Agricultural Economics Research Review
Vol. 30 (No.1) January-June 2017 pp 23-35
DOI: 10.5958/0974-0279.2017.00002.7

Tracking Transition in Calorie-Intake among Indian Households: Insights and Policy Implications

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Abstract

The long-run trend in calorie-intake among rural and urban households in India has shown a decline till the year 2009-10 which got reversed during 2011-12. The reversal in the trend in calorie-intake has several important implications for dietary transition and nutritional interventions. The improvement in nourishment during 2011-12 is accompanied by a decline in inequality in calorie-intake. Among the economic forces, squeezed food budget has been the major factor responsible for the decline in dietary energy intake during 1993-94 to 2004-05, while the sufficiently large increase in income along with improved PDS after 2004-05 has triggered the upward trend in energy intake during the recent years. The paper has indicated that effect of subsidies spent on in-kind PDS transfer on calorie-intake is 3.5-3.9 times the effect of direct cash transfer of food subsidy. Therefore, the study has underlined the strengthening of PDS functioning or conditional cash transfers for improved nutritional status of Indian households.

Key words: Undernourishment, inequality, trend reversal, PDS, cash transfer

JEL Classification: I14, I18, I38, Q18

Introduction

Ensuring food and nutrition security has remained one of the top priorities of the development agenda of India since independence. This was sought to be achieved by accelerating growth in food production, improving economic access to food, keeping a check on prices of food staples and providing subsidized foodgrains. Many studies have shown that despite these efforts, no significant progress could be achieved in reducing the incidence of hunger and under-nourishment in the country (Chand and Jumrani, 2013; Meenkashi and Vishwanathan, 2003; Deaton and Dreze, 2009; Patnaik, 2010; Basu and Basole, 2012), though there exists a wide variation in the estimates of undernourished population among different sources. Some studies have even reported deterioration in nutrition over time (Meenakshi and Vishwanathan, 2003; Deaton and Dreze, 2009; Patnaik, 2010; Basu and Basole, 2012). However, adequate explanation on why the increase in per-capita income and food production could not bring a significant decline in under-nutrition, is not available in the literature, except some plausible answers like voluntary hunger, poor awareness about nutrition, etc. (Chand and Jumarani, 2013).

It is observed that most of the studies on trends in nutrition intake have covered the period upto 2004-05[1] while big increases in per-capita income and food production have been experienced in the subsequent period. The per-capita real income in India increased by 4.39 per cent per year during 1993-94 to 2004-05

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[1] A few studies have estimated the incidence of under-nutrition during the year 2009-10 also, but it was an agriculturally abnormal year.

and then accelerated to 6.91 per cent during 2004-05 to 2011-12. Similarly, per-capita food production including livestock and fish products, has witnessed 2.79 per cent annual growth during 2004-05 to 2011-12 as compared to annual decline of 0.66 per cent per annum during 1993-94 to 2004-05. The farmers' income and wages of agricultural labour also experienced accelerated and unprecedented growth during 2004-05 to 2011-12 (Chand *et al*., 2015). The percentage of population below poverty line (BPL) fell from 37.2 per cent in 2004-05 to 21.9 per cent in 2011-12 based on Tendulkar methodology (GoI, 2013). It would be interesting to explore how the acceleration in growth rates of per-capita income and food production and a sharp decline in poverty after 2004-05, have affected the level of nutrition in the country.

The present study has examined whether the trends in food consumption and calorie intake have changed in the wake of increase in economic and physical access to food after 2004-05. The paper has also estimated the inequality in calorie-intake among Indian households and has analysed the underlying drivers influencing under-nourishment. Using the evidences from CES (Consumer Expenditure Surveys) data for various rounds, the paper has compared the effect of cash transfer and physical distribution of grains through PDS on nutritional security at household level.

Data and Methodology

The study has used household level CES data of National Sample Survey Office (NSSO) pertaining to the years 1993-94, 2004-05, 2009-10 and 2011-12. The level of under-nutrition was estimated from the gap between actual dietary intake of energy (calories) and recommended dietary norms. The per-capita actual calorie-intake was estimated by applying standard conversion factors on consumption of individual food commodities reported in the surveys (GoI, 2014a). As food consumption pattern of Indian households vary across geographical regions and expenditure-classes (Srivastava *et al*., 2013a, Srivastava *et al*., 2013b, Srivastava *et al*., 2013c), trend in mean calorie-intake was examined separately for the rural and urban areas of major states of the country and expenditure-classes therein. The expenditure-classes were constructed by categorizing households into ten decile groups based on monthly per-capita consumption expenditure (MPCE). The mean calorie-intake was compared with the minimum required calorie level for a healthy and active life, based on different norms, to assess the adequacy of nutritional intake. It is to be noted that a large difference exists in the use of calorie norms among different agencies. Indian Council of Medical Research (ICMR) recommends per-person per-day calorie norms of 2400 kcal for rural areas and 2100 kcal for urban areas, while Food and Agriculture Organization (FAO) uses a common minimum required calorie norm of 1800 kcal per-person per-day for both rural and urban population. Therefore, the estimates of under-nutrition were prepared by estimating *head count ratio* (proportion of population with lower calorie-intake than recommended norms) and comparing the actual calorie-intake with the recommended norms of ICMR and FAO.

The inequality in calorie-intake was quantified by estimating gini coefficient. The gini coefficient in this context is a summary statistics that measure how equitably calorie-intake is distributed in the population. It ranges from zero to one and the coefficient value closer to one indicates higher inequality. For estimating inequality, households were grouped into ten equal decile classes based on per-capita daily calorie-intake and gini coefficient was estimated by the formula (1);

$$G = \frac{1}{2n^2\mu}\sum_{j=1}^{m}\sum_{k=1}^{m} n_j n_k \mid y_j - y_k \mid \qquad \ldots(1)$$

where,

y_j, y_k = The per-capita calorie intake of j^{th} and k^{th} decile class (j,k=1,2,...,10),

n_j, n_k = Number of households in each decile class,

n = Total number of households, and

μ = Weighted mean per capita calorie intake.

The factors driving changes in the calorie-intake at household level were identified by fitting a calorie consumption function using the pooled data for the years 1993-94, 2004-05 and 2011-12. The monetary variables were expressed in real terms by deflating them with consumer price index for agricultural labour (CPI-AL) and CPI for industrial workers (CPI-IW) for rural and urban areas, respectively (GoI, 2014b). The functional form of the estimated relationship was as under:

$$CALPC = \beta + \beta_1 * REALCONSUMPEXP + \beta_2 * REALCALPRICE + \beta_3 * FOODSHARE + \beta_4 * PDSSUPPLY + \beta_5 * FARMING + \beta_6 * FAMILSIZE + \beta_7 * AGE + \beta_8 * EDUCATION + \beta_9 * YEARDUMMY2004 + \beta_{10} * YEARDUMMY2011 + \sum_{i=1}^{31} \beta_i D_i + e \quad \ldots (2)$$

where,

CALPC = The per-capita calorie intake (kcal/capita/day),

REALCONSUMPEXP = Real per-capita consumption expenditure (₹/capita/day)

CALPRICE = Real calorie prices (₹/1000 kcal)

FOODSHARE = Share of food in total consumption expenditure (%)

PDSSUPPLY = Consumption of rice and wheat from PDS (kg/capita/day)

FARMING = Dummy for household engaged in farming in rural areas (1= yes, 0= No)

FAMILSIZE = Family size (No.)

AGE = Age of household-head (years)

EDUCATION = Years of schooling of household-head (years)

YEARDUMMY2004 = Dummy for the year 2004-05 (1=2004-05, 0= other years)

YEARDUMMY2011 = Dummy for the year 2011-12 (1=2011-12, 0= other years)

D_i = State specific dummies, (i=1,2…, 31)

A close examination of unit-level household data revealed some observations with zero food consumption and some with more than 10,000 kcal intake per-day. The reason for calorie-intake exceeding the feasible level seems to be that entire food used for some social functions or ceremonies by such household might be treated as household consumption. Various methods were tried to eliminate the outliers at upper end. For fitting regression function, it was decided to remove 0.10 per cent sample household who were at the top in terms of calorie-intake. For removing these outliers, the upper cut off values for daily calorie- intake in rural areas were 7,162 kcal, 10,134 kcal, and 5,679 kcal during 1993-94, 2004-05 and 2011-12, respectively. For urban areas, the cut off values were 6,573 kcal, 11,818 kcal and 5,368 kcal during 1993-94, 2004-05 and 2011-12, respectively. At the lower end, all households with zero calorie-intake were removed from the data set. The regression function was fitted for rural and urban areas separately. For urban areas, dummy for farming activities was dropped from the function. Based on the estimated coefficients, marginal effects of different factors on calorie-intake were quantified to explain the changes in calorie-intake during 1993-94 to 2004-05, and 2004-05 to 2011-12. For comparing efficacy of PDS with cash transfer, nutritional effects of PDS supplies were expressed in terms of food subsidy and compared with nutritional effect of equivalent increase in consumption expenditure.

Results and Discussion

Trends in Calorie Intake and Under-nourishment

Between 1993-94 and 2004-05, the per-capita energy intake declined from 2153 kcal to 2047 kcal in rural areas and from 2071 kcal to 2020 kcal in urban areas (Figure 1). The dietary energy intake followed a further decline in the year 2009-10. In contrast to this, the per-capita calorie intake showed a sharp increase in 2011-12. Even if the year 2009-10 is excluded from the trend, considering it abnormal because of severe drought (GoI, 2013) and lower food availability in the country, the per-capita calorie-intake in the year 2011-12 shows increase over the year 2004-05. An average Indian consumed 54 more calories in 2011-12 than in

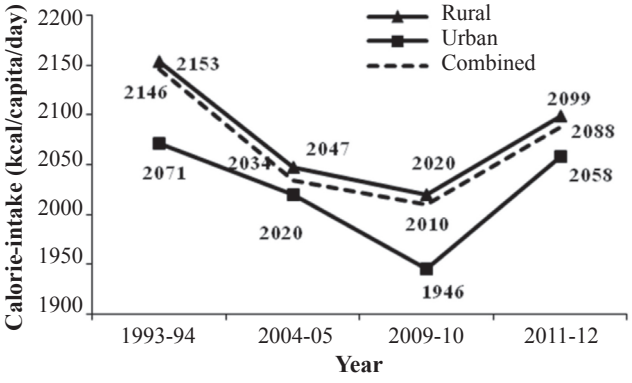

Figure 1. Trend in calorie-intake in India: 1993-94 to 2011-12

Table 1. Incidence of under-nourishment among Indian households: 1993-94 to 2011-12

(per cent)

Year	HCR based on ICMR norms			HCR based on FAO norms		
	Rural population	Urban population	Overall population	Rural population	Urban population	Overall population
1993-94	71.01	56.29	67.36	30.99	34.31	31.81
2004-05	80.08	64.14	76.04	37.07	38.36	37.32
2011-12	77.24	59.41	72.14	28.39	32.87	29.55

HCR: Head count ratio

2004-05. These changes suggest that downward trend in per-capita calorie-intake witnessed reversal of the past trend in both rural as well as urban areas during 2011-12. However, the existing level of calorie-intake is still below conventional Indian Council of Medical Research (ICMR) norms of 2400 kcal in rural areas and 2100 kcal in urban areas. Across the major states of India, the mean calorie-intake exceeded the norms only in Himachal Pradesh in rural areas and in Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Rajasthan, and Andhra Pradesh in urban areas (Appendix 1).

The incidence of under-nourishment was examined by estimating head count ratio (HCR) based on ICMR and FAO norms. Based on the conventional ICMR norms, 77.24 per cent of the total rural population and 59.41 per cent of the total urban population in the year 2011-12 consumed less calories than the prescribed minimum requirement (Table 1). Even in the states with relatively higher calorie-intake, at-least 50 per cent population in rural areas and at-least 31 per cent population in urban areas was under-nourished (Appendix 2). On the other hand, based on FAO norms of 1800 kcal, the HCR of under-nourished persons turned out to be 28.39 per cent among rural households and 32.87 per cent among urban households.

The choice of alternative norms completely alters the conclusions about the pattern and level of under-nourishment. For example, based on conventional ICMR norms, calorie deficit in rural areas was higher than in urban areas while it was the opposite based on FAO norms (Table 1). This contrasting pattern is because of the same cut-off value for rural and urban areas in FAO norms, and relatively higher calorie-intake by rural households than urban counterparts (Figure 1). However, temporally incidence of under-nourishment followed a similar trend based on both ICMR and FAO norms, though with varying rate of change. Between 1993-94 and 2004-05, the undernourished population increased by 8.68 percentage points based on ICMR norms and 5.51 percentage points as per FAO norms. This was followed by a decline in HCR of 3.9 and 7.7 percentage points between 2004-05 and 2011-12 based on ICMR and FAO norms, respectively. By and large, there is an inconclusive debate on the cut-off line for minimum calorie requirement (Sukhatme, 1993; Meenakshi and Vishwanathan, 2003; Chand and Jumrani, 2013). Overall, it can be concluded that the trend showing deterioration in under-nourishment has been reversed during the recent years. However, there exists a large-scale calorie deprivation among Indian households even based on a lower norm.

Calorie Intake across Expenditure-Classes and Inequality

The per-capita calorie-intake varied considerably across different expenditure-classes with low-income households consuming fewer calories than high-income categories (Table 2). Between 1993-94 and 2011-12, the mean calorie intake increased among the households belonging to the bottom four expenditure-classes in rural areas and bottom six classes in urban areas. In contrast to this, the relatively rich households have reduced dietary energy intake during the past 18 years. It is interesting to note that even at the higher economic level, where there is no economic constraint to consume food, the under-nourishment was increasing over the years - the same has been termed as 'voluntary hunger' in the literature (Chand and Jumrani, 2013). The possible factors behind the increasing calorie-intake by the poor households could be related to the

Table 2. Expenditure class-wise changes in calorie-intake in India: 1993-94 to 2011-12

(kcal/capita/day)

Expenditure class	Rural areas			Urban areas		
	1993-94	2004-05	2011-12	1993-94	2004-05	2011-12
0-10	1443	1477	1668	1430	1507	1678
10-20	1728	1676	1816	1715	1683	1809
20-30	1848	1798	1908	1833	1833	1902
30-40	1965	1877	1975	1929	1853	1989
40-50	2045	1957	2027	2052	1942	2074
50-60	2160	2038	2100	2147	2019	2163
60-70	2260	2151	2165	2279	2106	2258
70-80	2398	2257	2263	2474	2208	2365
80-90	2592	2370	2367	2738	2333	2546
90-100	3186	2782	2751	3482	2685	2934
Gini coefficient	0.16	0.15	0.13	0.18	0.17	0.14

improved access to food, while the factors such as increasing health consciousness, sedentary life-style and changing food habits might be leading to a declining calorie-intake by richer households.

The consequence of such differential trends across expenditure-classes is narrowing down of calorie-intake gap between low and high income households. The difference in the mean calorie-intake between the top and bottom decile expenditure-classes has declined from 1743 kcal/capita/day during 1993-94 to1083 kcal/capita/day during 2011-12 in rural India. Similarly, in urban areas, the mean difference has declined from 2052 kcal/capita/day to 1256 kcal/capita/day during the same period. The increasing convergence or declining inequality in dietary energy intake was captured by the declining values of estimated gini coefficients from 0.16 to 0.13 in rural areas and 0.18 to 0.14 in urban areas during the period 1993-94 to 2011-12 (Table 2). Srivastava *et al*. (2016) have found a tendency of convergence in calorie-intake across expenditure-classes between 1993-94 and 2011-12 at the rate of 7 per cent. Declining inequality in calorie-intake is a desirable trend from nutritional point of view.

It is evident that income is a very important determinant of nutritional intake. The estimates derived from unit-level data showed that in the bottom decile (poorest), about 98 per cent of the rural households and 92 per cent of urban households were undernourished. The gap in nutritional intake (actual and recommended dietary energy intake) was 30 per cent in rural and 20 per cent in urban, respectively in 2011-12 (Figure 2). On the other hand, in the top decile (richest) class, although the mean calorie-intake was higher than the minimum requirement, 42.27 per cent

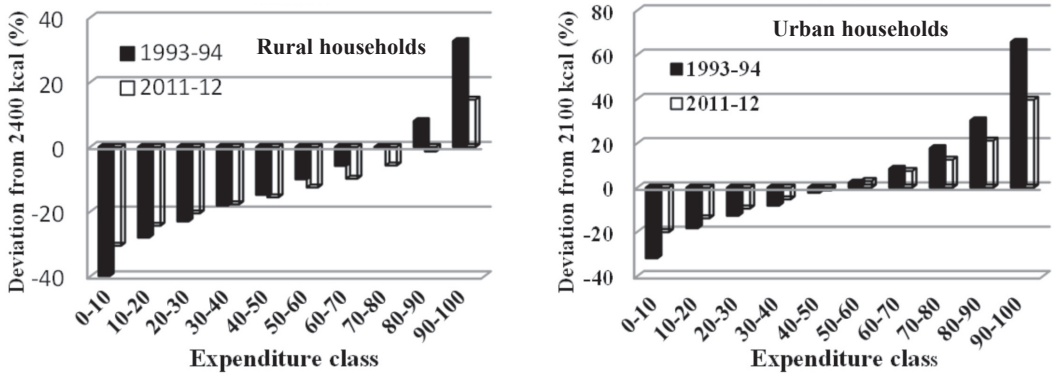

Figure 2. Expenditure class-wise changes in per cent deviation of calorie-intake from the recommended ICMR norms between 1993-94 and 2011-12

of the rich rural households and 22.28 per cent of the rich urban households were undernourished in 2011-12. Thus, measures are needed for fast increase in calorie-intake among low-income households and to generate awareness towards importance of minimum energy needs and increased physical activities to absorb the added energy, particularly among high-income households.

Drivers of Changes in Calorie-Intake

The observed level of nutrition is outcome of several socio-cultural, economic and policy related factors. The following section discusses the effect of various factors on the changes in calorie-intake among Indian households using multiple regression equation based on unit-level data for the years 1993-94, 2004-05 and 2011-12. The marginal effect of various factors was multiplied by the changes in explanatory variables to arrive at the sum of changes, as dictated by the variables included in the calorie consumption function. This estimated change in calorie-intake was compared with the actual changes in per-capita calorie-intake in the two periods, viz. 1993-94 to 2004-05 and 2004-05 to 2011-12. The idea of this exercise was to find out whether the factors included in the regression equation could explain the decline in dietary energy intake during 1993-94 to 2004-05 and the subsequent increase therein during 2004-05 to 2011-12. This will be useful in designing effective policies needed to address under-nutrition in the country. The estimates derived from the regression equation are presented in Table 3.

Table 3. Estimated calorie consumption function: 1993-94, 2004-05, 2011-12

Variable	Rural areas	Urban areas
Dependent variable	Dietary energy intake (kcal/capita/day)	
Explanatory variables		
Real consumption expenditure (₹/capita/day)	5.37*** (0.030)	3.20*** (0.023)
Real calorie price (₹/1000 kcal)	-12.54*** (0.425)	-8.88*** (0.328)
PDS supplies (kg of rice and wheat/capita/day)	464.37*** (13.934)	308.23*** (20.739)
Food share (per cent)	8.11*** (0.105)	8.77*** (0.129)
Farming (0= no, 1= yes)	200.62*** (2.716)	-
Family size (No. of household members)	-66.84*** (0.550)	-112.06*** (0.779)
Age of household-head (years)	7.55*** (0.099)	6.70 *** (0.128)
Education of household-head (years of schooling)	22.91*** (0.287)	23.22*** (0.335)
Year dummy (2011=1)	-125.37*** (3.685)	-154.66*** (4.434)
Year dummy (2004=1)	-122.71*** (3.125)	-130.82** (4.276)
State dummies	Yes	Yes
Intercept	1466.17*** (21.164)	1791.42*** (22.529)
R^2	0.2919	0.3400
Observations (No.)	206892	131087

Note: *** significant at 1 per cent level of significance; Figures within parentheses are standard errors of the estimated parameters; Estimated parameters of state dummies not given due to paucity of space and the same can be obtained on request

All factors included in the regression equation showed highly significant effect on per-capita calorie-intake in the rural as well as urban households. The effect of real consumption expenditure, which was used as a proxy for household income, was positive and the effect of real price of calorie was negative. An increase of one rupee in per-capita daily expenditure resulted in an increase in per-capita calorie-intake of 5.37 in the rural areas and 3.20 in urban areas. The effect of increase in the price of calorie was also more in rural than urban areas, indicating higher sensitivity of rural population to inflation as compared to urban population. The effect of PDS supply of rice and wheat was positive and much higher in the rural than in urban areas. The estimate showed that one kg increase in PDS supply of rice and wheat resulted in an increase of 464 kcal in dietary energy intake in rural areas and 308 kcal in urban areas. This is a very interesting result with important implications for PDS. One kilogram of rice or wheat contains around 3400 kcal energy. The PDS supply does not result in a matching increase in cereals intake nor does it result in a matching substitution of non-PDS consumption of cereals. The results of regression equation indicated that an increase of one kg in PDS supply of cereals would result in the net increase in cereals consumption by 136 grams in the rural areas and 90 grams in urban areas. This is

why the net marginal effect of PDS supply on calorie intake is only a fraction of calories available in PDS supply. The study has also shown that households, engaged in farming, consume more energy compared to non-farming households. The main reasons for this include the availability factor and higher energy requirement in performing farm operations. Family size was found to cause an adverse effect on per-capita dietary intake of energy, whereas the age and education of household-head had a positive effect on nutritional status of households.

The results of regression equations which provide estimates of marginal effect of various factors on per-capita calorie intake along with the changes in these factors can be used to explain the changes in nutrition between 1993-94 to 2004-05 and 2004-05 to 2011-12. Although the factors taken into consideration may not completely account for the changes in calorie-intake, they would provide useful insights about the nutritional transition among Indian households. The results are presented in Table 4.

Between 1993-94 and 2004-05, the per-capita monthly real expenditure in rural areas increased by ₹ 80 and real price per 1000 calorie declined from ₹ 9.30 to ₹ 9.10 showing a change of ₹ -0.20 (Table 4 and Appendix 3). The multiplication of these changes with their marginal effects would result in the increase of 14.28 kcal and 3.05 kcal per day calorie-intake, respectively. In the same period, the PDS supply among rural households increased by 0.49 kg/capita/month. This should result in an increase in the daily calorie-intake by 7.55 units. Similarly, the changes in family size and age of household-head might have resulted in an increase of 8.85 kcal in the daily calorie-intake between 1993-94 and 2004-05 in rural areas. However, positive effects of above factors on calorie-intake were negated by a stronger negative effect of squeezed food budget. Interestingly, food consumption during this period declined inspite of reduced prices and increased total expenditure (Appendix 3). This might be because of a modest increase in non-food expenses for education, health, transport, etc. (Deaton and Dreze,

Table 4. Effects of factors driving changes in calorie-intake among Indian households

Particulars	Rural areas		Urban areas	
	1993-94 to 2004-05	2004-05 to 2011-12	1993-94 to 2004-05	2004-05 to 2011-12
Changes in:				
Real expenditure (₹/capita/month)	80	270	311	591
Real calorie price (₹/1000 kcal)	-0.20	0.70	-1.00	1.80
PDS supply (kg /capita/month)	0.49	1.28	-0.07	0.58
Food share (percentage points)	-9.8	-6.2	-15.1	-3.9
Family size (No.)	-0.10	-0.40	-0.10	-0.40
Age of household-head (years)	1.10	0.70	1.70	0.40
Nutritional effects (kcal/capita/day) due to changes in:				
Real expenditure	14.28	48.36	33.20	62.95
Real calorie price	3.05	-8.94	8.76	-15.83
PDS supply	7.55	19.80	-0.67	5.98
Food share	-79.61	-50.28	-132.87	-33.95
Family size	0.56	27.76	18.32	38.16
Age of household-head	8.29	5.24	11.89	2.50
Sum of marginal effects	-46	42	-61	60
Change in mean calorie-intake of retained sample*	-125	67	-85	48
Change in calorie as per official report	-106	52	-51	38

Note: *The changes in estimated mean calorie intake differ from officially reported figures due to non-inclusion of intoxicants and extreme observations

2009) which could be possible only with the reduction in food expenditure, given a very small increase in total expenditure. Consequently, the share of food in total expenditure declined by 9.8 percentage points between 1993-94 and 2004-05 in rural areas. This when multiplied with the regression coefficient of "food share" resulted in a reduction of 79.61 kcal from the daily calorie-intake. The net effect of inter-play of these factors was a decline in dietary energy intake of 46 kcal by each member of the household.

In urban areas, the squeeze in food budget was much higher to compensate spending towards non-food items during this period. Such expenditure pattern resulted in a decline in the share of food in total expenditure by 15.1 percentage points between 1993-94 and 2004-05. The nutritional effect of such change was a reduction in daily calorie-intake by 132.87 kcal among urban households. Further, the increase in PDS supply could not neutralize the negative effects of changing expenditure pattern of urban households during this period because of its restructuring from the universal PDS to targeted PDS in 1997 (Himanshu and Sen, 2013). In fact, the per-capita monthly consumption of cereals from PDS among urban households declined from 0.77 kg in 1993-94 to 0.70 kg in 2004-05. The negative effects of squeezed food budget and PDS on nutrition outweighed the positive effects of increased total expenditure, decline in prices and favourable demographic changes. The sum of these effects comes to -61 kcal which is very close to the actual decline of 85 kcal in urban areas between 1993-94 and 2004-05.

The period after 2004-05 witnessed a much higher increase in real income than during the period 1993-94 to 2004-05 in both rural and urban areas (Table 4). At the same time, the unit prices of calorie in real term also increased. However, the positive effect of large increase in income on energy-intake was much stronger than the negative effect of price rise during 2004-05 to 2011-12. It is to be noted that although households spent about 75 per cent of the total increase in expenditure towards non-food items, the increase in total expenditure was sufficiently large to raise the level of food expenditure and food consumption, which in turn was large enough to negate the effect of price-rise on food consumption. This also led to a comparatively small decline in the share of food in total expenditure after 2004-05 as compared to the previous period. Thus, the negative nutritional effect of changing expenditure pattern away from food products, was much lower during 2004-05 to 2011-11 than during 1993-94 to 2004-05. In addition to this, the performance of PDS improved considerably after 2004-05 (Himanshu and Sen, 2013) and the cereals consumption out of PDS supplies doubled between 2004-05 and 2011-12. The improved PDS supplies resulted in the addition of 19.80 kcal to per-capita daily dietary energy-intake among rural households during this period. The changes in family size and age of family-head also added 33 calories. The net effect of above factors was the increase in per-capita daily dietary energy by 42 kcal as against the actual increase of 52 kcal in rural areas in the period after 2004-05.

In urban areas, the factors taken into consideration added up to 60 kcal in daily dietary energy, whereas the actual increase in calorie-intake was 48 kcal between 2004-05 and 2011-12. The higher estimated effect than the actual change in calorie-intake might be because of non-inclusion of few variables with negative effects in the analysis. Overall, it can be concluded from the preceding discussion that squeezed food budget was a major factor responsible for the decline in calories between 1993-94 to 2004-05, while sufficiently large increase in total and consequent food expenditure along with improvement in PDS supply after 2004-05 triggered the upward trend in energy-intake during the recent years.

Cash verses Kind Form of Food Subsidy

Amidst burgeoning food subsidy bill resulting from the rising difference between economic cost of foodgrains to FCI and prices charged from the PDS beneficiaries and high level of leakages due to inefficient management of PDS, it is often proposed to replace the MSP-PDS with system of direct cash transfer to the beneficiaries' bank account (Gulati and Saini, 2015). On the other hand, some researchers suggest caution in advocating cash transfers as a substitute of physical supply of foodgrains through PDS (Himanshu and Sen, 2013). Because of this disagreement, policy makers are in a dilemma to decide which option is better. As food subsidy is meant to address food and nutrition security at the household level, the choice of cash versus PDS can be based on effect of each option on nutrition level. However, empirical estimates of two types of options on household nutrition are not available in the literature.

Table 5. Comparative effects of out-of-pocket expenditure (cash transfer) and PDS transfer on calorie intake among Indian households, 2011-12

Sector	Marginal effect of PDS transfer (kcal/kg of PDS supplies)		Estimated leakages* (per cent)	Marginal effect of one rupee food subsidy on PDS (kcal/₹ food subsidy)		Marginal effect of expenditure (kcal/₹)
	Without leakage	At 46% leakage		Without leakage	At 46% leakage	
Rural	464	251	46	35.07	18.97	5.37
Urban	308	166	46	23.28	12.54	3.20

Notes: *Refer Appendix-3 for estimation of leakages in food supply; Leakages have been assumed to be same in rural and urban areas; #subsidy rate for food supply (rice and wheat) through PDS was ₹ 13.23 per kg during 2011-12 (FCI, 2011: 89)

This paper fills this important gap by estimating the nutritional effects of in-kind food transfer and direct cash transfer. Specifically, the study estimates the effect of one rupee spent on subsidised supply through PDS and same amount paid through direct cash transfer on calorie-intake. The results are presented in Table 5.

The estimated results show that one rupee paid directly to consumer as cash, assuming zero leakage in this system, would result in the increased intake of 5.37 kcal per capita per day in rural household and 3.20 kcal among urban households. Though one rupee can buy 102 calories in rural areas and 68 calories in urban areas, the consumers receiving cash assistance of one rupee will treat it as an increase in her/his income and may spend it the way incremental income is spent over various heads. Thus, empirical evidences indicate that only 5.26 per cent of cash transfers in rural areas and 4.7 per cent in urban areas will be spent on calorie supplying food and the remaining amount will be spent on other food and non-food items.

In the case of PDS supply, one kg of wheat and rice involved the subsidy of ₹ 13.23 in the year 2011-12 (FCI, 2011-12), which is translated into the net increase in daily calorie-intake of 35.07 kcal per person in rural areas and 23.28 kcal in urban areas, per rupee of food subsidy. However, as a part of PDS supply is reported to be leaked or lost in the distribution channel, an adjustment for this leakage is needed to compare the PDS with cash transfer. Our estimates have shown that there is a difference of 46 per cent in the PDS supply at household level and offtake, implying that 46 per cent of the PDS supplies do not reach the final beneficiaries (Appendix 4). After accounting for this leakage, one rupee spent on PDS by the country was found to raise calorie intake by 18.97 kcal in rural and 12.54 kcal in urban areas. These results show, that even after netting out for the difference/leakage between offtake and quantity received by the household, the PDS effect on calorie-intake would be 3.5 to 3.9 times the effect of cash transfer. These results clearly establish the superiority of PDS over the cash transfer in addressing the problem of under-nutrition in the country. However, the direct cash transfer will have other advantages over PDS like increased household income, increased consumption of foods not rich in calorie, and/or higher expenditure on non-food items.

One of the ways to improve the calorie-intake along with the realization of other advantages of direct cash transfers over PDS, could be to ensure that beneficiaries spend the cash subsidies only on staple foods like cereals. One possibility seems to be to implement a conditional cash transfer scheme which links cash transfer to purchase of staples rather than pure cash transfer of food subsidies. The nutritional outcome of such intervention is although outside the scope of the present paper.

Conclusions and Policy Implications

The study has revealed that the mean calorie-intake by Indian households followed a decline till the year 2009-10 and thereafter moved upward. This change in dietary energy- intake is significant and offers evidence to refute the paradoxical situation prevailing in India which has shown a decline in nutrition despite increase in income. There is also a need to develop some consensus on the norms for minimum calorie

requirement as the choice of alternative norms has shown large variations in the proportion of population with lower than required dietary energy intake and thus creates a confusion regarding the severity of hunger and under-nutrition in the country.

Despite improvement in nutritional status observed from the recent NSS round for the year 2011-12, there exists a large-scale calorie deprivation across states and across expenditure-classes based on ICMR norms. Even the FAO norms of calorie requirement, which is considered conservative, have shown that about 30 per cent population of the country remained undernourished in the recent year. The study has revealed that the trend in nutrition is not uniform across expenditure-classes. The healthy development is that the mean per-capita calorie-intake increased among the relatively low income household during the past 18 years and followed a decline among higher income households. This has resulted in narrowing down the calorie-intake gap between low and high income households and a decline in inequality in calorie-intake. The continued prevalence of undernutrition among high income households having no economic constraint, has confirmed the existence of 'voluntary hunger' due to ignorance about nutrition. The richer households may be targeted to generate awareness regarding the importance of minimum energy needs and increased physical activities to absorb the added energy.

The transition in dietary energy intake is influenced by a complex set of inter-related factors such as economic forces of income and prices, expenditure pattern, occupation structure, public support programmes, demographic changes, etc. As expected, the effect of real consumption expenditure, which has been used as a proxy for household income, on calorie intake has been found positive and the effect of real price of calorie was negative. Thus, improving income and controlling inflation are important means to improve nutritional status of Indian households. The regression analysis has revealed positive marginal effects of PDS on calorie intake. Among demographic factors, family-size has been found to cause an adverse effect on the per-capita dietary intake of energy, whereas the age and educational level of the household-head have been found to have a positive effect on nutritional status of households. The positive association between improvement in educational level and calorie- intake reinforces the need to generate awareness and knowledge about the importance of nutrition. Similarly, the study has underlined the benefits of having smaller family size and experienced family members in improving the nutritional status of households. In rural areas, involvement in farming activities has a positive association with the calorie intake due to availability of home-grown food products and higher energy requirement in performing farm operations.

The marginal effects of above factors on calorie intake along with changes in these factors have explained to a large extent the decline in dietary energy intake between 1993-94 to 2004-05 and the subsequent upward trend after 2004-05. The squeezed food budget has been a major factor responsible for the decline in calorie-intake during 1993-94 to 2004-05, while a sufficiently large increase in total and food expenditure along with improvement in the PDS, after 2004-05, have triggered an upward trend in energy intake.

The study has found that effects of in-kind PDS supplies on calorie-intake is much higher than of direct cash transfer of food subsidy even at the existing level of losses and leakages in PDS supply. In case such leakages are checked, the nutritional effects of PDS would increase by 46 per cent. The study has underlined the strengthening of the PDS functioning or conditional cash transfers for improved nutrition of Indian households.

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References

Basu, D. and Basole, A. (2012) *The Calorie Consumption Puzzle in India: An Empirical Investigation*. Economics Department working paper series, Paper 147. Available at: http://scholarworks.umass.edu/econ_workingpaper/147.

Chand, R. (2014) *From Slowdown to Fast Track: Indian Agriculture since 1995*. Working Paper 01/2014. ICAR-National Centre for Agricultural Economics and Policy Research, New Delhi.

Chand, R. and Jumrani, J. (2013) Food security and undernourishment in India: Assessment of alternative norms and the income effect. *Indian Journal of Agricultural Economics*, **68**(1): 39-53.

Chand, R., Saxena, R. and Rana, S. (2015) Estimates and analysis of farm income in India: 1983-84 to 2011-12. *Economic and Political Weekly,* **50**(22): 139-145.

Deaton, A. and Dreze, J. (2009) Nutrition in India: Facts and interpretations. *Economic and Political Weekly*, **44**(7): 42-65.

FCI (Food Corporation of India) (2011-12) *Annual Report, 2011-12*. Government of India.

GoI (Government of India) (2013) *Press Note on Poverty Estimates, 2011-12*. Planning Commission, New Delhi.

GoI (Government of India) (2014a) *Nutritional Intake in India, 2011-12*. Ministry of Statistics and Programme Implementation, New Delhi.

GoI (Government of India) (2014b) *Level and Pattern of Consumer Expenditure, 2011-12*. Ministry of Statistics and Programme Implementation, New Delhi.

Gulati, A. and Saini, S. (2015) *Leakages from Public Distribution System (PDS) and the Way Forward*. ICRIER Working Paper No. 294. Indian Council for Research on International Economic Relations, New Delhi.

Himanshu and Sen, A. (2013) In-kind food transfer-I: Impact on nutrition and implications for food security and its costs. *Economic and Political Weekly,* **48**(47): 60-73.

Meenakshi, J.V. and Vishwanathan, B. (2003) Calorie deprivation in rural India, 1983-1999/2000. *Economic and Political Weekly,* **38**(4): 369-375.

Patnaik, U. (2010) A critical look at some propositions on consumption and poverty. *Economic and Political Weekly*, **45**(6): 74-80.

Srivastava, S.K., Kumar, R., Hema, M. and Hasan, R. (2013a) Inter-regional variations and future household demand and production of major spices in India. *Journal of Spices and Aromatic Crops*, **22**(1): 47-54.

Srivastava, S.K., Mathur, V.C., Kumar, R., Sivaramane, N. and Jha, G.K. (2013b) Household demand and supply of milk and milk products in India: Regional trends and future projections. *International Journal of Agricultural and Statistical Sciences*, **9**(1): 353-363.

Srivastava, S.K., Mathur, V.C., Sivaramane, N., Kumar, R., Hasan, R. and Meena, P.C. (2013c) Unravelling food basket of Indian households: Revisiting underlying changes and future food demand. *Indian Journal of Agricultural Economics*, **68**(4): 535-551.

Srivastava, S.K., Balaji, S.J., and Kolady, D. (2016) Is there a convergence in dietary energy intake among expenditure-classes in India?. *Agricultural Economics Research Review*, **29** (Conference Number):119-128.

Sukhatme, P.V. (1993) *Note in Report of the Expert Group on Estimation of Proportion and Number of Poor*. Perspective Planning Division, Planning Commission, Government of India, New Delhi.

Received: December, 2016; Accepted May, 2017

Appendix

Appendix 1. State-wise average calorie-intake in India

(kcal/capita/day)

State	Rural areas			Urban areas		
	1993-94	2004-05	2011-12	1993-94	2004-05	2011-12
Jammu & Kashmir	2495	2358	2356	2431	2303	2352
Himachal Pradesh	2317	2323	2501	2501	2382	2511
Punjab	2417	2236	2327	2108	2148	2171
Haryana	2485	2224	2254	2162	2032	2164
Rajasthan	2457	2172	2263	2200	2114	2150
Uttar Pradesh	2316	2198	2112	2144	2122	2004
Bihar	2120	2045	2057	2234	2188	2080
Assam	1968	2040	2009	2152	2125	2037
West Bengal	2224	2067	2092	2199	2008	2026
Odisha	2206	2018	2116	2332	2136	2093
Madhya Pradesh	2162	1926	2110	2105	1951	2028
Gujarat	1999	1919	1914	2071	1988	2068
Maharashtra	1939	1893	2103	2039	1843	2038
Andhra Pradesh	2055	1986	2185	2012	1996	2150
Karnataka	2072	1838	2003	2057	1941	2005
Kerala	1999	2000	1971	2047	1989	2025
Tamil Nadu	1902	1837	1924	1969	1931	1972

Appendix 2. State-wise head count ratio of undernourished persons: 1993-94 to 2011-12

(Per cent)

State	Rural areas			Urban areas		
	1993-94	2004-05	2011-12	1993-94	2004-05	2011-12
Jammu & Kashmir	45	65	57	32	40	33
Himachal Pradesh	63	66	50	32	29	31
Punjab	58	67	63	57	54	49
Haryana	58	67	69	54	62	50
Rajasthan	51	74	66	47	58	52
Uttar Pradesh	63	73	76	54	58	65
Bihar	72	79	79	47	54	57
Assam	88	86	86	52	54	59
West Bengal	69	78	79	51	65	61
Odisha	72	78	78	39	53	53
Madhya Pradesh	72	87	76	56	68	60
Gujarat	72	84	88	60	24	63
Maharashtra	72	87	78	62	76	60
Andhra Pradesh	78	84	73	61	67	53
Karnataka	72	90	83	59	70	64
Kerala	72	80	82	62	64	64
Tamil Nadu	83	89	88	66	70	67

Appendix 3. Changes in factors influencing calorie intake in India

Particulars	Rural areas			Urban areas		
	1993-94	2004-05	2011-12	1993-94	2004-05	2011-12
Estimated food calories (kcal/capita/day)	2149	2024	2091	2086	2001	2049
Real consumption expenditure (₹/capita/month)	932	1012	1282	1566	1877	2468
Real unit calorie prices (₹/1000 kcal)	9.3	9.1	9.8	13.8	12.8	14.6
Real food expenditure (₹/capita/month)	600	552	619	881	771	919
Food share in total expenditure (%)	64.3	54.5	48.3	56.2	41.1	37.2
Family size (No.)	6.1	6.0	5.6	5.7	5.6	5.2
Age of household-head (years)	44.9	46.0	46.7	44.4	46.1	46.5
PDS supply (rice & wheat) (kg/capita/month)	0.66	1.15	2.43	0.77	0.70	1.28

Appendix 4. Estimation of leakages in food supplies through PDS during 2011-12

Sl No.	Particulars	Rural areas	Urban areas	All areas
(a)	Foodgrains (rice & wheat) offtake (million tonnes)[#]	-	-	56.28
(b)	Consumption of rice and wheat purchased from PDS (kg/capita/month) [*]	2.41	1.29	-
(c)	Population as on 1st January, 2012 (million)[$]	841.56	385.89	1227.45
(d)	Annual consumption through PDS (million tonnes): (b/1000)*12*c	24.38	5.96	30.34
(e)	Leakages from PDS (%): {1-(d/a)}*100	-	-	46.09

Data source: [#] Ministry of Food, Consumer Affairs and Public Distribution, Government of India
[*]NSS report No. 558 National Sample Survey Office (NSSO), Ministry of Statistics and Programme Implementation (MoS&PI), Government of India
[$]NSS report No. 554, NSSO, MoS&PI, Government of India