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Poverty Estimation in India

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Abstract

The paper points out two flaws in defining the poverty line and using it as a basis for measuring poverty. First, required nutritional intake is much lower for children than adults. Thus, it is necessary to consider the age structure of a household in determining whether it is poor. Second, in a diverse country like India the height of adults varies a lot especially when their racial origin is different. Variation in height implies variation in required calorie intake. The poverty line has to be adjusted accordingly. Measures of poverty lines are constructed to adjust for these flaws. A paper by Mitra and Pal (2006), currently in process, is working out estimates for poverty measures for Indian states, adjusted for age and anthropometric characteristics fir different periods of time.

While great strides have been made in poverty alleviation in India in the nineties India still houses around one third of the world's poor. Given the use of the poverty ratio in programmes such as subsidized distribution of food grains to BPL (below the poverty line) families it is important that we identify these families correctly. The norm which is still used in India is based on that that prescribed by Dandekar and Rath (1971) – the level of consumption expenditure which is associated with an adequate nutritional intake per capita of 2250 calories. Based on the above article the Planning Commission fixed the official poverty line in 1973-74 as that level of consumption expenditure which was consistent with an intake of 2400 calories per capita in rural areas and 2100 calories in urban areas (see Mahendradev, 2005 and Patnaik, 2004). Successive estimates of poverty have taken the consumption basket in the base year (1973-74) as given and calculated the poverty line as the cost of obtaining this basket in the current year by inflating the base year poverty line by the value of the current Consumer Price Index (see Deaton, 2003, Deaton and Dreze, 2002 and Tendulkar and Sundaram, 2003).

Critics point out that this poverty line is subject to two flaws: a change in the preferences of consumers over time and a change over time in the extent to which non-marketed consumption (such as consumption from common property resources) figures in the consumption bundle (see Patnaik, 2004 and Suryanarayana, 1996). Because of these reasons Patnaik (2004) and Mehta and Venkatraman (2000) have reworked the poverty estimates for 1993-94 and 1999-2000 respectively by obtaining the minimum

consumption expenditure class consistent with the nutrition norms mentioned above (and not by inflating the consumption bundle of 1973-74). Consequently they get results which are totally different from the official estimates. Mehta and Venkatraman, using a norm for 2410 calories for rural areas, estimated that 69.7% were poor in 1993-94. Patnaik (2004) used the original 2400 calorie norm in rural areas and found 69.7% to be in poverty in 1999-2000 as opposed to 27.1% estimated by the Planning Commission. Similarly, by using the 2100 calorie norm directly for urban areas she found out that 39.7% belonged to the ranks of the poor as opposed to the figure of 23.6% estimated by the Planning Commission. The Planning Commission's figure for the overall incidence of poverty is 26.1%. If the appropriate urban and rural population weights are used with Patnaik's results then her estimate for the overall incidence of poverty would be 62%.

Mahendradev (2005) points out that the highest incidence of rural poverty, according to Meenakshi and Vishwanathan (2003) (who use the direct calorie norm for state level data), occurs in some of the most prosperous states in terms of per capita income – Tamil Nadu (86.5%), Maharashtra (83%), Kerala (81.2%) and Gujarat (80.5%). Maharashtra, Gujarat and Tamil Nadu were ranked first, second and fifth in terms of per capita income in 1998-99 in the country (see www.indiastat.com). Further in terms of the Human Development Index (HDI) Kerala (which is the poorest state according to Meenakshi and Vishwanathan) was ranked first in 2001. Tamil Nadu, Maharashtra and Gujarat were ranked third, fourth and sixth respectively in HDI. On the other hand, according to Meenakshi and Vishwanathan, the less affluent states such as Orissa and Bihar had poverty rates of 74%, much lower than that of the more affluent states mentioned above.

How is it that the seemingly valid criticisms of critics such as Suryananrayana (1996) and Patnaik (2004) lead to the empirical contradictions mentioned by Mahendradev and this paper? The contention of this paper is that the reason lies in the uniformity of the calorie norm. In other words, a level of intake which might be inadequate for an adult might be certainly more than what is required for children. If the family structure is different across states (some states having a higher proportion of nuclear families in the population than others) then the contradictions mentioned above are possible.

Given the different required intakes of adults and children it is necessary to consider the age structure of households before classifying them as poor. A household consisting entirely of adults might have a much higher average intake than one consisting predominantly of children. Yet the difference in required intakes between adults and children might incorrectly lead us to classify the first household as non-poor and the second household as poor under certain circumstances if we implement the uniform calorie norm.

Consider the case of Kerala in which 51% of rural households had 4 members or less according to the 2001 census, (as compared to the national average of 38%) indicating the popularity of the nuclear family structure. Contrast that with Bihar with only 30% of the household having 4 members or less. Kerala also had only 6% of households with a membership of 9 individuals or more whereas for Bihar the corresponding figure was 18.8%. Households with 9 or more members should mostly be joint families in

both Bihar and Kerala. Bihar's Net Fertility Rate of 4.2 as opposed to 1.9 for Kerala is not large enough to justify the existence of so many more nuclear families (in percentage terms) of 9 members or more. Uttar Pradesh, another less affluent state which is shown to have a relatively low incidence of poverty by Meenakshi and Viswanathan, has 24% of households in the 9 (members) or more category and 40% in the 4 or less category.

Consider Tamil Nadu, another affluent state which has been categorized as one with a high incidence of poverty by Meenakshi and Viswanathan. As much as 58% of households in Tamil Nadu have four members or less. Only 3% of households have 9 or more members.[1] In Maharashtra, another prosperous state shown to exhibit a high incidence of poverty by Meenakshi and Viswanathan, the proportion of households falling in the 4 (members) and below and 9 and above categories are 43% and 7.6% respectively, the latter figure being significantly lower than that for Bihar and Uttar Pradesh. .

Given the higher child to adult ratio in nuclear families, no wonder we have an overestimation of poverty for states such as Kerala and Tamil Nadu, as compared to Bihar, Orissa and Uttar Pradesh. For example, consider a joint family with 4 adult members consuming 2600 calories each and a child consuming 1600 calories. The average consumption per family member is 2400 calories. Thus, all the members are classified as not being poor. However, if the family splits up into two nuclear families –one with two adults and the other containing the rest of the members then the first family and its members would be classified as non-poor whereas the second would be classified as poor because its average intake per member is 2267 calories. If the universe were to be made up of just the joint family mentioned above then nuclearization without any change in individual intakes would take the poverty rate from 0% to 60%. It should be added that an intake of 1600 calories is definitely normal for a child.

The uniform calorie norm, which does not distinguish between children and adults and hence is biased against nuclear families, in combination with the tendency of the Indian household to go nuclear over time might explain the high incidence of poverty reported by Patnaik (2004) through the direct application of the calorie norm as compared to official estimates for 1999-2000. Note that Patnaik's estimate for the incidence of rural poverty in India in 1999-2000 is 69.7%, much higher than 54.9% reported by the Planning Commission for even 1973-74, using the same uniform calorie norm per individual.

However, the problems with the uniform calorie norm do not end here. India is a diverse country and home to many races. For example, "the average height of Jats, a non-tribal community of Punjab and

[1] In Orissa which has a net fertility rate (comparable to Kerala) of 2.45, 45% of rural households have 4 or less members as compared to 51% for Kerala. On the other hand households with 6 or more members comprise 33% of the total number of rural households as compared to 26% for Kerala.. The low recorded incidence of poverty is not explained here to the same extent by a low proportion of nuclear families. Some explanation is provided by the high figure of 33% for households with 6 or more members. Similarly, Gujarat's high incidence of poverty, as shown by Meenakshi and Viswanathan, is not explained to the same extent by household size as in the case of Kerala and Tamil Nadu. . There are 9.7% rural households in the "9 or more" category and 39% in the "4 or less category". The rather wide categorization of 6-8 members followed by the Census might be to blame for our failure in these cases to see a link between household /structure and size and the contradictions in the reporting of poverty rates.

Haryana is 182.3 cm and that of the Lambada tribe in Karnataka and Bagadam Kallan and Kota of Tamil Nadu is 164 cm" (in "http://indiaculture.net" quoting from *Limca Book of Records*, 2002). While the application of the 2400 calorie norm is reasonably appropriate for rural adult Jats it is hugely inappropriate for the rural adult from the Lambada tribe. Even the norm of 1765 calories per individual in rural areas and 1694 in urban areas will over-report poverty for the Lambadas and underreport poverty for the Jats. However, the norm does capture the representative Indian household/ individual and it is possible that many of the negative and positive effects cancel out in the estimation of poverty at the national level. Nevertheless, state level estimates of poverty will still continue to be biased if we use the calorie norm to identify the demarcating consumer expenditure class separately for states. In the next section we will also discuss necessary adjustments which take into account the differences in calorie intake required by people of different areas.

A paper by Mitra and Pal (2006), currently in process, is working out estimates for poverty measures for Indian states, adjusted for age and anthropometric characteristics fir different periods of time.

II. Calculation of Poverty Line

In defining the poverty line we should take into account the age structure of the population as well as the household being examined. The table below shows the percentage of total population accounted for by each age group below the age of 14 years in the Indian population in 2002. This shows that the average age of a child is around 7.5 years.

A recent NSSO (National Sample Survey Organisation) survey shows that the average household size is around 6 in both rural and urban areas for the bottom 30 percentile of the population. Further, the overall average household size is 5 and 4.5 members for rural and urban households respectively Given that population below the age of 15 years constitutes 32.1% of the population, it would not be inappropriate to consider the reference household for estimation purposes as consisting of 4 adults and two children, one of each sex, in the age group of 4-8.

Table 1: Age Group-wise Percent Distribution of Estimated Population in India - 2002

Age group (years)	Percentage of total population	Adjusted mid-point of each group	
0-4	11.3	2.25	
5-9	10.3	7.25	
10-14	11.5	12.25	
Average age			7.51

Source: www.indiastat.com

Not only is the application of a uniform norm inappropriate it seems that the norm of 2400 calories for a rural individual and 2100 for an urban individual might be excessive. According to the Wikipedia encyclopedia, the average height for an Indian male is 1.68 metres and that for a female is 1.55 metres. This implies that in order for an average Indian adult male to have a BMI of 18.5 (which is the minimum BMI in the normal range) he should have a weight of $1.67^2 * 18.5 = 51.5$ kilos. Similarly, the lower bound for the normal weight of an average female adult is 44.5 kilos. The figures for recommended calorie intakes are given below. These are calculated on the basis of minimum weight to be maintained for good health under assumption of moderate exercise for urban adults and a very active life for rural adults (See Table 1 in the Appendix). The recommended calorie intake for children is based on Table 2 in the Appendix. The relevant figures are presented in Table 2 given below.

Table 2: Recommended calorie intake for representative Indian children and adults

	Rural	**Urban**
Male adult	1824	1710
Female adult	1568	1470
Male child (7.5yrs)	1500	
Female child (7.5yrs)	1300	

Note: Calculations for adults and children based on Appendix Table 1 and Table 2 respectively; assumption of 15 calories per pound for urban adults and 16 for rural adults.

In rural areas our reference household should have a total of 10588 calories per day, which is a total of 1765 calories per member. For urban areas the total is 10164 or 1694 calories per member. These are far less than the 2400 calorie norm and the 2100 calorie norm mentioned earlier. .

Arranging all households in the reference category into expenditure classes in ascending order allows us to find out the lowest class which attains the norms of 10588 calories per day for rural areas and 10164 calories for urban areas on an average. Dividing the average daily food expenditure of a household in this class by the average number of calories ingested gives the cost per calorie. The non-food expenditure per member gives the non food expenditure at the poverty line.

Now for any household the poverty line is given by:

Required expenditure on food (as given by calorie norms, age structure and calculated cost per calorie) + calculated non-food expenditure per family member.

As we have mentioned before, the drawback of this adjusted measure is that it assumes adults of the same sex all over the country to be uniform and as having the same nutritional needs. Clearly the discussion in the introduction shows that it is not the case. A family of six-footers needs a higher calorie

intake than a family of five footers as the ideal body weight (and therefore calorie intake) is dependent upon height. All that we need in addition to data on expenditure is the height of adult family members.

Thus for any household the poverty line is given by:

Required expenditure on food (as given by calorie norms for children and norms for maintaining a BMI of 18.5 for given height of adults and calculated cost per calorie) + calculated non-food expenditure per family member (calculated above).

This will become clear with the help of an example. Consider two households A and B consisting solely of 4 identical adults each. For the sake of simplicity, consider that a representative adult in household A is 1.8 metres tall whereas that in B is 1.6 metres tall. Their minimum healthy weights (those corresponding to a BMI of 18.5) are 60 and 47 kilos respectively. Under the assumption of light exercise, adult in A needs a minimum of 1980 calories per day to maintain this weight whereas an adult in B requires a minimum of 1560 calories per day to maintain his weight at 47 kilos. If we assume an expenditure of 1 paise per calorie (a figure for this has to be obtained from a survey) then the poverty line for adult A should be Rs 19.8*30 = Rs. 594 per month whereas that for B is only Rs. 468 per month. Thus, there is a difference of Rs. 126 between the two poverty lines. This can lead to a measure of functional poverty, something which identical norms cannot do. In a country like India where height and physique of people vary from region to region as a result of genetic differences, implementation of such a method is necessary.

At present we do not have data on height. However, it is possible to adjust to a certain extent for height even without data on height. Note that such adjustments will only take care of differences in average height of people from different regions, say people from Haryana and Tamil Nadu. Adjustments for intra-regional variation in height will not be possible.

Again consider the reference household at the All India level for rural areas. As we have seen that the poverty line for such households is the minimum average consumption expenditure which provides them at least 10588 calories Let the level of food expenditure corresponding to this level of consumption expenditure be given by F. Therefore , cost per calorie is given by

$$c = \frac{F}{10588}$$

Now suppose that in state i a reference household in the poverty line consumption expenditure group spends F_i on food. The number of calories consumed by the household is given by

$$C_i = \frac{F_i}{F} * 10588$$

Note that the norms for children say that they should consume a total of 2800 calories. However, the nutritional intake of adults depends upon their height. Given that we do not make any allowance in the calorie norm for intra-regional variation in height among adults and the fact that the minimum normal body weight of an average Indian male adult is around 16% higher than that of an average female adult we can write

$$2(1.16)x_i + 2x_i + 2800 = \frac{F_i}{F} * 10588$$

$$\Rightarrow 4.32x_i = (\frac{F_i}{F} * 10588) - 2800$$

$$\Rightarrow \hat{x}_i = (\frac{F_i}{F} * 2451) - 648.48 \text{ (}\textit{hat denotes estimated value}\text{)}$$

where x_i denotes consumption of calories per adult female in state i. Given that the variables on the right hand side are known after the survey the poverty line level of consumption expenditure for any family in state i consisting of p male adults, q female adults and r_{kl} children of sex l (l is either male or female) and age group k is given by

$$P_{ipqr_{Kl}} = (4.32\ \hat{x}_i + \sum_K \sum_l r_{Kl} C_{Kl}) * c + \{\frac{[E_i - F_i]}{6} * (p + q + \sum_k \sum_l r_{KL})\}$$

where E_i denotes the total consumption expenditure corresponding to the poverty line in state i for the representative Indian family and C_{Kl} represents the recommended calorie intake per child of sex l in age group k. $\frac{[E_i - F_i]}{6}$ corresponds to the non-food expenditure per individual in that family.

III. **Conclusion**

The starting point of this paper is the current dispute over the poverty estimates. One set of estimates uses the 1973-74 poverty line (official estimates by Planning Commission and those by Deaton and Tendulkar and Sundaram) inflated by the price index. This is subject to errors resulting from change in consumer preferences and a change in the availability of food outside the market. The other set of estimates does find out the expenditure class corresponding to the calorie norm in determining the poverty line but yields estimates which are controversial. For example, a prosperous state such as Tamil Nadu is shown to have the highest incidence of poverty, ahead of such states as Bihar and Orissa. In order to deal with these problems two sets of adjustments are suggested. In the first case we distinguish between the minimum nutritional intake of adults and children, as determined by the latest norms. This neutralizes the bias against states with a higher proportion of nuclear families in determining poverty. Note that nuclear families mostly have a higher proportion of children to adults. The second adjustment consists of adjusting for differences in nutritional intake between representative adults of different regions because of differences in their average heights. These differences are the outcome of differences in racial or genetic characteristics.

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Appendix

Table 1:Approximate daily caloric intake needed to maintain desirable body weight for adults

Activity level	*Calories per pound*	*Activity level*	*Calories per pound*
Very sedentary *(movement restricted such as patient confined to house)*	13	**Moderate activity** *(weekend recreation)*	15
Sedentary *(office job, light work)*	14	**Very Active** (*meets ACSM standards for vigorous exercise at least 3 times/week)*	16

Adapted from Patient Education for University of Utah Health Sciences Center, USA

Table 2: Calorie intake for children

	1 Year	**2–3 Years**	**4–8 Years**	**9–13 Years**	**14**
Calories†	100 cal	1100 cal			
Female			1300 cal	1400 cal	1600 cal
Male			1500 cal	1900 cal	2300 kal

Source: American Heart Association,

Note: Assumption of moderate physical activity has been made.