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Gender Bias in Nutrient Intake: Evidence From Selected Indian States

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Gender Bias in Nutrient Intake: Evidence From Selected Indian States*

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Abstract

The importance of nutrient intake in the development literature stems from its role as a determinant of economic growth and welfare via its link with productivity and deprivation. This paper analyses nutrient intake in rural India and provides evidence on its determinants in selected Indian States. Of particular interest is the analysis of gender bias in nutritional intake. The estimation results show that there is considerable heterogeneity in the experience of the various Indian States and between the various age groups. For example, while Kerala and Maharashtra record significant gender bias in the intra household allocation of nutrients to adults in the age group 18-60 years, the bias occurs in the younger age group, 11-17 years, in case of Haryana. None of the selected States records significant gender bias in the allocation of nutrients to young infants (0-5 years). The results of this study suggest that policies need to be tailored to the realities of the individual States for their effectiveness. The study also provides evidence that suggests that the conventional expenditure based poverty rates underestimate poverty considerably in relation to those based on minimum levels of calorie intake recommended by the Indian Planning Commission. Finally the results also show that the use of age and gender invariant "minimum" calorie levels overestimate poverty in relation to those that recognise their variation between individuals.

Key Words: Gender Bias, Nutrient Intake, India

JEL Classification Codes: O12, I12, C31

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1. Introduction

Much of the evidence on gender bias in household decisions in developing countries[1] has been on expenditure data and, to a lesser extent, on anthropometric data. The latter, it may be argued, provide only an indirect test of gender bias in household spending since little is known of the process by which an extra unit of spending affects the anthropometric status of boys and girls. As is now widely recognised, the expenditure-based tests do not show much evidence of gender bias. This is a puzzle since, in many developing countries such as India and China, other indicators such as infant mortality, birth rates, etc. do show significant gender effects.[2]

The principal motivation of this paper is to provide an alternative test of gender bias based both the household's intake of calories and also on the intake of the principal micronutrients, carbohydrate, protein and fat, which generate the calories. There is a large literature on the impact of household income or expenditure on calorie intake via its impact on the amount and composition of food spending. The principal focus of this literature is on the estimation of calorie elasticities. Examples include Behrman and Deolalikar (1987), Bouis and Haddad (1992), Ravallion (1990) and Subramanian and Deaton (1996). However, besides restricting themselves to calories and not going beyond them to the micronutrients mentioned above, these studies do not investigate the issue of gender bias in nutrient consumption, which is an important focus of this paper. The importance of this topic in the development literature largely stems from the central role that nutrient consumption plays in productivity, as postulated in the theory of efficiency wages.[3]

The present paper has some additional features that distinguish it from the existing literature. In keeping with the recent literature on non-unitary models, we investigate the

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[1] See Dasgupta (1993), Strauss and Thomas (1995) for surveys of the literature.
[2] See, for example, D'Souza and Chen (1980), Sen (1984) and Sen and Sengupta (1983).
[3] Following Leibenstein (1957), Mirrlees (1975) and Stiglitz (1976), the theory of efficiency wages predicts a non linear functional dependence of productivity on nutrient intake – see Strauss and Thomas (1998) for a review of empirical evidence on this dependence.

impact of the relative education levels of the adult female and male members of the household on the household's intake of the calorie and the micronutrients. From the estimation viewpoint, we recognise the potential endogeniety of the household expenditure variable in the micro nutrient regressions by reporting the results of 2SLS estimation that jointly estimates the expenditure and the nutrient variables. Since the exact nature (parametrically) of the relationship between per capita household expenditure and nutrient intake is open to debate, we also conduct non-parametric (kernel) estimation of the relationship between nutrient intake and per capita household expenditure.

The cultural and socio-economic heterogeneity between the various Indian States, especially in the rural areas, makes the comparison across the different states an interesting basis for an investigation of the existence and nature of gender bias in household decisions. As we report later, one of the main contributions of this paper is to warn against generalising the experience of an individual state to that of the country as a whole. The sharp differences between some of the states on the nutrient intake and on the results of the tests of gender bias point to the need for state level policies that are tailored to the realities of a particular state rather than country wide general policy interventions dictated by the Central government.

The rest of the paper is organised as follows. The data is described and its principal empirical features discussed in Section 2. The results of estimation are presented and discussed in Section 3. We end on the concluding note of Section 4.

2. Data and Principal Features

The data set used in our analysis is from the 55th round Household Expenditure Survey of the National Sample Survey Organisation, Government of India, covering the survey period, July 1999 – June 2000. This data set provides information, at the household level, on calorie intake. The corresponding information on the intake of carbohydrate, protein and fat was obtained from the calorie data by a process of detailed and tedious calculations, for every state, using the conversion factors of Indian Foods provided in Gopalan, et. al. (1999). These calculations involved using these conversion factors in conjunction with the information on food expenditure, disaggregated across the individual food items, to obtain the intake, at household level, of calories, protein, fat and carbohydrates.

Table 1 provides the summary information in the form of state specific mean values, over 30 days, of per capita intake of calories and the three micronutrients (carbohydrates, fat and protein), per capita expenditure on Food, per capita expenditure on all items considered in this study and that on all items consumed by the household as reported by the National Sample Survey. The last 4 columns report the mean value of the intake of the nutrients per unit of Rupee (the unit of Indian currency) in the various States and the Union territories. This table reveals several interesting features.

First, as per the estimate of the Indian Council for Medical Research (ICMR) that is used by the Planning Commission, the recommended minimum intake (per day) of calories in rural India is 2400 kcal of energy based on a balanced diet consisting of 409.72 gm. of carbohydrate, 58.37 gm of protein, and 58.63 gm. of fat. In monthly terms (30 days), these figures translate to 72000 kcals of energy, 12291.74 gm of carbohydrate, 1750.97 gm of protein and 1758.85 gm of fat. Keeping these subsistence figures in mind, Table 1 shows that very few of the larger Indian states report higher than subsistence level intake for the "average" individual residing in them. The states (and union territories) that report higher than subsistence calorie figures include Arunachal Pradesh, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajashan, Uttar Pradesh and Chandigarh. It is a sad reality that even after 52 years of independence, several Indian states, notably, Assam, Bihar, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and West Bengal report mean calorie intake figures that are considerably less than the minimum figures recommended by the

Indian Planning Commission. A further inspection of Table 1 reveals that much of the calorie deficiency is because of shortfalls in carbohydrates and, to a less extent, fat. All the states seem to do quite well on protein intake with none of the states reporting less than subsistence consumption (on average).

Second, while some of the states that report average calorie intake that exceed the recommended minimum also happen to be among the most affluent states (such as Punjab and Haryana), this is not true in general. A prominent example of a relatively poor state doing quite well on calorie intake is UP. In contrast, Kerala, which is held out as a model state in terms of several performance indicators, such as health and literacy, reports a large shortfall in its average intake of calorie and carbohydrate. This NSS based finding is consistent with data from the National Nutrition Monitoring Bureau (NNMB), which confirms that the intake of calories in Kerala was quite low in relation to the other Indian states. This observation leads to the "Kerala paradox" which arises from the fact that, notwithstanding its relatively low intake of calories, Kerala does quite well on age-wise mean anthropometric evidence (height, weight, arm circumference and related measures) and clinical signs of nutritional deficiency in children. One possible explanation of this phenomenon is that in Kerala, "nutrients are better utilised quite possibly because of the positive interaction between health care and nutrition"; also, "high levels of education enhanced health-seeking behaviour and nutrition information among the people" (see Swaminathan and Ramachandran (1999)).

The last four columns of Table 1 reveal wide differences between the various States and Union territories in their ability, via their food spending habits, to convert a unit of food expenditure (Rupee 1) into a vector of nutrients. If we focus attention on the last column, namely, calories, we notice that some of the severely undernourished states, such as Bihar and West Bengal that do badly on mean calorie intake figures do not perform as badly, in comparison with well nourished states such as Punjab and Haryana, in their ability to convert

Food expenditure into kcals. In other words, for states such as Bihar and West Bengal, the picture on malnourishment would have been far worse but for the fact that their diet is relatively rich in the nutrients.

Table 2 provides evidence on the strength of association between economic affluence and nutrient intake by reporting, for each State, the correlation magnitude between per capita household expenditure and the household's per capita intake of the nutrients. Clearly, there is considerable heterogeneity in the experience of the various states. For example, Maharashtra, which is the basis of Subramanian and Deaton (1996)'s study, reports a correlation magnitude between calorie and expenditure (0.35) that is considerably higher than the figures for Arunachal Pradesh (0.13) and Tamil Nadu (0.12) but lower than the figures for Gujarat (0.51) and Kerala (0.48). Table 2 also presents some evidence, though not very strong, of positive association between the four correlation magnitudes.

It is important to note that, in general, Table 2 does not provide evidence of a strong link between the household's per capita intake of the various nutrients and its per capita expenditure. In other words, from a policy viewpoint, it would not be a sensible strategy to simply rely on income enhancing policies to achieve a significant gain in the household's nutritional status. As the recent experience of Kerala and West Bengal shows[4], these States have achieved significant gains in nutritional status, even though they are not among the highest growth achievers.

The correlation magnitudes, reported in Table 2, do not however portray the true association between nutrient intake and household expenditure in the presence of non-linearities in the relationships. Strauss and Thomas (1990) present Brazilian evidence that suggests a non-linear relationship between calorie intake and per capita household expenditure. We have therefore performed Kernel regression to estimate non-parametrically

[4] See Swaminathan and Ramachandran (1999)

the relationship between nutrients and household expenditure, both in per capita terms. Figure 1 (Panels A – E) presents the estimated relationships for 5 selected states, namely Bihar, Haryana, Kerala, Maharashtra and Punjab.[5] The selected States span a wide spectrum economically, geographically and culturally. Consistent with the above discussion, there is wide variation between States in the nature of the relationships. In general, the per capita intake of the nutrients does increase monotonically, though non linearly, with per capita household expenditure. Exceptions occur in case of Kerala and Punjab at the higher expenditure levels.

Before turning to the results of estimation, let us present the disaggregated evidence on calorie consumption between the various percentiles arranged in increasing order of calorie intake in the major Indian states. Table 3 presents this evidence in case of both rural and urban India based on our calculation of calorie intake from the 55th round of the National Sample Survey used in conjunction with the nutrient scales reported in Gopalan, et. al. (1999). The states have been arranged in decreasing order of their calorie intake as obtained for their 25th percentile. First, notwithstanding some movements among the middle ranked states, there is, in general, a reasonable degree of stability in the calorie ranking of the states between the rural and the urban areas, especially at the extremes. Himachal Pradesh and Punjab (Northern Indian States) and Kerala, Tamil Nadu (Southern Indian States) are, respectively, among the highest and lowest achievers in calorie consumption. On these figures, the Planning Commission recommended minimum of 2400 kcal per capita (daily) in rural areas and 2100 kcal (daily) per capita in urban areas seem to be on the high side in relation to the actual consumption distribution of calories, consistent with the earlier discussion of Table 1. None of the Indian states, in either the rural or urban areas, achieve this minimum intake even at the 25th percentile mark. Indeed, several of the states (especially the

[5] Our regressions were also conducted for these 5 states.

Southern Indian states of Karnataka, Kerala and Tamil Nadu) do not achieve this minimum figure in the rural areas until very close to the 75th percentile. This raises serious questions on the use of these recommended minimum figures in the calculation of the poverty rates as suggested by the Planning Commission in India. This is underlined in Appendix Table A1, which compares the poverty rates based on expenditure based poverty lines with those based on calories. In case of the latter, Appendix Table A1 presents two sets of calorie based poverty rates, namely, ones which ignore the dependence of minimum calorie requirements on the age and gender of the individual and ones which do not. Though the latter poverty rates are lower than the former[6], they are still considerably higher than the expenditure based poverty rates that are used in policy debates. The South Indian states, Karnataka, Kerala and Tamil Nadu, which do reasonably well on conventional expenditure based poverty rates fare much worse on calorie based poverty rates. Note, incidentally, that the use of age and gender variant "minimum calorie" figures renders unnecessary the use of *adhoc* equivalence scales which can have a large impact on the poverty rates calculated from household budget data (see, for example, Lancaster, Ray and Valenzuela (1999), Meenakshi and Ray (2002)).

A recent study by Meenakshi and Vishwanathan (2003) on NSS data has also drawn attention to the sharp divergence between the income and calorie based poverty rates, and to the "need for fresh debate on the determination both of the calorie norm and the poverty line" (p. 369). This paper quotes FAO recommended "minimum calorie" figures that suggest that the corresponding figures recommended by the Indian Planning Commission and used here may be high and "incorporating a margin of safety". The Meenakshi and Vishwanathan (2003) study presents evidence which shows that the calorie based poverty rates drop sharply if we lower the subsistence calorie figures from those recommended by the Planning Commission.

[6] Srinivasan (1981) argues that if one overlooks the variation of the minimum calorie requirements between individuals and over time then "there is a danger in overestimating the proportion of truly malnourished" (p.3).

3. Methodology, Results and Analysis

3.1 Methodology

Let CAL, $PROT$, FAT and $CARB$ denote, respectively, the household's per capita intake of calories, protein, fat and carbohydrates (all in log terms) and $\ln x$ denote the log of per capita household expenditure. The estimation methodology involves 2SLS estimation of the following equations taking account of the potential endogeniety of the expenditure variable in the calorie/nutrient equations. Per capita household expenditure is used as a proxy for household permanent income. Household expenditure is easier to measure compared to household income and is typically measured with less error. Moreover, household expenditure is typically a better proxy for permanent income because while income might be subject to transitory fluctuations, households typically use a variety of mechanisms to smooth consumption over time. However household expenditure is also likely to be correlated with unobserved determinants of the calorie/nutrition intakes and failure to account for this potential endogeniety could result in inconsistent estimates.

$$\begin{aligned} CAL &= \alpha_0 + \alpha_1 \ln x + \alpha_2 (\ln x)^2 + \alpha_3 z + \varepsilon_1 \\ PROT &= \varphi_0 + \varphi_1 \ln x + \varphi_2 (\ln x)^2 + \varphi_3 z + \varepsilon_2 \\ FAT &= \phi_0 + \phi_1 \ln x + \phi_2 (\ln x)^2 + \phi_3 z + \varepsilon_3 \\ CARB &= \xi_0 + \xi_1 \ln x + \xi_2 (\ln x)^2 + \xi_3 z + \varepsilon_4 \end{aligned} \tag{1}$$

Note that z is a vector of other household characteristics that affect calorie/nutrient consumption within the household. Included in this vector are the education levels of adult female, adult male in the household as measured by the years of education of the most educated female and male member of the household, $MAXFEMED$ and $MAXMALED$ respectively, household size (in logarithmic terms) and the proportion of household members (p_i) belonging to the various age-sex groups, defined as n_i/n, where n_i is the number of members in age-sex category i and $n=\sum_{i=1}^{10} n_i$ is the total household size. The age-sex categories are: male infants aged 0 – 5 $(i=1)$, female infants aged 0 – 5 $(i=2)$, boys and girls aged 6 – 9 $(i=3,4)$, males and females aged 10 – 16 $(i=5,6)$, working age (17 – 60) males and females $(i=7,8)$ and elderly (aged 61 and higher) males and females $(i=9,10)$. The last group $(i=10)$ was used as the reference group and hence was the omitted category in the estimations. It has been argued that women's educational attainment, more than that of men, has a significant effect on the nutritional intake of the household since educated women (and mothers) are better informed about the long run benefits of better nutrition for the family. This argument is consistent with the "Kerala paradox" that we have referred to earlier i.e., high levels of educational attainment of women in particular have enhanced health-seeking behaviour and nutrition information among the people.

Of particular interest is the possible existence of gender bias in the household's expenditure patterns. Child characteristics typically affect adult demand in two different ways. The first is through the amount that adults get through the income-sharing rule (the income effect) and the second through demand functions directly (the substitution effect). The substitution effects refer to the re-arrangements that need to be made in response to having additional members in the household. The test that we use can be explained as follows. If one replaces a girl in a certain age group by a boy in that same age group, holding everything else constant, then the extent to which the calorie (or micro-nutrient) intake changes as a result of this thought experiment gives us a measure of gender bias. If the coefficient estimates on boys and girls are different, we can conclude that the regression function differs by gender. Note that if household size and expenditures are sufficient to explain demand, the coefficients of p_i will all be zero. However, in general, household composition will matter and in this case the coefficients of p_i will tell us the effects of changing household composition on nutrient intakes, holding the household size constant – for example, replacing a man by a woman or a young girl by a young boy. In the present study, the household is disaggregated by age and sex: males and females aged 0 – 5, males and females aged 6 – 10, males and females aged 11 – 17, males and females aged 18 – 60 and males aged 61 and above. If the coefficients for boys and girls are different, then we can conclude that, everything else constant, expenditure on a particular commodity depends on the gender composition of children. We conduct tests of the equality of male and female coefficients in each of the first four age categories (0 – 5, 6 – 10, 11 – 17 and 18 – 60). The four tests are:

(i) coefficient of $p_1 =$ coefficient of p_2;

(ii) coefficient of $p_3 =$ coefficient of p_4;

(iii) coefficient of $p_5 =$ coefficient of p_6;

(iv) coefficient of $p_7 =$ coefficient of p_8.

To account for the potential endogeniety of log per capita household expenditure $(\ln x)$ and the square of the log of per capita household expenditure $\left((\ln x)^2\right)$ in the calorie/nutrient equations, we have used 2SLS (IVREG) to estimate calorie/nutrient consumption. The instruments used are age, sex, marital status, employment status of household head, land ownership, access to electricity, main cooking medium and religion and caste of household, all of which are expected to be correlated with total household expenditure and uncorrelated with calorie/micro-nutrient intake. We also conduct a standard Durbin-Wu-Hausman test to examine whether endogeniety of $\ln x$ and $(\ln x)^2$ is indeed an issue. The test statistic is distributed as χ^2 with 2 degrees of freedom.

Estimation is conducted using data from five states in India. The states chosen are Bihar, Kerala, Maharashtra, Punjab and Haryana. These five states span a wide spectrum economically, geographically and culturally. Bihar, in Eastern India, is one of the most backward states in the country, both in terms of economic and also demographic indicators. Kerala on the other hand has performed much better than other states in terms of health, literacy, health infrastructure availability and gender issues. For example, Datt and Ravallion (2002) found that over the period 1960 – 2000 Kerala had the highest rate of poverty reduction and Bihar the second lowest. The third state we choose is Maharashtra which falls somewhere in between the two extremes of Bihar and Kerala.[7] Punjab and Haryana were chosen because of their impressive performance in agriculture that is referred to as the "green revolution".

3.2 Results

The results of the 2SLS estimation of CAL are presented in Table 4. Note that the null hypothesis of exogeniety of $\ln x$ and $(\ln x)^2$ cannot be rejected for Bihar and Haryana but is rejected for the other three states. This implies that the OLS estimates for Bihar and Haryana are consistent. The corresponding OLS estimates are presented in Table A2 in the Appendix. The main difference between the OLS and 2SLS estimates is that the estimated effects of $\ln x$ and $(\ln x)^2$ are stronger when estimated using OLS, but in the case of Maharashtra they are incorrectly signed. However the other results are quite similar. We also computed the 3SLS estimates but the null hypothesis of diagonal covariance matrix could not be rejected using a standard Breusch-Pagan test. The 3SLS estimates of per capita calorie intake are presented in Table A3. Generally (and with the exception of the estimated

[7] Data on Human Development Index shows that Kerala is ranked 1 in 1981, 1991 and 2001 among the 15 major states in India, Bihar is ranked 15 in each of the three years and Maharashtra is ranked 3 in 1981 and 4 in 1991 and 2001. http://planningcommission.nic.in/reports/genrep/nhdrep/nhdch2.pdf

coefficients for $\ln x$ and $(\ln x)^2$) the coefficient estimates are similar to those obtained using 2SLS. It is worth noting that the “signs” of the estimated coefficients of $\ln x$ and $(\ln x)^2$ are similar to those presented in Table 4 (2SLS estimation), though the standard errors are lower.

The estimated coefficients of $\ln x$ and $(\ln x)^2$ show that, only in the Western State of Maharashtra, namely the State considered by Subramanian and Deaton (1996), both the linear and quadratic coefficients of per capita household expenditure have a strong and statistically significant impact on per capita calorie intake. The present results, thus, warn against the danger of generalising Subramanian and Deaton’s (1996) evidence for one State to the whole of India.

A surprising result relates to the effect of educational attainment of males and females on per capita calorie consumption. The estimated coefficients show that the effects are generally significantly negative; or statistically insignificant as in the case of Kerala. In 4 out of the 5 States, whose estimates are presented in Table 4, the impact of male education on calorie intake registers a higher level of statistical significance than female education, Kerala being the exception. Also, with the exceptions of Bihar and Kerala, an increase in household size is associated with an increase in per capita calorie intake in the household.

Let us now turn to the estimated coefficients of the age/gender composition variables $p_i; i = 1, \ldots, 9$. With the exception of Haryana state, a ceteris paribus increase in the proportion of infants (p_1, p_2) leads to a significant decline in the household’s per capita calorie intake[8]. In the case of Haryana too, it is worth noting, the coefficient estimates are negative though not statistically significant. However, the null hypothesis of equality of coefficients $(\text{coefficient of } p_1 = \text{ coefficient of } p_2)$ cannot be rejected in any of the five states.

[8] This is consistent with Srinivasan’s (1981) argument, reflected in the poverty rates presented earlier, on the variability of the calorie intake and requirement between individuals of different age groups.

Some other results are worth noting. In Haryana, Kerala and Maharashtra, a ceteris paribus increase in the proportion of adult working age females (aged 18 – 60) significantly increases the per capita calorie intake in the household. In Maharashtra and Bihar a ceteris paribus increase in the proportion of adult working age males significantly decreases the per capita calorie intake in the household (though in the case of Bihar the effect is not statistically significant). It is worth noting that the null hypothesis of the equality of coefficients of working age males and females $\left(\text{coefficient of } p_7 = \text{ coefficient of } p_8\right)$ is rejected for Kerala, Maharashtra and Punjab. The actual coefficient estimates also tell a very interesting story: In the case of Punjab and Maharashtra, ceteris paribus increases in the number of working age males and females in the household have opposite effects on calorie intake and in Kerala, while the coefficients have the same sign, an increase in the number of working age females in the household (ceteris paribus) has a stronger effect compared to the effect of an increase in the number of working age males in the household. The other result worth noting is that in Haryana and Maharashtra an increase in the number of girls aged 11 – 17 (ceteris paribus) has a different impact on calories intake (larger increase in the case of Haryana and a smaller decrease in the case of Maharashtra) compared to an increase in the number of boys aged 11 – 17 (ceteris paribus).

Let us now turn to the 2SLS estimates of the three micro nutrient intakes. The estimated coefficients are presented in Table 5: Panel A for per capita protein intake, Panel B for per capita fat intake and Panel C for per capita carbohydrate intake. With a few exceptions, the Durbin-Wu-Hausman test rejects the null hypothesis that $\ln x$ and $\left(\ln x\right)^2$ are exogenous, implying that the OLS estimates are generally inconsistent.

There is wide variation in the nature and magnitude of the various determinants on the micronutrients both between the selected States and between the micronutrients themselves. We briefly summarize some of the important results.

First, as with the 2SLS estimates of calorie-intake, with the exception of Kerala, increases in the years of education of the most educated male and female member of the household have negative (and often statistically significant) effects on the intake of the three micronutrients. The results are consistent across all the three micronutrients. In the case of Kerala, while the estimated coefficients of *MAXMALED* and *MAXFEMED* are always positive, they are never statistically significant. This result is consistent with the proposition, stated earlier during our discussion of the "Kerala paradox", that while increased adult education leads to a better utilisation of the nutrients, it does not necessarily lead to a large increase in the intake itself.

Second, permanent income of the household generally has a statistically significant effect on the intake of protein and fat but the effect of household expenditure on the intake of carbohydrate is much weaker. Households in Maharashtra appear to be behaving quite differently compared to households in the other states. For example, in Maharashtra per capita intake of protein decreases with an increase in household expenditure and then increases beyond a certain point. For the other states the relationship between $\ln x$ and per capita protein intake is the opposite: intake of protein increases with an increase in the permanent income of the household to begin with and decreases beyond a certain point. In Maharashtra, unlike in the other states, changes in permanent income of the household do not have a statistically significant impact on fat intake but they have a statistically significant impact on carbohydrate intake (again unlike the other states).

There is again no evidence of a "consistent pattern" in gender bias. The strongest effect of gender difference in nutritional intake appears to be in the age group 18 – 60 (working age adults). But what is interesting is that with some minor exceptions (specifically, intake of carbohydrate in Punjab and Haryana), ceteris paribus an increase in the number of females in the household aged 18 – 60 has a stronger positive effect or a weaker negative effect on the intake of micro-nutrients relative to an increase in the number of males in the same age group. There is no evidence of gender effect on nutrient intake for children in the age group 0 – 10 yrs and, even in the age group 11 – 17 yrs, the effect is quite weak.

3.3 Expenditure Elasticities

While not the main focus of this paper, we can use the estimated coefficients to compute the expenditure elasticity of calorie/micro-nutrient intake as the percentage change in the predicted calorie/micro-nutrient intake with respect to a one percent increase in household expenditure. The expenditure elasticity of calorie intake can be written as $e_x \equiv \partial CAL / \partial \ln x = \hat{\alpha}_1 + 2\hat{\alpha}_2 \ln x$ where $\hat{\alpha}_1$ and $\hat{\alpha}_2$ are the estimated coefficients of α_1 and α_2 from equation (1).

Table 6 presents the expenditure elasticity (e_x) at the mean expenditure level. The standard errors were computed by bootstrapping with 100 replications.[9] The estimated elasticities are often close to zero. While calorie intake is, generally, a normal good, "fat" is a luxury item. Interestingly, while protein is a luxury item for households in Bihar and Kerala it is an inferior item for households in Maharashtra.

It could be argued that computing these elasticities at the mean expenditure do not give the full story and elasticities might vary considerably depending on whether the household is rich or poor. For example, the diet of poor households is likely to be quite different from that of rich households (driven primarily by resource constraints). This implies that the expenditure elasticities of rich and poor households could be quite different. To examine this issue further, we compute the expenditure elasticities at different points on the expenditure distribution, in particular at the 10th $(p=1)$, 20th $(p=2), \ldots,$ 90th $(p=9)$

[9] The data set was re-sampled randomly and the parameters and elasticities were estimated for each re-sampled data set.

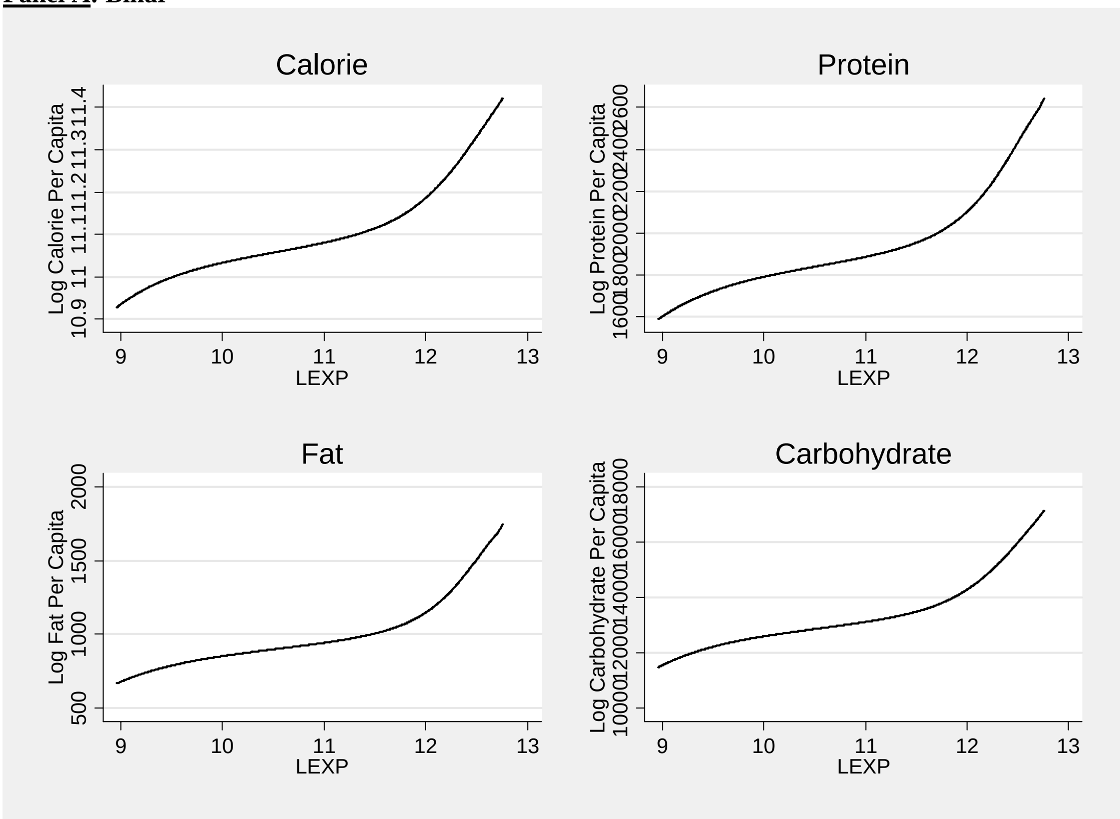
percentiles. These estimated elasticities of calorie and the micronutrients, calculated for the various percentile groups, are plotted and presented in Figure 2. The estimated elasticities are not constant across the different expenditure percentiles and this implies that simply looking at the expenditure elasticities at the mean could give us a misleading picture. The behaviour of calorie intake and also intake of the three micronutrients separately varies significantly across the different expenditure percentile. Additionally there is significant variation between states. It is worth noting that the estimated expenditure elasticity of fat intake falls monotonically as we move up the expenditure deciles and this result is common across the 5 states. However there is no general pattern in the behaviour of the expenditure elasticities of the other micronutrients and calorie intake: for example the expenditure elasticity of calorie intake falls in Bihar, Kerala and Punjab but increases in Haryana and Maharashtra as we move up the expenditure deciles.

4. Conclusion

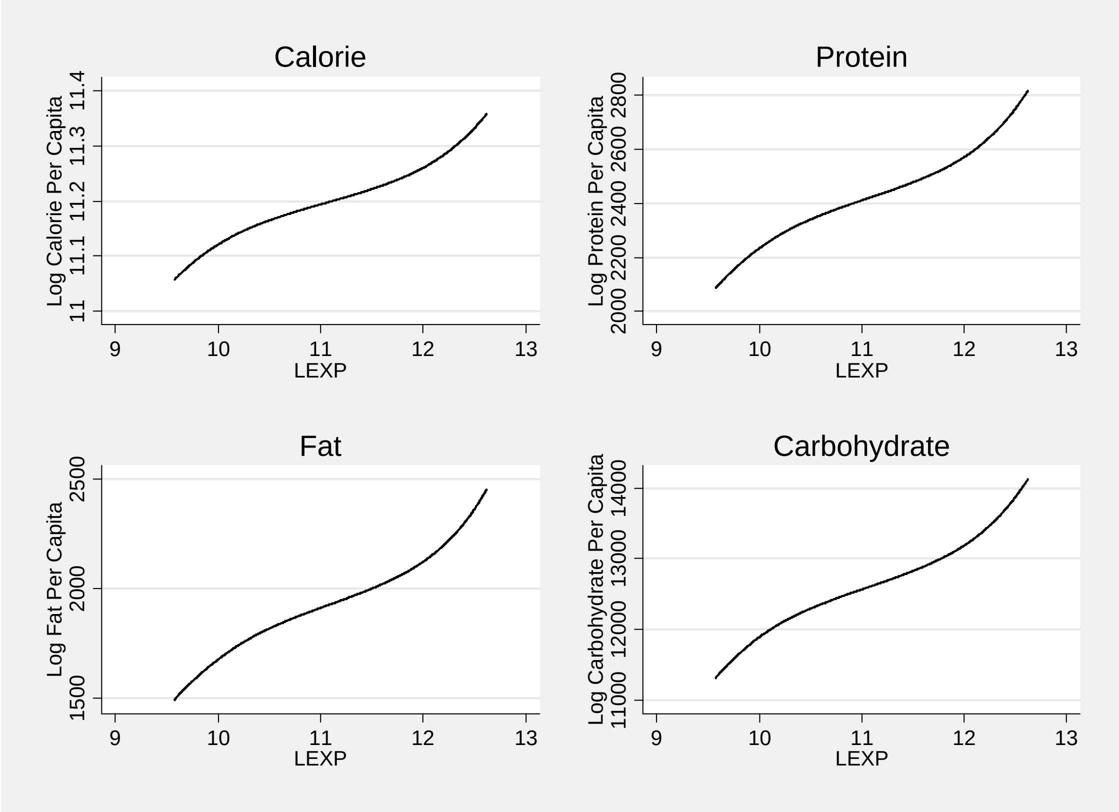
The principal motivation of this paper is to analyse nutrient intake and provide an alternative test of gender bias based on not only the household's intake of calories but, also, the principal micronutrients, namely, carbohydrate, protein and fat that generate the calories. In addition, the paper examines the effect of educational attainment of male and female members of the household on the household's intake of the calorie and the micronutrients and the effect of overall household prosperity on nutrient intake. From the estimation viewpoint, we recognise the potential endogeniety of the household expenditure variable in the micronutrient regressions by reporting the results of 2SLS estimation that jointly estimates the expenditure and the nutrient variables. The estimates vary widely between the 5 selected States in India and the results imply that generalising the results based on one State could lead to misleading policy implications. The sharp differences between some of the States on the nutrient intake and on the results of the tests of gender bias point to the need for State level policies that are tailored to the realities of a particular region rather than country wide general policy interventions dictated by the Central government.

Figure 1: Non-Parametric Estimation of the Relationship between Log of Calorie/Nutrient Consumption and Log of Per Capita Household Expenditure

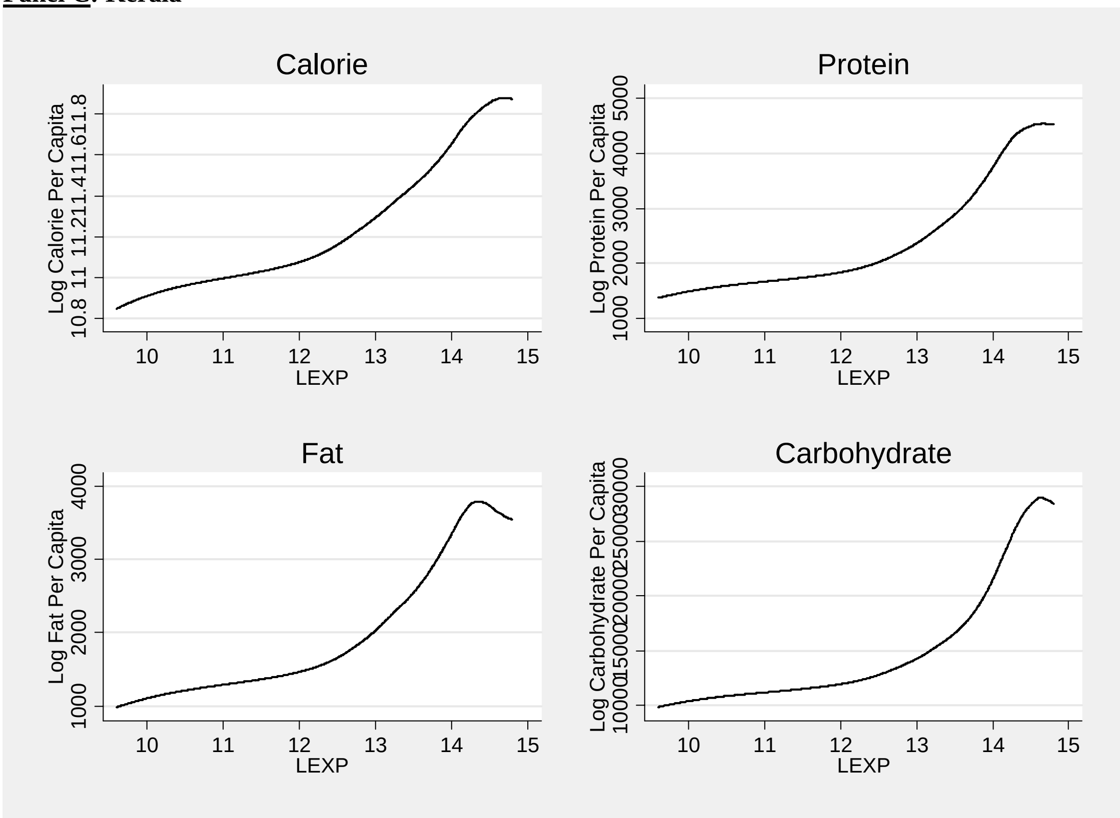
<u>Panel A</u>: Bihar



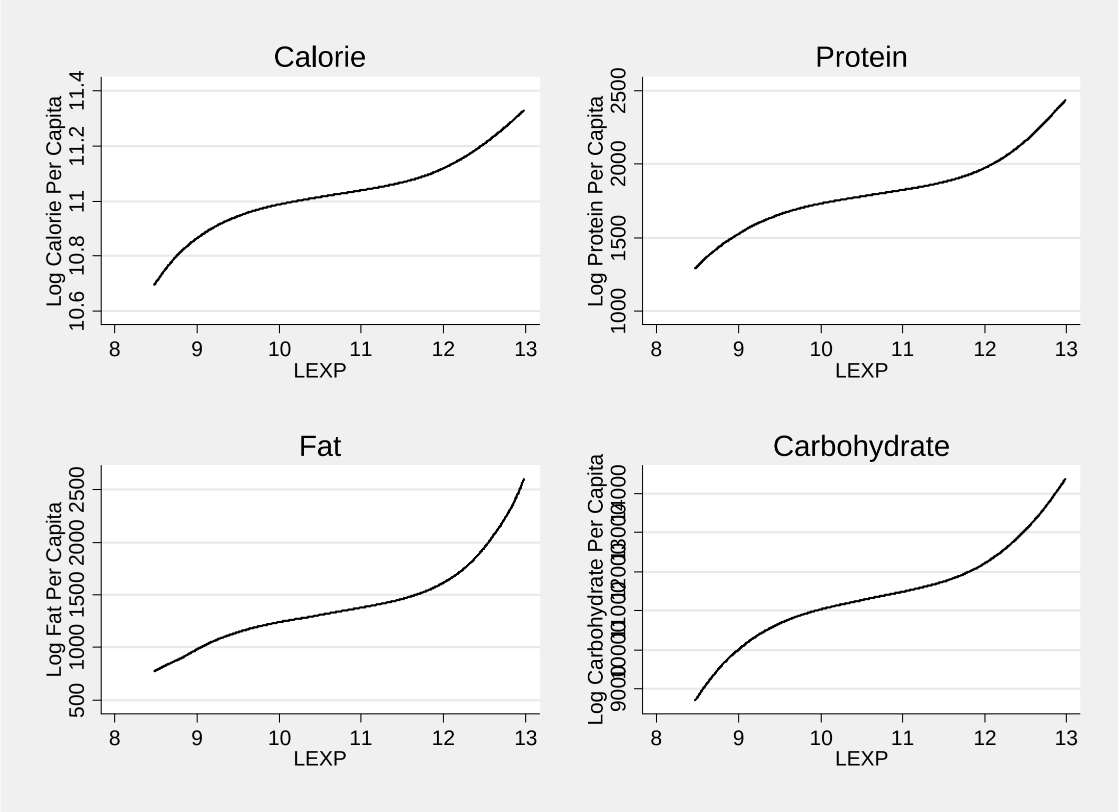
<u>Panel B</u>: Haryana



<u>Panel C</u>: Kerala



Panel D: Maharashtra



<u>Panel E</u>: Punjab

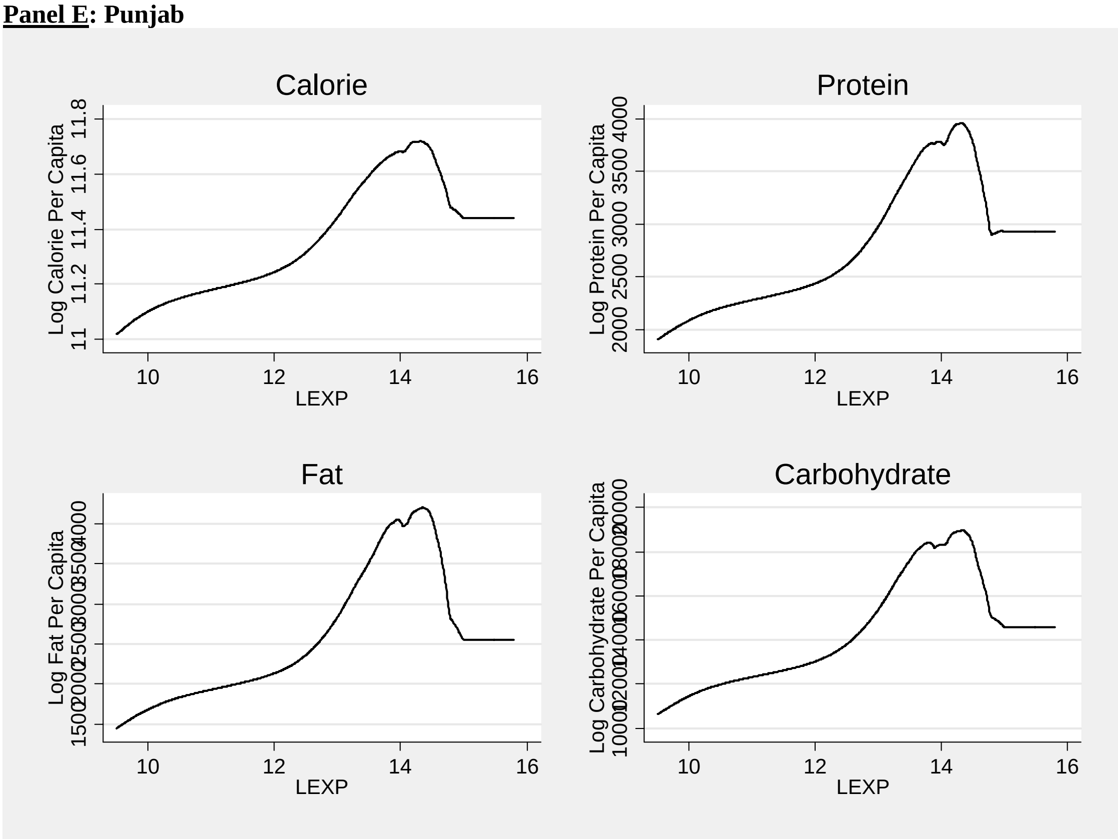
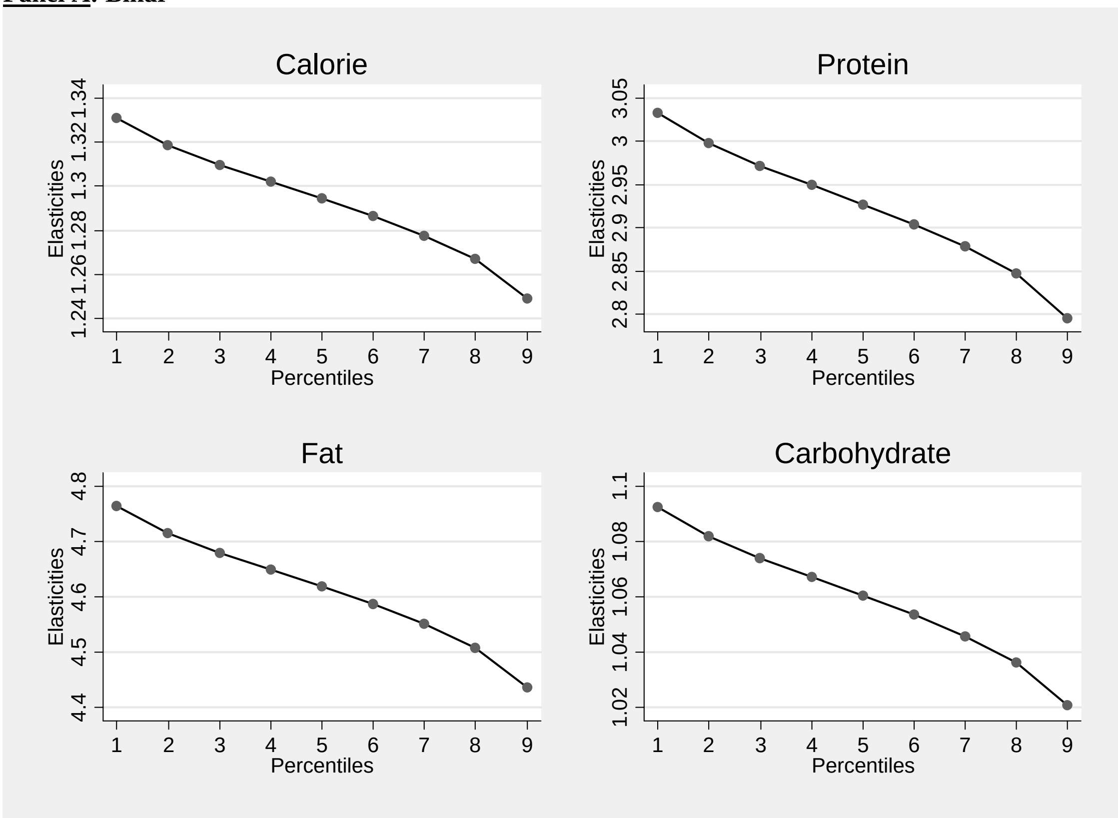
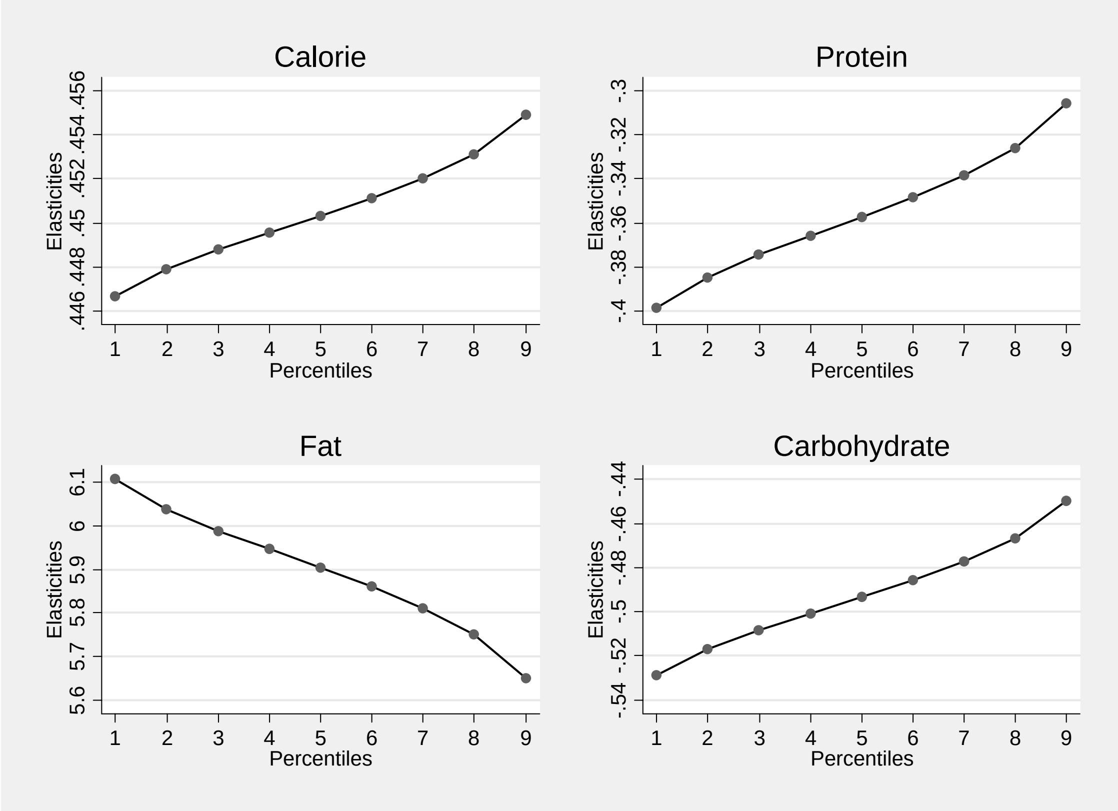


Figure 2: Estimated Expenditure Elasticities

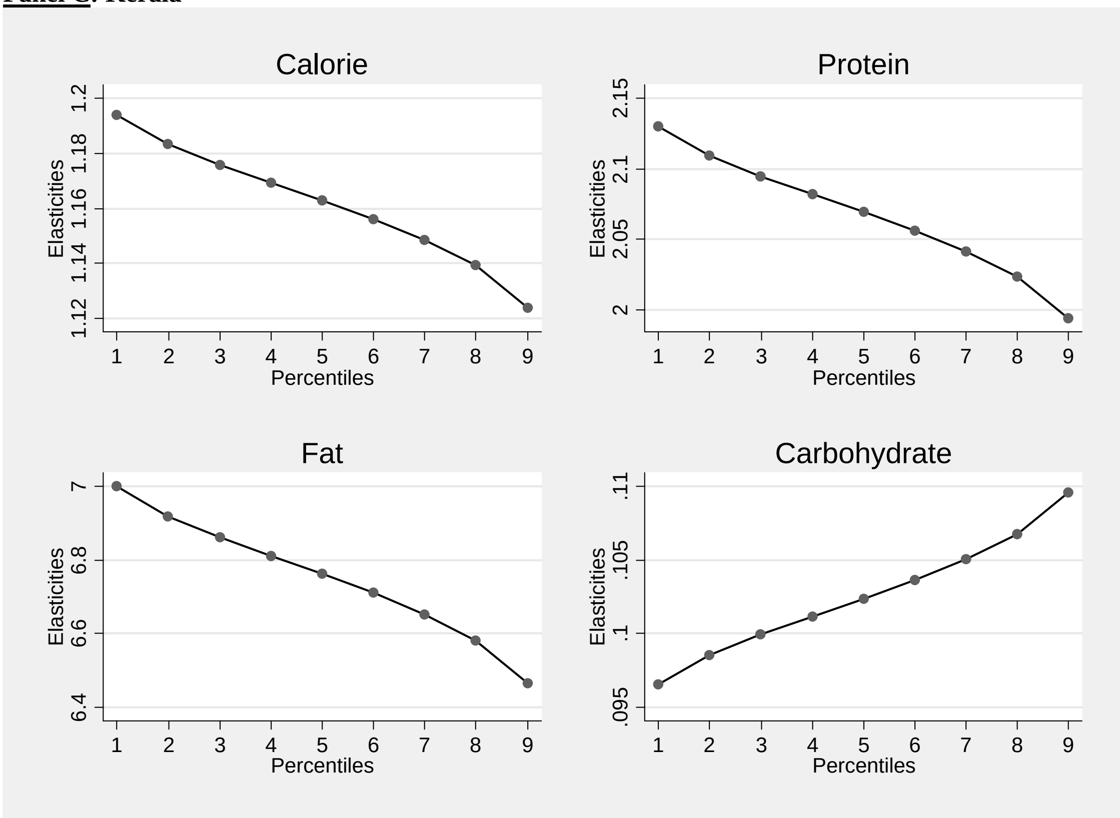
<u>Panel A</u>: Bihar



<u>Panel B</u>: Haryana



<u>Panel C</u>: Kerala



<u>Panel D</u>: Maharashtra

<u>Panel E</u>: Punjab

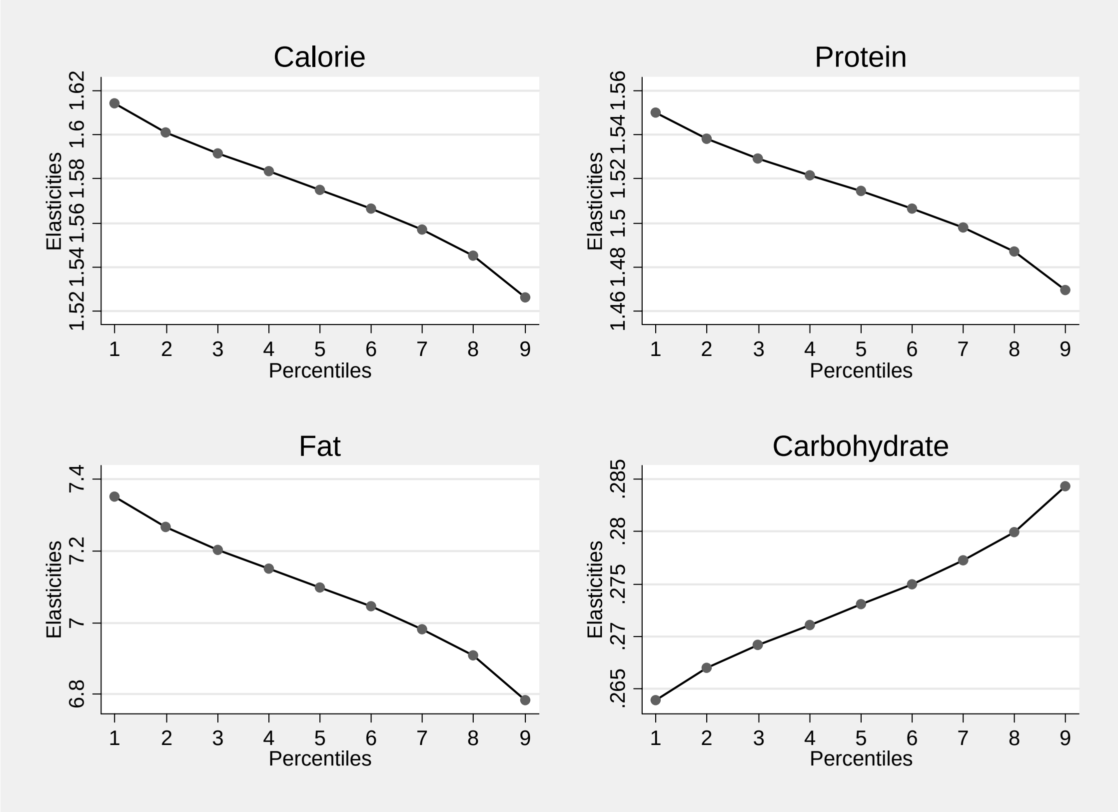


Table 1: Summary Means [(a)]

State	Per Capita Nutrient Intake[(b)]				Per Capita Expenditure[(b)]			Nutrient Intake per Rupee of Food Expenditure			
	Carbo	Fat	Protein	Calories[(c)]	Food	Items in Study	All Items	Carbo	Fat	Protein	Calories[(c)]
Andhra Pradesh	12320	1002	1569	64572	307	486.1	523.5	43.6	3.2	5.4	225.6
Arunachal Pradesh	15137	832	2208	76869	418	720.8	747.3	40.7	2.0	5.7	203.6
Assam	11747	698	1484	59208	313	461.7	472.7	40.2	2.2	5.0	200.5
Bihar	12871	862	1832	66569	282	410.0	434.3	49.1	3.0	6.9	251.0
Goa	11920	1631	1971	70250	566	936.5	1072.2	23.7	2.9	3.7	135.8
Gujarat	10290	1768	1744	64049	371	561.0	624.9	30.5	4.9	5.1	186.1
Haryana	12388	1921	2358	76271	424	703.9	758.2	32.3	4.5	5.9	193.4
Himachal Pradesh	12848	1700	2232	75624	431	683.3	777.4	33.0	4.0	5.6	190.8
Jammu & Kashmir	13020	1627	2058	74958	450	690.1	749.4	30.8	3.7	4.8	175.8
Karnataka	11809	1203	1712	64915	337	542.7	592.4	38.3	3.7	5.5	208.4
Kerala	11316	1329	1708	64058	464	772.3	918.6	27.3	2.9	3.9	151.0
Madhya Pradesh	12200	1021	1839	65342	262	419.4	463.2	51.0	3.9	7.6	269.1
Maharashtra	11318	1280	1776	63896	300	497.5	560.0	41.8	4.4	6.5	232.8
Manipur	13894	501	1621	66567	348	566.9	559.3	41.4	1.5	4.8	197.9
Meghalaya	11345	729	1519	58019	357	564.0	598.4	33.2	2.0	4.4	168.5
Mizoram	12808	780	1872	65734	476	812.4	801.9	29.0	1.6	4.2	147.5
Nagaland	14159	702	2126	71459	612	986.4	1079.9	25.0	1.1	3.6	124.6
Orissa	13862	565	1578	66841	265	399.2	422.9	56.9	2.1	6.3	272.1
Punjab	12301	1942	2285	75821	433	787.8	841.4	31.2	4.6	5.7	188.6
Rajasthan	12733	1770	2405	76481	363	563.3	621.8	38.4	4.9	7.1	225.7
Sikkim	11130	1034	1584	60163	341	558.2	610.9	36.1	3.2	5.0	193.3
Tamil Nadu	11266	1029	1481	60254	347	560.8	613.5	36.8	3.1	4.7	193.6
Tripura	12796	782	1692	64997	366	560.8	574.0	37.2	2.1	4.9	187.3
Uttar Pradesh	13317	1212	2165	72836	297	479.9	527.2	49.5	4.0	7.9	265.9
West Bengal	12978	820	1642	65864	334	511.5	533.3	42.1	2.4	5.2	210.9
A & N Islands	12471	1275	1785	68495	549	798.9	904.6	25.0	2.5	3.5	136.4
Chandigarh	12938	1908	2257	77954	560	892.8	1152.1	24.5	3.5	4.2	146.9
Dadra & Nagar Haveli	12082	1061	1652	64482	373	566.6	653.9	38.6	3.0	5.3	202.4
Daman & Diu	12678	1552	1810	71920	561	871.3	1039.0	25.7	3.0	3.6	144.4
Delhi	10365	1833	1935	65696	514	892.2	1097.8	22.1	3.7	4.0	137.1
Lakshdweep	13810	2020	1955	81244	649	986.3	1077.3	22.7	3.3	3.2	133.4
Pondicherry	11865	1179	1603	64479	391	610.6	705.5	34.2	3.1	4.4	181.9

Notes:

(a) These correspond to NSS 55th round data (1999/2000) for the rural areas

(b) The Nutrient intake and expenditure figures are over 30 days

(c) We have deleted the observations on households that report per capita calorie intake of more than 350,000 kcals over 30 days

Table 2: Correlation Between Per Capita Food Expenditure and Per Capita Nutrient Intake in Rural India (1999/2000)

State	Correlation between Expenditure and:			
	Carbo	Protein	Fat	Calorie
Andhra Pradesh	0.48	0.40	0.43	0.54
Arunachal Pradesh	0.06	0.04	0.14	0.13
Assam	0.15	0.17	0.25	0.20
Bihar	0.44	0.21	0.12	0.27
Goa	0.09	0.43	0.65	0.18
Gujarat	0.53	0.57	0.29	0.51
Haryana	0.31	0.25	0.63	0.42
Himachal Pradesh	0.33	0.12	0.20	0.26
Jammu & Kashmir	0.30	0.51	0.22	0.37
Karnataka	0.42	0.36	0.30	0.45
Kerala	0.41	0.51	0.45	0.48
Madhya Pradesh	0.48	0.55	0.17	0.39
Maharashtra	0.39	0.26	0.22	0.35
Manipur	0.06	0.06	0.07	0.07
Meghalaya	0.36	0.16	0.39	0.42
Mizoram	-0.09	0.07	-0.03	-0.07
Nagaland	0.34	0.44	0.10	0.29
Orissa	0.51	0.56	0.48	0.59
Punjab	0.11	0.14	0.13	0.13
Rajasthan	0.52	0.44	0.57	0.61
Sikkim	0.36	0.19	0.18	0.26
Tamil Nadu	0.10	0.12	0.16	0.12
Tripura	0.39	0.15	0.01	0.06
Uttar Pradesh	0.30	0.18	0.19	0.31
West Bengal	0.24	0.31	0.15	0.27
A & N Islands	0.61	0.64	0.62	0.67
Chandigarh	0.45	0.49	0.71	0.58
Dadra & Nagar Haveli	0.71	0.66	0.77	0.78
Daman & Diu	0.48	0.46	0.40	0.53
Delhi	0.41	0.47	0.36	0.49
Lakshdweep	0.57	0.67	0.54	0.69
Pondicherry	0.58	0.77	0.77	0.70

Table 3: Daily (Per Capita) Calorie Intake in Rural and Urban India by Percentiles[(a)]

Rural	1%	5%	10%	25%	50%	75%	90%	95%	99%	n[(b)]
Himachal Pradesh	1358	1685	1825	2068	2420	2827	3393	3817	5190	1634
Rajasthan	1232	1549	1717	2011	2405	2905	3541	4045	5647	3229
Punjab	1215	1494	1665	1955	2350	2931	3538	4118	5783	2152
Haryana	1178	1484	1653	1955	2425	2955	3612	4124	5421	1132
Uttar Pradesh	1086	1410	1576	1896	2283	2771	3415	3915	5821	9432
Orissa	1066	1375	1540	1813	2139	2537	3000	3373	4296	3477
West Bengal	980	1336	1479	1769	2126	2506	2953	3310	4328	4550
Bihar	1034	1334	1487	1753	2118	2535	3017	3444	4523	7311
Andhra Pradesh	883	1290	1448	1735	2065	2440	2914	3297	4559	5181
Maharashtra	987	1303	1446	1715	2048	2403	2863	3277	4605	4121
Gujarat	992	1282	1430	1703	2053	2468	2891	3274	4230	2479
Madhya Pradesh	965	1249	1416	1699	2058	2520	3040	3474	4755	5144
Karnataka	914	1190	1340	1675	2035	2496	3052	3583	5288	2763
Assam	955	1223	1362	1635	1922	2234	2589	2846	3612	3462
Kerala	863	1221	1371	1630	2022	2464	3029	3467	4531	2604
Tamil Nadu	844	1128	1272	1536	1881	2319	2827	3314	4495	4173
Urban	**1%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**99%**	**n[(b)]**
Himachal Pradesh	1368	1683	1858	2191	2575	3025	3612	4110	6630	947
Orissa	1151	1510	1691	1968	2350	2768	3241	3727	5112	1050
Rajasthan	1161	1435	1586	1865	2195	2649	3235	3702	5947	1985
Bihar	1064	1364	1524	1838	2249	2718	3393	3913	5373	2279
Punjab	1024	1395	1564	1838	2207	2715	3408	3824	5273	1883
Assam	1138	1390	1565	1809	2175	2530	3083	3541	7028	852
West Bengal	910	1323	1502	1788	2126	2500	2998	3410	5315	3432
Haryana	1035	1319	1477	1772	2110	2495	3031	3591	4786	758
Uttar Pradesh	1005	1302	1456	1765	2137	2601	3169	3698	5688	4638
Madhya Pradesh	964	1297	1444	1735	2100	2550	3122	3550	4914	3145
Gujarat	1032	1297	1466	1730	2051	2438	2844	3161	4025	2764
Maharashtra	938	1295	1451	1727	2082	2472	2901	3284	4502	5234
Andhra Pradesh	892	1288	1425	1706	2062	2456	2948	3418	4424	3806
Karnataka	311	1231	1383	1695	2069	2495	3065	3548	4418	2470
Kerala	775	1176	1366	1663	2052	2569	3186	3627	4259	2015
Tamil Nadu	159	1149	1313	1616	1979	2455	3085	3659	5170	4212

(a) The States have been arranged in descending order by their per capita intake figures at the 25th percentile
(b) n denotes the number of households

Table 4: 2SLS Estimation Results of Calorie Intake of Selected States (Dependent Variable CAL)

	Bihar	Haryana	Kerala	Maharashtra	Punjab
Years of Education of Most Educated Male	-0.0057***	-0.0091**	0.0023	-0.0140***	-0.0092***
	(0.0015)	(0.0036)	(0.0039)	(0.0022)	(0.0025)
Years of Education of Most Educated Female	0.0002	-0.0074*	0.0054	-0.0061**	-0.0170***
	(0.0012)	(0.0038)	(0.0035)	(0.0024)	(0.0027)
Log per capita expenditure	2.0935*	0.3699	1.8452	-3.9198**	2.4385
	(1.2119)	(3.2426)	(1.4245)	(1.6049)	(2.1889)
Log per capita expenditure Squared	-0.0750	0.0076	-0.0641	0.2038***	-0.0811
	(0.0566)	(0.1471)	(0.0628)	(0.0743)	(0.0977)
Log of Family Size	0.0063	0.0655***	-0.0743***	0.0562***	0.0579***
	(0.0083)	(0.0240)	(0.0220)	(0.0176)	(0.0144)
Proportion of Boys 0 – 5	-0.2219***	-0.1485	-0.2153***	-0.3516***	-0.2081***
	(0.0377)	(0.1005)	(0.0655)	(0.0585)	(0.0752)
Proportion of Girls 0 – 5	-0.2669***	-0.1427	-0.2439***	-0.4365***	-0.2308***
	(0.0384)	(0.1062)	(0.0670)	(0.0612)	(0.0833)
Proportion of Boys 6 – 10	-0.1028**	-0.0591	-0.0893	-0.1412**	-0.1060
	(0.0403)	(0.1046)	(0.0727)	(0.0633)	(0.0754)
Proportion of Girls 6 – 10	-0.1080**	0.0762	-0.0552	-0.1183*	-0.2253**
	(0.0421)	(0.1149)	(0.0704)	(0.0705)	(0.0905)
Proportion of Boys 11 – 17	-0.0532	0.0154	-0.0271	-0.1130**	-0.0752
	(0.0350)	(0.0911)	(0.0577)	(0.0494)	(0.0674)
Proportion of Girls 11 – 17	-0.0413	0.2048**	-0.0128	-0.0037	-0.0118
	(0.0373)	(0.1043)	(0.0558)	(0.0501)	(0.0711)
Proportion of Males 18 – 60	-0.0065	0.2228***	0.0154	-0.1025**	0.0272
	(0.0315)	(0.0792)	(0.0512)	(0.0417)	(0.0598)
Proportion of Females 18 – 60	-0.0056	0.1783**	0.1339***	0.1067***	-0.0697
	(0.0308)	(0.0876)	(0.0447)	(0.0364)	(0.0576)
Proportion of Males 61 and Higher	-0.0384	0.1861	0.1289*	-0.0464	-0.0635
	(0.0446)	(0.1168)	(0.0671)	(0.0539)	(0.0870)
Constant	-2.5859	6.0476	-1.5337	29.6739***	-5.7734
	(6.4764)	(17.7996)	(8.0339)	(8.6475)	(12.2583)
Sample Size	7310	1132	2603	4117	2152
Durbin-Wu-Hausman Test#	0.16	0.53	8.23**	38.03***	16.54***
Tests for Gender Bias##					
Age 0 – 5	2.35	0.00	0.15	2.14	0.10
Age 6 – 10	0.02	1.42	0.16	0.11	1.82
Age 11 – 17	0.15	4.52**	0.06	4.46**	1.00
Age 18 – 60	0.00	0.31	6.61**	21.03***	4.34**

Notes: Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; #:Durbin-Wu-Hausman Test for exogeniety of Log per capita expenditure and Log per capita expenditure. Distributed as $\chi^2(2)$. Instruments used: age, sex, marital status, employment status of household head, land ownership, access to electricity, main cooking medium and religion and caste of household. ##:Tests for Gender Bias: Distributed as $\chi^2(1)$

Table 5: 2SLS Estimation Results of Micro-Nutrient Intake for Selected States Panel A: 2SLS Estimates of Protein Intake (Dependent Variable: PROT)

	Bihar	**Haryana**	**Kerala**	**Maharashtra**	**Punjab**
Years of Education of Most Educated Male	-0.0076***	-0.0133***	0.0015	-0.0182***	-0.0124***
	(0.0017)	(0.0045)	(0.0044)	(0.0027)	(0.0027)
Years of Education of Most Educated Female	-0.0008	-0.0050	0.0038	-0.0097***	-0.0186***
	(0.0013)	(0.0047)	(0.0039)	(0.0029)	(0.0029)
Log per capita expenditure squared	5.2565***	-1.2641	3.3970**	-5.8910***	2.3005
	(1.3546)	(4.0073)	(1.5992)	(1.9285)	(2.3315)
Log per capita expenditure	-0.2188***	0.0852	-0.1247*	0.2965***	-0.0738
	(0.0633)	(0.1817)	(0.0705)	(0.0893)	(0.1041)
Log of Family Size	0.0373***	0.1086***	-0.0095	0.1330***	0.0933***
	(0.0093)	(0.0296)	(0.0246)	(0.0211)	(0.0153)
Proportion of Boys 0 – 5	-0.1798***	-0.0884	-0.1006	-0.4369***	-0.2366***
	(0.0421)	(0.1242)	(0.0735)	(0.0703)	(0.0801)
Proportion of Girls 0 – 5	-0.2085***	-0.0145	-0.0782	-0.5317***	-0.2968***
	(0.0430)	(0.1312)	(0.0753)	(0.0736)	(0.0887)
Proportion of Boys 6 – 10	-0.1036**	-0.0090	-0.0494	-0.1515**	-0.1093
	(0.0451)	(0.1292)	(0.0816)	(0.0760)	(0.0803)
Proportion of Girls 6 – 10	-0.1084**	0.2030	0.0503	-0.1636*	-0.2591***
	(0.0471)	(0.1420)	(0.0790)	(0.0847)	(0.0963)
Proportion of Boys 11 – 17	-0.0726*	0.0382	0.0377	-0.2172***	-0.0915
	(0.0391)	(0.1126)	(0.0648)	(0.0593)	(0.0717)
Proportion of Girls 11 – 17	-0.0427	0.3178**	0.0608	-0.0762	0.0023
	(0.0417)	(0.1289)	(0.0626)	(0.0602)	(0.0758)
Proportion of Males 18 – 60	-0.0627*	0.2425**	-0.0765	-0.1484***	0.0132
	(0.0353)	(0.0978)	(0.0574)	(0.0501)	(0.0637)
Proportion of Females 18 – 60	-0.0249	0.2326**	0.1851***	0.1175***	-0.0509
	(0.0344)	(0.1083)	(0.0501)	(0.0437)	(0.0613)
Proportion of Males 61 and Higher	-0.0812	0.2084	0.0993	-0.1158*	-0.1218
	(0.0498)	(0.1443)	(0.0753)	(0.0647)	(0.0927)
Constant	-23.5539***	11.0031	-15.0145*	36.5017***	-8.6655
	(7.2389)	(21.9968)	(9.0191)	(10.3910)	(13.0569)
Sample Size	7310	1132	2603	4117	2152
Durbin-Wu-Hausman Test#	7.09**	4.24	0.36	47.43***	23.98***
Tests for Gender Bias##					
Age 0 – 5	0.77	0.40	0.07	1.85	0.64
Age 6 – 10	0.01	2.29	1.09	0.02	2.53
Age 11 – 17	0.74	6.45***	0.12	5.13**	1.92
Age 18 – 60	2.01	0.01	25.55***	23.52***	1.68

Notes: Standard errors in parentheses; significant at 10%; ** significant at 5%; *** significant at 1%; #: Durbin-Wu-Hausman Test for exogeniety of Log per capita expenditure and Log per capita expenditure. Distributed as $\chi^2(2)$. Instruments used: age, sex, marital status, employment status of household head, land ownership, access to electricity, main cooking medium and religion and caste of household. ##:Tests for Gender Bias: Distributed as $\chi^2(1)$

Table 5 (Continued) Panel B: 2SLS Estimates of Fat Intake (Dependent Variable: FAT)

	Bihar	**Haryana**	**Kerala**	**Maharashtra**	**Punjab**
Years of Education of Most Educated Male	-0.0016	-0.0144***	0.0056	-0.0116***	-0.0040
	(0.0029)	(0.0054)	(0.0060)	(0.0036)	(0.0042)
Years of Education of Most Educated Female	0.0038*	-0.0069	0.0004	-0.0015	-0.0069
	(0.0023)	(0.0056)	(0.0053)	(0.0038)	(0.0045)
Log per capita expenditure squared	7.8373***	10.3726**	11.9914***	2.4163	12.6390***
	(2.3191)	(4.7848)	(2.1636)	(2.5509)	(3.6263)
Log per capita expenditure	-0.3023***	-0.4197*	-0.4912***	-0.0575	-0.5204***
	(0.1083)	(0.2170)	(0.0954)	(0.1181)	(0.1619)
Log of Family Size	0.0442***	0.0644*	0.0190	0.1207***	0.0503**
	(0.0159)	(0.0354)	(0.0333)	(0.0279)	(0.0238)
Proportion of Boys 0 – 5	0.3881***	0.1837	-0.2374**	-0.1160	0.0990
	(0.0721)	(0.1483)	(0.0995)	(0.0930)	(0.1246)
Proportion of Girls 0 – 5	0.3582***	0.1131	-0.1859*	-0.2649***	0.0094
	(0.0736)	(0.1567)	(0.1018)	(0.0973)	(0.1380)
Proportion of Boys 6 – 10	0.1666**	0.0496	-0.2196**	-0.0283	-0.0382
	(0.0771)	(0.1543)	(0.1104)	(0.1005)	(0.1249)
Proportion of Girls 6 – 10	0.1873**	0.6200***	-0.0761	0.0451	0.0229
	(0.0806)	(0.1695)	(0.1068)	(0.1120)	(0.1499)
Proportion of Boys 11 – 17	0.0653	-0.0459	-0.3167***	-0.0947	0.0161
	(0.0669)	(0.1345)	(0.0876)	(0.0785)	(0.1116)
Proportion of Girls 11 – 17	0.1120	0.2811*	-0.1520*	-0.1347*	0.0713
	(0.0713)	(0.1539)	(0.0847)	(0.0797)	(0.1178)
Proportion of Males 18 – 60	-0.0712	0.1678	-0.4468***	-0.3143***	0.0102
	(0.0604)	(0.1168)	(0.0777)	(0.0662)	(0.0991)
Proportion of Females 18 – 60	0.0745	0.3072**	-0.1273*	-0.0042	0.0499
	(0.0590)	(0.1293)	(0.0678)	(0.0578)	(0.0954)
Proportion of Males 61 and Higher	-0.0553	0.2297	-0.1632	-0.1670*	-0.0184
	(0.0853)	(0.1723)	(0.1019)	(0.0856)	(0.1441)
Constant	-42.5344***	-56.0591**	-65.2377***	-12.2053	-68.6928***
	(12.3930)	(26.2646)	(12.2018)	(13.7445)	(20.3084)
Sample Size	7310	1132	2603	4117	2152
Durbin-Wu-Hausman Test[#]	152.34***	15.82***	36.94***	147.20***	49.59***
Tests for Gender Bias[##]					
Age 0 – 5	0.28	0.25	0.21	2.60	0.59
Age 6 – 10	0.08	11.63***	1.24	0.43	0.17
Age 11 – 17	0.62	6.19**	3.32*	0.24	0.28
Age 18 – 60	10.16***	1.40	20.83***	18.28***	0.27

Notes: Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; [#]:Durbin-Wu-Hausman Test for exogeniety of Log per capita expenditure and Log per capita expenditure. Distributed as $\chi^2(2)$. Instruments used: age, sex, marital status, employment status of household head, land ownership, access to electricity, main cooking medium and religion and caste of household. [##]:Tests for Gender Bias: Distributed as $\chi^2(1)$

Table 5 (Continued) Panel C: 2SLS Estimates of Carbohydrate Intake (Dependent Variable: CARB)

	Bihar	**Haryana**	**Kerala**	**Maharashtra**	**Punjab**
Years of Education of Most Educated Male	-0.0068***	-0.0068*	0.0002	-0.0142***	-0.0109***
	(0.0016)	(0.0039)	(0.0044)	(0.0022)	(0.0027)
Years of Education of Most Educated Female	-0.0004	-0.0083**	0.0069*	-0.0072***	-0.0190***
	(0.0013)	(0.0041)	(0.0039)	(0.0024)	(0.0029)
Log per capita expenditure squared	1.7661	-1.2677	-0.0252	-2.8230*	0.0735
	(1.2838)	(3.5017)	(1.5821)	(1.5919)	(2.3250)
Log per capita expenditure	-0.0663	0.0727	0.0120	0.1447**	0.0187
	(0.0600)	(0.1588)	(0.0698)	(0.0737)	(0.1038)
Log of Family Size	0.0010	0.0583**	-0.0957***	0.0237	0.0550***
	(0.0088)	(0.0259)	(0.0244)	(0.0174)	(0.0153)
Proportion of Boys 0 – 5	-0.3211***	-0.2756**	-0.2371***	-0.3974***	-0.2994***
	(0.0399)	(0.1085)	(0.0727)	(0.0580)	(0.0799)
Proportion of Girls 0 – 5	-0.3657***	-0.2689**	-0.2996***	-0.4483***	-0.2800***
	(0.0407)	(0.1147)	(0.0745)	(0.0607)	(0.0885)
Proportion of Boys 6 – 10	-0.1444***	-0.1191	-0.0719	-0.1516**	-0.1158
	(0.0427)	(0.1129)	(0.0807)	(0.0627)	(0.0801)
Proportion of Girls 6 – 10	-0.1550***	-0.1478	-0.0876	-0.1082	-0.2786***
	(0.0446)	(0.1241)	(0.0781)	(0.0699)	(0.0961)
Proportion of Boys 11 – 17	-0.0754**	0.0162	0.0240	-0.0910*	-0.0889
	(0.0370)	(0.0984)	(0.0641)	(0.0490)	(0.0716)
Proportion of Girls 11 – 17	-0.0677*	0.1537	0.0089	0.0283	-0.0347
	(0.0395)	(0.1126)	(0.0619)	(0.0497)	(0.0756)
Proportion of Males 18 – 60	0.0002	0.2167**	0.1322**	-0.0278	0.0391
	(0.0334)	(0.0855)	(0.0568)	(0.0413)	(0.0635)
Proportion of Females 18 – 60	-0.0168	0.1180	0.1833***	0.1156***	-0.1069*
	(0.0326)	(0.0946)	(0.0496)	(0.0361)	(0.0612)
Proportion of Males 61 and Higher	-0.0388	0.1589	0.2035***	-0.0353	-0.0577
	(0.0472)	(0.1261)	(0.0745)	(0.0534)	(0.0924)
Constant	-1.7153	14.4233	8.0886	23.0176***	6.3943
	(6.8606)	(19.2217)	(8.9224)	(8.5773)	(13.0209)
Sample Size	7310	1132	2603	4117	2152
Durbin-Wu-Hausman Test#	10.81***	2.19	27.12***	14.45***	5.38*
Tests for Gender Bias##					
Age 0 – 5	2.06	0.00	0.57	0.78	0.07
Age 6 – 10	0.07	0.05	0.03	0.39	3.00*
Age 11 – 17	0.05	2.04	0.05	5.40**	0.65
Age 18 – 60	0.45	1.32	1.00	10.05***	8.75***

Notes: Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%; #:Durbin-Wu-Hausman Test for exogeniety of Log per capita expenditure and Log per capita expenditure. Distributed as $\chi^2(2)$. Instruments used: age, sex, marital status, employment status of household head, land ownership, access to electricity, main cooking medium and religion and caste of household. ##:Tests for Gender Bias: Distributed as $\chi^2(1)$

Table 6: Estimated Total Expenditure Elasticities at Mean Consumption Levels[(a), (b)]

	Bihar	Haryana	Kerala	Punjab	Maharashtra
Calorie Intake Per Capita	1.29 (0.82)	0.45 (2.02)	1.16 (1.03)	-1.74 (1.04)	1.57 (1.29)
Protein Intake Per Capita	2.90 (1.22)	-0.35 (2.80)	2.06 (1.09)	-2.72 (1.18)	1.51 (1.59)
Fat Intake Per Capita	4.61 (1.56)	5.89 (3.72)	6.74 (1.36)	1.80 (1.50)	7.08 (2.18)
Carbohydrate Intake Per Capita	1.06 (0.83)	-0.49 (2.12)	0.10 (1.17)	-1.28 (0.93)	0.27 (1.59)

Notes:
(a) Standard errors in parentheses
(b) Standard errors computed by bootstrapping with 100 replications

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APPENDIX:

Appendix Table A1: Comparison of Expenditure [(a)] and Calorie Based Poverty Rates [(b)] in Rural India

	Expenditure		Using Calorie < 2400 per person		Using Age and Gender Specific Minimum Calorie Requirements [(b)]	
	Household	**Individual**	**Household**	**Individual**	**Household**	**Individual**
Andhra Pradesh	8.0%	9.8%	72.8%	78.4%	62.3%	67.4%
Assam	33.1%	37.3%	83.4%	85.3%	74.3%	76.0%
Bihar	36.4%	40.8%	68.0%	71.9%	54.1%	55.8%
Gujarat	9.0%	11.0%	71.8%	78.0%	62.8%	68.4%
Haryana	6.3%	6.5%	49.0%	50.9%	38.3%	38.7%
Himachal Pradesh	5.6%	7.0%	48.8%	56.5%	35.7%	40.4%
Karnataka	11.8%	14.4%	70.8%	75.6%	63.4%	66.7%
Kerala	7.2%	9.9%	72.4%	79.7%	64.9%	71.7%
Madhya Pradesh	30.2%	33.2%	69.8%	74.8%	59.4%	62.3%
Maharashtra	18.4%	21.6%	74.5%	80.4%	64.1%	68.7%
Orissa	39.5%	41.1%	68.0%	71.7%	56.3%	58.8%
Punjab	4.6%	5.7%	53.2%	57.9%	40.7%	43.5%
Rajasthan	10.1%	12.2%	49.4%	55.0%	34.0%	36.9%
Tamil Nadu	14.1%	16.4%	78.2%	83.4%	72.4%	78.0%
Uttar Pradesh	24.6%	27.3%	57.1%	61.7%	40.7%	42.7%
West Bengal	24.4%	27.8%	69.2%	72.1%	57.8%	59.9%

(a) The expenditure based poverty rates use the poverty lines for 1999/2000 recommended by the Planning Commission

(b) The calorie based rates are constructed as follows (in terms of daily requirements)
Calorie Required = 1200 for Child Aged 0 – 3
Calorie Required = 1500 for Child Aged 4 – 6
Calorie Required = 1800 for Child Aged 7 – 9
Calorie Required = 2100 for Child Aged 10 – 12
Calorie Required = 2500 for Boy Aged 13 – 15
Calorie Required = 2200 for Girl Aged 13 – 15
Calorie Required = 3000 for Boy Aged 16 – 18
Calorie Required = 2200 for Girl Aged 16 – 18
Calorie Required = 2800 for Adult Male Aged 19 – 60
Calorie Required = 2200 for Adult Female Aged 19 – 60
Calorie Required = 1950 for Elderly Male Aged 61 and Above
Calorie Required = 1800 Elderly Female Aged 61 and Above

Appendix Table A2: OLS Estimates of Calorie Intake in Selected States (Dependent Variable CAL)

	Bihar	**Haryana**	**Kerala**	**Maharashtra**	**Punjab**
Years of Education of Most Educated Male	-0.0060*** (0.0013)	-0.0078** (0.0032)	-0.0027 (0.0032)	-0.0099*** (0.0018)	-0.0057** (0.0023)
Years of Education of Most Educated Female	-0.0000 (0.0011)	-0.0074** (0.0034)	0.0018 (0.0031)	-0.0007 (0.0020)	-0.0134*** (0.0025)
Log per capita expenditure	2.2437*** (0.1943)	2.0082*** (0.5299)	2.0112*** (0.2346)	2.4489*** (0.2108)	2.5855*** (0.2099)
Log per capita expenditure	-0.0817*** (0.0091)	-0.0677*** (0.0239)	-0.0685*** (0.0103)	-0.0956*** (0.0098)	-0.0917*** (0.0092)
Log of Family Size	0.0082 (0.0064)	0.0543*** (0.0184)	-0.0330** (0.0146)	-0.0201** (0.0098)	0.0295** (0.0123)
Proportion of Boys 0 – 5	-0.2180*** (0.0361)	-0.1765* (0.0928)	-0.2077*** (0.0633)	-0.2973*** (0.0461)	-0.2385*** (0.0681)
Proportion of Girls 0 – 5	-0.2627*** (0.0361)	-0.1686* (0.1001)	-0.2309*** (0.0656)	-0.3460*** (0.0465)	-0.2819*** (0.0716)
Proportion of Boys 6 – 10	-0.0990** (0.0385)	-0.0858 (0.0968)	-0.0847 (0.0702)	-0.0765 (0.0512)	-0.1268* (0.0737)
Proportion of Girls 6 – 10	-0.1038** (0.0403)	0.0442 (0.1061)	-0.0584 (0.0693)	-0.0235 (0.0521)	-0.2697***” (0.0792)
Proportion of Boys 11 – 17	-0.0527 (0.0350)	-0.0073 (0.0853)	-0.0258 (0.0534)	-0.0696* (0.0393)	-0.0878 (0.0638)
Proportion of Girls 11 – 17	-0.0389 (0.0368)	0.1705* (0.0908)	-0.0025 (0.0540)	-0.0167 (0.0433)	-0.0502 (0.0667)
Proportion of Males 18 – 60	-0.0071 (0.0313)	0.2129*** (0.0771)	0.0033 (0.0466)	-0.0328 (0.0351)	0.0299 (0.0577)
Proportion of Females 18 – 60	-0.0057 (0.0304)	0.1559** (0.0772)	0.1343*** (0.0405)	0.0654** (0.0318)	-0.0697 (0.0558)
Proportion of Males 61 and Higher	-0.0401 (0.0443)	0.1591 (0.1075)	0.1151* (0.0632)	0.0130 (0.0474)	-0.0537 (0.0814)
Constant	-3.4314*** (1.0348)	-2.8163 (2.9332)	-2.8302** (1.3259)	-4.0935*** (1.1321)	-6.0724*** (1.2005)

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix: Table A3: 3SLS Estimation Results of Calorie Intake (Dependent Variable CAL)

	Bihar	Haryana	Kerala	Maharashtra	Punjab
Years of Education of Most Educated Male	-0.0060***	-0.0078**	-0.0020	-0.0113***	-0.0083***
	(0.0013)	(0.0031)	(0.0036)	(0.0021)	(0.0026)
Years of Education of Most Educated Female	0.0000	-0.0070*	0.0027	-0.0036	-0.0153***
	(0.0011)	(0.0037)	(0.0033)	(0.0023)	(0.0027)
Log per capita expenditure	2.1983*	1.6007	1.6559	-5.1252***	5.7569***
	(1.1741)	(2.8275)	(1.4146)	(1.5967)	(1.1515)
Log per capita expenditure squared	-0.0796	-0.0496	-0.0535	0.2562***	-0.2302***
	(0.0551)	(0.1273)	(0.0623)	(0.0742)	(0.0505)
Log of Family Size	0.0083	0.0551***	-0.0367**	0.0409**	0.0476***
	(0.0068)	(0.0187)	(0.0171)	(0.0169)	(0.0149)
Proportion of Boys 0 – 5	-0.2183***	-0.1763*	-0.2020***	-0.4054***	-0.1722**
	(0.0365)	(0.0925)	(0.0650)	(0.0570)	(0.0761)
Proportion of Girls 0 – 5	-0.2631***	-0.1676*	-0.2243***	-0.4872***	-0.1862**
	(0.0371)	(0.1001)	(0.0664)	(0.0604)	(0.0830)
Proportion of Boys 6 – 10	-0.0995**	-0.0831	-0.0785	-0.1890***	-0.0938
	(0.0393)	(0.0992)	(0.0722)	(0.0627)	(0.0792)
Proportion of Girls 6 – 10	-0.1043**	0.0449	-0.0532	-0.1863***	-0.1779**
	(0.0409)	(0.1064)	(0.0699)	(0.0682)	(0.0902)
Proportion of Boys 11 – 17	-0.0528	-0.0058	-0.0210	-0.1573***	-0.0471
	(0.0349)	(0.0863)	(0.0573)	(0.0482)	(0.0693)
Proportion of Girls 11 – 17	-0.0390	0.1740*	0.0002	-0.0426	0.0091
	(0.0368)	(0.0958)	(0.0552)	(0.0496)	(0.0738)
Proportion of Males 18 – 60	-0.0074	0.2141***	0.0070	-0.1087**	0.0507
	(0.0315)	(0.0781)	(0.0508)	(0.0428)	(0.0618)
Proportion of Females 18 – 60	-0.0057	0.1607*	0.1355***	0.1082***	-0.0498
	(0.0308)	(0.0843)	(0.0443)	(0.0374)	(0.0598)
Proportion of Males 61 and Higher	-0.0402	0.1637	0.1199*	-0.0438	-0.0148
	(0.0444)	(0.1126)	(0.0666)	(0.0553)	(0.0877)
Constant	-3.1861	-0.5405	-0.7459	36.5770***	-24.2338***
	(6.2454)	(15.6372)	(7.9840)	(8.5654)	(6.5701)

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

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