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Curious Case of Child Nutrition
A Methodological Exposition

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Caste-Gender Intersectionalities and the Curious Case of Child Nutrition: A Methodological Exposition

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Abstract

A growing body of research has addressed the issue of intersectionality since the last three decades, mostly adopting qualitative methodologies. Quantitative attempts to capture intersectionality have been recent and few. We invoke the framework of intersectionality to shed light on the puzzle of an insignificant gender gap in child nutrition in India. Given the multifaceted intersections of caste and gender in shaping inequalities in other indicators such as childhood mortality, reported preference for sons and labour market outcomes, we examine the variations in nutritional status of children across the intersections of the two axes, sex and caste. This is a methodological paper, attempting to illustrate the various quantitative methods that have been used (with or without adhering to the term 'intersectionality') or may be used to capture intersectional inequalities. We elaborate three methods to study intersectionality, also discussing if and how they diverge substantively.

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1. Introduction

While the importance of identities associated with particular group affiliations is irrefutable with regard to well-being outcomes, the complex interactions of multiple identities have also attracted scholarly attention, particularly within the realm of feminist studies (Davis, 2008). Different axes of social power, such as gender, economic class, ethnicity and caste are often simultaneously operative, with significant interactions among each other. Crenshaw (1989) has coined the term 'intersectionality' to capture the multifaceted discriminations (associated with gender and race) faced by Black women to defy to the 'single-axis framework' that implicitly assumed all women to be White and all Blacks to be men. Bowleg (2008) has cited the tactless use of phrases such as 'women and minorities' (as distinct groups) in important policy documents following from a gross misunderstanding of how gender roles interact with other identities such as racial affiliations. It would not be extraneous to highlight the striking similarity of the title of the 'Working Group Report of the Development of Education of SC/ST/ Minorities/Girls and Other Disadvantaged Groups for 11th Five Year Plan (2007-2012)', released by the Planning Commission of India (Government of India, 2006). A growing body of research has addressed the issue of intersectionality (Weber and Parra-Medina, 2003), mostly adopting qualitative methodologies. Quantitative attempts to capture intersectionality have been recent and few (Iyer et al., 2007; Sen et al., 2007, 2009; Sen & Iyer, 2012; Mukhopadhyay, 2015; Mukhopadhyay, 2016). While qualitative methods help us understand the complex processes of simultaneous operations of multiple identities, quantitative techniques would enable us to make spatial and temporal comparisons of the magnitude of intersectional inequality. Sen et al. (2009) have used a simple and powerful method for quantitative analysis of the interactions of different axes of social power. Using this method, recent literature has asked important questions to analyse multi-dimensional inequalities in healthcare-seeking behaviour of individuals (Iyer et al., 2007; Sen et al., 2007; Sen et al., 2009; Sen and Iyer, 2011) and nutritional status of children (Mukhopadhyay, 2015, 2016). Studies have revealed that while outcomes differ starkly between groups at the extremes, stratifications along

multiple axes of social power often yield more interesting results, with groups in the middle of the social spectrum leveraging benefits from certain advantageous identities (Sen and Iyer, 2012; Mukhopadhyay, 2016). For instance, a poor upper caste woman or a poor backward caste man might be having better outcomes vis-à-vis a poor backward caste woman. This is essentially a methodological paper, attempting to discuss the various quantitative methods that have been used (with or without adhering to the term 'intersectionality') or may be used to capture intersectional inequalities. In what follows, we elaborate three methods to study intersectionality, also discussing if and how they diverge substantively.

We examine how the axes of caste and class interact in shaping nutritional status of children in India. While gender inequality in India is blatantly observable in indicators such as childhood mortality, reported preference for sons and labour market outcomes (Arokiasamy and Pradhan, 2006), childhood nutritional status is an indicator in which gender disparity is moot. A systematic review of 306 child nutrition surveys, all from developing countries (including India), concluded that girls do not face any relative disadvantage in anthropometric scores. In fact, in some of these countries that are otherwise infamous for gender discrimination, girls have significantly better nutritional outcomes as compared to boys (Marcoux, 2002). Scholars have long noted the absence of a significant gender gap in child nutrition in developing countries (Schoenbaum et al., 1995; Haddad et al., 1996; Sommerfelt and Piani, 1997; Sommerfelt and Arnold, 1998; Mishra et al. 1999). While some studies have derided the attempts of demographers and economists to overlay the fixated notion of gender-based discrimination on child nutrition (Basu, 1989), others have looked upon the absence of a gender gap in child nutrition as a puzzle, given the evidence of high son preference and higher mortality of girls in many of these countries (Mishra et al., 2004; Mukhopadhyay, 2016). Tarozzi & Mahajan (2007) point out that nutritional status of children, as indicated by anthropometric outcomes, are 'affected by all of the pathways through which gender bias operates'. Anthropometric data are also free from the problems of intentional misreporting and ex-post rationalization, which are major concerns in case of commonly used indicators of sex inequality based on ideal numbers of sons and daughters, as

reported by parents (Lin & Adsera, 2012; Mukhopadhyay, 2015).

Gender inequality in India has been well-documented. Sex-ratio witnessed a steady decline from 972 in 1901 to 933 females per thousand males in 2001, improving to 940 only in 2011. However, the 2011 census noted a child sex ratio of 914, the lowest since independence. Much ink has been spilt over the skewness in sex ratio against girls (Miller, 1981; Bhat, 1989; Das Gupta and Bhat, 1997; Desai, 1994; John, 2014). The colonial archive documented evidences of female infanticide and the Female Infanticide Act was passed in 1870 (John, 2014). Four decades after the act was passed, the Census Commissioner of India wrote in 1911 that 'female infanticide was resorted to', so that the 'troubles' stemming from the social norm of 'hypergamy' ('the rule that a girl must be given in marriage to a man of higher rank') could be avoided (cited in Raju and Premi, 1998; John, 2014). Miller (1981) detailed the processes of daughter neglect, often culminating in infanticide. Scholars have noted that son preference follows from a multitude of reasons, economic, social and religious (Dyson and Moore, 1983; Basu, 1989, Chen et al, 1981; Das Gupta, 1987; Arnold et al, 2002; Kishore, 1993). The issue of India's 'missing women' (a term coined by Sen (1990)) gained unprecedented attention after the census of 2001 revealed a 'new and disturbing trend' (John, 2014). Child sex ratio was falling (even below 800 in some parts of the country) in the face of an improving overall sex ratio.

Scholars have shown that historically women from certain social groups in India have been in a disadvantaged situation within the household. Miller (1981) has painstakingly described how daughters in upper caste and propertied households in north India were deprived in terms of allocation of food, healthcare and affection, compared to boys. This discrimination often had a direct and irreversible impact on their well-being and survival. Numerous later studies have corroborated the evidence of gender disparity among higher castes in India, particularly in the Northern states (Das Gupta, 1987; Anderson, 2003; Tarozzi & Mahajan, 2007). Societal norms such as patrilineal descent, patrilocal residence and high costs of marrying a daughter render women from upper castes unimportant in family and society (Chakraborty & Kim, 2010). High castes report a higher preference for sons and even families from

lower castes that have better economic status imitate the upper caste practice of a skewed son preference (Lin and Adsera, 2013; Agnihotri, 2000). Lin and Adsera (2013) find a significant association between reported son preference and burden of housework borne by daughters in high caste households, though children in high caste households do less housework than those from other caste households.

Given the large volume of literature on caste-gender interactions shaping different outcomes such as child mortality, it is somewhat surprising that the conundrum of an absent sex-gap in child nutrition has been little explored in terms of such intersectionalities (Mukhopadhyay, 2015; Mukhopadhyay, 2016). This paper attempts to invoke the framework of intersectionality to shed light on the puzzle of an insignificant gender gap in nutrition. Given the multifaceted intersections of caste and gender in shaping inequalities in other indicators (particularly mortality), we investigate the variations in nutritional status of children across the intersections of the two axes, sex and caste. The last two decades witnessed the growth of scholarly interest in complex interactions of multiple identities, particularly within the realm of feminist studies (Collins, 1991; Glenn, 1999; Whittle & Inhorn, 2001; Östlin, 2002; Davis, 2008). The limitations of the single axis framework in bringing out the complex interactions of various identities have been pointed out since the last three decades (Crenshaw, 1989). However, the methodology adopted by these studies has been predominantly qualitative and quantitative attempts to capture intersectionality have been recent and few (Iyer et al., 2007; Sen et al., 2007, 2009; Sen & Iyer, 2012; Mukhopadhyay, 2015; Mukhopadhyay, 2016).

The first method follows the regression approach. This method has been pioneered in the last decade as a simple and elegant tool to capture intersectionality quantitatively (Iyer et al., 2007; Sen et al., 2007, 2009; Sen & Iyer, 2012; Mukhopadhyay, 2015; Mukhopadhyay, 2016). The method requires creation of a set of dummy variables for each intersecting category. With two dimensions, for example, sex and caste (taken as a dichotomous variable, with two castes, reserved caste and other), there would be four categories in the heuristic matrix: d1 = reserved caste boy; d2 = reserved caste girl, d3 = other caste boy and d4 = other caste girl.

Treating d1 (reserved caste boy) as the reference category, each of the dummies (d2, d3 and d4) can be treated as a separate variable and assigned a unique identity. For example, d2 = 1 if reserved caste and girl, and 0 otherwise; d3 = 1 if other caste and boy, and 0 otherwise; d4 = 1 if other caste and girl, and 0 otherwise. The differences between the dummies can be then tested using multivariate logit regression, where nutritional status (undernourished or not) is regressed on a list of covariates and these intersectional dummies.

The second method undertakes a 'decomposition of pure inequality'. It seeks to measure the share of intersectional inequality in pure, total or interpersonal inequality. For this, we decompose inequality in nutritional status of Indian children along the axes of caste and sex. Inequality is measured by the most commonly decomposable measures of the General Entropy Class. We first use the traditional method of inequality decomposition and find out how the 'between-group' component differs when we consider different groupings, namely caste, sex, and caste-sex intersections. However, since the traditional method of inequality decomposition is sensitive to the relative sizes and the number of groups under question, the decompositions are not comparable across alternative groupings (Elbers et al., 2008). Since the 'between-group' component is bound to increase when we consider intersections (automatically increasing the number of stratifications), we use a corrected method of inequality decomposition and examine if the share of 'between intersectional groups' component actually increases when we consider sex-caste intersectional categories.

The third and final method undertakes a 'decomposition of health inequality into contributing factors'. This method draws from the literature on health inequalities and decomposes the most commonly used measure of socioeconomic health inequality, i.e. the concentration index, into contributing factors. We measure wealth-related inequality in undernutrition (by the concentration index) and find out how much of it can be explained by sex and caste. The concentration index has the attractive property of decomposability and can be expressed as a weighted average of the concentration indices of the regressors (including caste group

affiliation of the child's household, on which nutritional z-score is regressed, as in the first method discussed above). The weight for each regressor is the elasticity of nutritional status with respect to that regressor (Wagstaff et al., 2003; O'Donnell et al., 2008). Thus, the contribution of each regressor in the health concentration index can be measured as the product of the individual concentration index and the elasticity. We argue that this is a unique way to capture intersectionalities along sex and caste that interact with household economic status and shape nutritional inequalities among children.

Section 2 discusses the data used for the study and elaborates on the three methods of capturing intersectional inequality. In Section 3, we present and discuss the results. The fourth and final section concludes, summarizing and pointing out the limitations of the paper.

2.Data and Methods

Following the Waterlow classification scheme, there are three measures of undernutrition, namely stunting or low height-for-age, underweight or low weight-for-age and wasting or low weight-for-height (Waterlow et al. 1977). The anthropometric indicators are usually expressed in standard deviation units (z-scores) from the median of the reference population. If the z-score is below minus two standard deviations (-2 SD) from the median of the reference population, the child is considered to be undernourished in that dimension. Children below minus three standard deviations (-3 SD) from the median of the reference population are considered to be severely undernourished. Stunting is a cumulative or long-term indicator of nutritional deprivation from conception. It is relatively independent of current conditions, and is an indicator of permanent or chronic undernutrition. Wasting, by contrast, measures body mass in relation to body length and describes current nutritional status; it is usually taken to be an indicator of short-term or temporary undernutrition. Underweight is a comprehensive measure, capturing both long-term and short-term dimensions. The second and the third method discussed in this paper are illustrated with the continuous indicator of height-for-age scores and the first method uses the binary indicator of stunted or not so.

2.1 Data

We use data on 46,655 children below five years from the third round of the Indian NFHS, conducted in 2005-06. The NFHS is a nationwide survey conducted with a representative sample of households throughout the country. Until now, four such surveys have been conducted: NFHS-1 (1992–93), NFHS-2 (1998–99), NFHS-3 (2005–06) and NFHS-4 (2015–16). These surveys, organized by the Ministry of Health and Family Welfare of the Government of India, aim to develop a demographic and health database for the country. The NFHS provides nation and state-level estimates of fertility, family planning, infant and child mortality, reproductive and child health, nutrition of women and children, the quality of health and family welfare services and socioeconomic conditions. Standardized questionnaires, sample designs and field procedures are used, following the general format of Demographic and Health Surveys (DHS Programme, 2015). The urban and rural samples within each state were drawn separately and the sample within each state was allocated proportionally to the size of the state's urban and rural populations. A uniform sample design was adopted in all states. In each state, the rural sample was selected in two stages, with the selection of Primary Sampling Units (PSUs), which are villages, with probability proportional to population size (PPS) at the first stage, followed by the random selection of households within each PSU in the second stage. In urban areas, a three-stage procedure was followed. In the first stage, wards were selected with PPS sampling. In the next stage, one census enumeration block (CEB) was randomly selected from each sample ward. In the final stage, households were randomly selected within each selected CEB. The third round of the NFHS collected information from a nationally representative sample of 109,041 households, 124,385 women aged 15–49, and 74,369 men aged 15–54 living in all the 29 states of India. NFHS-3 enumerated a total of 515,507 individuals who stayed in the sample households the night before the interview. Anthro-pometric data were collected for 46,655 children, below five years of age, who stayed in the household the night before the interview (IIPS & ORC Macro, 2007).

Majority of women and men are Hindu (81 and 82 percent, respectively) and a minority are Muslim (14 and 13 percent, respectively), followed by Christians, Sikhs, and Buddhists/Neo-

Buddhists. All other religions account for less than 1 percent of the female and male respondents. 19 percent of women and men belong to the scheduled castes, eight percent to the scheduled tribes, and 39 percent to the other backward class. 48% of children under five years of age are stunted and 43 percent are underweight. A substantial portion of children are severely undernourished, 24 percent according to height-for-age and 16 percent according to weight-for-age. One in five of children under five years of age is wasted.

2.2 Methods

In what follows we discuss the three methods that may be used to capture intersectionality. The nutritional indicators used are stunted or not so (as a binary) and continuous height for age percentage and z-scores respectively in the first, second and third methods.

2.2.1 The Regression Approach

As discussed in the first section, this method regresses the binary dependent variable (in our case, stunted or not so) on a set of covariates (elaborated in the next section) along with dummies for each intersectional category. Sen et al. (2009) and Mukhopadhyay (2016) point out the uniqueness of this approach in allowing statistical testing of three types of differences. First, the significance of each dummy can be tested relative to the reference group. Second, the difference between any pair of dummies, be it at the extreme or in the middle of the social spectrum, can be tested using chi-squared tests. For instance, the significance of difference in the outcomes between upper caste girls and backward caste boys (groups with non-extreme but different positionality with respect to sex and economic class) can be tested, something that is not permissible in the standard analysis. Third, it also allows the difference in the magnitudes of different social gaps to be tested in different social settings; for example, it empowers us to test if the sex gap among the upper caste is greater than that among the backward castes. It is the latter kind of enquiry that this paper pursues. The novelty of this approach lies in the fact that such differences can be tested without running numerous regressions with limited comparability. Moreover, the approach can be extended to study intersectionality, even with polytomous categorization of

groups (Sen et al., 2009).

This paper analyses sex disparity in stunting among children below five years of age in India. Logistic regression of the indicator of long-term nutritional status (stunted or not) is done on sex of the child, religion, caste and a list of covariates, drawing from the relevant literature, to see if there is evidence of sex disparity. Following the broad framework of Sen et al. (2009), the paper then studies if sex disparity in long-term health of a child (as reflected by stunting status) varies among religious groups. Religious groups are classified as Hindus (comprising more than 80% of the population) and 'other' (mainly Muslims, who comprise more than 13% of the total population). This is done to ask if a systematic difference in nutritional outcomes disfavouring girls is a typical feature of the caste-based Hindu society. The next level of inquiry studies the intersections among two dimensions of social power, namely sex and caste, in determining child nutrition in the caste-based Hindu society. Caste is classified into four groups, i.e. SC, ST, OBC (Other Backward Caste) and upper caste Hindus. The third level of inquiry addresses the simultaneous interaction of sex and caste. Treating SC girls as the reference group, logit regression of nutritional status is run on covariates, now including seven dummies for the sex-caste groups of children (detailed in Table 2). Statistical testing of differences between girls and boys in each caste group allows sex disparity to be examined in different social settings.

2.2.2 Decomposition of Pure Inequality:

Borrowing from the income inequality literature, we measure inequality in nutritional status by the measures of the General Entropy Class (Cowell and Jenkins, 1995), given by:

$$\begin{aligned} GE(c) &= 1/n c(c-1) \sum_i [(y_i / \mu)^c - 1] \text{ for } c \neq 0, 1 \\ &= 1/n \sum_i \log(\mu / y_i) \text{ for } c = 0 \\ &= 1/n \sum_i [(y_i / \mu) \log(y_i / \mu)] \text{ for } c = 1 \end{aligned}$$

where n is the total population, y_i is the outcome (in our case height-for-age percentage) of individual i , μ is the mean outcome and c is a parameter, chosen by the researcher.

As the value of c increases, the sensitivity to inequality among those in the upper end of the distribution increases. While Theil entropy measure is obtained from a c value of 1, a c value of 0 gives Theil L or mean log deviation. GE (2) is ordinally equivalent to the squared coefficient of variation (Elbers et al., 2008).

The General Entropy class of measures can be conveniently decomposed into a 'between group' and a 'within group' component (Cowell and Kuga, 1981; Shorrocks, 1984), as illustrated below:

$$\begin{aligned}
 GE &= 1/c(c-1) [\sum_j g_j (\mu_j / \mu)^c - 1] + \sum_j GE_j g_j (\mu_j / \mu)^c \text{ for } c \neq 0, 1 \\
 &= [\sum_j g_j \log(\mu / \mu_j)] + \sum_j GE_j g_j \text{ for } c = 0 \\
 &= [\sum_j g_j (\mu_j / \mu) \log(\mu_j / \mu)] + \sum_j GE_j g_j (\mu_j / \mu) \text{ for } c = 1
 \end{aligned}$$

where j is the population sub-group, g_j is the population share of the j^{th} subgroup and GE_j is the inequality within the j^{th} subgroup.

While the first term depicts the 'between-group' component of total inequality, the second term denotes inequality within the subgroups. The 'between group' component gives the level of inequality pertaining to a distribution where everyone within each subgroup has the same outcome μ_j (Elbers et al., 2008). The between-group component can be summarized as follows.

$$R_B (\Pi) = I_B (\Pi)/I,$$

for any population partition Π , where $I_B (\Pi)$ is the 'between-group' component and I is total inequality.

However, since the traditional method of decomposition of total inequality into 'between-group' and 'within-group' components is sensitive to the number and relative sizes of the groups under examination, the decompositions are not comparable across different groupings. Also, the contribution of the 'between-group' component automatically increases when we consider a large number of intersectional groups across the social spectrum. To overcome this problem, Chakraborty and Mukhopadhyay (2017) (who in a similar exercise, decompose nutritional inequality among children into inter-class, inter-caste and inter caste-class intersectional contributions) follow Elbers et al. (2008), who argue

that total inequality is an extreme benchmark to find out the contribution of the ‘between-group’ component and propose to evaluate the ‘between-group’ component against a benchmark of maximum possible ‘between-group’ inequality, keeping the number and relative sizes of groups for the same partition unchanged. The benchmark is in fact a ‘counterfactual between-group inequality constructed from the same data, using the same number of groups and relative sizes, but where households in the income distribution are reassigned to the population groups in such a manner so as to maximize between-group inequality’ (Elbers et al., 2008). The index proposed by Elbers et al. (2008) is given by

$$R_B^{\wedge}(\Pi) = I_B(\Pi) / \{\text{Max}\{I_B|\Pi(j(n), J)\}\} = R_B(\Pi) / \text{Max}\{I_B|\Pi(j(n), J)\}$$

where the denominator gives ‘the maximum between-group inequality that could be obtained by reassigning individuals across the J sub-groups in partition Π of size $j(n)$ ’.

Chakraborty and Mukhopadhyay (2017) illustrate the method with a hypothetical example. Suppose there are two racial groups in a society, with population shares 20% and 80% respectively. 50% of the first group and 30% of the second group are respectively undernourished. The counterfactual distribution would partition the population into two groups, the first comprising the bottom 20% of the nutritional distribution and the second comprising the rest. The ‘between group’ component of the decomposition exercise, applied to the counterfactual distribution is thus the ‘maximum possible’ ‘between group’ inequality. The corrected method takes this (as opposed to total interpersonal inequality) in the denominator and calculates the share of ‘between group’ inequality in the actual distribution. Elbers et al (2008) illustrate this point with reference to South Africa. They show that when inequality is decomposed by racial group defined in terms of a “white/non-white” classification, the conventional decomposition suggests that only about 27% of inequality is attributable to between-group differences. Their alternative statistic, on the other hand, shows that two groups are 80% of the way towards a completely partitioned South African income distribution. In this paper, we similarly construct counterfactual groups from the nutritional distribution corresponding to the groups formed along sex, caste and the intersectional categories. We reassign children constructing counterfactual distributions for

each partitioning (namely sex, caste and caste-sex intersections), keeping the number and relative sizes of subgroups the same, so that 'between-group' inequality is maximised.

In this paper, we show that compared to the traditional method of inequality decomposition, the corrected method is more meaningful even in the non-income space. We argue that though anthropometric indicators are cardinal in nature, the inequality decomposition exercise cannot be directly translated from the income space to the space of child nutrition. While the interpretation of inequality in the income space invokes the notions of relative deprivation, envy and 'lag of real accomplishments behind expectations' (Hirschman and Rothschild, 1973), inequality in health and nutrition can have a meaningful connotation only in terms of the associated physiological and functional hazards (Mukhopadhyay, 2011). Biomedical literature shows that physiological and functional risks increase multiplicatively as the nutritional shortfall increases further below the cut-off (Scrimshaw et al., 1968; Pelletier et al., 1994).

For the first method, we use nutritional status as a binary – stunted (if height for age z-score falls below the cut-off of -2) or not so. The anthropometric measure that we consider to illustrate the second method of capturing intersectionality is height-for-age percentage of median (henceforth hap), which is defined as the ratio of the measured height of a child to the median height of the reference population of children for the same sex and age (O'Donnell et al., 2008). The reason for using height for age scores as a measure of child nutrition is that it captures the long term nutritional status of a child, right from conception to date. The alternatives would be to use the weight for height or weight for age scores. While the former is an extremely volatile measure, the latter is a summary measure, mainly used by international agencies to make inter-temporal or cross country comparisons (Svedberg, 2002). Though the earlier studies on child nutrition typically used the hap scores (Barrera, 1990; Thomas et al., 1991), the standard practice now is to use the indicator of height for age z-score (defined as the difference between the height of a child and the median height of the reference population of the same sex and age, divided by the standard deviation of the reference population). It is considered to be superior

to the hap score, since the latter is not standardized for the dispersion in the reference population (O'Donnell et al., 2008). However, the z-scores are negative for a considerable part of the distribution while the General Entropy Class of inequality measures are applicable only to positive real values. Previous studies by Pradhan et al. (2003) and Omilola (2010) that have decomposed nutritional inequalities applying the General Entropy Class of inequality measures have transformed the anthropometric z-scores to positive numbers by arbitrarily adding a constant greater than the negative value of the smallest z-score to each z-score. However, this procedure is incorrect, given that the inequality measures of the General Entropy Class do not satisfy translation invariance. Moreover, Omilola (2010) admits that this procedure introduces 'a small bias to the results'. One can easily check how the value of the inequality measure changes, as the value of the arbitrary constant changes. To overcome this limitation we use the indicator of hap score that assumes positive real values throughout the distribution. For the third method, we use height for age z-score as the dependent variable for its obvious advantage over any other indicator.

2.2.3 Decomposition of Inequality into Contributing Factors

Nutritional status of children, measured in terms of continuous anthropometric scores (as opposed to the binary, undernourished or not so, as described in the previous section) may be regressed on a list of covariates including the child-specific factors such as sex and age, household economic status, maternal education and environmental factors such as drinking water and sanitation facilities. Economic literature on child nutrition (Thomas et al 1991; Currie 2000) synthesizes the biomedical health production function with Becker's model of household behaviour (Becker 1965). In these models, child health (produced in the household using health inputs and child care) is considered as one of the arguments in the household's utility function. Parents invest in children's human capital in order to get maximum returns from children at old age. Well-nourished offsprings also have an intrinsic value to parents (Mukhopadhyay, 2013). The 'unitary' or 'unified' preference model assumes absence of conflicting preferences of household members. Household utility is maximized subject to a budget constraint, each individual's time constraint and child health

production function (Behrman 1992/2000; Thomas et al 1991; Currie 2000). Solving the maximization exercise, one obtains the demand function for child nutrition (measured as height for age z-scores), that depends on the characteristics of the child, household level factors such as social group affiliation and economic status, parental characteristics and the environment. In this paper, we measure economic status as an asset index constructed from 31 indicator variables on asset possession and housing characteristics. We purposely exclude sanitation and drinking water from this index, since we consider them as environmental factors and analyse their effects separately. We also take a caste dummy (that equals 1 for children backward caste (SC/ST) households and 0 otherwise).³

The wealth-related concentration index, CI, on the other hand, may be computed using the convenient covariance formula. Wagstaff et al. (2003) show that the concentration index can be suitably decomposed as

$$CI = \sum(\beta_k x_k' / \mu) C_k + GC_\varepsilon / \mu$$

For any linear additive regression specification

$$haz = \alpha + \sum \beta_k x_k + \varepsilon$$

where haz is the height for age z-score multiplied by -1 (so that a higher haz indicates higher undernutrition), μ is mean haz, x_k' is mean x_k , C_k is the wealth-related concentration index of x_k , and GC_ε is the generalized concentration index for the error term ε (O'Donnell et al., 2008).

This decomposition exercise expresses CI as the weighted total of the individual C_k 's, the weight equalling the elasticity of haz with respect to x_k . The last term captures the residual, measuring wealth-related inequality in child undernutrition, which cannot be explained by wealth-related variations in the regressors. This part would reduce with improvements in model specification.

³. It would be better if we would have more categories based on caste group affiliations. However, we adhere to a binary classification and club the two historically deprived groups, Scheduled Castes and Scheduled Tribes together so that the results can be interpreted meaningfully.

3. Results and Discussion

3.1 The Regression Approach

Corroborating our findings in the last section, simple cross-tabulation of data from NFHS-3 (as reported in Table 1) reveals no apparent difference in child stunting by sex of children. In fact, compared with girls, prevalence of stunting is slightly higher among boys. Inspecting the outcomes across religious groups, no apparent sex disparity is found among Hindus. In contrast, boys from other religions show a higher incidence of stunting than girls. Considering children from the caste-based Hindu society, the incidence of stunting is found to be lower among girls from SC and ST households. However, girls have worse nutritional status than boys among OBCs and upper castes.

Table 1: Prevalence of Stunting (%) in Different Social Settings in India

Social Identities	Girl	Boy
Hindu	48.36	48.01
Other Religions	47.55	49.55
Hindu SC	53.69	55.02
Hindu ST	54.10	54.59
Hindu OBC	49.27	48.42
Hindu Upper Caste	37.54	36.63
Total	48.24	48.45

The next step is to statistically test the significance of the sex gap in different caste groups. The study uses three models (reported in Table 2) to analyse the intersection between sex and caste in the determination of child nutrition. Following the analyses in Mukhopadhyay (2015, 2016), Model 1 includes sex of child, household economic status (poor or non-poor) and religion as separate covariates. Sex of the child turns out to be a statistically non-significant covariate of stunting status. In order to probe deeper into this inconclusive result on sex disparity in child nutrition, the intersection of sex and religion is considered in Model 2. Treating Hindu girls as the reference group, Hindu boys and other girls are significantly less (whereas other boys are significantly more) likely to be stunted than Hindu girls. Statistical testing shows that among 'other' religions, boys are significantly more likely to be stunted.

With evidence of sex disparity among Hindus, the paper now focuses on the set of Hindu children in the final and third model. Model 3 inspects the interaction of social group affiliation (SC, ST, OBC and upper caste Hindus) and sex inequality in stunting status among Hindu children, showing an interesting pattern. While sex disparity is non-significant among SCs, ST girls have a relative advantage over ST boys in terms of stunting status. Girls are significantly more likely to be stunted among OBCs and upper caste Hindus.⁴

Mukhopadhyay (2016) notes that albeit some of the early studies on sex inequality in India noted greater undernutrition among girls in developing countries such as India and Bangladesh (Chen et al., 1981; Sen & Sengupta, 1983 Abdullah & Wheeler, 1985), most recent studies using large scale secondary data do not find a significant sex bias in child nutrition (Arnold, 2001; Marcoux, 2002; Pande, 2003; Mishra et al., 2004; Borooah, 2005). Scholars have looked into child-specific household-level factors such as birth order and sex composition of older siblings in order to shed light on the puzzle of an absent sex gap in child nutrition in India.) Three specific explanations have been put forward by Mishra et al. (2004). First, only some and not all girls are discriminated against. Girls belonging to households with no living son and of birth order three or more have the worst nutrition. Second, the discrimination against girls when there are few boys, offset, at least to some extent, the discrimination against boys when there are few girls. Third, some manifestations of favouritism for boys (such as exclusive breastfeeding even beyond six months of age) perversely affect them.

Using this approach, we argue that supplementing the analysis focusing on child-specific household-level factors, the puzzle of sex inequality needs to be explored in the context of the intersection of sexual identity with other dimensions of social identity such as religion and caste (Mukhopadhyay, 2016).

4. In a similar exercises, Mukhopadhyay (2015) and Mukhopadhyay (2016) look into the simultaneous intersections of caste class and sex in determining children's nutritional outcomes.

Table 2: The Intersection of Gender with Religion, Caste and Economic Class in the Determination of Child Stunting in India

Covariates		Model 1 (Total)	Model 2 (Total)	Model 3 (Hindus)
Rural		1.00	1.01	1.01
Age (Base Category: 0-1)	1-2	3.81	3.78	3.84
	2-3	4.35	4.33	4.10
	3-4	3.98	3.96	3.84
	4-5	3.36	3.34	3.16
Birth Order (Base Category: 1)	2	1.26	1.26	1.27
	3	1.34	1.35	1.32
	Higher	1.43	1.43	1.44
Young Mother (<20 years)		1.38	1.39	1.36
Short Mother		1.87	1.81	
Mother's Education (Base Category: None)	Primary	0.81	0.81	0.80
	Secondary	0.70	0.70	0.73
	Higher	0.42	0.42	0.45
Father's Education (Base Category: None)	Primary	0.98	0.98**	1.04
	Secondary	0.90	0.90	0.94
	Higher	0.64	0.64	0.65
Female Household Head		1.03	1.02**	1.06
Community Water		0.99	0.98	
Community Toilet Facility		0.78	0.78	0.78
ICDS		0.92	0.93	0.94
Hindu		0.97	-	-
Sex of Child		1.00	-	-
Poor		1.25	1.26	1.20
Gender and Religion (Base Category: Hindu Girls)	Hindu Boy	-	0.97	-
	Other Girl	-	0.95	-
	Other Boy	-	1.06	-

Covariates		Model 1 (Total)	Model 2 (Total)	Model 3 (Hindus)
Caste (Base Category: Upper Caste Hindus)	SC	-	-	-
	ST	-	-	-
	OBC	-	-	-
Gender and Caste (Base Category: SC Girl)	SC Boy	-	-	1.01
	ST Girl	-	-	0.89
	ST Boy	-	-	0.96**
	OBC Girl	-	-	0.94
	OBC Boy	-	-	0.88
	Upper Caste Girl	-	-	0.82
	Upper Caste Boy	-	-	0.75

Notes:* $p < 0.1$, ** $p < 0.05$, bold numbers $p < 0.01$

3.2 Decomposition of Pure Inequality

The first two rows of Table 3 illustrate the conundrum of an absent sex gap in child nutrition in India. The population shares of the two sexes match their shares in total nutrition (an abstract concept defined analogously as total income) and inequality within girls replicates inequality within boys (in turn replicating total or interpersonal inequality). However, the level of inequality is systematically higher among the backward castes. Table 4 provides the results of decomposition of total inequality into 'between group' and 'within group' components for each grouping parameter, following the traditional method and the corrected method, as discussed in Section 2.2.1.

The puzzle of an absent sex gap convolutes our results in Table 4. Since the share of the 'between sex' component in total inequality is zero, the traditional method and the corrected method do not give different values for the 'between sex' component (The difference between the two methods is caused by a difference in the denominators; the invariant numerator being zero, the results do not diverge.) Nevertheless, the share of the 'between caste' component rises from 1.8% to a bit more than 2% when we consider the corrected method. The share of caste-sex intersectional inequality exactly equals that of caste inequality since the share of inter-sex inequality is zero.

Application of this method would yield meaningful results in presence of a sex gap in nutritional scores. Chakraborty and Mukhopadhyay (2017) analyse caste-class intersections in child nutrition in India and find that by the traditional method of decomposition, the share of intersectional inequality is higher than both 'between class' and 'between caste' inequalities. However, by the corrected method, inter-group intersectional inequality is dominated by inter-class inequality. This means that the stark disparity in nutritional outcomes across the single axis of class is to a certain extent assuaged when we consider stratifications across the social spectrum. Intersectionality literature, particularly in the context of health outcomes, has shown that while outcomes differ starkly between groups at the extreme, stratification along multiple axes of social power often reveal groups in the middle leveraging advantages from certain beneficial identities (Sen and Iyer, 2012).

Table 3: Population Share, Nutrition Share and Inequality in Different Sub-Groups of the Population of Children below Five Years in India

Grouping Parameter	Sub-Group	Population Share (%)	Share in Nutrition	GE(0)	GE(1)	GE(2)
Sex	Girl	47.44	47.41	0.0023	0.0023	0.0023
	Boy	52.56	52.59	0.0022	0.0022	0.0022
Caste	SC	24.40	24.20	0.00226	0.00226	0.00227
	ST	10.44	10.30	0.00254	0.00256	0.00258
	OBC	44.08	44.10	0.00216	0.00216	0.00217
	Others	21.08	21.42	0.00196	0.00195	0.00195
Caste-Sex Intersection	SC Girl	10.31	10.22	0.0023	0.0023	0.0023
	SC Boy	10.94	10.87	0.0022	0.0022	0.0022
	ST Girl	4.27	4.24	0.0026	0.0026	0.0026
	ST Boy	4.60	4.06	0.0025	0.0025	0.0025
	OBC Girl	20.48	20.44	0.0024	0.0024	0.0024
	OBC Boy	23.21	23.21	0.0021	0.0021	0.0021
	Other Girls	12.38	12.51	0.0021	0.0021	0.0021
	Other Boys	13.81	13.96	0.0022	0.0022	0.0022
Total Population		100	100	0.0022	0.0022	0.0022

Source: Authors' Calculations from NFHS-3 Unit-Level Data

Table 4: Share of ‘Between-Group’ and ‘Within-Group’ Components in Total Inequality by the Traditional Method of Decomposition

Grouping Parameter	Between Group Share (%)					
	Traditional method			Corrected Method		
	GE(0)	GE(1)	GE(2)	GE(0)	GE(1)	GE(2)
Sex	0	0	0	0	0	0
Caste	1.80	1.80	1.80	2.11	2.11	2.12
Sex-Class Intersection	1.80	1.80	1.80	2.11	2.11	2.12

Source: Authors’ Calculations from NFHS-3 Unit-Level Data

3.3 Decomposition of Inequality into Contributing Factors

Table 5 summarizes the results of the exercise of decomposing the concentration index into contributing factors. The negative concentration index in the last row of the table shows that there is wealth-related inequality in child undernutrition to the disadvantage of the poor. The second column gives the elasticity of undernutrition to the contributing factor, the third column gives the wealth-related concentration index of each contributing factor and the last column shows the contribution of each factor in total concentration index. Our analysis shows that most of the wealth-related inequality in child undernutrition can be explained by the direct effects of household wealth and mother’s education on child nutrition (as detailed in Table 5). Again, similar to the findings of previous studies decomposing the concentration index (Wagstaff et al., 2003; O’Donnell et al., 2008), we find large wealth-related inequalities in sanitation and drinking water. We also find relatively high wealth-related inequality in maternal education.

We find that sex of the child does not have any contribution in explaining wealth-related inequality in child nutrition. This is because of two effects. First is the absence of a significant sex gap in nutritional scores of children (that is captured by ‘elasticity’ in this approach). Second, the wealth-related CI for child sex is marginal, though negative. A negative CI for child sex counter-intuitively indicates a pro-female sex ratio among the wealthier. However, on

further investigation we find the CI for sex is not significant (results not reported).

However, we find that the contribution of caste in wealth-related CI of child nutrition is higher. This can again be explained in terms of two effects. First, children from backward caste households have significantly worse height for age and second, there is a concentration of backward caste households at the lower end of the wealth scale.

Table 5: Decomposition of Concentration Index for Height for Age Z-Scores of Children < 5 Years, India, 2005-06

Covariates	Elasticities	Concentration Indices	Contributions
Age Squared	0.108	-0.003	-0.004
Sex	-0.006	-0.003	0
Residence	-0.437	-0.066	0.002
Wealth Index	-0.208	0.285	-0.059
Piped Water	-0.004	0.349	-0.014
Flush Toilet	-0.009	0.613	-0.005
Mother's Education	-0.110	0.421	-0.046
Caste	0.015	-0.241	-0.004
Residual	-	-	0.003
Total	-	-	-0.115

4. Conclusion

Though India is infamous for gender discrimination, child nutrition is a typical variable in which a stark sex gap is absent. Given how caste interacts with sex in shaping outcomes such as childhood mortality and son preference, this paper invokes the framework of intersectionality to study caste-sex interactions in child nutrition. Intersectionality literature, until recent times, has been dominated by qualitative enquiries. While qualitative analysis details the processes of simultaneous and complex interactions of different identities, spatial or temporal comparisons of the magnitude of intersectional inequality can be done only by applying quantitative methods on large scale survey data. This paper analyses three methods that may be used to capture intersectionality quantitatively. The second and third methods, which respectively

decompose pure nutritional inequality and socioeconomic nutritional inequality, find that sex cannot explain nutritional inequality. This is mainly because of the close average scores of the two sexes. However, when we use the first method and investigate how nutrition differs across the social spectrum, we do find a significant sex gap among certain social groups such as upper caste Hindus. More work needs to be done on how intersectional inequalities evolve over time. An interesting extension of our work would be a comparison of intersectional inequalities in child nutrition using data from different rounds of the National Family Health Survey (NFHS). Also, one might be interested in making inter-state or inter-country comparisons of the share of intersectional inequality in total, interpersonal inequality. Such exercises can be carried out only by using rigorous quantitative techniques on large scale survey data.

A serious limitation of the paper is that the three methods use three different nutritional indicators and the substantive conclusions are thus incomparable. We end the paper on a cautionary note that irrespective of the statistical significance of covariates or the magnitude of the between group component, any difference in well-being that systematically varies with religion, caste and sex, is normatively unacceptable. For instance, though ST girls have a statistically significant advantage over ST boys in terms of nutritional scores, both girls and boys from ST households have extremely high levels of undernutrition and deserve policy attention. Again, as Kanbur (2006) points out, if group affiliation has a role in shaping individual identity, then the ratio of mean outcomes for two groups has 'socio-political salience', even if the proportion of the between-group term in total inequality (as revealed in a standard exercise of inequality decomposition) is low. Thus, one should not naively set a low policy priority on group inequality whenever the contribution of the 'between-group' component is low. Notwithstanding the importance of decomposition exercises in positive analyses of inequality, to base policy stances 'naturally' on the decomposition methodology would be problematic.

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SPECIAL LECTURES

1. *Education for Profit, Education for Freedom* by Martha C. Nussbaum, March 2008.
2. *Always Towards : Development and Nationalism in Rabindranath Tagore* by Himani Bannerji, May 2008.
3. *The Winding Road Toward Equality for Women in the United States* by Diane P. Wood, June 2008.
4. *Compassion : Human and Animal* by Martha C. Nussbaum, July 2008.
5. *Three 'Returns' to Marx : Derrida, Badiou, Zizek* (Fourth Michael Sprinker Lecture) by Aijaz Ahmad, March 2012.
6. *Inequality: Reflections on a Silent Pandemic* by Ashwani Saith, December 2009.
7. *A Study in Development by Dispossession* by Amit Bhaduri, March 2015.

WORKING PAPERS

1. *Primary Education among Low Income Muslims in Kolkata: Slum Dwellers of Park Circus* by Zakir Husain, July 2004.
2. *Impact of District Primary Education Programme (DPEP) on Primary Education: A study of South 24 Parganas* by Suman Ray, July 2004.
3. *Representation of Public Health in the Print Media : A Survey and Analysis* by Swati Bhattacharjee, January 2009.
4. *Maternal Anthropometry and Birth Outcome Among Bengalis in Kolkata* by Samiran Bisai, April 2009.
5. *Transfer of Technology and Production of Steel in India*, An interview of Anil Chandra Banerjee by Amiya Kumar Bagchi, December 2013.

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1. *Webs of History: Information, Communication and Technology from Early to Post-colonial India* eds. Amiya Kumar Bagchi, Dipankar Sinha and Barnita Bagchi, New Delhi, Manohar, 2004.
2. *Maladies, Preventives and Curatives: Debates in Public Health in India*, eds. Amiya Kumar Bagchi and Krishna Soman, New Delhi, Tulika, 2005.
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 5. *The Trauma and the Triumph: Gender and Partition in Eastern India*, Volume 2, eds. Jasodhara Bagchi, Subhoranjan Dasgupta and Subhasri Ghosh, Kolkata, Stree, 2009.
 6. *Identities and Histories: Women's Writing and Politics in Bengal* by Sarmistha Dutttagupta, Kolkata, Stree, 2009.
 7. *Labour, Globalization and the State: Workers, Women and Migrants Confront Neoliberalism*, edited by Michael Goldfield and Debdas Banerjee, London and New York, Routledge, 2008.
 8. *Eastern India in the Late Nineteenth Century, Part I: 1860s-1870s* eds. Amiya Kumar Bagchi and Arun Bandopadhyay, New Delhi, Manohar and Indian Council of Historical Research, 2009.
 9. *Indian Railway Acts and Rules 1849-1895: Railway Construction in India: Selected by Documents (1832-1900)*, ed. Bhubanes Misra (General Editor: Amiya Kumar Bagchi) Vol. IV, New Delhi, Indian Council of Historical Research, 2009.
 10. *Colonialism and Indian Economy* by Amiya Kumar Bagchi, New Delhi, Oxford University Press, 2010.
 11. *Eastern India in the Late Nineteenth Century, Part II: 1880s-1890s* eds. Amiya Kumar Bagchi and Arun Bandopadhyay, New Delhi, Manohar and Indian Council of Historical Research, 2011.
 12. *Rabindranath: Bakpati Biswamona*, Volume 1, edited by Sudhir Chakravarti, Rabindranath Tagore Centre for Human Development Studies, May 2011.
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 14. *Four Essays on Writing Economic History of Colonial India* by Amiya Kumar Bagchi, David Washbrook, Arup Kumar Maharatna and Arun Bandopadhyay, Institute of Development Studies Kolkata and Progressive Publishers, 2011.
 15. *Market Media and Democracy*, compiled by Buroshiva Dasgupta, Institute of Development Studies Kolkata, 2011.
 16. *Universally Loved: Reception of Tagore in North-east India*, ed. Indranath Choudhuri, Rabindranath Tagore Centre for Human Development Studies and Progressive Publishers, 2012.

17. *Transformation and Development: The Political Economy of Transition in India and China*, eds. Amiya Kumar Bagchi and Anthony P. D'Costa, Oxford University Press, 2012.
18. *Indian Skilled Migration and Development* eds. Uttam Bhattacharya, Gabriela Tejada, Binod Khadria and Christiane Kuptsch, Springer, 2014
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22. *The Look East Policy and Northeast India* eds. Gorky Chakraborty and Asok Kumar Ray, Aakar Books, 2014.
23. *An Introduction to the History of America* (jointly with C. Palit), New Delhi: Cambridge University Press, 2014.
24. *History and Beyond: Trends and Trajectories* (jointly edited with C. Palit), New Delhi: Kunal Books, 2014.
25. *Southern India in the Late Nineteenth Century, Vol. 1, Part IA: 1860s-1870s* eds. Amiya Kumar Bagchi and Arun Bandopadhyay, New Delhi: Manohar, 2015.
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27. *Pratyaha: Everyday Lifeworlds Dilemmas, Contestations and Negotiations* eds. Prasanta Ray and Nandini Ghosh, New Delhi: Primus Books, 2015.
28. *Accumulation and Dispossession: Communal Land in Northeast India* by Gorky Chakraborty (jointly with Asok Ray and Bhupen Sarmah), Aakar Books, 2017
29. *Rethinking Tribe in the Indian Context: Realities, Issues and Challenges* eds. Bidhan Kanti Das and Rajat Kanti Das, Rawat Publications, 2017
30. *Impaired Bodies, Gendered Lives: Everyday Realities of Disabled Women* by Nandini Ghosh, New Delhi, Primus Publisher, 2016.
31. *Interrogating Disability in India: Theory and Practice* ed. Nandini Ghosh, Springer, 2016.

