Inequalities in Child Undernutrition in India

A Decomposition Analysis using NFHS 3

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Abstract

This paper sifts the National Family Health Survey – 3 data in its efforts to present certain broad descriptive features of the phenomenon of child undernutrition in India. Further, we employ some of the standard decomposition techniques to comprehend causes and sources of child nutritional inequality. The paper finds that, apart from income, health outcomes are largely dependent upon maternal and community level correlates. Specifically, it is observed that maternal correlates are explaining over 20 percent of the nutritional inequality. Health action on these lines along with the ongoing efforts on coverage of full immunization and normative regulations of fewer births can help to reduce the underweight inequalities by another 10 percent. There is also ample scope for policies in the form of community-based interventions, especially in pockets with heavy concentration of scheduled caste and tribes. The study also observes significant cluster level effect (around 19 per cent) engendering inequality.

Keywords: child undernutrition, health inequality, decomposition, Oaxaca, India

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1. Introduction

The first few years of human life requires adequate care and attention to overpower morbidity risks and nutritional traps. Unfortunately, in India, one in every two children endures some form of health and nutritional deprivation (see IIPS, 2007). From a human right's perspective it disregards the fundamental right of children to lead a life free of hunger and morbidity. Such a combination of under-nourishment and onslaught of infectious diseases leads to several preventable deaths among children. Notwithstanding its magnitude, it is discomforting to notice greater concentration of this misfortune is among children belonging to lower socioeconomic status (Gwatkin et al, 2007). Such consistent experience of nutritional deprivation among poorer children indicates of significant association between indicators of poverty and undernutrition. Though the income-health gradient has an intuitive appeal but inequalities in child nutritional outcomes, to a large extent, depends upon individual and maternal correlates and is also influenced by the household and community structures. In this regard, for effective policymaking it becomes important to comprehend the major causes by decomposing the total observed inequalities into its sources. In the Indian context such assessment so far does not seem to have received serious attention. It is important that such trends in a rapidly growing country are assessed, timely and systematically, not only to provide sincere inferences for policy but also to increase its importance in analytical and political spheres.

With this elementary purpose, the paper sifts the Indian National Family Health Survey[1] (2005-06) data, in its efforts to present certain broad descriptive features of the phenomenon of child health deprivations in India and its distribution across well-defined socio-economic groups classified by gender and sector-of-origin, and its dispersal across space. We employ widely accepted measurement techniques to assess inequities in underweight outcomes (W/A). Underweight outcomes is preferred over the other indicators such as stunting and wasting as it confounds the effects of both short- and long-term health and nutrition problems. To retain the sensitivity of the nutritional outcome indicators, the domain of child underweight outcomes has been taken as a major criterion. Children whose weight-for-age measures are below minus two standard deviations (-2 SD) from the median of the reference population are defined as underweight (low weight-for-age) for their age. Specifically, we use the NFHS-3 information provided on the basis of the new international reference population released by World Health Organization (WHO) in April 2006 (WHO Multicenter Growth Reference Study Group, 2006) and accepted by the Government of India (IIPS, 2007). To focus attention on issues of association and causation, we have utilized the information on key maternal and household level correlates.

2. Methods

In order to examine income-related inequality, we adopt the standard technique of employing concentration indices (C). C could be written in many ways, one being;

(1) $$C = 1 - \frac{2}{n.\mu}\sum_{i=1}^{n} h_i (1 - R_i)$$

Where h is the health variable whose inequality is being measured, μ is its mean, R_i is the i^{th} individual's fractional rank in the socioeconomic distribution and cov(h_i, R_i,.) is the covariance. The CI ranges between +1 and -1 and if it takes negative values ill-health outcomes are disproportionately concentrated among the poor. Underlying this technique is a simple but interesting principle of defining equity. The principle involved stipulates that the cumulative proportions of ill-health must match with the cumulative population shares and any mismatch between the two sets is defined as inequity. The concentration index (CI) have certain attractive properties as compared to certain other measures of health disparities (Wagstaff et al. 1991, Kakwani et al. 1997) and are employed here as a means for quantifying the degree of income-related inequality. Following Wagstaff (2002), the extensions to the concentration index are also incorporated to comprehend the attitudes to inequality and to provide a general measure of nutritional achievement that captures inequality in the distribution of underweight outcomes and also its mean. The extended concentration index is written as follows;

(2) $$C(v) = 1 - \frac{v}{n.\mu}\sum_{i=1}^{n} h_i (1 - R_i)^{(v-1)}$$

Here, v is the inequality-aversion parameter (v>1). When (v = 2), the weight is the same as in the regular concentration index. By contrast, when (v = 1), everyone's health is weighted equally to say that inequalities in health do not matter (C(1) = 0). If v is raised above 1, the health of the poor persons are weighed more and the weight attached to the health of people who are above the 55th percentile decreases (see Appendix 1). For (v = 6, 8) respectively, the weight attached to the health of persons in the top two quintiles and those in the top half of the income distribution is virtually zero.

Alternatively, the concentration index can be computed easily by making use of the convenient covariance result (Kakwani, 1980; Jenkins, 1988; Lerman and Yitzhaki, 1989) as follows

(3) $C = 2\,\mathrm{cov}(h_i, R_i) / \mu$,

For estimation from microdata, an equivalent estimate of the concentration index can be obtained from a convenient regression of a transformation of the underweight (negative) z-score variable of interest on the fractional rank in the living standards distribution (Kakwani, Wagstaff, and van Doorslaer 1997) as follows;

(4) $$2\sigma_r^2\left(\frac{h_i}{\mu}\right) = \alpha + \beta R_i + u_i$$

where, σ_r^2 is the variance of the fractional rank variable and β is the estimated concentration index. This method gives rise to an alternative interpretation of the concentration index as the slope of a line passing through the heads of a parade of people, ranked by their living standards, with each individual's height proportional to the value of his or her health variable, expressed as a fraction of the mean (O'Donnell et al, 2008). In this paper, the extended concentration index has been computed by means of a convenient regression;

(5) $$-v\mathrm{Var}[(1-R_i)^{v-1}].\left[\frac{h_i}{\mu}\right] = \alpha_1 + \beta_2.((1-R_i)^{v-1} + u_i$$

In order to measure achievement, Wagstaff (2002) suggests a measure which combines both the mean level of health as well as its distribution inequality. This measure could be written as;

(6) $I(v) = \mu\ [1-C(v)]$

If ill-health is concentrated among poor than the I(v) value would increase to suggest the worsening of mean achievement in a given population. Further in the descriptive section, we adopt a multivariate framework to describe how underweight outcomes vary with certain factors. As we are utilizing a survey data the issue of stratification and cluster sampling are taken into account while performing multivariate analysis. Since there could be a higher degree of homogeneity within clusters hence greater correlation between observable and unobservable factors could be expected. To elaborate, consider the following model;

(7) $h_{ic} = \lambda_c + \beta X_{ic} + u_{ic}; E[u_{ic} \mid X_{ic}, \lambda_c] = E[u_{ic}] = 0$

where i and c are individual (household) and cluster level indicators, respectively; X_{ic} is a vector of regressors; λ_c are cluster effects and u_{ic} idiosyncratic errors. λ_c is called a 'random effect' when it is treated as a random variable and a 'fixed effect' when it is treated as a parameter to be estimated for each cross section observation i (Woolridge, 2002). Technically in a random effect model, we assume that the cluster effects are independent of the regressors $E[\lambda_c \mid X_{ic},] = E[\lambda_c]$ and the composite error would be ($\varepsilon_{ic} = \lambda_c + u_{ic}$) (O'Donnell et al, 2008). Under such conditions the Ordinary Least Squares (OLS) estimators are consistent but inefficient if there is cluster-induced correlation in the standard error (Deaton, 1997). To overcome this problem Generalized Least Squares (GLS) is used where within-cluster correlation is estimated and taken into account while estimating the model parameter. A Lagrange Multiplier test is performed to test the null that the cluster-effects are insignificant and the OLS is efficient. However, if we relax the assumption of independence between cluster effects and regressors, $E[\lambda_c \mid X_{ic},] \neq E[\lambda_c]$, we arrive at the fixed effects model. Hausman test is performed to test the null hypothesis of independence between cluster-effects and the regressors and to decide the superiority of the model (Woolridge, 2002). In order to complement the continuous measure of nutritional deprivation we also resort to binary response models, Linear Probability Model, Logit and Probit, in estimating the correlates of discrete form of child underweight outcomes.

After obtaining the descriptive results, it is of interest to probe further into the causes of inequalities in nutritional outcomes. Two distinct analytical approaches are employed to comprehend such differences. Firstly, the computed concentration index for underweight outcomes is decomposed to know the contributions of the identified correlates to income-related inequality. The advantage of this method is that it allows for decomposition of health inequalities across the full distribution of income. Secondly, we employ Oaxaca decomposition which helps to explain the gap in the means of the outcome variable (here weight-for-age z-score) between two groups, such as poor and non-poor. This type of decomposition permits us to make a distinction between the contributions of differences in the magnitudes (or endowments) and the effects (coefficient as well as interaction effect) of determinants.

First, let us briefly discuss the technique of decomposing the concentration index. A health outcome, h, could be explained with the help of a set of k determinants, x_k, in a linear regression model as follows;

(8) $$h_i = \alpha + \sum_k \beta_k x_{ki} + u_i$$

where β_k are coefficients and u_i the disturbances. It is assumed that the interpersonal variations in health outcomes arise due to systematic variations in x_k's across income groups. Based on the relationship between h_i and x_k's the concentration index for h can be written as follows; (see Wagstaff et al, 2003; Rao, 1969; Podder, 1993 for details)

$$(9) \qquad C = \sum_k \left(\frac{\beta_k \overline{x_k}}{\mu} \right) C_k + \left(\frac{GC_u}{\mu} \right)$$

where, μ is the mean of h, C_k is the concentration index for x_k and GC_u is the generalized concentration index[2] for u_i, defined as;

$$(10) \qquad GC_u = \frac{2}{n} \sum_{i=1}^{n} u_i R_i$$

where, C is decomposed into two components; a deterministic component (the first term on the right hand side of equation 9), given by the weighted sum of the C_k's where the weights are given by the elasticity of h with respect of x_k (and evaluated at sample mean) and a residual component (the second term) that represents unexplained part of the model.

In the Oaxaca (1973) type decomposition, the total population is divided into two groups (poor and non-poor). Now, for each group the health outcome, h, could be explained with the help of a set of variables in a regression model as;

(11) $h_i^p = \beta^p x_i^p + u_i^p$, if poor (p)

and

(12) $h_i^{np} = \beta^{np} x_i^{np} + u_i^{np}$, if non-poor (np)

where, the intercept term is also incorporated in the vector of β parameters. Now the gap between the outcomes of these two groups could be expressed as;

(13) $h^{np} - h^{p} = \Delta x\beta^{p} + \Delta\beta x^{p} + \Delta\beta\Delta x$

where, $\Delta\beta = (\beta^{np} - \beta^{p})$, $\Delta x = (x^{np} - x^{p})$ and $\Delta\beta\Delta x$ is the interaction effect. The first term on the right hand side could also be called as the endowment effect (E), the second term as the coefficient effect (C) and the third term as an interaction effect (CE). Such a method allows partitioning the outcome gap between poor and the non-poor into a part attributable to the fact that the poor have worse x's than the nonpoor, *or the explained component*, and a part attributable to the fact that *ex hypothesi* they have worse β's than the nonpoor, *or the unexplained component* (O'Donnell et al, 2008; see appendix 2 for a graphical representation). Alternatively, equation (13) can be rewritten as equation (14 & 15) where the interaction effect is placed in the unexplained and the explained components, respectively.

(14) $h^{np} - h^{p} = \Delta x\beta^{p} + \Delta\beta(x^{p} + \Delta x) = \Delta x\beta^{p} + \Delta\beta x^{np}$

(15) $h^{np} - h^{p} = \Delta x(\beta^{p} + \Delta\beta) + \Delta\beta x^{p} = \Delta x\beta n^{p} + \Delta\beta x^{p}$

Oaxaca's decomposition could be also written as a special case of another decomposition given by equation (16),

(16) $h^{np} - h^{p} = \Delta x[D\beta^{np} + (I-D)\Delta\beta^{p}] + \Delta\beta[(I-D)x^{np} + D\Delta x^{p}]$

where, in a simple case, x is a scalar, I is the identity matrix (here I=1), and D is the matrix of weights. Here D=0 in case of equation (14) and D=1 in case of equation (15). Different types of weighing schemes (D's) have also been suggested by various scholars. For instance, Cotton (1988) suggested for weighing the differences in x's by mean of the coefficient vector (D=0.5); Reimers (1983) suggested weighing the coefficient vectors by the proportions in the two groups, so that if f_{np} is the sample fraction in the non-poor group ($D=f_{np}$) and Neumark (1988) used the coefficients obtained from the pooled data regression equation as weight.

3. Undernutrition in India: An overview

Table 1 shows the percentage of children (under-five years of age) classified as undernourished based on three standard indices of physical growth, *stunting*, *wasting* and *underweight*, and by selected socioeconomic and demographic characteristics. These figures reveal that almost half of the child population is stunted (48 per cent) and almost 43 per cent is underweight. The prevalence of wasting is also quite a serious problem in India (20 per cent). The problem of severely stunted (24 per cent) and underweight (16 per cent) children is also substantial. Such findings indicate that the problem of cumulative linear growth failures, chronic nutritional inadequacies and episodes of frequent illness is very high among the Indian children. Further, it is observed that undernutrition outcomes are substantially higher in rural areas than in urban areas but certainly this by no means suggests that urban areas have reasonable nutritional profiles. In fact, 40 percent of urban children are found to be stunted whereas 33 percent are underweight. With almost one out of every two children being undernourished at the national level, the regional dispersion of the problem can’t be expected to be any better. However, this problem is much more concentrated among low-income states of Madhya Pradesh, Bihar, and Jharkhand. A few states such as Kerala, Punjab and smaller states such as Goa, Mizoram, Sikkim and Manipur possess relatively lower levels of undernutrition. As far as the temporal improvements in the nutritional condition are concerned a comparison of NFHS-3 with its preceding round (NFHS-2) suggests of marginal reductions in the problem of underweight and stunting. For instance, underweight incidence (for children aged less than three years) decreased from 43 percent in NFHS-2 to 40 percent in NFHS-3, and the incidence of severe underweight decreased from 18 percent to 16 percent. However, a greater decline in the incidence of stunting (from 51 percent to 45 percent) and severe stunting (from 28 percent to 22 percent) is observed.

[INSERT TABLE 1 ABOUT HERE]

From the Table, we find that the pattern of growth failure varies with age. The proportion of children who are stunted or underweight shows significant increases after age level of 20-23 months. On an average, Indian children start with higher negative weight-for-age z-score (around [-1]) but after two to three months of birth the z-scores decline sharply and underweight outcomes increase rapidly. These average z-scores for height-for-age and weight-for-age do not register any serious decline after 20-24 months. The observations are also along the expected lines for the indicators of birth order and birth interval. Better nutritional outcomes are observed for first births and gradual increments in undernourishment are noted with increasing birth order. With the exception of wasting, smaller birth intervals are found to be significantly associated with poor nutritional performance.

Importantly, children who are judged by their mother to have been small or very small at the time of birth are more likely to be undernourished than those who were reportedly of average size or larger. As a matter of concern, it is observed that during the first six months of life (breastfed period) around 20-30 percent of children are found to be undernourished on these three nutritional scales. This reflects the problem of inadequate maternal dietary intake and supplementation during pregnancy and even after childbirth. Perhaps, the role of hygiene, sanitation and childhood ailments may also be contributing to the undernutrition outcomes among the breastfed babies. Another important observation could be made in terms of the nutritional status of children being significantly dependent upon maternal nutritional status. A glance at Table 1 effectively suggests that problems of undernutrition are higher for children of undernourished mothers (body mass index below 18.5). This raises an important question while analyzing nutritional performance of children in isolation with the maternal correlates and calls for effective interventions right from the birth conception stage. The finding on mother's education vis-à-vis child's nutritional performance revalidates the strongly grounded negative relationship in the literature between the two. Mothers with no education have higher proportions of undernourished children compared to mothers with higher education.

Some evidence of variations in the levels of undernutrition is also found across the broad caste categories. For instance, the prevalence of underweight and stunting are higher among the children belonging to scheduled castes, scheduled tribes and other backward classes. Particularly, children belonging to scheduled tribes are having the poorest nutritional status on almost every measure. Very little evidence of gender disparities are observed in terms of overall underweight outcomes at the national level. Perhaps, due to aggregation problem we are not observing any support to the hypothesis of gender discrimination but inferences may vary if we disaggregate the information across region or along other pertinent socioeconomic dimensions. All the three anthropometric measures decrease steadily with an increase in the wealth index score of the household. Children from households with a lower standard of living are twice as likely to be undernourished as children from households with a higher standard of living. Although it is an obvious finding but its importance prompts us to pursue some analysis on health inequalities that get manifested along the income domain.

4. Underweight outcomes: Descriptive analysis

The underweight outcomes based on the measure of weight-for-age are used to carry out further analysis on inequalities in nutritional outcomes and their causes. As a justification for its selection, it is useful to look at the correlation between the three anthropometric indicators of height-for-age, weight-for-height and weight-for-age. Fig. 1a-1c suggests that height-for-age (captures chronic nutritional inadequacies or illness) and weight-for-height (captures current nutritional status) is not correlated with each other but both show significant correlation with weight-for-age. This may be because weight-for-age is a composite measure of height-for-age and weight-for-height and could be used for monitoring growth and to assess changes in the magnitude of malnutrition over time. The distribution of weight-for-age z-scores for the total child population under five years of age shown in figure 1d presents a clear picture of undernutrition prevalence in India. The entire distribution appears to be shifted towards the left side with a lower mean in comparison to the reference distribution. For analytical purposes, households belonging to lowest two wealth quintiles are classified as poor households and a comparative view (fig. 1e and 1f) of the distribution against the reference population (the normal density curve) indicates that the distribution of the poor children lies further to the left of the reference distribution. Even for the non-poor children the distribution of the z-scores is also observed to be shifted towards the left side from the reference distribution.

[INSERT FIGURE 1 ABOUT HERE]

If we disaggregate the overall underweight outcomes by sex very little evidence of gender disparities is observed. By and large, this holds true even if the disaggregation is performed on the basis of wealth quintiles (see Fig. 2). However, the female group is observed to be at small disadvantages if they belong to households in the middle of the wealth distribution. Perhaps, this is not providing a strong support to the hypothesis of intra-household bias at the all-India level but inferences may vary if viewed from a regional perspective or along any other socioeconomic dimension.

[INSERT FIGURE 2 ABOUT HERE]

The inequalities in child weight-for-age outcomes are measured using (the negative of) z-scores as it conveys more information when a distributional construct of concentration index is applied (see Table 2). The children are ranked in terms of the factor score provided to construct the wealth index. As mentioned earlier, here v=2 provides us the value of standard concentration index and for India it is computed to be -0.115 suggesting its significant concentration among the poorer sections of the society. Further, if more weightage is provided to the prevalence of malnutrition among the poorer sections, the concentration index values shows a systematic increase in favour of the better off individuals. The C values for all-India is observed to be more sensitive when v is increased from 2 to 3 and it results in an increment of -0.045 in the C value. If the top half of the population is not weighed (near zero weight; v=6, 8) than the concentration index for undernutrition is computed to be well above -0.20. As v increases the overall achievement index also shows increases because it captures both the mean z-scores as well as the inequality levels in the country. From a policy perspective it unravels the depth of the problem and perhaps in this case reflects more disappointments.

[INSERT TABLE 2 ABOUT HERE]

In order to describe the variations in the mean underweight outcomes conditional upon certain key socioeconomic factors, including maternal correlates, a general anthropometric regression framework is used. Here, the negative of the z-score (multiplied by 100) is taken as the dependent variable therefore while interpreting the results a positive coefficient here indicates a negative correlation with weight-for-age. To give a quick overview of the results (see Table 3), it is observed that the child's age has a concave relationship with underweight outcomes. Sex of the child, possesses a negative sign implying that males are in an advantageous position in terms of underweight outcomes, however the effect turns out to be statistically insignificant. Child's birth size as well as birth order number also has significant effect on the nutritional status. Immunization status of the child as well as recent ailment history (for instance, diarrhea) also shows a significant effect. Maternal correlates emerge to be important in this context, especially if mother's age at child's birth was above 18 and if she doesn't have a poor nutritional status (low BMI). The results also indicate that underweight outcomes are lesser among educated mothers. As evident from the bivariate analysis presented earlier, here also we observe that children coming from better-off households have better nutritional status. Satisfactory sanitary and drinking water facilities also have significant effect in lowering underweight outcomes. There is lack of significant support for the hypothesis of a positive impact of female headed households on child's nutritional performance. The underweight outcomes are also significantly higher among the scheduled castes and scheduled tribes in comparison to other caste categories.

[INSERT TABLE 3 ABOUT HERE]

The OLS provided sensible results but it does not purge the cluster effect of the NFHS sample. To elucidate this consider the fixed effects model reported in the same Table. The standard errors of the fixed effects model, in general, are lower than the standard errors observed in the OLS estimation. For each of the regressions standard errors are robust to general heteroscedasticity. Irrespective of the choice of the models, the intuitions behind the results remain unaffected mainly because of the strength of the variable itself. However, as we move towards the fixed effects model we find that the sensitivity of the cluster specific variables changes. For instance, the point estimates for individual specific variable such as child's age or size at birth does not change much but for household variables such as economic conditions and sanitary facilities show a weakening of impact. Even for certain maternal level variables, such as mother's education, similar effect is observed as all these variables are expected to demonstrate low variability within a cluster. The effect of female headed households increases as we control for the cluster effects suggesting a higher within cluster variation. A similar strengthening of relationship is observed in the case of the variable of child's birth order number. The superiority of the fixed effects estimator is also validated by the Hausman test which rejects the null of zero correlation between the cluster effects and the regressors.

[INSERT TABLE 4 ABOUT HERE]

To complement the analysis performed on individual z-scores, we employ three different binary response models to examine the correlates of underweight outcomes among children. The estimates of the parameters of the regression are presented in Table 4. The standard errors reported here are robust to general heteroscedasticity. All the parameters are consistent in terms of the observed level of significance. Unlike the OLS results (with weight-for-age z-scores as dependent variables) presented earlier, sex of the child turns out to significant in determining the underweight outcomes when the dependent variable is dichotomous. However, the effect turns out to be marginal. The partial effects obtained from the logit and probit models are very close and are larger than the LPM coefficients. The results indicate that if the child's size at birth is average and above, the probability of being underweight decreases by 11 per cent. In case of any recent experience of ailments such as diarrhea the probability of child's underweight outcome is increased by over 4 per cent. Mother's age, her educational qualification as well as her nutritional status also has important contributions and favourable conditions it can help reduce the probability of underweight by 0.05 to 0.12. The probability of child being underweight in female headed households is marginally lower. In terms of household's economic conditions, a child belonging to upper 60 percent of the population is likely to be 9 percent lower than the child belonging to the bottom 40 percent of the wealth distribution. Safe sanitary facilities also indicate that child could have underweight outcomes lower by 5 per cent. Safe drinking water also has a significant impact however; the probability of improvements in nutritional performance is very small. Caste of the households emerges to be an important variable and underweight outcomes among the general caste categories may be lower by 0.05.

5. Underweight outcomes: Decomposition Analysis

The analysis so far indicates that maternal correlates emerge to be an important feature to explain the observed inequalities in nutritional outcomes as well as for its prevalence among the non-poor households. To be specific about its contribution to malnourishment this section provides significant insights from the decomposition analysis. Table 5 reports the results of decomposition of the concentration index. The last column suggests the percentage contribution of each of the variables. From this column it could be inferred that bulk of the inequality in undernutrition was arising because of inequalities in household's economic conditions (including sanitary facilities), inequalities in mother's educational as well as nutritional status and inequalities in the fixed effects. However, given this regression framework around 18 percent of contribution towards inequality remains unexplained. The fixed effects contribution indicates that the malnourished children were staying together in clusters which have characteristics or tendencies for fostering lower weight-for-age outcomes. Variables like sex of the child, size at birth, birth order, any recent experience of diarrhea and immunization status were contributing marginally to the observed inequalities. The role of child's age towards inequalities is totally negated out by the contribution by the square of child's age. Inequalities in caste seems to contribute around -0.006 (5 per cent) to a total of -0.094 of explained C. The concentration of variables such as sanitation, wealth, mother's education and her nutritional status among the richer households are to a great extent responsible to the weight-for-age C values. The elasticities of the z-scores with respect to variables such as caste, wealth status and mother's BMI also contribute towards the observed inequalities.

[INSERT TABLE 5 ABOUT HERE]

In this last analysis performed here we aim to explain the difference between the poor and the non-poor in child malnutrition, measured anthropometrically through height-for-age z-scores. As discussed in the methodology section, the result from the Oaxaca decomposition helps to explain the mean differences in the malnourishment levels among the poor and the non-poor children. The gap is decomposed into a part that is due to group differences in the magnitudes of the determinants of the outcome in question, on the one hand, and group differences in the effects of these determinants, on the other. The parameters in the obtained regression coefficient vector have been tested to conclude that they differ systematically from zero. Coming to the results, without much surprise, it is observed that poor tend to have a lower weight-for-age z-score (-2.093) than the non-poor group (-1.508). Now we focus on central task of explaining the mean difference of 0.585 between the poor and the non-poor group. The results indicate that around 0.281 of these differences arise due to differences in the endowments, another 0.172 due to differences in the coefficients and the remaining 0.133 due to their interaction. It is important to note that gap in endowments accounts for only half of the gap in outcomes. As a policymaker it provides good scope to bridge the gap by utilizing the coefficient and interaction effects.

Further, when we provided different weightages to the poor and the non-poor group coefficients, the explained component varied within the range of 29 to 52 percent for D=1 to D=0, i.e., equation (16) and (17) respectively. In case of Cotton's and Reimer's weighting scheme, i.e., with D=0.5 and D=0.528 respectively, the explained component is observed to be 41 and 40 per cent respectively. This suggests that differences, both in part of effects (or the unexplained component) and endowments (or the explained component) are imperative while demonstrating differences in overall malnourishment prevalence among poor and the non-poor groups.

[INSERT TABLE 6 ABOUT HERE]

Table 6 allows the user to see how far gaps in individual endowments, reflected through the identified variables, contribute to the overall explained gap. We find that except for gaps in the age of the child, all other gaps in the identified variables disfavour the poor group. Among these, prominent are the gaps in mother's education, her BMI and child's birth order number as it reflects a better endowment effect among the non-poor group. In case of other identified variables while gaps are noted to be disfavouring the poor but are relatively smaller to the above mentioned variables. The coefficient effect for birth order number, age of the child and safe drinking water are in favour of the poor group but for other important variables the coefficient effect notably higher for the non-poor group and overshadows the impact of the former variables. Significant interaction effect is observed for maternal correlates which only produce over 20 per cent of the differences between the poor and the non-poor group. For the unexplained component, the coefficient effect was observed to be higher for the variable of child's size at birth. The maternal variables of education, her nutritional status also have significant coefficient effect. The interaction effect was observed to be higher for the variables of child's birth order, mother's education and sanitary facilities in the household.

6. Discussion and conclusion

This paper applies different methods to examine malnourishment among Indian children and to comprehend the sources of income-related inequalities. We find that the alarming proportions of undernutrition and its heavy concentration among the poor irrefutably consign India as one of the unconvincing performers in the nutritional scenario across the region. Coming to the causes of inequalities, it is important to observe that maternal correlates are explaining over 20 percent of the causes of health inequality. It provides a strong direction for policy action. Health action on these lines along with the ongoing efforts on coverage of full immunization and normative regulations of fewer births can help to reduce the underweight inequalities by another 10 percent. Perhaps, there is also ample scope for policies in the form of community-based intervention, especially in pockets with heavy concentration of scheduled caste and tribes. Significant cluster level effect was also observed which contributed significantly (around 19 per cent) to the total inequality. This indicates that there is a scope to identify such clusters and greater efforts in the form of community development schemes or from area development programmes to reduce these inequalities.

To eradicate the risk of undernutrition, it is warranted that interventions are made towards provisioning of basic services such as food supplementation, complete basic immunization and better health care for children and their mother. However, the unacceptably higher malnourishment levels of India raise several concerns regarding the policies pertaining to child health interventions in India. In India nutritional intervention is primarily covered through the Integrated Child Development Scheme (ICDS), which provides eight types of services to its beneficiaries - children and mothers. These are supplementary feeding, immunisation, health checkups, referral, and nutrition and health education for mothers, micronutrient supplementation, and introduction to formal education to child aged between three to six years. But the haphazard implementation and performance of ICDS has not offered much to celebrate (Das Gupta, 2005). Given the current state-of-affairs, the government – both Central and State – should work towards enhancing the effectiveness of the existing schemes or should engineer new mechanisms to resolve the problem. For instance, the State of Tamil Nadu has designed the Tamil Nadu Integrated Nutrition Project (TNIP) which targets the children below two years of age wherein, if they are found to be underweight for ninety consecutive days they are directly provided with food supplementation. Besides, the programme also provides health care to children in terms of treatment of diarrhoea, deforming, immunisation as well as regular check-ups for child and mother. These services are extended to pregnant and lactating women as well.

We now turn to the larger question, namely the one relating to the type of social policies that could be pursued by the State to reduce health inequalities. It is important to stress upon the efforts to recognize the differential constraints in accessing medical care across regions for maternal and child health care. For instance, for some, availability may be an issue while for others it may not actually be the major worry. Similarly, availability alone may not be sufficient; it may have to be supported by a policy of greater subsidization of health facilities through special schemes of food supplementation, nutritional monitoring and regular health check ups for mothers as well as the children. As evident from the significant findings on the role of mother's education in promoting health of the child, problems of poor levels of awareness for some mothers needs to addressed effectively. Given such possibilities and the fact that the poor sections have different types of needs it becomes essential for the social planner to acquire fuller information with regards to the sources of inequality and identification of the vulnerable groups. To conclude, the State should acknowledge the fact that social sector expenditures, particularly on health and education, are complementary in nature and if put together do produce greater individual as well as social benefits.

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Table 1: Percentage of children (under age five years) classified as malnourished according to three anthropometric indices of nutritional status, by background characteristics, India, 2005-06

	Height-for-Age			Weight-for-Height			Weight-for-Age		
	Mean z-score	*S**	*S***	*Mean z-score*	*W**	*W***	*Mean z-score*	*U**	*U***
Age in months									
<6	-0.6	20.4	8.4	-1.2	30.3	13.1	-1.4	29.5	10.9
18-23	-2.2	57.8	30.4	-1.1	22.2	7.6	-1.9	45.9	19.5
48-59	-2	50.3	23.9	-1	15.7	4.1	-1.9	44.8	15.3
Sex									
Female	-1.9	48	23.4	-1	19.1	6.1	-1.8	43.1	16.4
Male	-1.9	48.1	23.9	-1	20.5	6.8	-1.8	41.9	15.3
Birth interval in months									
First birth	-1.6	41.1	18	-0.9	17.8	5.4	-1.6	36.1	12.1
<24	-2.2	55.6	30.4	-1	18.9	6.1	-2	47.6	19
24-47	-2	51.2	26	-1.1	21.8	7.3	-1.9	46.2	17.9
Birth order									
1	-1.6	41	17.9	-0.9	17.8	5.4	-1.6	36.1	12
2-3	-1.8	47.8	22.2	-1	19.6	6.3	-1.8	41.4	14.4
4-5	-2.1	54.3	30.4	-1.1	21.8	7.6	-2	49.9	21.2
6+	-2.3	61	37.2	-1.2	24.5	8.7	-2.2	56.6	26.3
Size at birth									
Very small	-2.1	53.4	28.2	-1.3	28.7	9.6	-2.1	54	23.6
Small	-2	53.9	27.3	-1.2	25.8	8.2	-2	51.5	20.5
Average or larger	-1.8	46.5	22.7	-1	18.2	5.9	-1.7	40.1	14.5
Mother's nutritional status									
Underweight	-2.1	53.5	27.3	-1.3	25.2	7.9	-2.1	52	20.9
Normal	-1.8	46.3	22.5	-0.9	17.4	5.9	-1.7	38.7	13.6
Overweight	-1.3	31.2	12	-0.5	9.3	2.7	-1.1	20.1	4.6
Mother's education									
No education	-2.2	57.2	31.6	-1.2	22.7	8	-2.1	52	22.1
<5 years complete	-1.9	50.4	24.1	-1.1	20.8	6.2	-1.9	45.8	15.6
8-9 years complete	-1.6	40.7	15.6	-0.9	17.5	5.2	-1.6	34.9	9.4
12 or more years	-1	21.9	7	-0.6	12.8	4	-1	17.9	4.5
Residence									
Urban	-1.6	39.6	17.6	-0.8	16.9	5.7	-1.5	32.7	10.8
Rural	-2	50.7	25.6	-1.1	20.7	6.7	-1.9	45.6	17.5
Caste/tribe									
Scheduled caste	-2.1	53.9	27.6	-1.1	21	6.6	-1.9	47.9	18.5
Scheduled tribe	-2.1	53.9	29.1	-1.3	27.6	9.3	-2.1	54.5	24.9
OBC	-1.9	48.8	24.5	-1	20	6.6	-1.8	43.2	15.7
Other	-1.6	40.7	17.8	-0.8	16.3	5.2	-1.5	33.7	11.1
Wealth index									
Lowest	-2.3	59.9	34.2	-1.2	25	8.7	-2.2	56.6	24.9
Second	-2.1	54.3	27.9	-1.1	22	6.7	-2	49.2	19.4
Middle	-1.9	48.9	23.1	-1	18.8	6.2	-1.8	41.4	14.1
Fourth	-1.6	40.8	16.5	-0.9	16.6	5	-1.5	33.6	9.5
Highest	-1.1	25.3	8.2	-0.7	12.7	4.2	-1.1	19.7	4.9
Total	**-1.9**	**48**	**23.7**	**-1**	**19.8**	**6.4**	**-1.8**	**42.5**	**15.8**

Source: NFHS 3, IIPS and ORC Macro (2007)

Table 2 Inequality results for extended concentration index with weighting scheme in weight-for-age z-score among children, India 2005-06

v	Mean z-score	CI(v) values	I(v) values
1	-1.8	0.000	-1.780
2	-1.8	-0.115	-2.007
3	-1.8	-0.160	-2.088
4	-1.8	-0.184	-2.131
6	-1.8	-0.209	-2.176
8	-1.8	-0.220	-2.196

Source: computed by authors using NFHS 3 data
Note: Mean z-score is computed for negative of z-score

Table 3 Regression analysis of weight-for-age z-scores (*–100), India 2005-06

N=41055	OLS		Fixed effects	
Explanatory Variables	Coeff.	Cluster Adj. SE	Coeff.	SE
Constant	209.91***	3.7879	194.08***	3.6922
Child's age (months)	3.159***	0.1519	3.374***	0.1491
Child's age squared	-3.527***	0.2320	-3.937***	0.2306
Child is male	-1.101	1.1528	-1.291	1.1427
Size at birth (average and above)	-33.040***	1.5809	-33.953***	1.5315
Birth order	4.406	0.4239	3.365***	0.3920
Diarrhea (recently)	13.661***	2.0769	11.514***	2.037
Full immunization	-7.522***	1.4437	-7.768***	1.3980
Mother's age (at child birth above 18 years)	-15.731***	2.3451	-12.143***	2.2481
Mother's BMI (not low)	-40.342***	1.3905	-29.766***	1.3034
Education of mother (primary & above)	-24.830***	1.6738	-15.522***	1.5611
Female headed household	-3.445	2.1132	-5.505***	1.9758
Child is non-poor	-24.170***	1.8388	-16.877***	1.8049
Safe sanitation	-17.174***	1.7979	-12.436***	1.8160
Safe drinking water	-4.687***	1.6946	0 .6722***	1.9205
Caste if general	-4.582***	1.6861	-14.376***	1.6680
R^2 = 0.144; Hausman = 311.32 (0.000)				

Note: Dependent variable is negative of z-score, multiplied by 100. Regression also contains region dummies at the level of stratification. *** indicate 1% significance according to unadjusted standard errors.

Table 4 Estimates from binary response models of underweight, India 2005-06

N=41055	LPM (OLS)	Logit (MLE)		Probit (MLE)	
Explanatory Variables	Coefficients	Coefficients	Partial effect	Coefficients	Partial effect
Constant	0.5692***	0.2813***	-	0.1761***	-
	(0.00377)	(0.01675)	-	(0.01026)	-
Child's age (months)	0.0095***	0.0433***	0.0105	0.0264***	0.0103
	(0.00017)	(0.00079)	(0.00019)	(0.00048)	(0.00018)
Child's age squared	-0.0113***	-0.0515***	-0.0125	-0.0314***	-0.0122
	(0.00027)	(0.00125)	(0.00031)	(0.00076)	(0.00029)
Child is male	-0.0076***	-0.0353***	-0.0086	-0.0210***	-0.0082
	(0.00140)	(0.00634)	(0.00154)	(0.00388)	(0.00151)
Size at birth (average and above)	-0.1074***	-0.4751***	-0.1171	-0.2918***	-0.1151
	(0.00179)	(0.00790)	(0.00196)	(0.00483)	(0.00191)
Birth order	0.0155***	0.0679***	0.0165	0.0417***	0.0163
	(0.00043)	(0.00192)	(0.00047)	(0.00117)	(0.00045)
Diarrhea (recently)	0.0434***	0.1960***	0.0481	0.1192***	0.0469
	(0.00242)	(0.01088)	(0.00270)	(0.00668)	(0.00264)
Full immunization	-0.0239***	-0.1016***	-0.0246	-0.0628***	-0.0244
	(0.00160)	(0.00719)	(0.00174)	(0.00441)	(0.00171)
Mother's age (at child birth)	-0.0418***	-0.1865***	-0.0458	-0.1159***	-0.0456
	(0.00251)	(0.01091)	(0.00270)	(0.00669)	(0.00265)
Mother's BMI (not low)	-0.1099***	-0.4822***	-0.1176	-0.2968***	-0.1162
	(0.00150)	(0.00654)	(0.00159)	(0.00401)	(0.00157)
Education of mother (primary & above)	-0.0764***	-0.3347***	-0.0812	-0.2066***	-0.0805
	(0.00174)	(0.00752)	(0.00182)	(0.00462)	(0.00179)
Female headed household	-0.0053**	-0.0239**	-0.0058	-0.0156**	-0.0061
	(0.00218)	(0.00985)	(0 .00239)	(0.00606)	(0.00236)
Child is non-poor	-0.0887***	-0.3759***	-0.0912	-0.2329***	-0.0908
	(0.00184)	(0.00795)	(0.00192)	(0.00489)	(0.00190)
Safe sanitation	-0.0469***	-0.2263***	-0.0544	-0.1388***	-0.0538
	(0.00188)	(0.00881)	(0.0021)	(0.00535)	(0.00205)
Safe drinking water	-0.0137***	-0.0646***	-0.0156	-0.0381***	-0.0148
	(0.00168)	(0.00771)	(0.00187)	(0.00471)	(0.00183)
Caste	-0.0499***	-0.2204***	-0.0538	-0.1350***	-0.0529
	(0.00160)	(0.00702)	(0.00173)	(0.00431)	(0.00169)
	R^2 = 0.093		Pseudo R^2 = 0.071		Pseudo R^2 = 0.071

Table 5: Decomposition of inequality in weight-for-age z-scores among children, India 2005-06

Variables	**Coeff.**	**Mean**	**Elast**	**CI**	**Contr**	**%**
Child's age (months)	0.033	30.068	0.564	-0.001	-0.001	0.49
Child's age squared	-0.041	11.949	-0.274	-0.002	0.001	-0.48
Child is male	-0.039	0.523	-0.011	0.008	0.000	0.08
Size at birth (average and above)	-0.331	0.797	-0.148	0.016	-0.002	2.06
Birth order	0.037	2.746	0.057	-0.122	-0.007	6.05
Diarrhea (recently)	0.118	0.093	0.006	-0.001	0.000	0.01
Full immunization	-0.072	0.384	-0.015	0.196	-0.003	2.56
Mother's age (at child birth)	-0.122	0.897	-0.061	0.016	-0.001	0.85
Mother's BMI (not low)	-0.278	0.612	-0.095	0.093	-0.009	7.68
Education of mother (primary & above)	-0.158	0.509	-0.045	0.295	-0.013	11.54
Female headed household	-0.021	0.113	-0.001	-0.040	0.000	-0.03
Child is non-poor	-0.156	0.528	-0.046	0.470	-0.022	18.80
Safe sanitation	-0.142	0.285	-0.023	0.573	-0.013	11.46
Safe drinking water	0.069	0.313	0.012	0.356	0.004	-3.71
Caste	-0.158	0.700	-0.062	0.098	-0.006	5.28
Constant (Mean Fixed effects)		2.037	1.144	-0.019	-0.022	18.90
Total Explained					*-0.094*	*81.53*
Residuals					*0.021*	*18.47*
C					**-0.115**	**100**

Table 6: Oaxaca Decomposition: Contributions to overall explained gap

Variables	E(D=0)	C	CE	D=1	D=0.5	D=0.528
Lnage	-0.002	-0.069	-0.000	-0.002	-0.002	-0.002
Child is male	0.000	0.011	0.000	0.001	0.001	0.001
Size at birth (average and above)	0.010	0.083	0.004	0.014	0.012	0.012
Birth order	0.040	-0.101	0.030	0.070	0.055	0.056
Diarrhea (recently)	-0.000	0.013	0.000	-0.000	-0.000	-0.000
Full immunization	0.017	0.009	0.008	0.024	0.021	0.021
Mother's age (at child birth)	0.005	0.033	0.002	0.007	0.006	0.006
Mother's BMI (not low)	0.046	0.063	0.021	0.066	0.056	0.057
Education of mother (primary & above)	0.076	0.026	0.042	0.118	0.097	0.098
Female headed household	0.002	0.024	-0.003	-0.001	0.000	0.000
Child is non-poor	0.000	0.000	0.000	0.000	0.000	0.000
Safe sanitation	0.038	0.003	0.044	0.082	0.060	0.061
Safe drinking water	0.023	-0.005	-0.011	0.012	0.017	0.017
Caste	0.026	-0.009	-0.003	0.023	0.025	0.025
Total	**0.281**	**0.172**	**0.133**	**0.413**	**0.347**	**0.351**

Figure 1

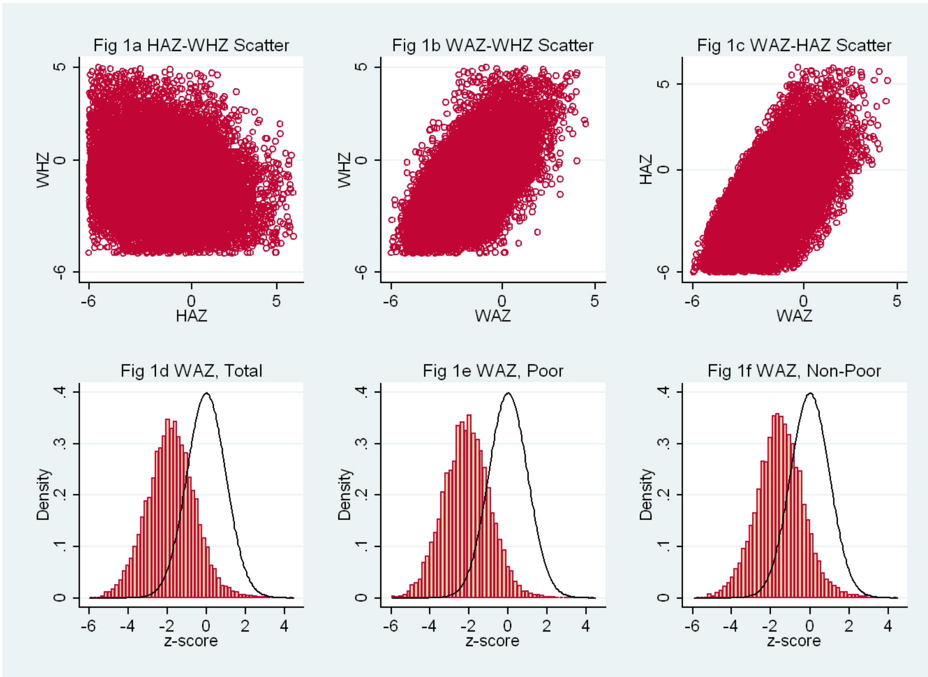
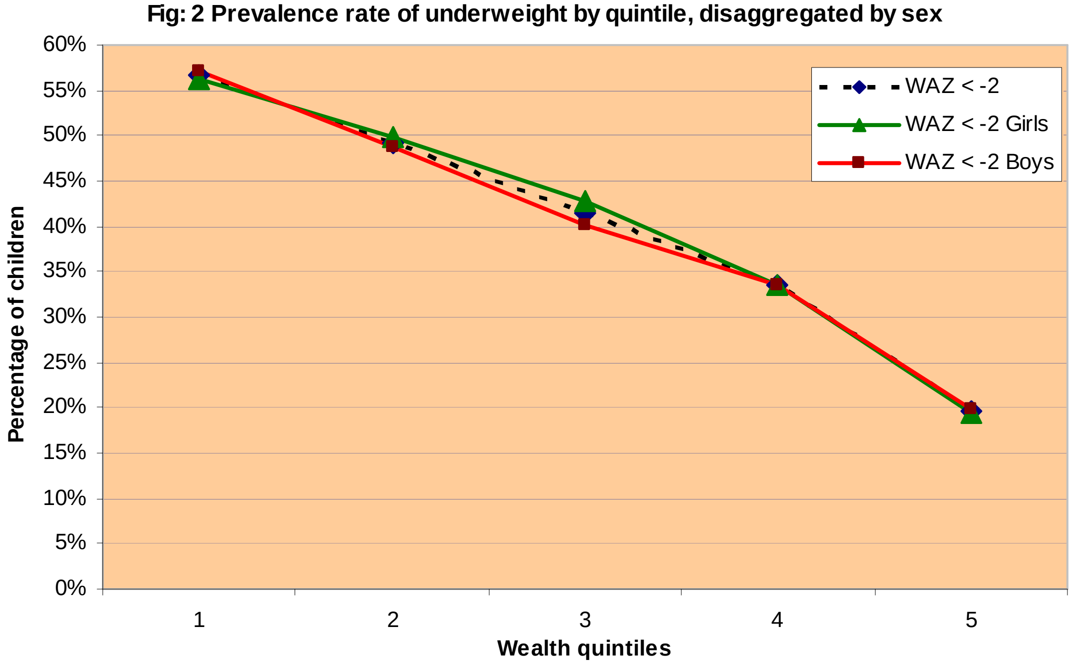
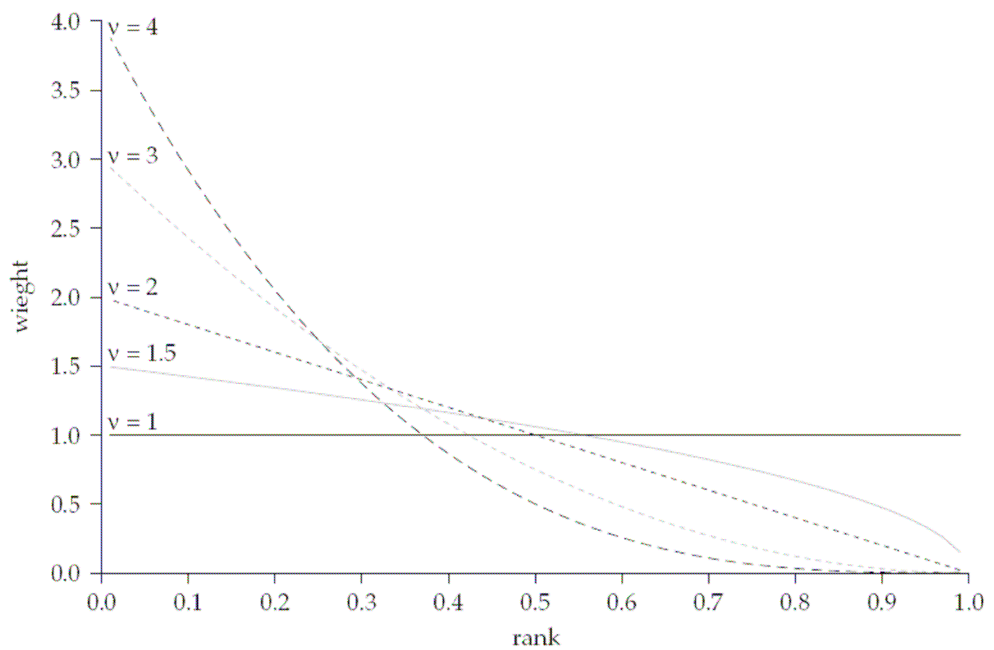


Fig: 2 Prevalence rate of underweight by quintile, disaggregated by sex

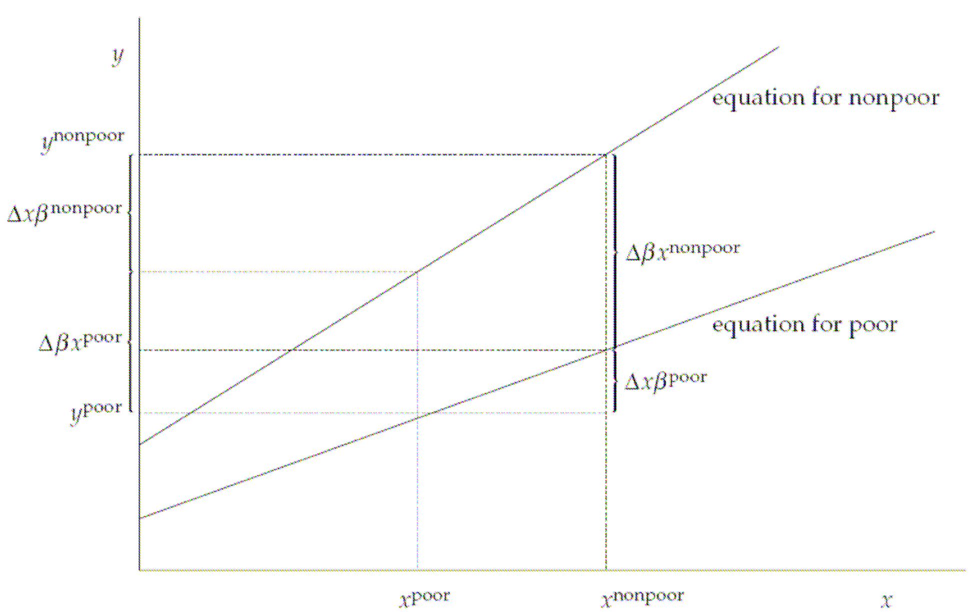


Appendix 1: Weighting scheme for extended concentration index



Source: Wagstaff (2002)

Appendix 2: Oaxaca decomposition



Source: O'Donnell et al, 2008

Endnotes

[1] The National Family Health Survey (NFHS-3, 2005-06), the third in the series of these national surveys, was preceded by NFHS-1 in 1992-93 and NFHS-2 in 1998-99. It was conducted under the supervision of the International Institute for Population Sciences (IIPS) and ORC MACRO. Approximately 124,000 ever-married women 15–49 years old were surveyed. For each state, a multi-stage, systematic, stratified sampling design was adopted, where the primary sampling units were selected systematically, with probability proportional to size. Households were then sampled using systematic sampling with equal probability, and all eligible women in each household were interviewed. National and state level sampling weights were created to reflect sampling design (IIPS, 2007). For NFHS-3, approximately 56,000 children under five years of age could be used for the analysis (approximately 42,000 in rural areas and 14000 in urban areas). The NFHS-3 wealth index used for much of the analysis on health inequality using concentration index, is based on 33 assets and housing characteristics on which information was obtained (for details see, NFHS 3 Report - India, IIPS 2007).

[2] GC_u is analogous to the Gini coefficient corresponding to the generalized Lorenz curve (Shorrocks, 1983).