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Abstract

This study investigates whether mother's empowerment measured by her education attainment relative to father's, domestic violence and autonomy is related to children's nutritional status using the three rounds of NFHS data in India. First, mother's relative education is associated with better nutritional status of children in the short run. Second, the quantile regression results show strong associations between women's empowerment and better nutritional status of children in the long run at the low end of its conditional distribution. Finally, we find the relation between access to health schemes and better nutritional measures of children.

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1. Introduction

Malnutrition remains a major concern in India despite the country's impressive recent record of economic growth. India has one of the worst levels of low birth weight, underweight and wasting among children in BRIC and SAARC[1] countries (IAMR, 2011). While 43% (38%) of children under age five are moderately underweight (stunted) in India, the corresponding figures are 6% (11%) in China, 23% (14%) in Sri Lanka, 31% (37%) in Pakistan, 39% (43%) in Nepal and 41% (36%) in Bangladesh in 2000-7 (ibid., 2011). India therefore certainly epitomises what has been called as the "Asian Enigma" (Smith et al., 2003, p 2).[2]

However, this is not to deny the gradual decline in the rates of moderately underweight and stunted children in India experienced over the past three decades (Deaton and Drèze, 2009). Research employing the first two rounds of National Family Health Survey data dated 1992-93 and 1998-99, documents that notwithstanding the rise in rural-urban disparity favouring urban children and gender disparity favouring girls, there was an improvement in overall nutritional status of children under three during the 1990s (Tarozzi & Mahajan, 2007). Another study based on the survey conducted in 2010-11 covering 112 rural districts of nine relatively poor states, reports that (i) the prevalence of underweight children declined from 53 % in 2004 to 42 % in 2010-11 with an average annual rate of reduction of 2.9%; (ii) the nutritional advantage of girls over boys aged 0-3 years is reversed in the 3-5 age category (in both height-for-age and weight-for-age); and (iii) underweight children are more prevalent among mothers with low levels of education (Naandi Foundation, 2011).

Despite the reduction of malnutrition levels, the rates are high enough to cause concern, especially since they persist amidst a phase of impressive economic growth. The high levels of child malnutrition potentially impact a prospect for continued economic growth as child malnutrition in early years may result in malnutrition, lower cognitive skills and lower

productivity in adult years. Additionally, high rates of prevalence of nutritional deprivation is a humanitarian concern requiring policy-makers and international communities to refocus their policy priorities on direct and indirect interventions to reduce children's malnutrition.

The extant literature on determinants of child health and malnutrition in developing countries in general and in India in particular highlights the significance of economic, social, cultural, and/or infrastructural factors impacting at multiple levels, such as individual, household and community (Ackerson & Subramanian, 2008; Allendorf, 2007; Kandpal & McNamara, 2009; Kravdal, 2004; Smith & Haddad, 2002; Smith et al., 2003). Recent empirical studies on child malnutrition in India tend to focus on one of the following three factors as determinants of children's nutritional or health status: (i) mothers' education, health, presence of domestic violence (Ackerson & Subramanian, 2008; Gaiha & Kulkarni 2005; Kandpal & McNamara, 2009), to which the present study has a close link, (ii) social capital at community levels (Borooah, 2005; Kravdal 2004); and (iii) policy interventions such as the Integrated Child Development Services (ICDS) (Das Gupta et al., 2005). Although the results are context specific, mother's characteristics have consistently emerged as significant when examining child malnutrition status (Duflo 2012; Eklund et al., 2007; Gaiha & Kulkarni 2005; Imai & Eklund, 2008; Kravdal 2004; Luke & Xu 2011; Shroff et al., 2009).

The findings on women's role in reducing the prevalence of malnutrition are corroborated by the opinions of the policymakers. For instance, Olivier de Schutter in his presentation to the United Nations in March 2013 argued that "sharing power with women is a shortcut to reducing hunger and malnutrition, and is the single most effective step to realizing the right to food," and urged "world governments to adopt transformative food security strategies that address cultural constraints and redistribute roles between women and men". In the context of children's health outcomes, given that women are typically the primary care takers of

children, redistribution of decision making roles in favour of women has the potential to improving children's health outcomes (de Schutter, 2013).

Drawing upon nationally representative household datasets for India, the present study aims to contribute to the existing knowledge on the association between women's empowerment and development outcomes in the context of India and developing countries in general. We estimate the determinants of nutritional measures for children under age three in rural India during the period 1992-2006 with the focus on the role of mother's empowerment. We address the following two questions: (i) Whether mother's empowerment as measured by her educational attainment relative to father's, presence of domestic violence and mother's freedom of movement is associated with the nutritional status of her children? and (ii) What are the household level, infrastructural and policy variables that are related to children's nutrition status?. We employ all the three rounds of National Family Health Survey data (NFHS henceforth) conducted in 1992-93, 1998-99 and 2005-06. In addition to the ordinary least squares and instrument variable estimation, we carry out quantile regression analyses to assess the relationship between women's empowerment and child nutritional status at points other than the mean on the conditional distribution. Also, we construct the pseudo panel which enables an improved understanding of change over time, as compared to analysing each round of cross-sectional data separately.

The rest of the paper proceeds as follows. The next section reviews the existing body of literature on child malnutrition in the context of developing countries in general and in the context of India in particular. Section 3 outlines the basic analytical framework which underlies our econometric analysis. After describing the data in Section 4, we discuss the econometric models and specifications in Section 5. Section 6 reports the econometric results. The final section offers concluding remarks.

1. Literature Review

We briefly review the following two strands of literature that are pertinent to the present study. The first dimension pertains to the definitions and measurement of women's empowerment or relative bargaining power. The second strand relates to the more empirical question of how women's empowerment or relative bargaining power affects children's nutritional status.

(1) Definitions and measurement of women's empowerment

Women's empowerment is a multi-dimensional concept with disagreements in its definition and measurement (Agarwal, 1997; Duflo, 2012; Kabeer, 1994, 1999). Women's empowerment can be conceptualised as the power to make choices (Kabeer, 1994, 1999; Malhotra et al, 2002) or the women's ability to access the components of quality of life (Duflo, 2012) or as "women's relative position or exercise of power within the gender system"[3] (Williams, 2005, p.7).

Empirical investigations of women's empowerment have employed a wide range of indicators to capture its multidimensionality. The commonly used measures include inheritance and divorce laws or assets at the time of marriage (Agarwal, 1994; Quisumbing & Malluccio, 2003; Fafchamps et al., 2009), male and female non-labour income (Thomas et al., 1997), an education difference (Smith et al., 2003; Thomas, 1994) and ratio of female to male life expectancy at birth (Smith & Haddad, 2002). Other studies have employed less economic/quantifiable measures. For instance, Fafchamps et al. (2009) employ violence or cognitive ability as proxies of women's empowerment. In the context of microcredit programmes in Bangladesh, Hashemi et al. (1996) use decision-making power, political and legal awareness, and participation in public protest and political campaign as indicators of empowerment. Afridi (2010) constructs an index combining decision making, freedom of

movement, physical abuse and access to money along with educational attainment. Bloom et al. (2001) focus on control over finances, decision-making power, and freedom of movement. In recognition of the critical role of the norms and perceptions in which individuals exercise their agency (e.g. Agarwal, 1997), cultural and gender norms with respect to marriage and divorce have been taken into account as measures of empowerment (Anderson & Eswaran, 2009; Rahman & Rao, 2004).

In addition to empowerment, a concept that has increasingly received attention, especially in the literature analysing intra-household resource allocation and decision making from the point of gender equality is that of bargaining power.[4] Evidently, given that one of the intrinsic components of empowerment comprises the position of women relative to men and/or other members of the household, the concept of bargaining power is closely intertwined with that of empowerment, though the distinction between the two remains important, for example, because a wife who has complete control over household resources as her husband is a migrant may have only restricted participations in village activities or employment if she is among socially disadvantaged groups (e.g. Scheduled Castes).[5] However, in many circumstances, women's empowerment is reflected in intra-household resource allocation in household outcomes (e.g. children's nutritional status) (Doss, 2013), greater power of decision making, absence of domestic violence, or a combination of these factors. The assessment of women's empowerment as women's bargaining power within the household can admittedly be contended as a narrow approach to measuring empowerment. Following this scheme of thought, however, we assume that bargaining power can be a component of the overarching conception of empowerment. Empirically, an overwhelming proportion of the analyses of women's bargaining power tend to concentrate on the position of women relative to men which in marital relationship implies between spouses (Doss, 2013). A basic issue is whether it should be measured in terms of variables that drive the bargaining process

or bargaining strength (e.g. access to employment, credit) or in terms of outcomes of bargaining (household allocation of expenditure on health and education of children) (ibid., 2013). It may be noted that women's preferences are taken as revealed in the outcomes.[6] Given that the empirical specifications for women's empowerment and those for relative bargaining power overlap significantly, we will use these two terms interchangeably.

In line with the previous studies, we employ the following indicators to measure women's empowerment; (a) relative educational attainment measured by the ratio of mother's and father's schooling years; (b) presence of domestic violence indicated by whether a husband beats a wife if she is unfaithful to him; and (c) whether the wife needs permission from the husband when she goes to the market. The first variable captures the educational background of mother relative to father which affects the bargaining process (Smith et al., 2003; Thomas, 1994). The second indicator is a proxy for the extent to which a wife is threatened by physical violence that potentially affects her power of decision-making and autonomy (Ackerson et al., 2008; Fafchamps et al., 2009).[7] The third variable directly measures the extent of freedom of movement and autonomy in decision-making. It reflects social norms of societies and as there is often a close interplay between social norms and women's autonomy and decision-making (Doss, 2013), we expect the former to be significant in determining autonomy and decision making.

(2) The relationship between women's empowerment and child nutrition

Most of the studies evaluating the association between women's empowerment and children's nutritional status find the relationship to be positive. Smith et al. (2003) using cross-country data conclude that women's empowerment has a positive influence on child nutrition indicators. Using various measures of women's bargaining in rural Ethiopia, Fafchamps et al. (2009) infer that female bargaining power improves child nutritional status.

However a caveat may be in order here. The evidence in most cases suffers from the biases stemming from the fact that more educated women differ from less educated women in ways that are not always quantifiable (Duflo, 2012). Nonetheless, it appears that the positive role of women's empowerment in children's nutritional outcomes is robust and hence worthy of attention.

In the context of India, as in other parts of the developing world, the relationship between women's empowerment and children's nutritional status is largely positive though at times ambiguous. For instance, drawing upon the 1994 NCAER data, Gaiha and Kulkarni (2005) find that reduction in wage gap between men and women reduces severe stunting in terms of the number of stunted children in a household. Also, their analysis indicates that household income, composition of household and a number of children and caste affiliation are significant variables in reducing stunting. Using the NFHS-2 data, Maitra (2004) shows that child health is affected only indirectly through the improved usage of health care, which is determined by women's education and control over household resources or bargaining power. Kravdal's (2004) study, again, employing the NFHS-2 data finds that women's empowerment as measured by i) the response to the question, whether a husband is justified in beating his wife in certain situations and ii) average women's education in the census enumeration area, have significant association with child mortality levels. Ackerson et al. (2008) based on NFHS-2 data find that domestic violence, an indication of weak bargaining power of wives against husbands increases the prevalence of stunted children and of underweight adult women.

2. Theoretical Considerations

This section discusses theoretical arguments on how women's bargaining power affects child nutritional status. Researchers have generally adopted the following two conceptualisations in

understanding correlates of child nutritional status. They either specify a structural health production function (Thomas, 1994) or model the intrahousehold bargaining between the mother and the father and then derive the reduced form equation for child health or nutrition where the empowerment index is used as a determinant together with household characteristics. Thomas (1994) combines a health production function wherein child health (as an output) is a function of a number of inputs such as nutrient intakes and the quantity and quality of child/health care and individual and household characteristics with a standard utility function of the household member under a budget constraint for the household. This technique can be typically done in the framework of unitary household models in which the household head makes a decision on behalf of household members, all the household resources are pooled, and both the parents have an identical taste (Becker, 1974, see Park, 2007, for the application to child nutrition)[8]. However, the unitary model has been empirically invalidated by Lundberg et al. (1997) who found evidence that the family spending on women's and children's clothing, relative to men's clothing, increased after policy change in the United Kingdom that transferred a child allowance to wives in the late 1970s.

In the non-unitary model framework in which personal preference and bargaining power matter, consists of cooperative bargaining models and non-cooperative bargaining models. In the cooperative bargaining models, the mother or the father derives her or his utility from own consumption of commodities and public goods (e.g. health or nutritional status of children) and the bargaining process is affected by an outside option or the extra-household environmental parameters (EEP) which are, for example, conditional on the threat of martial dissolution or on other environmental factors (McElroy & Horney, 1981; McElroy, 1990). In case of bargaining over child health or nutritional status, the mother and the father are assumed to make decisions over the quality of health, nutritional conditions of children or the

spending on child health care independently as a part of his or her utility maximization problem (Maitra, 2004, Park, 2007, Fafchamps et al., 2009)[9, 10].

Because the health production approach requires detailed data on health inputs (e.g. health care, nutritional intakes, and prices), our conceptual framework is based on the cooperative bargaining model following most of the empirical studies of child health and nutrition. We assume that a household consists of a mother, m ,a father, f , and a certain number of children, k, considered to be 'a public good' for both parents. It is assumed that children are not decision-makers and for simplicity parents care about the health quality or nutritional status of children.[11] Let x_j be the j^{th} person's consumption ($j = m, f$), and q be the (average) health quality of children. The j^{th} person's utility is defined as $U_j\left(x_{j,}\, q_j \middle| A_j\right)$. Here we define A_j, EEP, a vector consisting of exogenous factors that determine the preferences of the individual j. A_j may depend on the factors determined outside the household, e.g. unearned income for j, as well as his or her individual characteristics.

Each individual is assumed to choose x_j (own consumption) to maximise q (child health quality). In this setting, the household utility function is defined as $\gamma U_m\left(x_m, q;\, A_m\right)+\left(1-\gamma\right)U_f\left(x_f, q;\, A_f\right)$ where γ represents the "bargaining power" of the mother (wife) in a household $(0<\gamma<1)$. The household's utility maximization problem is specified as follows:

$$\underset{x_m, x_f,\, q}{Max}\; U^H = \gamma U_m\left(x_m, q;\, A_m\right)+\left(1-\gamma\right)U_f\left(x_f, q;\, A_f\right) \qquad (1)$$

subject to

$$I = p_m x_m + p_f x_f + p_c q \qquad (2)$$

where I is a household's income, p_i is the price of the private goods for the mother or the father, and p_c is the shadow price of public goods, that is, children in this case. In general, the

optimal q^* (health quality of child) will depend on parameters such as γ, p_c, I, p_i, and A_i as follows:

$$q^* = q^*(\gamma, I, p_m, p_f, p_c, A_m, A_f) \quad (3)$$

This model sheds light on the household decision on child health. For example, "bargaining power" γ may reflect women's empowerment represented by female education and female labour force participation. Given that the mother is more likely than the father, to value q, the quality of children's health, the stronger bargaining power of the mother reflected in higher γ leads to a better nutritional outcome. In this framework, a higher level of education is likely to improve the nutritional status of children through higher γ. A_i represents each household member's attitude toward health care, which may be different in various classes or social groups. Economic growth increases a household's income level I and improves the health of children.

However, the above conceptual framework is limited in the sense that the "bargaining power" γ is treated as an exogenous variable and determined by, for instance, female education or female labour force participation which in turn is a reflection of, among others, of cultural factors. However, the bargaining coefficient, γ, can be endogenous in reality, that is, the household decision on the health quality of children in turn affects γ, as modelled by Basu (2006) who assumed the endogeneity of γ in the collective-bargaining model. Our framework does not account for the endogeneity of γ , though it is econometrically addressed by the instrumental variable estimation in the empirical analysis.

3. Data

This study draws upon three rounds of NFHS data, NFHS-1 (year 1992-93), NFHS-2 (year 1998-99) and NFHS-3 (year 2005-06). The NFHS is a major nationwide, large multi-round survey conducted in a representative sample of households in India with a focus on health

and nutrition of household members, especially of women and young children.[12] The survey covers the issues including fertility, family planning, maternal and child health, gender, HIV/AIDS, nutrition and malaria. Data were collected at the individual level (children, mothers and fathers in NFHS-3) as well as household and community level. This study uses the data on children aged zero to three years in rural areas for three rounds of NFHS data. This is because children below age four are covered in NFHS-1, below age three in NFHS-2, and below age five in NFHS-3. It is also well known that nutritional conditions from zero to three years have the most fundamental effect on stunting in later life (Maluccio et al., 2007).

We measure the nutritional status as z scores of height-for-age (stunting), weight-for-age (underweight) as well as weight-for-height for children below three years. We follow the z score measure based on children from a diverse set of countries such as Brazil, Ghana, India, Norway, Oman and the USA' (WHO 2006, p.1) put forward by WHO (2006). Following WHO (1997), we define z score as:

$$z\ score = \left(x_i - x_{median}\right) / \sigma^x \qquad (4)$$

where x_i is, for example, height of child i, x_{median} is the median height from the reference population of the same age and gender, and σ^x is the standard deviation from the mean of the reference population. The z-score for the reference population has a standard normal distribution in the limit. Thus, there is a less than 2.3% probability that a healthy child will have a z score less than -2 (WHO, 1997). We classify, as per the common practice, children with a z score below -3 as "severely stunted", and those with a z score between -3 and -2 as "moderately stunted". Underweight or wasting is defined in a similar manner. In this study, however, we define children with z score below -4 as "acutely malnourished" given the large number of children severely or moderately malnourished. Such a classification would help us examine the determinants of acute malnutrition at the tail end of the distribution. Although there is no clear biological justification for "-4" as a threshold, yet given that WHO defines

children with "z score below -3" as "severely stunted", the level of malnutrition for those below "-4" should be acutely severe and is likely to have serious health consequences in their later life.[13] Also, as the factors influencing underweight and overweight children are likely to be different, we consider the factors affecting those in other appropriate ranges.

4. Econometric Specifications

Our main objective of the econometric analyses is to identify determinants of child malnutrition in rural India to test (i) 'Whether the mother's empowerment as measured by mother's relative (to father's) bargaining power is associated with the nutritional status of her children?' and (ii) 'Which factors (including those associated with children, households, infrastructure and policy) are correlated with children's nutritional status?'. Methodologically, we apply multiple techniques which make the present study distinct from extant empirical studies on child malnutrition in India. First, following Borooah (2005) and Kandpal and McNamara (2009), we apply quantile regression (QR) technique in addition to the ordinary least squares (OLS) to estimate different coefficient estimates at different points in the conditional distribution of nutritional status, rather than at the mean. Second, instrumental variable (IV) estimation has been applied to take into consideration the endogeneity of (i) bargaining power of women and (ii) access to health insurance schemes. Third, we use pseudo panel data models by combining multiple rounds of the NFHS data.

OLS and IV

We presented a simple version of the bargaining model in Section 3, but it is not easy to find the variables which would exactly capture different factors specified in the theoretical model (e.g. the extrahousehold environmental parameters and the bargaining coefficient, γ). We therefore use the reduced form equation approach in which the child nutritional condition is a

function of the bargaining indicators and household characteristics since the NFHS data do not contain the variables, such as prices specific to father's or mother's consumption or the individual unearned income. Here we distinguish three units, child, household and community.[14] We denote *i* for the i^{th} child (or an ID number identifying a particular child) and *h* for the h^{th} household (a household ID number) in a total sample at time *t* (year). We estimate q_{ih}, a nutritional status indicator (namely, z score of height-for-age, weight-for-age, or weight-for-height) as:

$$q_{ih} = q_{ih}(\gamma_h,\ B_i,\ X_h,\ Z_h,\ H_h, R, P) \tag{5}$$

It is assumed here that A_m and A_f (or A_m/A_f) in the equation (3) can be captured by a single variable γ_h representing the mother's relative (to father's) bargaining power. The variable, γ_h is our measure of women's empowerment and comprises our central independent variable. As we discussed in Section 2, we proxy γ_h by (i) the proportion of mother's years of schooling to father's years of schooling ([schooling years of mother]/ [schooling years of father]) (after controlling for average schooling years of mother and father); (ii) a dummy variable on whether the father (husband) is justified in hitting or beating the mother (wife) when the mother (wife) is unfaithful to the father (husband) (1 for Yes; 0 for No); (iii) a dummy variable on whether the mother (wife) needs permission from the father (husband) when she goes to market (1 for Yes; 0 for No).

In case of the IV estimation which has been tried for NFHS-3[15], γ_h is instrumented by the (proportional) difference of father's age and mother's age on the grounds that the relatively older father tends to have a greater bargaining power, but it does not have a separate and direct impact on their child's nutritional conditions. Also, we use the village-level average of the ratio of predicted wage rates for women and those of men as an additional instrument.[16] The idea is that the gender difference of implied aggregate wages would determine the extent

to which a woman is disadvantaged in her village, yet as it is based on village level aggregate, it is unlikely to have a direct effect on child nutrition at the individual level. The instrument is validated by the specification tests, as will be shown in the next section.

B_i is a vector of characteristic of the i^{th} child: whether male or not; age and its square; and the birth order of the child - whether the second, third or fourth child. X_h is a vector of household specific variables, such as household characteristics and compositions, including, household size; share of children under the age of five in total number of household members; the average schooling years of the mother and the father; mother's age; its square; and whether a household has access to electricity; whether a household has a radio (or a TV; bicycle; a flush toilet). Z_h is a vector of variables capturing the social, environmental or infrastructural factors specific to the h^{th} household: time necessary for getting water; whether a household belongs to scheduled castes (SCs), scheduled tribes (STs) or other backward groups; religion dummies (Hindu, Muslim, Christians). H_h is a policy variable that would affect child's health: 'Whether any member of the household to which a child belongs has access to a health insurance or a healthcare scheme?'. This is a household level variable. Health insurance or a healthcare scheme is broadly defined as an aggregate category that includes government sponsored health insurance schemes or private medical insurance schemes. This is instrumented by two instruments in the IV regression; (i) the infrastructure variables to capture the availability of information, as indicated by the number of households in the village that have access to a telephone[17] and (ii) the village-level need for health care which is proxied by the village-level average of the access, both of which are likely to have only weak correlations with child malnutrition at the individual level. One may criticise that both of these may affect child malnutrition even though the village-level averages are taken, but these are validated by specification tests, as will be shown in the next section. Also, it may be noted that the coefficient estimate for H_h is at best, Intent-to-Treat (ITT) estimates

(not ATT, Average Treatment Effects on Treated) and that the estimate does not imply causality. R is a vector of regional dummies (BIMARU [18], South, East, and West) as well as state dummies to take account of the state fixed effects. P is a price vector (for sugar, egg, and cereal).

QR

As discussed by Aturupane et al. (2008) and Borooah (2005), it is important to estimate the effect of various variables on child nutritional status on different points in its conditional distributions because behavioral response to predictors (e.g. mother's bargaining power) is likely to be different between a malnourished child and an overweight child. As in Koenker and Bassett Jr. (1978), quantile regression for the θ^{th} percentile takes the form:

$$\underset{b \in R^{K}}{Min}\left[\sum_{i \in \{i: q_i \geq X_i b\}} \theta \left| q_i - \mathrm{X}_i b \right| + \sum_{i \in \{i: q_i \prec X_i b\}} (1-\theta) \left| q_i - \mathrm{X}_i b \right|\right] \qquad (6)$$

where $0 < \theta < 1$, q_i is a dependent variable (z score of child nutritional status), and X_i is a vector of all the explanatory variables in Equation (5). For example, if θ=0.5, this is a median regression. Most of the studies show the results θ=0.05, 0.1, 0.25, 0.75 and so on, but we have chosen the median of each nutritional group for θ to estimate the (approximate) determinants of nutritional conditions for each group. For example, if we find that 12% of children are severely undernourished ($z < -3.0$), we have used 0.06 as θ. Also, because the error terms in each group are likely to be heteroscedastic, bootstrap estimates of the asymptotic variances are calculated with 1000 repetitions.

Pseudo Panel Data Model

One of the limitations of the above model is that each round of the NFHS data is used separately for the cross-sectional estimations. To overcome this and to identify the

determinants of child nutritional status over the years, we apply the pseudo panel model which aggregates micro-level data by any cohort that is commonly observed across cross-sectional data sets in different years. We apply the pseudo panel for the cohort *k* based on the combination of states and mother's age groups (15-19 years, 20-24 years, … , 45-49 years).[19] The cohort is denoted as *k* in the equation (7) below.

$$\overline{q_{ih\,kt}} = \overline{q_{ih\,kt}}\left(\overline{\gamma_{h\,kt}}, \overline{B_{i\,kt}}, \overline{X_{h\,kt}}, \overline{Z_{h\,kt}}, \overline{P_{kt}}\right) \qquad (7)$$

where k denotes cohort and t stands for survey years for three rounds of NFHS data, NFHS-1 (1992-93), NFHS-2 (1998-99) and NFHS-3 (2005-06). The upper bar means that the average of each variable is taken for each cohort, k, for each round, t. Regional variables do not have time variation and have been dropped. A variable on health scheme or health insurance has been also dropped as this is available only in NFHS-3. Equation (7) can be estimated by the standard static panel model, such as fixed effects or random effects model.

$$\overline{q_{i\,kt}} = \alpha + \sum_{l=1}^{w} \overline{X_i^{\,l}}_{kt} \beta^l + D_t\,\chi + \bar{\mu}_{kt} + \bar{e}_{kt} \qquad (8)$$

where $\overline{q_{i\,kt}}$ is a dependent variable, $\overline{X_{i\,kt}^{\,l}}$ represents explanatory variables in Equation (7), D_t is a vector of year dummies, $\bar{\mu}_{kt}$ is the unobservable individual effect specific to cohort *k* (e.g. cultural effects which are not captured by explanatory variables), and $\bar{e}_{kt}$ is an error term. The issue is whether equation (8) is a good approximation to the underlying household panel models for household i in equation (8)' below. It is not straightforward to check this as we do not have "real" panel data.

$$q_{it} = \alpha' + \sum_{l=1}^{w} X^{l}{}_{it}\,\beta^l + D_t\chi + \mu_i + e_{it} \qquad (8)'$$

However, as shown by Verbeek and Nijman (1992) and Verbeek (1996), if the number of observations in cohort *k* tends to infinity, $\bar{\mu}_{kt} \to \mu_k^{*}$ and the estimator is consistent. In our case, the average number of observations in each cohort (combination of states and mother's age groups) is 73.6 for NFHS data. This is not ideal, but reasonably large reflecting the huge

sample size of our datasets covering all parts of India and thus the estimator is close to being consistent. It may be noted that, we, as is usually done, interpret the results of pseudo panel estimations with caution. Once we take account of the cohort population, Equation (8) will become the model developed by Deaton (1985) whereby $\overline{q}_{i\,kt}$ and $\overline{X}_{i\,kt}$ are considered to be error-ridden measurements of unobservable cohort means, which leads to so-called "error-in-variables estimator" (see Fuller, 1987, for more details).

5. Results

This section discusses the central results emerging from the models presented in Section 5. Table 1 summarizes the coefficient estimates of bargaining indicators estimated by the three rounds of NFHS data, namely, a) the ratio of mother's schooling years to father's schooling years (for NFHS-1, NFHS-2 and NFHS-3); b) whether a husband is justified in beating his wife when she is unfaithful; or c) whether a wife is allowed to go to the market without permission from a husband (NFHS-2 and NFHS-3 only). Each variable is included one at a time. The average education of a father and a mother is considered as a control variable for the ratio of schooling years. Table 2 provides a summary of the signs and statistical significance of coefficient estimates for all the explanatory variables based on OLS, IV and QR applied to the three rounds of NFHS data. Table 3 reports the results of pseudo panel model based on NFHS data. As the variables available for NFHS-1 are limited, we present two sets of results for the three different child nutrition measures in two parts. The first part is based on NFHS-1, NFHS-2 and NFHS-3 and the second part is based on NFHS-2 and NFHS-3. These are shown in columns (1) to (6) in Table 3. The choice between fixed effects model and random effects model is based on the Hausman test and except one case for weight-for-age (column (2), Table 3), we have chosen the fixed effects model. In the interest of space, we discuss the key findings for several representative explanatory variables categorized as; a)

women's empowerment measures, b) Health insurance or health care schemes, and c) other selected covariates.

(Tables 1, 2, and 3 to be inserted)

(1) Women's empowerment measures

In the ensuing paragraphs, we discuss the results based on the three variables, (a) the ratio of mother's to father's schooling years, (b) presence of domestic violence (whether a husband beats a wife if she is unfaithful) and (c) autonomy in the wife's decision-making in everyday life (proxied by whether she is allowed to go to market without her husband's permission).

Relative educational attainment of mothers

It should be noted that in all the regressions, we have controlled for the average schooling years of a father and a mother to see the conditional correlation between their relative difference in educational attainments and child nutritional status. The average schooling years are positive and significant in most cases, irrespective of years or estimation methods (OLS, IV, or QR) except Table 3 where the pseudo panel model is applied. Our results underscore the importance of parental education in improving child nutrition[20], though the estimates need to be interpreted cautiously since statistical significance does not necessarily imply causality between parental education and child nutrition. The same caveat applies to all the regression results in Tables 1-3.

Our results on "the ratio of mother's and father's schooling years" show that, after controlling for the average level of parental education, a child whose mother is relatively better educated tends to have a better nutritional status in some cases. For the NFHS-1 data, the conditional correlation between the two variables is statistically significant for the stunting measure (which relies mainly on the statistical correlation for relatively stunted children, as suggested by the QR results) and for the underweight measure (on average -

based on OLS). In case of NFHS-2, the statistical relation between the two is significant for the underweight measure on average (based on OLS results) as well as for relatively underweight children (based on QR results). It is also significant, in case of NFHS-3, for the stunting measure for relatively stunted children (as suggested by QR results) as well as for the wasting measure on average (based on OLS and IV results), and for relatively under-nourished or normal children (based on QR results) (Table 1). A significant correlation is also found in the second column of Table 3 in which the random-effects model is applied for pseudo panel. While the results vary according to the specifications, we can conclude that the empowerment of women (proxied by their relative education) is associated with better nourishment of children at the lower conditional distribution of nutritional measures. This suggests that children of mothers with little education tend to be undernourished and they have to be supported by government interventions.

Domestic Violence

'Domestic violence' is not statistically significant in OLS for any of the three child undernutrition measures as shown in NFHS-2 data in 1998-99, but it is noted that it is statistically significant at the tail end of distribution (for the acutely undernourished children with Z score -4.0) for weight-for-age and weight-for-height measures. That is, the lack of women's empowerment, which is represented by domestic violence, is statistically associated with the short-term measures of children's undernourishment in 1998-99. In 2005-06, domestic violence is *positively* associated with height-for-age measure, though this is a counter-intuitive result that seems to be driven by adequately or over nourished children (with Z score 1 to 2), as suggested by QR. On the contrary, it is *negatively* associated with weight-for-height mainly for overweight children (with Z score 2 to 3). Overall, the violence variable, based on the OLS estimate, is negative and significant at 5 % level. As a larger value in height tends to increase height-for-age and decrease weight for height, this is not

surprising and more emphasis should be placed on the QR results. However, the pseudo-panel analysis, shown in Table 3 (Column (5)), indicates domestic violence is *positively* correlated with weight-for-age, though it does not suggest any causal relationships.

Autonomy in wife's decision-making in everyday life

As per NFHS-2 data in 1998-99, wife's autonomy in decision-making in everyday life as proxied by the variable on "whether she is allowed to go to market without her husband's permission" is positive and statistically significant in the case of OLS for height-for-age and weight-for-age, though not significant for weight-for-height. The results of QR suggest that the positive association for weight-for-age is more clearly observed for children undernourished or "adequately" nourished than those over-nourished. Taking the case of weight-for-age, the coefficient estimate is positive and significant for those with z score ranging from -4 to -2 with the estimate larger for more malnourished children. The size of coefficient implies that having autonomy (changing the value from 0 to 1) is associated with improvement in z score for underweight by 0.067 to 0.142 for undernourished children. With the caveat that the results show conditional statistical correlations rather than causality, they suggest that wife's autonomy could play a potentially important role in reducing the prevalence of underweight children.

On the other hand, the autonomy in everyday decision-making is positively and significantly associated with height-for-age, chronic measure of child nutrition in 2005-06, but not with weight-for-age or weight-for-height (except one case for the latter, z score of -2.0, where a negative and significant correlation is found). On the results of QR for height-for-age, significant and positive coefficient estimates are found for z score of -3.0. Here wife's autonomy could reduce the prevalence of stunted children given the same caveat. It is not easy to generalize the pattern of the results, but the pseudo panel analysis in Table 3 supports the significant and positive association between the measures of wife's autonomy

with those of stunting and underweight. This confirms the overall significant correlation between women's empowerment and child undernutrition.

(2) Household access to health insurance or healthcare schemes

The variable on whether a household has access to health scheme or health insurance is available for only NFHS-3. When we apply IV to weight-for-age, where it is instrumented by the availability of telephone in the region and village-level access to vaccination to take account of the endogeneity problem, the result suggests that household access to health insurance or healthcare schemes is associated with better nutritional status of children. Results for IV estimations are shown in the last panel of Table 1 (Case 1 of each panel). In the first stage, the availability of landline telephone as an instrument is statistically significant at the 1% level and the village-level access to vaccination is insignificant with t values ranging between 1.29 and 1.40. The result of under-identification test implies that the excluded instruments are correlated with the endogenous regressors and the correlation is not weak. Also, Hansen's over-identification test shows that the joint null hypothesis that the instruments are uncorrelated with the error term is not rejected, which supports the validity of the instruments.

Apart from the need for cautious interpretations for the over-identification test, Deaton (2010) argued that the IV result should not be interpreted as guidance for policy because of the underlying heterogeneity of the impact across different agents - which in our view is partly addressed by QR - and the difficulty in establishing the case for "exogeneity", which is often confused with "externality" by researchers. While IV results cannot be used as evidence for the causal relationship between the health insurance scheme and child nutritional status, it is safe to infer the conditional correlation between the two (household access to health insurance scheme and is nutritional status of children) as positive and statistically significant.

The actual "impact" of health insurance scheme would have to be evaluated by using real panel data or by carrying out carefully designed experimental studies.

(3) Other Covariates

In the interest of brevity, we only summarise the results based on the cross-sectional regressions for three rounds of NFHS data in Table 2.[21] The first column of each panel summarizes the results of OLS and IV where '+' or '-' are shown in case the coefficient estimate is significant. If it is significant only for OLS or IV, it is shown as, e.g., "+(ols)" or "+(IV)". If the variables are not available, it is shown as '(NA)'. In case of QR, while '+' and '-' signs indicate statistically significant cases, we show, e.g. '+*M*' for the case where a positive and significant coefficient is found in one of the categories 'malnourished' (z score <-2.0), '+*N*' (or '-*N*') for significant cases for 'normal' (-2.0<z < 2.0) and '+*O*' (or '-*O*') for significant cases for 'over-nourished'. In an exceptional case with both negative and positive significant coefficient estimates observed in different categories, the results are summarized, for example, as "-*MN*; +*O*".

It is important to note that the coefficient estimates of OLS based on the mean of the conditional distribution of a dependent variable do not necessarily reflect the coefficient estimates of each group derived by QR. Though as expected the results of OLS by and large reflect the results for the mean (which is normally close to the median). The results of QR are useful to check whether those of OLS will hold for all the nutritional groups across the entire conditional distribution of z. In a few cases, the results of QR are not only different from those of OLS, but change the signs at different points of conditional distributions. For example, a child's age is positive and statistically significant for weight-for-height (wasting) in OLS and IV for NFHS-3 (see the final column of Table 2), but is positive and significant up to the group with z score <-1.0, not significant for the group with z between -1.0 and 1.0,

and negative and significant for those with z score >1.0. This implies that the change of weight-for-height is in the direction of being equalized as the child gets older, but OLS is not able to capture that. This is the point emphasized by Borooah (2005). However, such cases are few and far between and we get results mostly consistent across different estimation methods. Again, given the space limitations, we highlight estimates provided in Tables 2 and 3 for select covariates in addition to the women's empowerment variables.

Environment

'Time necessary for getting water' has an expected negative and significant sign in some cases (Table 2). Pseudo panel analysis confirms that it is negatively and significantly associated with weight-for-height. As women are responsible for fetching water, there is an unavoidable trade-off between this activity and childcare. Access to electricity has a positive and significant coefficient in a number of cases in Table 2. It is negative and significant in column (3) of Table 3, "weight-for-height" for pseudo panel applied to all the three rounds.

Child characteristics

Consistent with previous studies (Borooah, 2005; Kandpal & McNamara, 2009), whether a child is male is negative and significant in most cases in Table 2 and for weight-for-height in Table 3. However, given that previous research suggests that the sign of a sex dummy of a child over the years can differ across countries (Charmarbagwala et al. 2004), our results are likely to be context specific. Age of a child is negative and significant with its square positive and significant in both Tables 2 and 3, implying that z score decreases as a child grows older but a marginal change will be smaller as age of the child increases. Consistent with Gaiha and Kulkarni (2005), the present estimates in Table 2 show that irrespective of which measure is used higher birth order negatively affects nutritional status. This is consistent with Jayachandran & Pande (2013a, b) who showed that the malnourishment in terms of the

height-for-age for the second and third born children in India tend to be more pronounced than for those in Sub-Saharan Africa.

Household Compositions or Characteristics

Mother's age is positive and significant with its square negative and mostly significant, implying that older mothers tend to have better nourished children with a non-linear effect (Table 2 and Columns (2), (3) and (6) of Table 3). Having more children under the age of five is associated with lower levels of nutrition mainly for short-term measures of undernutrition, namely weight-for-age and weight-for-height for NFHS-1 (Table 2). However, it is negative and significant in Column (4) of Table 3 where height-for-age is estimated by the pseudo panel method covering NFHS-2 and NFHS-3. Owning a TV is associated with better child nutritional status across different years and for different measures, particularly for the children undernourished (Table 2), which has been broadly confirmed by the pseudo panel estimates (Table 3). This result implies that TV may help households access the information on nutrition. There is some evidence that having a flush toilet at home is associated with better child nutrition. Further, children belonging to SC, ST or other backward groups tend to have lower nutritional levels than the rest (Table 2).

Food Price

As hypothesised, in Table 2 we obtained negative and significant coefficient estimates for food price for NFHS-1 in 1992-93. Further, food price is *positive* and significant for weight-for-age for the pseudo panel for NFHS-2 and NFHS-3 (see Column (5), Table 3). Price of sugar is negative and significant for height-for-age in 2005-06. These inconsistencies across years call for further examination, in terms of, for instance, whether a household is a net food consumer or a net food producer (Ivanic & Martin, 2008). Moreover, the commodity disaggregation has to be more detailed to reflect changing compositions of different food commodities. For instance, sweetened beverages, and fried and processed foods need to be

taken into account as their intake increases. Finally, cross-price effects on complements and substitutes are often significant and not captured here.

6. Concluding Observations

This study investigates whether mother's empowerment measured as mother's bargaining power relative to father's has any statistical association with children's nutritional status using three rounds of NFHS data for the years 1992-93, 1998-99, and 2005-06.[22] OLS, IV, quantile regressions (QR) and pseudo panel models are applied to these data sets. We summarise our central findings in the following paragraphs.

First, the measure of mother's bargaining power pertaining to education, namely, the share of mother's schooling years over father's schooling years is positively and significantly associated with z scores pertaining to the short-term measures of nutritional status of children, namely, weight-for-age and weight-for-height for all the three rounds of data. The results of QR suggest, however, that the bargaining power is statistically correlated with a chronic measure of nutritional status, height-for-age, at the low end of conditional distribution of z score. Second, the result of IV estimation indicates that access to health scheme or health insurance is statistically associated with higher values of weight-for-age in 2005-06. Third, health-related facility, infrastructure and environment are related to lower prevalence of child malnutrition. We find that better access to a flush toilet is related to better nutritional status of children in terms of stunting and underweight. Easier access to water seems associated with higher z score in weight-for-height. The results of QR imply that access to TV is correlated with better measures of "stunting" and "underweight" particularly at the lower distribution. Also, children belonging to Scheduled Caste (SC) tend to be more undernourished than those from non-SC households.

In sum, our results underscore the role of education as one of the critical indicators related to better nutritional indicators of children. However, enhancing educational levels may be a necessary but not a sufficient condition in improving child health outcomes (Dulfo 2013). Improved access to health care and sanitation expectedly play a significant part. The relevance of these factors corroborates the recommendations made by previous research in this area (Smith el al., 2003). Also, though the direction of the relationship with respect to domestic violence and autonomy is not consistent across all the measures of malnutrition, it appears that absence of domestic violence and greater autonomy for mothers are associated with lower levels in child malnourishment.

If we go by the predictions of household models, both Beckerian and bargaining, expanding outside employment options for women is key to their empowerment. However, there are many other factors, such as women's own asset holding, income, consumption or production skills, which would also lead to women's empowerment (Doss, 2013; Kabeer, 1999, 2005). Future research should carry out rigorous evaluations of policy interventions or poverty alleviation measures, such as microfinance, in terms of whether they would affect these outside options that empower women and thus reduce the prevalence of child malnutrition in developing countries.

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Table 1. *A Summary of Relationships between Bargaining Power of Mother and child malnutrition in Rural India (NFHS 1, 2 and 3)*

NFHS-1 Rural 1992-3

	OLS	**Quantile Regression**							
		Under-nourished			**Normal**			**Over-nourished**	
		(1) Z score -4.0	(2) Z score -3.0	(3) Z score - 2.0	(4) Z score -1.0	(5) Z score -0	(6) Z score 1.0	(7) Z score 2.0	(8) Z score 3.0
	Height for Age *1 *2	**Height for Age**							
[Mother's Schooling Yrs/	0.0508	0.000238	**0.122***	**0.0750***	0.0442	0.00342	-0.0315	-0.0740	-0.179
Father's Schooling Yrs]	(1.485)	(0.00399)	**(2.333)**	**(2.078)**	(1.275)	(0.0682)	(-0.237)	(-0.510)	(-1.532)
Average Schooling Years	**0.0343+**	0.0110	0.0402	**0.0490***	**0.0415+**	**0.0465+**	0.0227	0.0576	0.0866
	(1.784)	(0.323)	(1.237)	**(2.208)**	**(1.870)**	**(1.882)**	(0.431)	(0.522)	(1.217)
	Weight for Age	**Weight for Age**							
[Mother's Schooling Yrs/	**0.0400+**	**0.0741+**	**0.0672***	**0.0406+**	**0.0591***	0.00499	-0.00794	-0.0656	-0.127
Father's Schooling Yrs]	**(1.874)**	**(1.718)**	**(2.453)**	**(1.738)**	**(2.474)**	(0.196)	(-0.266)	(-1.523)	(-1.583)
Average Schooling Years	**0.0446****	0.0214	**0.0435***	**0.0505****	**0.0544****	**0.0613****	**0.0597****	**0.0684****	0.00818
	(3.606)	(0.854)	**(2.314)**	**(3.779)**	**(3.594)**	**(3.901)**	**(3.233)**	**(2.608)**	(0.203)
	Weight for Height	**Weight for Height**							
[Mother's Schooling Yrs/	-0.00508	-0.0830	-0.0387	0.0630	0.0173	4.13e-06	-0.0427	-0.0349	-0.0708
Father's Schooling Yrs]	(-0.175)	(-1.031)	(-0.522)	(1.526)	(0.462)	(0.000139)	(-1.068)	(-0.542)	(-0.366)
Average Schooling Years	**0.0381***	0.0661	0.0476	**0.0548+**	0.0319	**0.0376+**	0.0310	**0.0565+**	0.0283
	(2.315)	(1.483)	(1.178)	**(1.647)**	(1.625)	**(1.955)**	(1.457)	**(1.824)**	(0.326)

Table 1. *A Summary of Relationships between Bargaining Power of Mother and child malnutrition in Rural India (NFHS 1, 2 and 3) (cont.)*

NFHS-2 Rural 1998-9

	OLS		**Quantile Regression**							
			Under-nourished			**Normal**			**Over-nourished**	
			(1) Z score -4.0	(2) Z score -3.0	(3) Z score -2.0	(4) Z score -1.0	(5) Z score -0	(6) Z score 1.0	(7) Z score 2.0	(8) Z score 3.0
	Height for Age *1 *2		**Height for Age**							
[Mother's Schooling Yrs/	0.000597		0.0277	0.0183	-0.00162	-0.00940	0.00407	0.00550	-0.0177	-0.0284
Father's Schooling Yrs]	(0.0490)		(1.020)	(1.416)	(-0.137)	(-0.701)	(0.259)	(0.307)	(-1.171)	(-0.747)
Average Schooling Years	**0.0440****		**0.0416****	**0.0551****	**0.0490****	**0.0470****	**0.0398****	**0.0310****	0.0175	0.0303
	(8.080)		**(3.997)**	**(7.645)**	**(8.518)**	**(7.472)**	**(5.101)**	**(2.948)**	(1.003)	(1.145)
Whether a husband beats	0.0104		0.0290	0.0161	0.0128	-0.0168	0.0355	0.0620	-0.139	**-0.474****
if a wife is unfaithful	(0.308)		(0.453)	(0.385)	(0.346)	(-0.403)	(0.705)	(0.878)	(-1.316)	**(-3.318)**

Whether a wife is allowed to go to market without permission from a husband	**0.0807***		0.0607	0.0701	0.0318	-0.00761	0.0725	0.0794	-0.0939	4.70e-05
	(2.152)		(0.953)	(1.496)	(0.774)	(-0.172)	(1.248)	(0.981)	(-0.865)	(0.000289)
	Weight for Age		**Weight for Age**							
[Mother's Schooling Yrs/	**0.0219***		**0.0649****	**0.0364****	**0.0272****	0.00654	0.0221	0.0118	0.00631	-0.0423
Father's Schooling Yrs]	**(2.226)**		**(2.960)**	**(2.671)**	**(2.763)**	(0.559)	(1.546)	(0.716)	(0.209)	(-0.790)
Average Schooling Years	**0.0446****		**0.0420****	**0.0603****	**0.0505****	**0.0396****	**0.0383****	**0.0276****	0.0252	0.0291
	(10.22)		**(3.809)**	**(8.275)**	**(8.611)**	**(7.265)**	**(6.387)**	**(3.148)**	(1.523)	(1.483)
Whether a husband beats	-0.0296		**-0.141***	-0.0290	-0.0317	-0.0124	0.00586	-0.0400	-0.0283	-0.0248
if a wife is unfaithful	(-1.061)		**(-1.975)**	(-0.662)	(-0.892)	(-0.342)	(0.160)	(-0.695)	(-0.276)	(-0.138)
Whether a wife is allowed to go to market without permission from a husband	**0.0510+**		**0.142+**	**0.124***	**0.0672+**	0.0382	**0.0878***	0.0107	0.126	0.0989
	(1.694)		**(1.947)**	**(2.487)**	**(1.698)**	(1.076)	**(2.052)**	(0.147)	(1.207)	(0.560)
	Weight for Height		**Weight for Height *3**							
[Mother's Schooling Yrs/	0.0132		0.0324	**0.0623****	**0.0401***	0.0136	0.0201	0.00560	-0.0321	-
Father's Schooling Yrs]	(0.898)		(0.777)	**(3.497)**	**(2.134)**	(1.135)	(1.498)	(0.251)	(-0.996)	-
Average Schooling Years	**0.0167***		**0.0384****	**0.0531****	**0.0376****	**0.0307****	**0.0170****	0.00883	-0.00674	-
	(2.359)		**(2.747)**	**(5.433)**	**(4.885)**	**(5.791)**	**(2.871)**	(0.807)	(-0.736)	-
Whether a husband beats	-0.0654		**-0.156+**	-0.0631	-0.0380	**-0.0782***	-0.0461	-0.0553	-0.0458	-
if a wife is unfaithful	(-1.507)		**(-1.695)**	(-0.838)	(-0.780)	(-2.244)	(-1.252)	(-0.764)	(-0.826)	-
Whether a wife is allowed to go to market without permission from a husband	0.0769		**0.188***	-0.0183	0.0746	0.0663	**0.105***	**0.162***	**0.104+**	-
	(1.617)		**(2.038)**	(-0.258)	(1.334)	(1.641)	**(2.453)**	**(1.981)**	**(1.686)**	-

Table 1. *A Summary of Relationships between Bargaining Power of Mother and child malnutrition in Rural India (NFHS 1, 2 and 3) (cont.)*

NFHS-3 Rural 2005-6

	OLS	**IV**			**Quantile Regression**							
					Under-nourished			**Normal**			**Over-nourished**	
					(1) Z score -4.0	(2) Z score -3.0	(3) Z score -2.0	(4) Z score -1.0	(5) Z score -0	(6) Z score 1.0	(7) Z score 2.0	(8) Z score 3.0
	Height for Age				**Height for Age**							
		Case 1	Case 2	Case 3								
[Mother's Schooling Yrs/	**0.0418****	**0.0225+**	0.0395	-0.0237	**0.0635****	**0.0359****	0.0111	-0.000497	-0.0104	0.00210	-0.00410	-0.0619
Father's Schooling Yrs]	**(6.671)**	**(1.674)**	(0.554)	(-0.939)	**(4.153)**	**(2.644)**	(1.085)	(-0.0427)	(-0.693)	(0.0491)	(-0.119)	(-0.962)
Average Schooling Years	**0.129****	**0.130****	0.134	**0.0384****	**0.0416****	**0.0492****	**0.0502****	**0.0449****	**0.0350****	**0.0208***	0.0144	-0.0286
	(4.017)	**(3.584)**	(0.633)	**(3.531)**	**(3.275)**	**(7.348)**	**(8.925)**	**(8.963)**	**(5.297)**	**(2.529)**	(0.943)	(-1.062)
Whether a husband beats	**0.0800+**		-0.298		-0.0192	-0.0532	-0.0320	0.0420	**0.0840+**	**0.183***	**0.310***	**0.330+**

if a wife is unfaithful	**(1.741)**	(-0.030)			(-0.261)	(-1.138)	(-0.816)	(1.094)	**(1.797)**	**(2.535)**	**(2.488)**	**(1.754)**
Whether a wife is allowed to go to market without permission from a husband	**0.0944***			0.571	0.000545	**0.0910***	0.0335	0.0564	0.0232	0.106	0.152	0.124
	(2.138)			(0.354)	(0.00751)	**(1.961)**	(0.890)	(1.559)	(0.508)	(1.507)	(1.041)	(0.671)
Whether a household has access to Health Insurance or Health case schemes	-0.0141	4.729			-0.115	0.222	-0.0241	0.0820	-0.0954	0.0389	0.180	-0.207
	(-0.121)	(1.605)			(-0.401)	(1.463)	(-0.220)	(0.797)	(-0.541)	(0.282)	(0.502)	(-0.501)
		First Stage IV			***Specification Tests for IV** (the cases in favour of valid instruments are shown in bold)							
		Case 1*	Case 2*	Case 3*								
Village-level average land-line phone access		**0.0796 (2.42)***			***Case 1: Underidentification test (Kleibergen-Paap rk LM statistic): 6.770* (Chi-sq(2) P-val = 0.0339)** **Hansen J statistic (overidentification test of all instruments): 2.325 (Chi-sq(1) P-val = 0.1273)**							
Village-level access to vaccination		0.016 (1.29)			***Case 2: Underidentification test (Kleibergen-Paap rk LM statistic): 0.122 (Chi-sq(2) P-val = 0.9407)** **Hansen J statistic (overidentification test of all instruments): 0.278 (Chi-sq(1) P-val = 0.5980)**							
Age difference of mother and father			0.00039 (0.30)	0.0007 (0.49)	***Case 3: Underidentification test (Kleibergen-Paap rk LM statistic): 4.714+ (Chi-sq(2) P-val = 0.0947)** **Hansen J statistic (overidentification test of all instruments): 0.150 (Chi-sq(1) P-val = 0.6985)**							
Village-level the ratio of men's and women's implied wage rates			-0.013 (-0.17)	**-0.157 (-2.10)***								
	Weight for Age				**Weight for Age**							
	OLS	**IV**										
[Mother's Schooling Yrs/ Father's Schooling Yrs] Average Schooling Years	-0.00424 (-0.341) **0.0439** (9.134)**	0.00374 (0.266) **0.0267* (2.462)**	0.0185 (0.445) 0.0746 (1.360)	-0.0218 (-1.017) **0.0323** (3.127)**	-0.0302 (-0.724) **0.0537** (3.359)**	0.0237 (1.279) **0.0615** (9.278)**	0.0102 (1.044) **0.0469** (8.848)**	0.00422 (0.431) **0.0392** (9.431)**	0.00904 (0.807) **0.0370** (6.659)**	0.0212 (1.199) **0.0395** (5.968)**	-0.0111 (-0.415) 0.0208 (1.534)	-0.0228 (-0.283) -0.00315 (-0.367)
Whether a husband beats if a wife is unfaithful	-0.0142 (-0.416)		3.880 (0.554)		-0.00647 (-0.0651)	-0.0492 (-0.987)	-0.0175 (-0.471)	0.0142 (0.451)	0.0123 (0.340)	0.0638 (1.204)	0.108 (1.055)	-0.0430 (-0.438)
Whether a wife is allowed to go to market without permission from a husband	0.0316 (0.971)			2.103 (1.441)	0.0290 (0.230)	0.0381 (0.778)	0.0202 (0.638)	-0.0147 (-0.484)	-0.0384 (-1.116)	-0.0465 (-0.861)	0.0424 (0.419)	0.210 (1.306)
Whether a household has access to Health Insurance or Health case schemes	0.000801 (0.00857)	**4.622+ (1.900)**			0.0697 (0.362)	0.0888 (0.780)	0.0153 (0.120)	0.0328 (0.410)	0.0507 (0.427)	0.184 (0.483)	**0.666* (2.063)**	0.176 (1.098)
		First Stage IV			***Specification Tests for IV** (the cases in favour of valid instruments are shown in bold)							
		Case 1*	Case 2*	Case 3*								
Village-level average land-line phone access		**0.0783 (2.45)***			***Case 1: Underidentification test (Kleibergen-Paap rk LM statistic): 7.007* (Chi-sq(2) P-val = 0.0301)** **Hansen J statistic (overidentification test of all instruments): 0.140 (Chi-sq(1) P-val = 0.7079)**							
Village-level access to vaccination		0.016 (1.31)			***Case 2: Underidentification test (Kleibergen-Paap rk LM statistic): 0.470 (Chi-sq(2) P-val = 0.7905)** **Hansen J statistic (overidentification test of all instruments): 0.846 (Chi-sq(1) P-val = 0.3577)**							
Age difference of mother and father			0.00088 (0.68)	0.00010 (0.08)	***Case 3: Underidentification test (Kleibergen-Paap rk LM statistic): 5.106+ (Chi-sq(2) P-val = 0.0779)** **Hansen J statistic (overidentification test of all instruments): 0.325 (Chi-sq(1) P-val = 0.5685)**							

Village-level the ratio of men's			-0.0039	**-0.168**
and women's implied wage rates			(-0.05)	**(-2.26)***

Table 2. *Summary of Results of OLS, IV and Quantile Regressions (QR) based on NFHS Data*

	Weight for Height				**Weight for Height**							
[Mother's Schooling Yrs/	**0.0286***	**0.0300***	0.0451	0.00609	0.0325	**0.0297+**	0.00530	0.00527	0.00188	0.0219+	0.0217	-0.00318
Father's Schooling Yrs]	**(2.236)**	**(2.268)**	(0.850)	(0.259)	(1.202)	**(1.740)**	(0.448)	(0.452)	(0.182)	(1.703)	(0.980)	(-0.0921)
Average Schooling Years	**0.0284****	**0.0266****	0.0545	0.0160	**0.0404****	**0.0583****	**0.0399****	**0.0245****	**0.0208****	**0.0204****	**0.0255***	0.0114
	(5.568)	**(3.325)**	(0.686)	(1.434)	**(2.989)**	**(4.538)**	**(6.662)**	**(5.217)**	**(4.558)**	**(3.343)**	**(2.384)**	(0.704)
Whether a husband beats	**-0.0847***		3.531		0.144	-0.0801	-0.0667	**-0.0712***	-0.0384	-0.0358	**-0.123+**	**-0.327***
if a wife is unfaithful	**(-2.321)**		(0.332)		(1.586)	(-0.924)	(-1.550)	**(-2.043)**	(-1.213)	(-0.833)	**(-1.646)**	**(-2.107)**
Whether a wife is allowed	-0.0388			2.041	0.0531	-0.109	**-0.0673+**	-0.0449	-0.0275	-0.0381	-0.0119	0.0642
to go to market without permission from a husband	(-1.122)			(1.319)	(0.726)	(-1.347)	**(-1.672)**	(-1.358)	(-0.885)	(-0.978)	(-0.188)	(0.363)
Whether a household has access to Health Insurance or Health case schemes	-0.00355	0.695			0.591	0.0590	-0.0382	0.0241	0.0577	-0.00242	0.153	-0.321
	(-0.0365)	(0.439)			(1.542)	(0.380)	(-0.378)	(0.189)	(0.565)	(-0.017)	(0.738)	(-0.909)

		First Stage IV		
		Case 1*	Case 2*	Case 3*
Village-level average land-line phone access		**0.0868 (2.63)****		
Village-level access to vaccination		0.017 (1.40)		
Age difference of mother and father			0.000558 (0.43)	0.00040 (0.30)
Village-level the ratio of men's and women's implied wage rates			0.0093 (0.12)	**-0.168 (-2.22)***

***Specification Tests for IV** (the cases in favour of valid instruments are shown in bold)

***Case 1: Underidentification test (Kleibergen-Paap rk LM statistic): 8.040* (Chi-sq(2) P-val = 0.0179)**
Hansen J statistic (overidentification test of all instruments): 0.159 (Chi-sq(1) P-val = 0.6904)
***Case 2: Underidentification test (Kleibergen-Paap rk LM statistic): 0.109 (Chi-sq(2) P-val = 0.2961)**
Hansen J statistic (overidentification test of all instruments): 1.263 (Chi-sq(1) P-val = 0.2611)
***Case 3: Underidentification test (Kleibergen-Paap rk LM statistic): 5.062+ (Chi-sq(2) P-val = 0.0796)**
Hansen J statistic (overidentification test of all instruments): 0.316 (Chi-sq(1) P-val = 0.5742)

Notes: *1. t-statistics in parentheses (** p<0.01, * p<0.05, + p<0.1). Statistically significant coefficients are shown in bold. *2. Coefficient estimates cannot be obtained in the case of "Z score 3.0".

	NFHS-1 (1992/3)						NFHS-2 (1998/9)						*NFHS-3 (2005/6)*					
	HAZ[*1]		WAZ[*1]		HWZ*[1]		HAZ[*1]		WAZ[*1]		HWZ*[1]		*HAZ[*1]*		*WAZ[*1]*		HWZ*[1]	
VARIABLES	OLS	QR	OLS	QR	OLS	QR	OLS	QR	OLS	QR	OLS	QR	*OLS/IV*	*QR*	*OLS/IV*	QR	OLS/IV	QR
Bargaining/ Women's Empowerment																		
Ratio of schooling years (mother/father)		**+*M***	**+**	**+*MN***					**+**	**+*M***		**+*M***		**+*M***			**+**	**+*MN***
Average schooling years	**+**	**+*MN***	**+**	**+**	**+**	**+*NO***	**+**	**+*MN***	**+**	**+*MN***	**+**	**+*MN***	**+(ols)**	**+**	**+**	**+**	**+**	**+**
Whether a husband beats his wife if she is unfaithful	*(Data 'Not Available' or NA)*							**-*O***		**-*M***		**-*MN***	**+(ols)**	**+*NO***			**-(ols)**	**-O**
Whether a wife is allowed to go to market without husband's permission	*(NA)*						**+**		**+**	**+*MN***	**+**	**+**	**+(ols)**	**+*M***				**-*M***
Policy																		
Whether a household has access to health insurance/healthcare scheme	*(NA)*						*(NA)*							**+*M***	**+(IV)**	**+*O***		**+*M***
Environment																		
Time necessary for getting water		**-*NO***						**-*MN***	**-**	**-*MO***		**+*M***	**-(ols)**	**-*M***		**-*MN***		**-*MN***
Whether a household has access to electricity			**+**	**+**	**+**	**+*N***	**+**			**+*MN***	**-**	**+*M***		**+*MN***		**+*M*; -*O***	**-**	
Child Characteristics																		
Whether child is Male	**-**	**-*M***		**-*MN***		**-*MN***	**-**	**-**	**-**	**-*M***	**-**	**-**	**-**	**-**	**-**	**-*M***	**-**	**-*MN***
Child's Age	**-**	**-**	**-**	**-**			**-**	**-**	**-**	**-**	**-**	**-*NO***	**-**	**-**	**-**	**-**	**+**	**+*MN*; -NO;**
Age squared	**+**	**+**	**+**	**+**	**+**	**+*NO***	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**		**-*M*; +*O***
Whether second child		**-*N***		**+*M*; -*NO***		**+*O***	**-**	**-*MN***	**-**	**-*MN***						**-**	**-**	**-*NO***
Third child		**-*O***	**-**	**-*NO***		**-*N***	**-**	**-*MN***	**-**	**-*MN***	**-**	**-*N***		**-*MN***		**-*MN***		**-*N***
Fourth more	**-**	**-*NO***	**-**	**-*NO***	**-**	**-*NO***	**-**	**-*MN***	**-**	**-*MN***	**-**	**-*N***	**-**	**-MN**	**-(IV)**	**-*MN***		**-*N***
Household Composition & Characteristics																		
Mother's age	**+**	**+*NO***	**+**	**+**	**+**	**+*N***	**+**	**+*MN***	**+**	**+*MN***	**+**	**+*N***	**+**	**+*M*N**	**+(ols)**	**+*M*N**		**-O**
Mother's age squared		**+*NO***	**-**	**-**	**-**	**-*N***	**-**	**-*M*N**	**-**	**-*MN***	**-**	**-*N***	**-**	**-*M*N**	**-**	**-*M*N**		**+O**
Household size		**+*O***		**-*O***				**-*MO***						**-*N*; +*O***			**+**	**+*M*N**

Share of children under 5		-O		-O	-	-NO				-M; +O			-	-NO		-O		+N
Whether a household holds Radio		+M	+	+M	+	+MN								+MN		-MN		-M
-- TV	+	+M		+MO			+	+MN	+	+MN		+MN		+MN	+	+	+(ols)	+N
-- Fridge		-O		+N		+N				+M		+M	+	+	+(ols)	+MN		+M
-- Bicycle							-	-N		+M				+M; -O		-NO	-	-NO
-- Flush toilet		+MO		+MN ;-O		-O	+	+MN	+	+N				+MN	+	+		+N
Whether a household belongs to Scheduled Caste		+MN			-	-N	-	-MN	-	-MN		-M	-	-	-	-		
Whether a household belongs to Scheduled Tribe						-N		-N	-	-MN		-MN	-	-MN	-	-MN	-	-MN
Whether a household belongs to Other Disadvantaged Groups	-	-M		-MN	+	+MO		-MN	-	-MN		-MN	-	-MN	-	-NO		+M
Hindu		+O				-M	-	+NO	-	-MN	-	-MN		+				+O
Muslim		+O		-N		-M	-	+O	-	-N				+NO				
Christian		+O		+O				+NO		+O								
Sikh		+O		+O			-	+O	-	-		-MN		+NO				
Regional Dummies																		
BIMARU							-	-M; +O	-	-			-	+NO	-		-(ols)	
South				+MN			+		-		-		-	+	-(IV)	+MO		-MN
East		+N;-O	-				+		-		-		-(IV)	+O	-(IV)		+(IV)	+N
West	+	+NO	-	-O	-	-NO			-	+M; -O	-		-(IV)	-MN	-	-N; +O	-(ols)	-N
Food Price																		
Food Price	-	-		-N		+M; -NO		+NO										
Sugar Price				(NA)					(NA)				-	+	+(ols)	+		+N
Egg Price				(NA)					(NA)				-(iv)	-NO			+(IV)	-N
Cereal Price				(NA)					(NA)					-O		+O		

*1 HAZ: Z score for Height for Age; WAZ: Z score for Weight for Age; WHZ: Z score for Weight for Height. *2 "+" or "-" is shown in the case where the coefficient estimates are statistically significant. In the case of Quantile Regression (QR), M stands for 'Malnourished'(shown as Italics to emphasise the factors associated with the nutritional changes of under-nourished children). That is, "+M" means "positive and statistically significant only for malnourished children. Similarly, N stands for Normal and O stands for Over-nourished. We put M (or N, O) if we find any sub-group for which a coefficient estimate is statistically significant. A full set of results are furnished on request.

Table 3. *Pseudo Panel for Z Score of Children based on the NFHS data*

VARIABLES	(1) Height for Age	(2). Weight for Age	(3). Weight for Height	(4). Height for Age	(5). Weight for Age	(6). Weight for Height
Fixed or Random	Based o NFHS 1, 2 and 3			Based on NFHS 2 and 3		
Effects Model	FE[*1]	RE[*1]	FE	FE	FE	FE
Bargaining/ Women's Empowerment						
[Mother's Schooling Yrs/	0.0432	**0.197**** [*3]	**0.280****	0.0601	**0.243****	**0.281***
Father's Schooling Yrs]	(0.476) [*2]	**(3.372)**	**(3.451)**	(0.497)	**(3.047)**	**(2.484)**
Average schooling years	0.0143	0.00645	-0.0354	0.0353	0.0231	-0.0298
	(0.367)	(0.316)	(-1.012)	(0.814)	(0.809)	(-0.736)
Whether a husband beats his	-	-	-	0.388	**0.376***	0.260
wife if she is unfaithful				(1.451)	**(2.140)**	(1.040)
Whether a wife is allowed to go to market without husband's permission	-	-	-	**0.453+**	**0.342***	0.136
				(1.946)	**(2.230)**	(0.627)
Environment						
Time necessary for getting water	0.00188	-0.00105	**-0.01000****	0.00276	0.00300	**-0.00894***
	(0.468)	(-0.404)	**(-2.772)**	(0.627)	(1.035)	**(-2.175)**
Whether a household has access	0.349	-0.0861	**-0.463+**	0.296	-0.169	-0.447
to electricity	(1.273)	(-0.638)	**(-1.890)**	(0.988)	(-0.858)	(-1.595)
Child Characteristics						
Whether child is male	-0.0312	-0.156	**-0.400***	-0.174	**-0.292+**	**-0.468***
	(-0.145)	(-1.043)	**(-2.076)**	(-0.735)	**(-1.876)**	**(-2.123)**
Child's age	**-0.218****	**-0.0760***	**-0.0785+**	**-0.149****	**-0.0675+**	-0.0722
	(-4.153)	**(-2.103)**	**(-1.670)**	**(-2.654)**	**(-1.823)**	(-1.374)
Age squared	**0.00357****	**0.00182***	**0.00208+**	0.00194	0.00133	0.00198
	(2.752)	**(2.030)**	**(1.792)**	(1.396)	(1.454)	(1.531)
Whether second child	0.566	-0.213	-0.472	**0.829+**	0.0624	**-0.890***
	(1.401)	(-0.776)	(-1.306)	**(1.813)**	(0.207)	**(-2.084)**
Third child	0.354	-0.368	-0.427	**1.072+**	-0.167	**-0.909+**
	(0.781)	(-1.194)	(-1.053)	**(1.920)**	(-0.454)	**(-1.745)**
Fourth more	0.480	**-0.721****	**-0.844***	**1.122***	-0.0291	**-1.041***
	(1.132)	**(-2.694)**	**(-2.222)**	**(2.347)**	(-0.0923)	**(-2.331)**
Household Composition & Characteristics						
Mother's age	0.0259	**0.124****	**0.115***	-0.0730	0.0263	**0.113+**
	(0.412)	**(2.979)**	**(2.040)**	(-1.029)	(0.564)	**(1.710)**
Mother's age squared	-0.000351	**-0.0017****	**-0.00158***	0.000809	-0.000455	-0.00148
	(-0.405)	**(-2.982)**	**(-2.030)**	(0.824)	(-0.705)	(-1.614)
Share of children under 5	-0.485	**-0.381+**	0.0672	**-3.348****	0.398	**2.541***
	(-1.521)	**(-1.885)**	(0.235)	**(-3.012)**	(0.544)	**(2.448)**
Whether a household holds	0.400	0.237	-0.324	-0.0536	0.0240	-0.251
Radio	(1.533)	(1.492)	(-1.390)	(-0.181)	(0.123)	(-0.907)
- TV	0.00482	0.165	**0.767****	**0.752***	**0.675****	**0.914****
	(0.0163)	(0.905)	**(2.893)**	**(2.155)**	**(2.939)**	**(2.803)**
- Fridge	0.311	0.0471	0.0649	0.0581	0.371	-0.0460
	(0.814)	(0.203)	(0.190)	(0.119)	(1.155)	(-0.101)
- Bicycle	0.363	0.161	-0.112	-0.0972	0.215	-0.137
	(1.534)	(1.302)	(-0.528)	(-0.354)	(1.187)	(-0.535)
- Flush Toilet	**0.949****	**0.654****	**-0.647***	0.374	-0.0266	**-0.688***
	(3.274)	**(4.184)**	**(-2.495)**	(1.024)	(-0.111)	**(-2.017)**
Whether a household belongs to	**-1.191****	**-0.699****	**-0.499+**	**-1.402****	**-1.036****	**-1.000****
Scheduled Caste	**(-3.884)**	**(-3.731)**	**(-1.819)**	**(-3.845)**	**(-4.318)**	**(-2.937)**
Whether a household belongs to	0.378	-0.00342	-0.0479	-0.217	-0.382	-0.427
Scheduled Tribe	(1.078)	(-0.0197)	(-0.153)	(-0.502)	(-1.344)	(-1.059)

Whether a household belongs to	-0.137	0.129	**0.388+**	-0.129	0.112	0.110
Other Backward Groups	(-0.522)	(0.895)	**(1.658)**	(-0.422)	(0.556)	(0.385)
Hindu	-0.389	**-0.431+**	0.157	-0.592	0.118	0.185
	(-0.538)	**(-1.648)**	(0.243)	(-0.740)	(0.224)	(0.248)
Muslim	-1.140	-0.380	0.111	**-1.674***	-0.350	-0.0777
	(-1.529)	(-1.406)	(0.166)	**(-1.983)**	(-0.630)	(-0.0986)
Christian	**-1.190+**	-0.245	0.161	**-1.242+**	0.309	0.385
	(-1.925)	(-0.999)	(0.292)	**(-1.910)**	(0.723)	(0.634)
Sikh	**-2.442***	-0.375	**1.871***	**-2.605***	0.0285	2.176*
	(-2.344)	(-1.033)	**(2.007)**	**(-2.377)**	(0.0396)	(2.125)
rural	-	-0.629	-	-	-	
		(-0.906)				
Regional Dummies						
BIMARU	0.392	**-0.310****	**1.169****	0.526	**0.716***	**1.316****
	(0.968)	**(-3.831)**	**(3.229)**	(1.229)	**(2.544)**	**(3.295)**
South	**-0.819***	**-0.199***	-0.00629			0.329
	(-2.463)	**(-2.537)**	(-0.0212)			(0.960)
East	-0.440*	**-0.296****	-0.201	-0.505*	**-0.581****	-0.286
	(-2.447)	**(-3.893)**	(-1.249)	(-2.553)	**(-4.468)**	(-1.551)
West		**-0.255****		0.570	0.0563	
		(-3.078)		(1.551)	(0.233)	
Food price	-0.000239	-0.00124	0.00242	0.00420	**0.00625***	0.00640
	(-0.0941)	(-1.377)	(1.065)	(0.875)	**(1.978)**	(1.427)
Time Dummies						
Whether 1998	0.0809	**0.461+**	**2.054+**			
	(0.0631)	**(1.736)**	**(1.791)**			
Whether 2005	0.523		1.900	1.688	**1.917***	1.039
	(0.258)		(1.050)	(1.210)	**(2.089)**	(0.798)
Constant	-0.211	-1.728	-3.896	0.706	-4.204	-4.172
	(-0.0939)	(-1.852)	(-1.935)	(0.344)	(-3.118)	(-2.191)
Observations	390	419	390	338	338	338
R-squared	0.377		0.486	0.408	0.404	0.498
Number of state	29	29	29	29	29	29
Hausman Test	$Chi^2(29)$=	$Chi^2(30)$=	$Chi^2(29)$=	$Chi^2(30)$=	$Chi^2(30)$=	$Chi^2(31)$=
	93.17**	19.23	280.85**	59.79**	138.07**	66.55**
Prob>chi^2	0	0.935	0	0.001	0	0.0002
Chosen Model (fixed-effects (FE) or random-effects (RE) model)	FE *1	RE *1	FE	FE	FE	FE

Notes: *1. FE stands for Fixed-Effects Model and RE random effects model. *2. t-statistics in parentheses (** p<0.01, * p<0.05, + p<0.1). *3. Statistically significant coefficients are shown in bold.

NOTES

[1] BRIC comprises the fast growing countries of Brazil, Russia, India and China. SAARC stands for the South Asian Association for Regional Cooperation.

[2] Also, height-for-age among children is lower in India than in Sub-Saharan Africa despite the former's high level of economic growth (Jayachandran & Pande, 2013a, b).

[3] "Gender system" refers to the "socially constructed expectations for male and female behaviour that are found (in variable from) in every known society" (Mason, 1995, p.1, cited by Williams, 2005, p.7).

[4] See Doss (2013) for an excellent review of the conceptual and empirical literature on intra-household bargaining power.

[5] One of the reviewers has raised this important issue.

[6] Doss (2013, p.35) argues that "(g)iven the convincing evidence that bargaining power is important in some specific cases, we should be more willing to accept the findings of less rigorous studies as well as those that simply demonstrate correlations."

[7] The limitations of these measures should be fully noted. For instance, the relative education can represent the overall access to information to be influenced by social norms, rather than, dynamic aspects in autonomous decision making. Likewise, the presence of violence may be affected by social or cultural norms at communities as to the extent to which violence is justified (Koenig et al., 2006). As better proxies are not available in the survey data, we will use these measures recognising their limitations.

[8] The health production approach could be incorporated in non-unitary or bargaining household models (Thomas, 1994).

[9] Maitra (2004) assumes that parents bargain over the use of health care (e.g. prenatal care and hospital delivery) and examines the effects of health care on child mortality. To avoid complication in the empirical model, we assume that parents can directly bargain over child

health and nutritional status where the bargaining coefficient captures both direct effects of bargaining and indirect effects through the use of health care.

[10] Non-cooperative bargaining models include Lundberg and Pollak's (1993) model which specifies the threat point as a non-cooperative equilibrium within marriage and define it in terms of traditional gender roles and gender role expectations.

[11] An underlying assumption is that parents care about the average health quality of their children without their preferences over boys or girls in improving their health following the theoretical literature (e.g. Maitra, 2004) as inclusion of different preferences for mothers and mothers will unnecessarily complicate the model. Further, the nutritional advantage of girls over boys aged 0-3 years has been found in India (e.g. Naandi Foundation, 2011) and it is not entirely clear the extent to which son's preference exists among parents and how it results in different nutritional outcomes between boys and girls. We have included the interaction of child's age and various women's empowerment measures to see how its or their effects on child's nutritional status differ according to child's sex, but they are not statistically significant. This implies that there is no significant interacted effect between women's empowerment and child's sex. This does not necessarily imply the lack of son's preference, but it indirectly supports our assumption in the model.

[12] See http://www.nfhsindia.org/index.html for the detailed description of NFHS.

[13] Sachdev et al. (1992) reported that 37 died among 382 children under 5 due to fatal diarrhoea in India had a mean z score of -4.3 (with s.d. 1.2) for weight- for- age and of -3.8 (s.d. 1.3) "for height- for- age", which implies the acuteness of malnutrition corresponding to z score under -4.

[14] Variance has been clustered at the household level using Stata 13.0 (*ivreg2* and *qreg2*).

[15] IV estimations were tried for the NFHS-2 as well, but no plausible results were obtained due to the lack of valid instruments.

[16] As the NFHS-3 data do not include wage rates, we have estimated men's wage rates and women's wage rates separately using the NCAER data in 2005 and applied Two Sample Two Stage Least Squares to obtain the implied wage rates for men and women separately using the NFHS-3 data and then have taken village-level averages. Details of the results of wage equations will be furnished on request. This method is limited as the wage levels are derived as implied values, but will be useful in obtaining a valid instrument for bargaining variables under the data constraints. This method is not possible with NFHS-2 due to the data limitations (e.g. lack of the data for adult men or unavailability of NCAER data in the same year).

[17] Ideally, the variable on mobile phone access should be also used, but the survey did not cover such data.

[18] BIMARU stands for the states of Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh.

[19] It is assumed here that the regional effects are supposed to be constant. Taking account of time-variant regional factors, such as regional health initiatives, is important, but our data do not include such information.

[20] The positive and significant coefficient estimate of the average education could imply the importance of knowing about appropriate parenting practices, knowing where to access additional information (e.g. health clinic, ICDS center, TV, newspaper) and being able to use these sources of information. We thank one of the referees for pointing this out.

[21] A full set of results will be furnished on request.

[22] The National Council of Applied Economic Research (NCAER) data in 2005 were also used to derive the implied values of wage rates for women and men which have been used to construct an instrument. In fact, we have used NCAER data in 1994 and 2005 and attempted all the cases (OLS, IV, QR and pseudo panel) to cross-check the results. While there are a

few inconsistencies (e.g. the bargaining variables are not statistically significant), the overall patterns of the results are similar. The results will be furnished on request.