simpson index of diversity for the k^{th} food group, P_{ik} is proportion of the i^{th} food item in total monthly consumption of all items in the k^{th} food group by the members of a household. The weighted Simpson index of diversity was computed using Equation (2):

$$SID = \sum_{k=1}^{n} w_k * SID_k \quad (2)$$

where, w_k is the relative cost per unit of calories of the k^{th} food group as compared to cereal group, and n is the number of food groups viz. cereals, pulses, vegetables, fruits, milk, livestock and poultry and processed food products.

The estimates pertain to the years 1983-84 and 2011-12. The Simpson Index value ranges between 0 and 1, with its value moving towards 0 in case of complete specialization. Separate estimates for diversity in food consumption across households belonging to income groups were obtained and compared over time to examine dynamics in food consumption diversity, during the study period.

Limitations of the Methodology

The methodological approach followed in the study is liable to cause potential bias arising out of the following reasons; firstly, it is assumed that, a particular food item irrespective of its source, quality and level of processing has the same nutrient composition. However, the authors acknowledge the fact that, changes in source and quality as well as level of cooking and processing can alter the calorie and nutrient content of food items and this could be a limitation of the study, particularly when it comes to absolute measurement of calories and nutrients. Secondly, it is assumed that there is no distinction between calorie intake and calorie absorption, which again is a simplification that cannot be avoided in a socio-economic study like this. Further, the choice of vitamins and minerals covered in the paper are not exhaustive and is guided by the availability of authentic information on the nutritive value of common food items in India with respect to the said nutrients. While comparing the nutrient intake gap of sample respondents over the period 1983 to 2011, it is assumed that the nutrient requirement of people remains unchanged over time. However, several studies have pointed out the limitations of following such time-invariant nutrient intake norms. This point is further substantiated in the forthcoming discussion. Lastly, the usual caveat regarding the recall bias associated with reporting of food consumption on a 30-day recall period as followed in NSSO data, also applies here.

Results and Discussion

Changes in Dietary Pattern

The food consumption pattern of people of India has undergone significant changes during the past three decades. Several recent studies (Radhakrishna, 2005; Kumar *et al.*, 2006; 2007; Chand, 2007; Kumar *et al.*, 2011) have observed that food basket of Indian consumers is diversifying gradually from a cereals-dominated one to a mix of high-value commodities. This shift is evident from Table 2, which shows a reduction in the average annual consumption of cereals by the sample population between 1983 and 2011. Between 1983 and 2011, consumption of total cereals declined more across rural areas (23.5 %) than in urban areas (12.8%). Except in case of rice consumption by urban households, where it has increased by nearly 2 percent, the decline in consumption of all other cereals has been unilateral, irrespective of the rural-urban divide, thereby contributing to the overall reduction in cereals consumption.

In relative terms, the magnitude of reduction was highest in coarse cereals, followed by wheat and rice.

Table 2: Changes in dietary pattern in rural and urban households of India, 1983-2011 (kg/capita/annum)

Food commodity	Rural India			Urban India			All India		
	1983	2011	Change, %	1983	2011	Change, %	1983	2011	Change, %
Rice	87.02	85.45	-1.80	70.15	71.50	1.92	81.09	80.1	-1.22
Wheat	53.51	47.06	-12.05	58.37	48.84	-16.33	55.22	47.74	-13.55
Corse cereals	41.87	7.07	-83.11	13.10	3.11	-76.26	31.74	5.55	-82.51
Total cereals	182.41	139.57	-23.49	141.62	123.45	-12.83	168.05	133.39	-20.62
Pulses	11.48	9.62	-16.20	12.46	10.53	-15.49	11.82	9.97	-15.65
Edible oils	3.64	7.54	107.14	6.14	8.92	45.28	4.52	8.07	78.54
Vegetables	46.36	55.25	19.18	50.95	57.86	13.56	47.97	56.25	17.26
Fruits	2.85	10.51	268.77	4.16	14.21	241.59	3.31	11.93	260.42
Milk &milk products	39.24	61.00	55.45	55.57	71.19	28.11	44.99	64.91	44.28
Sugar	11.18	9.80	-12.34	11.79	10.33	-12.38	11.4	10.01	-12.19
Meat, fish & eggs group	4.69	6.92	47.55	6.59	8.41	27.62	5.36	7.49	39.74

Note: Milk and milk products were measured in terms of 'milk equivalent' constructed based on standard conversion factors

Notably, the annual per-capita consumption of coarse cereals fell by a whopping margin, from 41.9 kg to 7.1 kg in the rural areas (83.1% reduction) and from 13.1 kg to 3.11 kg in the urban areas (76.3% reduction) during this period. As in the case of cereals, there was a general shift away from pulses as well, the reduction in their consumption being 16.2 percent in the rural and 15.5 percent in the urban areas. On the other hand, gains were noticed in the consumption of several other food items; such as edible oils, vegetables, fruits, milk and meat, fish & egg (MFE). The hike in consumption of edible oils has been quite high in both rural (107.14 %) and urban (45 %) areas. While consumption of vegetables increased moderately at 19.2 percent in rural and 13.6 percent in urban areas, the gain in consumption of fruits was quite apparent and estimated to be 269 percent in rural and 242 percent in urban areas between 1983 and 2011. The consumption of milk and milk products as well as meat, fish& egg group commodities also increased appreciably in both urban and rural areas, the change being more visible in the rural areas. In case of milk and milk products, their increased consumption was highlighted in several recent studies that used NSS data for analysis (Kumar *et al.*, 2014; Kumar *et al.*, 2007; Verma *et al.*, 2007). However, the data of National Nutrition Monitoring Bureau (NNMB) which is an authentic source of such information, and based on robust diet surveys conducted in selected states of India, shows opposite trends as revealed by Radhakrishna (2006). Therefore, further analysis and scrutiny is required in this regard to get the facts right. Apart from cereals and pulses, sugar was another commodity which showed a reduction in its consumption. In a nutshell, consumers gradually moved away from the traditional, low-value food commodities; such as coarse cereals, pulses, etc. to high-value commodities such as fruits, vegetables, edible oils, milk and non-vegetarian foods that they could afford due to rise in their incomes, changes in life style, etc. As noted by Mittal (2006), such changes have substantial implications for the future of agricultural sector as resources have to be appropriately allocated to contain the emerging food supply-demand imbalance at the aggregate level.

To understand the disparity in dietary diversification across households belonging to different income groups, consumption of various food commodities by the 'poor', 'middle- income' and 'rich' households was compared for the years 1983 and 2011. In general, diversification from traditional diets to high-value food commodities was found operational irrespective of household income status, though its magnitude varied across income groups. The only exception was consumption of rice among poor households, which increased over time, mainly because of subsidised rice schemes. In terms of magnitude of change across income groups, variations across commodities were noticed. Evidently, the

percent decrease in consumption of total cereals was lowest across poor households and highest across rich households. A similar trend was observed in the case of pulses and sugar. This observed pattern is quite in line with the intuitive logic, as income elasticity of demand for low-value essential commodities is generally lower for higher income households. An opposite trend was observed in the case of relatively more essential, but high-value commodities such as edible oils, vegetables, milk, etc., wherein the inter-temporal gains in consumption were found higher for lower income households. For instance, the rise in consumption of edible oils was highest (100 %) across poor households, followed by middle income (63.8 %) and rich (33.0%) households (Table 3). A similar trend was observed in vegetables, the consumption gains being 17.89 percent, 5.57 percent and -0.17 percent respectively for poor, middle-income and rich households, respectively. The trends in milk consumption were also no different. On the other hand, consumption gains of commodities such as fruits, meat, fish & eggs (MFE), which are considered luxury foods, depicted an increasing trend on moving from lower to higher income groups. The poor, middle-income and rich households registered gains of consumption at rates of 161.29 percent, 171.96 percent and 174.07 percent in case of fruits. Corresponding gains in MFE group were11.04 percent, 16.16 percent and 12.71 percent, respectively.

Measuring Dietary Diversification

The above discussion reveals that food preferences of households have diversified over time heavily in favour of fruits, vegetables, non-vegetarian food items, etc. Table 4 presents the diversity estimates (SID) for the years 1983 and 2011 along with their percent change and growth during the period. In general, diversity in food consumption deepened across income classes with rich households registering higher diversity than their counterparts in terms of SID.

The level of diversity also varied with time, as the SID estimates for the year 2011 higher than that of 1983 for all income groups. These findings convey two key messages. First, the food basket in terms of variety of commodities consumed by the households broadened with rise in income status. Second, the food basket also widened over time due to factors like changing lifestyles, availability of new food items as a result of innovations in processing infrastructure, urbanization-induced consumption changes, increasing health consciousness and quality awareness. In short, the findings suggest that dietary diversification has been occurring in terms of both variety and quality of food commodities being consumed by the households in India.

The SID values were also estimated for different states of India and are available upon request. The estimates varied between 0.44 and 0.63 across states in 2011. In relative terms, dietary diversity was lower

Table 3: Changes in dietary pattern across households of different income groups in India, 1983-2011 (kg/capita/annum)

Food commodity	Poor households			Middle income households			Rich households		
	1983	2011	Change, %	1983	2011	Change, %	1983	2011	Change, %
Rice	64.79	76.72	18.41	89.97	81.89	-8.98	94.02	80.24	-14.66
Wheat	45.26	41.55	-8.20	53.48	45.29	-15.31	71.06	51.54	-27.47
Corse cereals	35.41	5.00	-85.88	30.29	6.37	-78.97	28.23	5.25	-81.40
Total cereals	145.46	123.27	-15.26	173.75	133.55	-23.14	193.31	137.03	-29.11
Pulses	7.89	7.05	-10.65	11.47	8.64	-24.67	17.71	11.86	-33.03
Edible oils	2.71	5.42	100.00	4.31	7.06	63.81	7.27	9.67	33.01
Vegetables	35.78	42.18	17.89	47.91	50.58	5.57	65.07	64.96	-0.17
Fruits	1.55	4.05	161.29	2.71	7.37	171.96	6.44	17.65	174.07
Milk	16.70	22.71	35.99	40.32	44.76	11.01	89.67	92.93	3.64
Sugar	6.70	6.27	-6.42	10.67	8.58	-19.59	18.76	12.27	-34.59
Meat, fish & eggs	3.17	3.52	11.04	4.95	5.75	16.16	8.89	10.02	12.71

in the north-eastern states of the country, whereas states like Tamil Nadu, Karnataka, Pondichery, Delhi, Gujarat and Haryana stood on the top of the list. As observed across income groups, dietary diversity was found to deepen over time in all the states except Sikkim, where a negative change in the index was observed. The highest diversification was noticed in the states of Manipur, Pondichery and Tamil Nadu.

Changes in Dietary Nutrients Intake

The dietary nutrients intake of sample households, estimated in terms of calories, proteins, fat, calcium, iron, zinc and Vitamin A equivalent, are presented in Table 5. The estimates pertained to rural, urban and all households for three income groups, viz. poor, middle- income and rich, for the years 1983 and 2011. On an average, the per-capita calorie consumption of all households in India varied between 1690 kcal/day to 2342 kcal/day in 2011, the former pertaining to poor households and the latter to rich households. The calorie consumption also varied across rural and urban households, with per capita calorie consumption being higher across rural than urban households, irrespective of their income status. Another notable finding was the decrease in calorie intake from 2153 kcal/capita/day in 1983 to 2104 kcal/capita/day in 2011 at all-India level. This reduction was pervasive across income groups and rural-urban divide, with depiction of higher changes across rural than urban households and by rich households in relation to poor households. For instance, the change in calorie consumption was -2.2 percent for rural poor households and much higher in magnitude at -19.0 percent for rural rich households. On the other hand, the urban poor households showed a marginal increase of 2.9 percent in calorie consumption, whereas, urban rich households showed a reduction of -7.2 percent. The general drop in calorie intake levels can be attributed to the changes in life-styles, health status, technological advancements and the resultant changes in energy requirements of routine work, wherein the general physical activity level of people has decreased over time. Deaton and Dreze (2009) have explained this by showing, a steady downward drift in the calorie Engel curves, particularly in the rural areas, wherein per-capita calorie consumption at a given level of per-capita expenditure has drifted down over time.

Table 4: Dietary diversity index across income classes in India, 1983-2011

Income	1983	2011	Change, %	Growth, %
Income class (all India)				
Poor	0.40	0.50	25.0	0.80
Middle income	0.43	0.53	23.3	0.75
Rich	0.46	0.58	26.1	0.83
All	0.43	0.55	27.9	0.88

As observed in case of calorie intake, the average protein intake of sample population also showed a decline over time, the decline being highest across rural rich (-22.0 %) and the lowest across urban poor (-5.3 %) households. The variations in protein intake across income groups and rural-urban divide were similar to those in calorie consumption. Contrary to this, fat consumption in India increased considerably over time, the relative changes being much higher than that observed for the calorie and protein consumption. At all-India level, the per capita consumption of fat increased by 51.8 percent, from 29.3 g/day in 1983 to 44.5 g/day for all income groups. In general, the rural households exhibited higher levels of gain in fat intake in relation to urban households and so were poor households in relation to rich households. The marked increase in consumption of fat-rich food items such as edible oils, milk and its products, as well as, non-vegetarian foods, as observed in dietary diversification, might have contributed to this shift.

Among minerals, the average intake of calcium and zinc increased and of iron decreased between 1983 and 2011. The average changes in intake of these minerals were 18.3 percent for calcium, 16.9 percent for zinc and -11.7 percent for iron. However, across income groups and rural-urban divide, there were mixed patterns. Vitamin A, exhibited a general increase in its intake over time. In terms of magnitude, the poor households registered the highest change (15.6 %) and rich households the lowest (0.6 %). However, contrary to the general trend, the middle- income and rich households in urban areas displayed a reduction in intake of Vitamin A by -2.9 percent and -3.5 percent respectively. In a nutshell, the study has clearly brought out changes in nutrients intake pattern in India, consequent to the changes in their dietary consumption.

Table 5: Changes in intake of dietary nutrients in rural and urban India, 1983-2011

Income class	Rural India			Urban India			All India		
	1983	2011	Change, %	1983	2011	Change, %	1983	2011	Change, %
				Calories (kcal/capita/day)					
Poor	1758	1718	-2.2	1599	1646	2.9	1703	1690	-0.7
Middle income	2264	2010	-11.2	1992	1862	-6.5	2176	1965	-9.7
Rich	2949	2389	-19.0	2456	2280	-7.2	2755	2342	-15.0
All income	2243	2131	-5.0	1987	2059	3.7	2153	2104	-2.3
				Protein (g/capita/day)					
Poor	50.0	44.6	-10.9	45.9	43.4	-5.3	48.6	44.1	-9.2
Middle income	63.5	53.1	-16.4	55.9	49.6	-11.3	61.0	52.0	-14.7
Rich	83.3	65.0	-22.0	69.1	62.2	-10.0	77.7	63.8	-17.9
All income	63.4	57.0	-10.0	56.2	55.6	-1.0	60.8	56.5	-7.1
				Fat (g/capita/day)					
Poor	15.8	24.8	56.7	20.6	28.2	36.9	17.5	26.1	49.4
Middle income	25.1	35.9	42.9	32.6	37.8	15.8	27.6	36.5	32.3
Rich	44.2	53.7	21.5	53.2	59.5	11.9	47.7	56.2	17.8
All income	26.5	42.1	58.9	34.5	48.3	40.2	29.3	44.5	51.8
				Calcium (mg/capita/day)					
Poor	294	302	2.6	321	333	3.9	303	314	3.5
Middle income	448	457	1.8	485	457	-5.7	460	457	-0.7
Rich	776	733	-5.6	790	778	-1.4	781	752	-3.7
All income	474	556	17.3	518	617	19.0	489	579	18.3
				Iron (mg/capita/day)					
Poor	31.2	28.3	-9.1	32.3	29.3	-9.5	31.6	28.7	-9.1
Middle income	40.3	33.5	-16.8	39.2	32.4	-17.4	39.9	33.2	-16.9
Rich	57.0	40.4	-29.2	49.3	40.0	-18.9	54.0	40.2	-25.5
All income	41.1	35.7	-13.0	39.8	36.1	-9.1	40.6	35.9	-11.7
				Zinc (mg/capita/day)					
Poor	7.1	8.3	16.7	6.3	7.6	20.8	6.8	8.0	17.4
Middle income	8.9	9.5	6.9	7.8	8.5	9.2	8.5	9.2	7.7
Rich	11.2	11.0	-1.3	9.7	10.9	12.3	10.6	11.0	3.5
All income	8.8	10.0	13.7	7.8	9.7	23.9	8.4	9.9	16.9
				Vitamin A equivalent (µg/capita/day)					
Poor	107	123	15.3	113	131	15.2	109	126	15.6
Middle income	156	172	10.0	176	171	-2.8	163	172	5.5
Rich	248	255	3.0	286	276	-3.5	262	264	0.6
All income	161	201	25.3	186	223	19.6	170	210	23.4

The disparity in intake of calorie and nutrients across states of India was investigated and the detailed results are available upon request. Results show that, in 2011, the average calorie intake was highest in the state, Himachal Pradesh (2525 kcal/capita/day) followed by Uttarakhand (2433 kcal/capita/day), Jammu & Kashmir (2350 kcal/capita/day), Tripura (2288 kcal/capita/day), Punjab (2257 kcal/capita/day),

and Rajasthan (2243 kcal/capita/day).Some states like Meghalaya, Goa, Manipur, Nagaland, Sikkim, Tamil Nadu, Gujarat, and Kerala were characterized by lower levels of average calorie intake. In terms of changes in calorie intake over time mixed trends were observed across states. While states like Kerala, Pondicherry, Tamil Nadu, Andhra Pradesh, Tripura and West Bengal displayed an increase in per-capita calorie intake between 1983 and 2011, most of the other states exhibited a decline in calorie intake over this period. Similar to the trend in calorie intake, wide variations were observed in intake of other nutrients such as proteins, fats, minerals and vitamin A across states. Different states also displayed deviant patterns in their temporal behaviour, in terms of nutrients intake.

The observed pattern of declining intake of calories should be interpreted with care, as the calorie requirements of people itself might have undergone changes in line with their changing life style and activity levels. As cautioned by Deaton and Dreze (2009), it may be rather treated as a limitation of the set pattern of nutritional norms which have more or less remained time-invariant. They have further noted that calorie/nutrient requirements could be highly context-specific, depending on activity levels, epidemiological environment demographic status, composition of population, and such other factors. Therefore, such evaluations should be clinically vetted based on anthropometric indicators as well to avoid any misinterpretations.

Dietary Sources of Nutrients

To further understand the changing pattern of nutrients intake, compositional changes in food items towards the supply of calories and nutrients were analysed over time. Table 6 presents the share of major food items as sources of calories, proteins, fats, calcium, iron, zinc and Vitamin A for the year 1983 and 2011. It was observed that cereals continued to constitute the main source of calories in both the years considered, though there was a decline in their share over time. In 1983, the contribution of cereals was 73.55 percent of the total calories consumed by the sample households, which declined to 59.63 percent by the year 2011. The share of pulses as calorie source also reduced marginally from 5.20 percent to 4.48 percent during this period. On the other hand, the shares of all other food items in total calorie intake increased during this period with notable changes in cases of edible oils, milk, and other foods. This finding is consistent with the general trend of decreasing consumption of food grains and their substitution by other high-value food items.

As for calories, the contribution of cereals as a source of proteins was also found substantial. On an average, 59.4 percent of the total protein intake of sample households was sourced from cereals in 2011, down from 72.2 percent in 1983. Pulses served as an important source of proteins after cereals, with 10.9 percent contribution in 2011, though their share declined from 12.1percent in 1983. In contrast, the share of milk in protein supply increased appreciably from 6.99 percent to 11.91 during this period. Other emerging sources of proteins were livestock products.

In India, fat requirements are mainly met from edible oils, whose share has increased over time from 42.27 percent in 1983 to 49.74 percent in 2011. The second largest fat source has been milk, followed by cereals. However, while the share of milk as a source of fat remained more or less same, the share of cereals declined substantially from 21.08 percent in 1983 to 8.33 percent in 2011. Other foods have upgraded their contribution towards fat intake over time. As in the case of calories, proteins and fats, the share of cereals as a major provider of minerals (calcium, iron and zinc) has also declined with time. Between 1983 and 2011, the share of cereals waned from 30.09 percent to 15.43 percent for calcium, from 70.03 percent to 62.91 percent for iron and from 65.07 percent to 44.16 percent for zinc. Though not to that extent, the share of pulses as a source of minerals also dwindled over time. The gaps created by cereals and pulses were mainly filled by milk and other food items in the case of calcium, and by vegetables and other food items in case of iron and zinc. Vegetables maintained its status as the biggest source of Vitamin A in the form of β-carotene (54.98 % in 1983 and 52.21 % in 2011), whereas milk as the second biggest contributor of Vitamin A improved its share from 23.33 % in 1983 to 27.26 % in 2011. The share of edible oils dropped from 4.02% in 1983 to negligible in 2011.

Energy and Nutrient Intake Gap

The study assessed the gap between recommended and actual intake levels of calories and nutrients of the sample households and the estimated proportions

Table 6: Dietary sources of calories and major nutrients for households in India, 1983 and 2011 (% share of total intake)

Year	Cereals	Pulses	Edible oils	Vegetables	Fruits	Milk	MFE	Sugar	Other foods
				Calories					
1983	73.55	5.20	5.18	3.44	0.29	5.45	0.70	5.67	0.52
2011	59.63	4.48	9.46	3.87	1.51	8.34	1.14	5.17	6.40
				Proteins					
1983	72.22	12.06	0.00	3.84	0.12	6.99	4.05	0.13	0.59
2011	59.44	10.9	0.00	4.71	0.59	11.91	6.49	0.06	5.90
				Fat					
1983	21.08	2.32	42.27	1.15	0.13	29.70	1.32	0.04	1.99
2011	8.33	1.22	49.74	0.58	2.73	28.26	1.64	0.00	7.50
				Calcium					
1983	30.09	10.3	0.00	9.78	0.38	41.57	1.81	5.10	0.97
2011	15.43	7.31	0.00	9.69	1.14	50.68	2.13	3.79	9.83
				Iron					
1983	70.03	5.87	0.00	5.83	0.27	6.07	2.71	8.77	0.45
2011	62.91	5.56	0.00	7.73	1.11	0.99	4.29	8.71	8.70
				Zinc					
1983	65.07	10.07	0.00	15.8	0.70	1.31	2.56	0.00	4.49
2011	44.16	7.26	0.00	15.84	2.16	1.62	3.06	0.00	25.90
				Vitamin A equivalent					
1983	7.91	2.76	4.02	54.98	1.92	23.33	0.93	3.86	0.29
2011	2.98	1.87	0.00	52.21	5.61	27.26	1.05	2.75	6.27

of population below the recommended intake are presented in Table 7. The results pertain to various income classes of households belonging to rural India, urban India and all-India and are for the years 1983 and 2011. Wide variations in nutrient gaps were noticed across rural-urban divide and income status. In terms of calories intake, nearly 73 percent of rural and 59 percent of urban population fall below the recommended levels in 2011. At the country level, the corresponding estimate was 67.95 percent in 2011, up from 65.62 percent in 1983. The deterioration in calories-intake status was pronounced for rural population, whose proportion increased from 65.85 percent to 73.43 percent during the period. Urban population on the other hand improved their status by reducing the proportion from 65.2 percent in 1983 to 59.14 percent in 2011. A perusal on the above aspects across income classes of households revealed mixed patterns. The maximum proportion of households with under-intake of calories belonged to the lower-most income class, followed by middle-income class. In general, while the poor households have improved their energy-intake status with time, the middle-income and rich households have experienced deterioration in their energy-intake status. Consequently, between 1983 and 2011, the proportion of households getting less than recommended dietary calories decreased from 89.09 percent to 87.66 percent across the poor and increased across middle income (from 63.29 % to 76.63%) and rich (from 35.42 % to 55.31%) classes at all India level. Similar patterns were observed in rural and urban areas across different income classes.

In the case of protein intake, the changes noticed were not inspiring. Between 1983 and 2011 the proportion of protein-deprived households increased from 28.55 percent to 29.38 percent in the rural areas and decreased from 39.71 percent to 34.71 percent in the urban areas. At the country level, there was a marginal improvement in under-intake status of protein (from 32.48% to 31.42%). The temporal patterns of change across income classes in protein intake broadly

Table 7: Percent population below recommended intake of dietary calories and nutrients across income classes in rural and urban households of India, 1983 and 2011

Nutrient	Household income class	Rural India		Urban India		All India	
		1983	2011	1983	2011	1983	2011
Calories	Poor	89.54	89.72	88.24	84.32	89.09	87.66
	Middle income	62.41	78.39	65.13	72.62	63.29	76.63
	Rich	34.33	63.12	37.09	45.09	35.42	55.31
	All income	65.85	73.43	65.2	59.14	65.62	67.95
Proteins	Poor	47.07	50.18	61.21	57.52	51.94	52.99
	Middle income	21.34	33.3	35.96	44.94	26.08	36.83
	Rich	9.49	18.03	16.85	22.83	12.39	20.11
	All income	28.55	29.38	39.71	34.71	32.48	31.42
Fats	Poor	93.94	71.01	76.48	48.45	87.93	62.37
	Middle income	71.98	38.33	39.38	21.98	61.41	33.36
	Rich	38.06	14.11	14.96	5.02	28.97	10.17
	All income	71.78	33.2	46.06	17.25	62.73	27.09
Calcium	Poor	94.57	97.33	95.88	97.22	95.02	97.29
	Middle income	82.36	83.22	80.26	85.04	81.68	83.77
	Rich	51.23	52.68	44.73	43.3	48.67	48.61
	All income	78.97	71.71	75.01	63.57	77.58	68.59
Iron	Poor	21.88	15.49	18.89	13.6	20.85	14.77
	Middle income	5.4	5.32	4.36	6	5.06	5.53
	Rich	1.73	1.69	1.39	1.35	1.6	1.54
	All income	11.07	5.53	9.08	4.77	10.37	5.24
Zinc	Poor	91.75	72.38	97.13	82.42	93.6	76.23
	Middle income	70.28	63.66	87.91	78.49	75.99	68.16
	Rich	45.7	50.33	65.68	53.21	53.56	51.57
	All income	72.37	59.11	84.42	64.85	76.61	61.31
Vitamin A equivalent	Poor	99.87	99.99	99.97	100	99.91	100
	Middle income	99.74	99.99	99.88	99.97	99.79	99.98
	Rich	96.2	98.36	95.71	98.32	96.01	98.34
	All income	98.85	99.24	98.59	99.04	98.76	99.16

matched with those of calorie intake. In the intake pattern of fats, however, there was a marked improvement over time, across rural-urban divide or across income classes. The proportion of households being less than the recommended levels of fat intake dropped sharply from 62.23 percent in 1983 to 27.09 percent in 2011.

Similar reductions in proportions were noticed in both rural (71.78 % to 33.2 %) and urban (46.06 % to 17.25 %) areas. All three income classes of households exhibited improvements in fat intake between 1983 and 2011, the change in under-intake proportions being: poor (87.93 % to 62.37%); middle-income (61.41% to 33.36%) and rich (28.97% to 27.09%) households. A declining trend in the proportion of nutrients-deprived households was visible with respect to intake of calcium, iron and zinc between 1983 and 2011. The proportions fell by 8.99 percent points in calcium-intake, 5.13 percent points in iron-intake and by 15.3 percent points in zinc-intake. This trend was pervasive across all the three income classes for these three minerals. The estimates of

Iron presented here are however in variance with that reported by NNMB. The reports of NNMB (NIN, 2000; 2002) show that the shares of population with under-intake of iron range above 50 per cent in almost all age-groups of respondents, across the states. The magnitude of anaemia reported by the NFHS III (2005-06) also supports this proposition. Therefore, this discrepancy needs further investigation.The proportions of households having less than recommended levels of dietary calcium and zinc were quite large, 69 percent in case of calcium and 61 percent in case of zinc. The intake gap for Vitamin A was glaring as more than 95 percent of sample households registered its under-intake irrespective of rural-urban divide or income strata. For the two bottom income strata, almost 100 percent households were deficit in Vitamin A intake, which indicated the severity of the situation. In general, energy and nutrient deprivation was quite rampant in India even in the year 2011, though improvements in intake were visible over time for nutrients like fats, iron, calcium and zinc.

State-wise analysis on intake gaps in major nutrients was also carried out and is available upon request. Consistent with the general disparity in intake of nutrients, the results show that, wide variations in intake gaps were noticed across states as well. More than half of the households in all states, except Himachal Pradesh, were found deficit in calorie-intake. A widespread under-intake of other nutrients, especially of fats, calcium, zinc and Vitamin A, was noted across states. However, the observed trends over the period 1983-2011 were encouraging as the proportion of households with under-intake of the above nutrients declined considerably in most of the states. Notwithstanding the above observations, the limitations noted before on account of time-invariant calorie and nutrients intake norms apply here. It may be misleading to base the temporal comparisons entirely on the basis of these norms, as their requirements might have undergone considerable changes over time.

Conclusions and Policy Implications

This article has examined the dynamics of food consumption and nutrients intake pattern in India during the past three decades. The analysis is based on the nationally representative sample survey data on food consumption obtained from the NSSO for the years 1983 and 2011. The overall trends have revealed gradual diversification in the food basket, resulting largely from the growing inclination of consumers towards high-value commodities such as edible oils, fruits, vegetables, milk and its products, and non-vegetarian food items, from the traditionally narrow dietary mix dominated by food grains and pulses. This process of diversification was, however, not evenly visible across the income strata of households. The households belonging to the bottom-income group have reduced their consumption of cereals and pulses in much lower proportions than by their top-income counterparts during the period under study. On the other hand, the relative temporal improvement in consumption of most of the high-value commodities by the bottom-income group was in higher proportions in relation to the top-income group. The deepening of diversity in food consumption over time has been verified empirically by estimating Simpson Index of Diversity for households of different income groups. Results suggested that irrespective of income status, the estimates of diversity index have increased between 1983 and 2011.

Subsequently, the study has looked into the changes in nutritional status of households belonging to different income groups by estimating the calorie and nutrients intake of sample households during the period 1983-2011. This was conducted by converting the quantity consumption of each food item to its equivalent calorie and other nutrients based on standard nutrient charts. Further, gaps in intake of calories and nutrients by the households have been assessed against RDA and the percentage of households below the recommended intake levels has been determined. The results have revealed that calorie and nutrient intake varied considerably across rural-urban divide and income status of households. Notably, the average calorie intake per capita per day decreased appreciably over the years with reflections across various sections of consumers. Changes in intake of other nutrients were also noticed over time but with case to case variations.

The estimated gaps between RDA and real-time intake of calorie and nutrient have revealed widespread prevalence of nutrition deprivation in the country. Calorie gap has been observed to deepen over time with increase in proportion of calorie-

deprived households over the study period, mainly inrural areas. Similarly, the households belonging to lower-income groups have exhibited higher levels of calorie-intake gaps. However, this finding is subject to a caveat that the intake norms used for both the reference years were the same and there is a possibility that calorie requirements might have changed over time due to various factors outlined above. Therefore, the observed increase in calorie deprivation may be notional and may not actually imply worsening of nutritional levels. The same trend of widening nutrient gap was observed for other nutrients such as proteins,calcium and Vitamin A, particularly among low income rural households. However, per cent population with under-intake of fats, Iron and zinc decreased over time, thereby indicating improvements in nutritional outcomes with respect to these nutrients.

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