

Mother's education and female child survival: An empirical study from India

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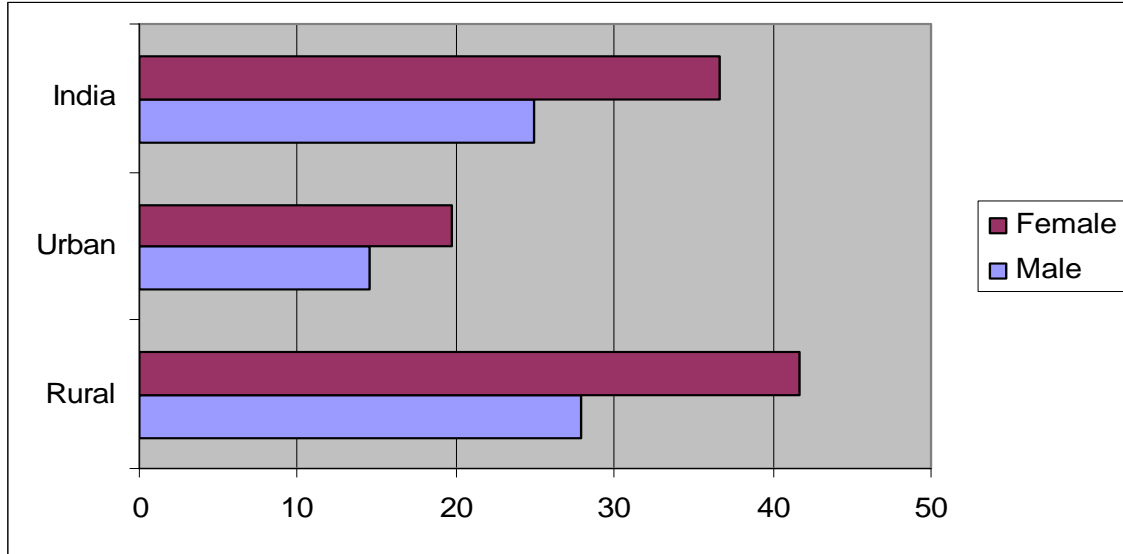
Abstract: In India, child mortality rates for girls are much higher than those for boys, indicating discrimination against girls in the intra-household allocation of resources. In addition, overall child mortality rates remain high in many parts of the country. This paper attempts to understand important predictors of both child and excessive female child mortality in India, with a focus on variables relating to maternal agency and education. Attempts are made to isolate the precise channels through which mother's education influences survival probabilities of children, particularly, girls in India. Overall education effects are decomposed into autonomy, information and other effects and then regressed on child and excessive female child mortality variables in India. It is found that while information effects of education are important in both child mortality and excess female child mortality regressions; autonomy enhancing effects of education are much more important in predicting excess female child mortality than child mortality as a whole. In addition, even after controlling for autonomy and information effects, education significantly and negatively affects both child and excessive female child mortality, indicating that other direct benefits of education (beyond information and autonomy) are important. These results have interesting social and policy implications and indicate several promising lines of research.

JEL codes: I 12, I 20, J 13, J 16

1 Introduction

There is a growing consensus regarding how households are an arena often marked by conflict, contestation and discord, wherein the welfare of different members may differ dramatically. In many south Asian countries, including India, there is considerable discrimination against women within the household. Most women in this region find themselves treated unequally with respect to bodily safety, basic nutrition, health care, education, employment and social and political voice. Most commonly, the female disadvantage is seen to be mirrored in the low sex ratios (Mayer 1999) and the high mortality rates of women (Visaria 1971).

In India, the mortality rates of women exceed that of men till the age of 35, this despite fairly strong medical evidence to the effect that – given similar care, women tend to have lower age specific mortality rates than men (Sen 1984). The consensus among demographers seems to be that discrimination against girls and the neglect of women in general, are responsible for the higher female mortality rates (Visaria, 1971; Mitra, 1978). Sen's seminal work on '*missing women*' (Sen 1989) looked at the relative role of different factors in explaining excessive mortality of girls in India, most of which relate to some form of discrimination against the female child. Most often, this discrimination takes the form of compromised access to critical resources like nutrition and health care.



Source: NFHS (1998-99)

Figure 1: Probability of dying between 1st and 5th birthday by child's sex

2 Post natal discrimination against girls in India

The phenomenon of post natal discrimination against girls in India is closely linked with strong son preference prevalent in large parts of the country. In India, society tends to be organized along strictly patriarchal lines. It is characterized by patrilineal descent and patrilocal residence (Altekar 1962, Karve 1965). Such patterns of social organization have been known to be detrimental to female agency in general and their social and economic worth in particular. Women have few opportunities outside the household and their mobility and freedoms are rigidly controlled. Daughters get married early and are not encouraged to maintain strong ties with their natal families. Sons on the other hand, are expected to take care of their parents in old age, are much more likely to engage in paid work and are able to inherit land. All these factors create strong incentives for couples to strive for a greater proportion of sons in their family. Sons are considered valuable assets to the household while daughters are viewed as liabilities.

Dyson and Moore (1983) show that for India low female survival rates are significantly correlated with region, north India showing highest excess female mortality. At the same time, it is in north India that norms of patriarchy and female exclusion are most strictly enforced. This indicates that differences in kinship patterns across the country may be important. In addition, Bardhan (1984) contends that the female disadvantage in some parts of the country is directly linked to their low participation in agriculture. North India has predominantly dry land cultivation where female participation has traditionally been low as compared to the wet land cultivation found in south India.

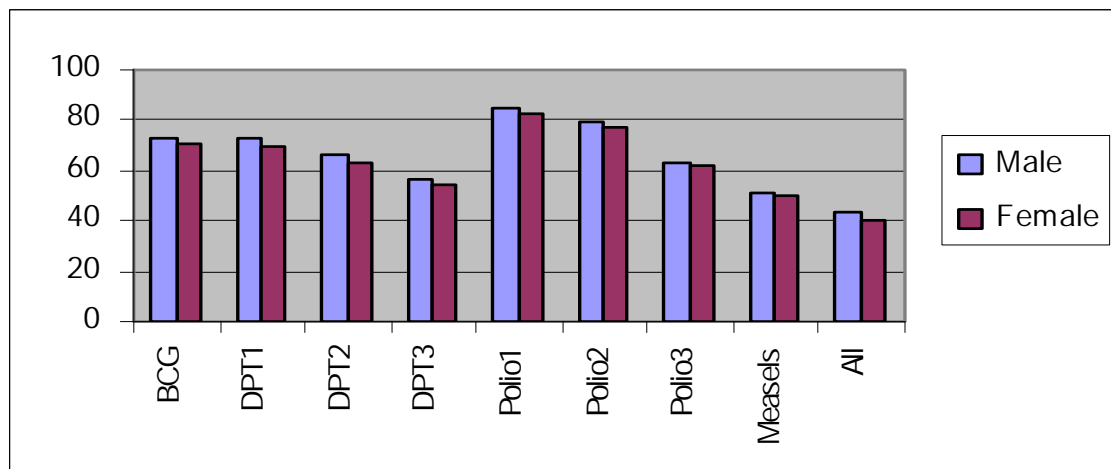
In addition, parity has been considered an important factor in post natal discrimination. A lot of research in south Asia for example proves that the pattern of discrimination against the female child intensifies at higher parities and this is borne out by the disproportionate percentage of female child mortality being concentrated on the higher birth parities (Das Gupta, 1987; Muhuri and Preston 1991; Pebley and Amin 1991). Das Gupta (1987) argues that this trend seems to indicate that discrimination against girls is not a generalized cultural phenomenon but instead may be a part of deliberate family building strategy. It is also interesting to note that the pattern of excess female mortality is not found to be related to the distribution of per capita income across the country (Das Gupta 1987).

It has been contended that in India, females' life chances are systematically compromised by their greater deprivation with respect to food. However, how deeply gender affects food distribution remains unclear. Some studies show that the female disadvantage does not necessarily include lower access to food. A study by Brahman, Shastry and Rao (1988), found no discrimination in the intra-household distribution of food. Studies that decompose fundamental aspects of female well-being into food, health care and other forms of care (such as clothing provision and protection from accidents) have found far less evidence of discriminatory allocation of food than for discriminatory allocation in health and care (Basu 1989, Pelletier 1998).

On the other hand, food intake data from India's National Nutrition Monitoring Bureau show that where calorie intake does not differ by gender, protein energy malnutrition is still more prevalent among girls (Rao 1987). Even in areas where Indian girls are not disadvantaged in intake, they still exhibit more evidence of growth retardation (Gopalan 1987). Behrman's work on intra-household discrimination in rural India (Behrman 1988) shows that there is a bias against female children in the allocation of household nutrients, most especially against the higher birth order girls. This bias is pronounced in the northern states of India and is sharpest during the lean agricultural season. When food is scarce in north India, it is the less endowed, female and low caste children who are placed at greater nutritional risk. However, during the surplus season, parents appear to allocate food among their children more along the lines of need. This suggests that male advantage in terms of access to nutrition within the household might be somewhat of a localized and context specific issue. The implication seems to be that it is acute scarcity that which forces households to practice discrimination in a remorseless way.

It needs to be remembered that the paucity of gender-disaggregated data makes it difficult to provide great conceptual clarity on this subject. Also, most studies measure nutritional adequacy through caloric intake. It is also common in Indian society to understate the energy and nutrient requirements for women by underestimating and devaluing the physical work that they do. In addition, calorie adequacy does not necessarily confer dietary adequacy and calorie adequate diets might be deficient in micro-nutrients and/or proteins. Also, other mechanisms of discrimination might include a late position in serving order and the channeling of special foods to men (Haddad et al 1997). Boys may also be favored by being given first priority in breast feeding and in food supplementation (Pettigrew 1986).

Some studies claim that in India, the sphere in which discrimination against female children manifests itself most strongly is health care. This is clear from the fact that even utilization of free medical services is often lower for females (Dandekar 1975, Miller 1981). Monica Das Gupta (1987) found in her study of Ludhiana district, Punjab (north India) that families spent more than twice as much on the health care of boys than on that of girls in the first two years of life. She also found evidence that this discrimination was more pronounced for the higher birth order girls. Basu (1989) claims that evidence of sex differentials in use of health care services is very strong in the case of treatment of ill health but not so conclusive when it comes to preventive measures such as vaccination and immunization.



Source: NFHS (1998-99)

Figure 2: Percentage of children vaccinated by sex

It must be recognized that health care and nutritional deficiency are closely linked in explaining the higher mortality rates of girls. Mosley and Chen (1984) list nutrition as one of proximate determinants of mortality, but recognize that nutritional deficiency usually works in synergy with illness to produce death. Malnutrition has to be exceptionally severe to be a proximate cause of death, yet even mild malnutrition increases death rates attributable to infectious diseases (Pelletier 1998). Hence, malnutrition multiplies the number of child deaths caused by infectious diseases without malnutrition being the proximate cause of those deaths (Pelletier 1998). Therefore, given the excess female child mortality rates and the evidence regarding lower access of females to food, relatively deficient health care for the female sex cannot be ruled out.

3 Female Education as an agent of change

A great deal of demographic and developmental literature emphasizes the importance of women's education in improving child health. Studies in Bangladesh show that educated mothers bear heavier infants with a greater chance of survival, in part because of their own superior height and fitness (Chowdhury 1982). Mosley and Chen (1984) claim that educated women may achieve higher birth weights than their uneducated counterparts due to a number of reasons. It could be because more educated women are more likely to flout the taboos concerning the consumption of protein sources such as chicken and eggs during pregnancy; because they are more innovative on seeking antenatal care; because they engage in less heavy manual labor during pregnancy; or because they are a healthier group to start with.

Mortality is an extreme form of ill health and there certainly is a great deal of empirical literature corroborating the premise that an increase in mother's education leads to a decline in infant and child mortality rates in developing countries (Murthi, Guio and Dreze 1995; Jeffery and Jeffery 1996). Caldwell (1979) in his Nigerian study shows that, compared to mothers with no formal education, mothers with primary education

experienced 42% less child mortality, and those with secondary education experience 36% less. In contrast, other studies show that in many developing countries, the move from primary to secondary education of mothers is much more important than the original step to primary education (Caldwell and MacDonald 1982). Also, there is evidence that the impact of maternal education on child health tends to be higher in rural areas compared with urban areas (Schultz 1993).

How and why is it that educating mothers affects the survival probability of their children so profoundly? Most of the theories propounded to explain this relationship attribute it to the overarching benign influences of education as a harbinger of individual and social change. Education is seen as a panacea cure bringing with it information, knowledge, skills and particularly for women; freedom, empowerment and numerous capabilities. However, not much effort has been made to isolate the precise mediating channels through which mother's education influences child mortality. Caldwell (1979) has delineated three relationships as being important in linking maternal education with child health. These are: 1) a reduction in fatalism in the face of children's ill health; 2) a greater capability in manipulating the world (e.g. in knowing where facilities are and in securing the attention of doctors and nurses); and 3) a change in the traditional balance of family relationships that shifts the focus of power away from the patriarch and the mother-in-law and ensures that a greater share of available resources are devoted to children. In consonance with this theory, I propose three major pathways through which maternal education influences child health. These include a) information effects of education; b) autonomy effects of education and c) other effects of education (including, changes in aspirations and ideology with respect to child health, reduction in fatalism in face of child's ill health and greater faith in modern and scientific treatments).

One of the significant pathways through which increasing female education may influence child mortality is through the much celebrated '*education-autonomy*' link. There is considerable evidence from all over the world that schooling for women is positively related with their autonomy. Education for women is seen as a means of improving their bargaining power within the household, their domain of decision making and their ability to exercise control over their own lives and those of their children. At the same time, education is believed to improve women's access to *information* and also their ability to process acquired information thereby improving among other things survival probabilities of their children. In addition, maternal education can influence child mortality in *other ways*, beyond its influence through autonomy and information.

What is more contentious however is the role of education with respect to the excessive female child mortality within households. As the increasing level of maternal education leads to a decline in child mortality within the household, does the gap between deaths of girls and boys also decline? Or does it in fact remain unchanged or at worst increase as more educated women attempt to attain their desired family composition? Census data as well as some more detailed research suggests that educated women, on one hand experience lower absolute levels of childhood mortality, but at the same time may simultaneously experience a greater gender gap in childhood mortality compared to uneducated women (Basu 1989, 1992; Pal 1999). Others have argued that a decline in

fertility will lead to a decline in excess female mortality, since parents with fewer children are more likely to be able to provide them with better nutrition and health care, regardless of their sex (Tabutin and Willems 1995). The debate regarding the influence of female education on excess female child mortality is in large part unresolved, the results are seen to be heavily contingent on the area under study and threshold effects of female literacy (impact of literacy is different for different levels of education) are considered important. India, with its conjunction of son preference, female disadvantage and rapidly rising female literacy rates perhaps presents an ideal setting for this discussion. In the context of excessive female child mortality also, I look at the decomposed structure of education effects viz. a) autonomy effects of education, b) information effects of education and c) other direct effects of education.

Education and increased autonomy in turn can significantly impact the perceived differences in the net value of sons and daughters. For relatively independent women, their prestige is less likely to be tied up with the number of sons they have and more importantly they are less likely to need sons as a means of economic security in their old age (Jeffery and Basu 1996). Autonomous women are also more effective in establishing nuclear households thereby removing themselves from the sphere of influence of their traditional in laws who are likely to lay greater emphasis on sons. In addition, autonomy brings with it greater control of household resources and increased ability to influence others' decisions. Such trends are likely to lead to a decrease in the economic and somewhat to a lesser degree social disadvantages of having a girl child and reduce the pressures to have a male child thereby negatively influencing both the magnitude of son preference and female disadvantage within the household.

Other direct impacts of education on excessive female child mortality are more complicated. It is conceivable that education affects incentives to discriminate against daughters more directly. Educated mothers are likely to have educated daughters who by themselves prove less of a burden than uneducated daughters. Educated mothers may help in increasing the total resources available to the household and hence reduce the need for discrimination against girls in the household. Education also increases the information and access to modern technologies of contraception and sex selection such as ultrasound and amniocentesis. Educated women are therefore more likely to prevent the birth of a child with unwanted sex and less likely to continue having children once desired sex composition within the family has been achieved, thereby reducing the probability and number of 'unwanted' children who might be discriminated against. Another fallout of the lower fertility seen among more educated women is what DasGupta and Bhat (1997) call the 'Parity Effect'. In their paper they discuss the fact that in some parts of India excessive female child mortality is concentrated among higher birth order girls and with lower fertility proportion of high birth order girls within the family declines thereby reducing overall excessive female child mortality.

However, DasGupta and Bhat (1997) go on to discuss some of the reasons why households with educated mothers might actually exhibit higher excessive female mortality rates due to what she calls the 'intensification' effect. Educated women desire small families and if at the same time they desire to have a certain number of sons within

the family, post natal discrimination against daughters might intensify as a part of family building strategy. Monica Das Gupta (DasGupta 1987) did some groundbreaking work on this hypothesis in North India. By studying 11 villages in Punjab (an area with some of the most masculine sex ratios in the country) found that women's education is associated with reduced child mortality but stronger discrimination against the higher birth order girls. She further argues that "higher education and later age at marriage have not increased the value of daughters to their parents because the patrilineal kinship system has remained largely untouched by them", therefore even with changes in the autonomy indicators for women she expects son preference to remain unchanged. With a decrease in desired family size but a persistence of son preference, couples are under greater pressure to remove girls. Another unattractive hypothesis concerns the idea that educated women would be better at achieving desired sex composition within the family by adopting a strategy of discrimination against their daughters. They would have greater ability to prevent deaths of 'wanted' children and bring about deaths of 'unwanted' children.

The socio-cultural background described above indicates that the relationship between mother's education and excessive female child mortality is a complicated one and for that reason should be studied and interpreted with care. For instance, it is indicated that one should distinguish between the indirect effects of education which operate through the '*education-autonomy*' pathway and the other more direct effects of education described above. If autonomy as an independent variable is omitted then the positive impact of education on post natal discrimination is likely to be overstated. If on the other hand education is simply treated as a proxy for female autonomy then on the one hand, we might get misleading results due to the omission of other more important dimensions of autonomy and on the other hand the more direct effects of education on excessive female child mortality might be obscured. This has important policy implications as well in so far as mother's education is used as an instrument to improve relative survival probabilities of girls in India. There is little doubt that education can be a strong and benign force in the lives of men and women. In regions where women have traditionally been disadvantaged education for females is seen as an important channel for social, economic and demographic change. However, the very fact that education is a powerful, life changing experience can make it difficult to understand its full implications and easy to confuse or overstate them.

4 Theoretical Model

This theoretical model attempts to illustrate how in societies with low autonomy or women and in the absence of formal social security mechanisms, sons are an important source of old age security for parents in India. At the same time constraints on the agency of women restrict the manner and degree to which daughters can be useful to parents in their old age. In such a scenario parents have greater incentive to invest in the health of their sons compared to their daughters, a fact that could explain excessive female child mortality in parts of India. This model also depicts the manner in which female education

and autonomy may significantly alter the existing economic and social rationales for postnatal discrimination against the girl child.

Consider a microeconomic household model with a representative couple which has one son and one daughter. There exists a household utility function which includes a composite index of health of children and a composite consumption good G as its arguments.

$$U(Q_S, Q_D, G) \quad (1)$$

Where Q_S and Q_D represent the quality of son and quality of daughter respectively. Child quality is produced using market bought goods and services (X_i , $i = S, D$) and care given by mother (T_{Qi} , $i = S, D$). Further, the production of child health is affected by mother's education (E) and child's health endowment (ρ_i , $i = s, D$). Hence the production function of child health can be represented as follows:

$$Q_S = q_S(X_S, T_{QS}; E, \rho_s) \quad (2)$$

$$Q_D = q_D(X_D, T_{QD}; E, \rho_D) \quad (3)$$

Where variables before the semicolon are endogenous variables for the household and the variables after the semicolon are exogenously given. In this model I assume that father spends all his time in the labor market and that mother divides her time between the labor market and taking care of children. Assume T_L indicates the time spent by the mother in the formal labor market and ϕ reflects the total time available to her then the household is faced with a time constraint for mother:

$$T_{QS} + T_{QD} + T_L = \phi \quad (4)$$

Household derives income from the wages earned by parents where father's income is exogenously given (F), mother's wage rate is a function of her education ($W_M(E)$). In addition, household makes child quality decisions on the basis of a lifetime budget constraint which includes the transfers expected from children when they grow up. Assuming that there are no formal social security arrangements in this society, parents rely completely on their children to provide them with old age support. Once children grow up they are expected to transfer fraction λ_i ($i = S, D$) of their income to their old parents. In many parts of India low female autonomy and the practice of exogamy means that on marriage daughters are expected to lose contact with their natal kin, hence λ_D depends in part on the existing social norms relating to female autonomy (μ). The income of children in turn depends on their quality. Here again existing social norms with regard to female autonomy often dictate how acceptable it is for women to work in the formal labor market and how long can parents expect transfers from their daughters after marriage. The wages earned by sons and daughters is given by $W_S(Q_S)$ and $W_D(Q_D)$ respectively and the time spent by them in the labor market is given by t_s and $t_D(\mu)$ respectively. The lifetime budget constraint for the household is therefore given by:

$$F + W_M(E)T_L + \lambda_S W_S(Q_S)t_s + \lambda_D(\mu)W_D(Q_D)t_D(\mu) = P_Q X_S + P_Q X_D + P_G G \quad (5)$$

It is easy to combine the nominal budget constraint with the time constraint to arrive at a full income budget constraint which is given by:

$$F + W_M(E) \{\varphi - T_{QS} - T_{QD}\} + \lambda_S W_S(Q_S)t_S + \lambda_D(\mu)W_D(Q_D)t_D(\mu) = P_Q X_S + P_Q X_D + P_G G \quad (6)$$

Maximizing (1) with respect to (2), (3) and (6) we obtain the first order conditions of the household optimization problem. Let η_1 , η_2 and η_3 be the Lagrange multipliers associated with the constraints (2), (3) and (6) respectively. The first order conditions for the household optimization problem are as follows:

$$\begin{aligned} dQ_S / dX_S \{ (dU/dQ) + \eta_1 + \eta_3 \lambda_S t_S (dW_S/dQ_S) \} &= P_Q \\ dQ_D / dX_D \{ (dU/dQ) + \eta_2 + \eta_3 \lambda_D(\mu) t_S(\mu) (dW_D/dQ_D) \} &= P_Q \\ dQ_S / dT_{QS} \{ (dU/dQ) + \eta_1 \} &= \eta_3 W_M(E) \\ dQ_D / dT_{QD} \{ (dU/dQ) + \eta_2 \} &= \eta_3 W_M(E) \end{aligned}$$

The first order conditions give intuitively appealing results in that household decisions regarding the optimal amount of health care inputs to be invested in a child of sex i would depend on the efficacy of these inputs in improving child health, the marginal utility of child health, the expected resource contribution of the child to the household and the contribution of child health in improving child income. In this simple analysis we assume that the marginal product of market bought health inputs in improving child's health is constant ($dQ_S/dX_S = dQ_D/dX_D$)¹. Similarly, the marginal product of health in improving wages is also assumed to be constant ($dW_S/dQ_S = dW_D/dQ_D$). In such a situation the shadow relative price of sex specific health inputs would depend on the relative values of λ_i and t_i ($i = S, D$). Recall that λ_i refers to the fraction of income that the child is expected to transfer to his parents in their old age and t_i refers to the labor force participation of the child. Thus if there are substantial differences in expected resource transfers (either because of λ 's and/or t 's) from sons and daughters then there would be corresponding differences in the optimal health care resources invested in the children.

The theoretical model presented above gives rise to an interesting hypothesis relating to the compromised relative survival probabilities of girls in India. Given the rigidly patriarchal and relatively primitive social structure found in many parts of India, couples have substantial economic and social incentives to invest more in the survival of their sons compared to their daughters. In India, daughters have limited opportunity to work outside the household and also limited freedom to transfer resources to their parents and as the theoretical model predicts this compromises their access to nutrition and healthcare while growing up. In a situation of severely constrained resources such a situation could well translate into excessive female child mortality which is indeed found in many parts of the country.

¹ This is a simplifying assumption. It is usual to assume that marginal product of health inputs is a convex function.

Another important implication emerging from this theoretical model is the importance of patriarchal social norms in reinforcing the female disadvantage. Deeply entrenched social norms restricting the agency of women are an important reason for the existence and perpetuation of discrimination against females with respect to their access to nutrition and health care. This implies that social policy geared towards changing these norms and improving the capabilities of women in society would be the best way to tackle the problem of excessive female mortality in India. To this end female education is a powerful instrument. This model illustrates several channels through which mother's education and mother's autonomy can improve relative survival probabilities of girls. More educated women are less likely to depend on their children for old age security (will have higher wages and hence higher savings). Women with more autonomy and/or more education are also more likely to have educated daughters who will in turn have higher λ_D and t_D thereby transferring greater resources to their natal kin. Education of women is also likely to influence social norms relating to autonomy (μ) towards greater gender equity and more opportunities for women.

5. Data and Methods

The theoretical literature described above attempts to clarify some of the important pathways through which mother's education could affect both child mortality on one hand and excessive female child mortality on the other. As described above, mother's education can influence child and excessive female child mortality through a) information effects, b) autonomy effects and c) other direct effects. In order to disentangle these effects and to test the predictions of the theoretical framework, two models are proposed. Model 1 looks at the impact of mother's education on child mortality on the whole. Model 2, on the other hand is concerned with the impact of maternal education on excessive female child mortality.

I use data from the 1998-1999 National Family Health Survey (NFHS) in India (IIPS 2000). This is the largest demographic survey ever conducted in India. It covers a representative sample of about 91,000 ever-married women age 15-49 from 26 states in India. The NFHS does not provide any direct data on household wealth or income. There is however some data on asset ownership and quality of housing. We use these variables to construct an 'asset index' reflecting the standard of living of the household (Filmer and Pritchett 2001). Several variables indicating the ownership of various assets and the quality of sanitation and drinking water facilities are considered and by means of the Principal Component Analysis technique, they are assigned scoring factors which become their weights in the construction of the asset index. A large majority of Indians are Hindus, while Muslims constitute the second largest religion in India. The relative population of Muslims and Hindus varies significantly by region. Christianity and Sikhism are the other two religions in India with sizeable populations. Caste is an important dimension of household characteristics and has played an important role traditionally in defining the status of households. Although with the spread of western ideology and government's affirmative programs, the importance of caste system is declining, it still remains an important variable in the Indian context. There are a number

of castes and sub castes in India but the government has identified certain socially and economically backward castes which are considered to be in need of special protection, these are called Scheduled Castes and Scheduled Tribes and constitute a significant part of the Indian population.

Table 1: Selected Socioeconomic characteristics of Households in Sample
All India N=85091

Variable	Mean
Age of Mother	31.17
Urban Household (%)	31.46
Rural Household (%)	68.54
Mother's Education in single years	4.02
Father's Education in single years	6.59
Religion (%)	
Hindu	78.44
Muslim	11.12
Christian	5.54
Sikh	2.38
Other	2.46
Caste (%)	
Scheduled Caste	17.01
Scheduled Tribe	12.30
Read Newspaper once a week (%)	24.70
Watch TV once a week (%)	50.70
Mother Working (%)	34.90
North India (%)	69.15
South India (%)	16.87
Live in Big City (%)	11.29
Living with Mother in Law (%)	1.6

Source: NFHS 1998-99

An *autonomy index* for mothers is created based on the survey responses. NFHS surveys (IIPS 2000) are designed to capture some of the more critical dimensions of autonomy in a married woman's life. These reflect to some extent the degree to which a married woman can expect to exercise choice and manipulate her external environment. For the purpose of this index, I concentrate on the following attributes; constraints on mobility, decision making domain, relationship with natal kin and exposure to physical violence. These are identified as some of the more meaningful indicators of autonomy (Basu and Koolwal 2005). Survey responses relating to these key dimensions are identified (see table below) and rescaled to yield an *autonomy score* which ranges from 0 to 6. The national mean for the autonomy score is 3.43. It is seen that though women are restricted in terms of their physical mobility, most women have some economic decision making power and are relatively free from physical coercion. It is also interesting to note that in India, a woman's husband and in-laws can exert considerable influence on her relationship with her natal kin. The purpose of creating this autonomy index is to examine the predictive power of *autonomy effects* of education (and overall maternal autonomy in general) in child mortality and excessive child mortality regressions.

Table 2: Key Dimensions of Women’s Autonomy used to build Autonomy Score
Survey Question (n = 90303) **% women**

Physical Mobility

Not allowed to go to market	4.7
Can go to market but only with permission from husband/others	62.0
Can go to market without permission	33.3
Not allowed to visit relatives/ friends	1.3
Can visit relatives/friends but only with permission from husband/others	72.2
Can visit relatives/friends without permission	26.4

Relationship with Natal Kin

Husband/others decide if respondent can stay with family	48.5
Decision to stay with family taken jointly with husband/others	37.9
Respondent herself decides if she can stay with family	13.6

Decision-Making Domain

Husband/Others make decision on obtaining healthcare	45.7
Decision to obtain health care taken jointly with Husband/Others	25.6
Respondent herself makes decision on obtaining healthcare	28.7
Not allowed to have money set aside	38.3
Allowed to have money set aside	61.4

Exposure to Physical Violence

Has been beaten since she turned 15	19.4
Has not been beaten since she turned 15	80.6

Source: NFHS 1998-99

It is plausible that mother’s autonomy might be influenced by child mortality levels within the household. In households exhibiting very strong son preference, death of female children and the resultant increase in the sex ratio (male/female) of the surviving children might increase the autonomy levels of the mother. Incidence of female child mortality could improve the status of the mother within the household by making her child bearing career appear more successful. Since, there is a possibility that child mortality and excessive female child mortality rates may affect mother’s autonomy level therefore the problem of endogeneity exists. To resolve this issue a Two Stage Least Squares (2SLS) approach is proposed wherein predicted values of women’s autonomy index are used in the child mortality regressions.

The autonomy score is regressed on a number of socio-economic traits of the mother using an Ordered Logit Regression, since the dependent variable is ordinal in nature. From this regression we obtain predicted values for the ‘autonomy score’ of women. This autonomy score is then used in two regressions aimed at distilling the impact of mother’s education on child mortality and excessive female child mortality in India. In addition, a variable to capture the *information effects* of education is introduced. For the child mortality regression, I use a Hazard Model and for the excessive female child mortality I use the model described below.

$$EY_i = \alpha_0 + \alpha_1 A_i + \alpha_2 B_i + \alpha_2 C_i + e_{1i}$$

EY_i is an index of excess female child mortality in household i . A_i is a vector of mother’s characteristics, B_i a vector of household characteristics and C_i a vector of community characteristics that influence excessive female child mortality. Given the theoretical model presented above mother’s characteristics have several important dimensions that affect incentives for discriminating against girls. One is her autonomy (A_{ai}) within the household; second is her information level with respect to health related issues (A_{bi}); in addition there exist other direct effects of mother’s education (A_{ci}) and lastly there are the other socio-demographic characteristics of the mother (A_{di}) that influence her behavior with regard to intra-household allocation of resources. Hence the expanded form of the equation is:

$$EY_i = \alpha_0 + \gamma_1 A_{ai} + \gamma_1 A_{bi} + \gamma_2 A_{ci} + \gamma_3 A_{di} + \alpha_2 B_i + \alpha_2 C_i + e_{1i}$$

I use predicted values of women’s autonomy (\hat{A}_{ai}) obtained above in this regression. Coefficient γ_1 gives the upper bound of the indirect effect of female education on excessive female child mortality via the autonomy pathway. However, since in most cases there exist other important predictors of female autonomy, the indirect effect of female education cannot be cleanly separated from the effects of other autonomy related variables. Based on the theoretical model presented above we would expect this coefficient to be positive and significant. Coefficient γ_2 , could be positive or negative depending upon whether increased information is used to improve survival of girls or as Das Gupta (1987) predicts in the case of Punjab, to systematically discriminate against girls more effectively as a means of attaining desired family sex composition. Also, the direct effect of mother’s education on excessive female child mortality and could be positive or negative depending upon relative weight of various other factors described above.

6. Results

The results of the Ordered Logit regression for autonomy score of ever married women aged 15 to 49 years are given below. These results for most part confirm to the existing literature relating to female autonomy in developing countries. Autonomy for married women is seen to be positively and significantly related to woman’s age, urban living, education, labor force participation and high standard of living. Since education for

women is strongly positively (significant at the 1% level) related to autonomy, the hypothesis relating to the ‘education-autonomy’ link is borne out for women in India. Autonomy for women is found to be much lower in the northern part of the country. Dummy for south is also negatively associated with autonomy but this variable is insignificant. Lower caste women seem to have greater autonomy compared to their more upper caste cohorts; this corroborates the Sanskritization hypothesis (Srinivas, 1956), which suggests that upper castes maintain greater constraints on the women in the household due to greater emphasis on maintaining ‘purity’ of the household. The only surprising results seem to be that for women, working status does not have a significant impact on their autonomy; also women married to more educated men seem to enjoy lower levels of autonomy. This however can be rationalized in view of the fact that more educated men often come from upper caste families and hence this negative relationship could also indicate *sanskritization*. Since this is an ordered logit regression we obtained predicted probabilities for women having a particular autonomy score (0 to 6). The predicted value for probability that a woman has an autonomy score of 6 (highest) is used as an explanatory variable in the child mortality and excess female child mortality regressions.

Table 3: Estimated parameters of ordered logit regression of women’s autonomy on socioeconomic variables.

N = 85143

Variable	Coefficient
Age	-.04277*** (.00074)
Education	.05681*** (0.00189)
Husband’s Education	.00418** (0.00166)
Residence (Urban=0/Rural=1)	-.32215*** (.01645)
North	-.31730*** (.01984)
South	.10764*** (.02350)
Muslim	-.26369*** (.02012)
Christian	.17045*** (.03044)
Sikh	.58560*** (.03892)
Scheduled Caste	-.01352 (.01716)
Scheduled Tribe	.04331**

	(.02212)
Asset Index	.27529***
	(.01120)
Working	.20291***
	(.01356)

*** $p < 0.001$, ** $p < 0.005$, * $p < 0.010$

A preliminary analysis of child mortality in India is attempted by using a Hazard model. This is done to understand the contours of child mortality in the country and determine whether sex of the child has important predictive power for his probability of dying. Mother's education and the predicted values of her autonomy (obtained in the regression above) are used as explanatory variables. The absence of any suitable proxy variables for mother's exposure to health related information, prevent the inclusion of mother's information index as an explanatory variable in this regression. However, several other socioeconomic characteristics of the mother and household are included in the hazard regression. I present two models below; Model 1.1 includes mother's education but not her autonomy level as explanatory variables in child mortality regression. Model 1.2 on the other hand includes both mother's education and autonomy level as explanatory variables.

For the child mortality regression, *NFHS child's recode dataset* is used. It focuses on information on child health in India and contains the pregnancy, birth and health data, collected for the children born in the month of interview and the 59 months prior to the survey. The data for the mother of each of these children is present. In this file, the child is the case, as opposed to the general NFHS datasets wherein women aged 15-49 are the cases. Since the manifestation of sex related mortality becomes apparent only after six months in a child's life, observations begin at age six months and are right censored at 60 months. The sample consists of 20,812 children out of which 52% are male and 48% are female.

Table 4: Child mortality hazard estimates

	Model 1.1	Model 1.2
	Mother's Education (OLS)	Mother's Education and Autonomy (2SLS)
No. of observations	20,742	20,739
Child's Sex (Male=0/Female=1)	.2877*** (.0958)	.2878*** (.0958)
Child's Birth Order	-.1455*** (.0355)	.1462*** (.0355)
Mother's Age	-.0397*** (.0134)	-.0418*** (.0147)
Mother's Education	-.0706*** (.0193)	-.0765*** (.0261)
Mother's Autonomy Index	—	4.045

		(11.87)
Father's Education	-.0289**	-.0288**
	(.0127)	(.0127)
Residence	.0363	.0572
(Urban=0/Rural=1)	(.1558)	(.1679)
North	.4530**	.4813**
	(.1926)	(.2102)
South	-.1315	-.1305
	(.2580)	(.2580)
Muslim	-.5209***	-.5049***
	(.1669)	(.1733)
Christian	.2700	.2374
	(.2653)	(.2825)
Sikh	-.1587***	-.2229
	(.4179)	(.4600)
SC	-.0890	-.0862
	(.1239)	(.1241)
ST	.0037	-.0008
	(.1450)	(.1455)
Asset Index	-.3594***	-.3812***
	(.1096)	(.1272)

*** $p < .001$, ** $p < .005$, * $p < .01$

The results from the hazard model clearly indicate that in India child's sex significantly affects his probability of dying thereby reinforcing the hypothesis of post natal discrimination against girls in India. The interesting result relates to the role of mother's education and mother's autonomy in influencing child mortality on the whole. Not surprisingly, mother's education affects child mortality negatively and significantly. Mother's autonomy level on the other hand is not significantly related to child mortality at all. This has important implications for our understanding of the channels through which mother's education affects child mortality. The results above seem to suggest that the *education-information channel* is relatively more important than the education-autonomy channel in explaining the relationship between mother's education and child mortality in India.

It is also interesting to note that father's education is also negatively and significantly (at the 5% level) related to child mortality. Higher birth order children are much more likely to die in the first five years of their life. Muslim households appear to experience much less child mortality than others. Still result needs to be explored further and possible mediating influences should be studied in greater detail. As expected, standard of living is negatively and significantly related to child mortality within households.

Lastly but most importantly, we confront our analysis so far with the question of excess female child mortality. Once the fact of post natal discrimination against girls is

established it is important to concern ourselves with understanding the covariates of this phenomenon in general and the role of mother's education in particular. To accomplish this two OLS models are proposed. The dependent variable is an index of excess female child mortality within the household calculated as follows:

$$\begin{aligned} \text{Female Survival Ratio (FSR)} &= \text{fmort}/(\text{fsuv}+\text{fmort}) \\ \text{Male Survival Ratio (MSR)} &= \text{mmort}/(\text{msuv}+\text{mmort}) \\ \text{Exmort} &= [\text{FSR}/\text{MSR}]_i \end{aligned}$$

The variables *fmort* and *mmort* reflect the number of female and male children respectively who die before the age of five and the variables *fsuv* and *msuv* indicate the total number of living female and male children (respectively) within the household between the ages 0 and 5. This index is calculated for each household *i*. In order to minimize the number of dropped observations I make the following corrections to the formula:

- a) $\text{FSR} = 0$ if $\text{fmort}=\text{fsuv}=0$. Similarly, $\text{MSR} = 0$ if $\text{mmort}=\text{msuv}=0$
- b) $\text{Exmort}=0$ if $\text{mmort}=\text{msuv}=0$.
- c) $\text{Exmort}=[(\text{fmort}/\text{fsuv}) \text{msuv}]$ if $\text{mmort}=0$ but $\text{msuv}>0^2$.

This *Exmort* variable is regressed on a number of socio-economic characteristics of the household using an OLS framework. In addition to mother's education and autonomy, an attempt is made to include her exposure to health related information. I use respondents' information regarding ways to avoid AIDS, as a proxy for maternal health related information. This variable is identified as *maternal information index*. Three sub-models are proposed, in Model 2.1 mother's education is included as an independent variable but mother's autonomy index is left out. In Model 2.2, both mother's education and her autonomy index are included as independent variables. In Model 2.3, all three variables viz. mother's education, mother's autonomy index and mother's information index are used as explanatory variables. Since mother's autonomy index variable used in this regression is in fact the predicted probability of women having high autonomy rates obtained from the regression above therefore Model 2 is actually a 2SLS (Two Stage Least Squares) regression.

Table 5 : Estimated parameters of excess female child mortality regressions

Covariate	Model 2.1	Model 2.2	Model 2.3
	Mother's Education (OLS)	Mother's Education and Autonomy (2SLS)	Mother's Education, Autonomy and Information (2SLS)

² This is a simplifying assumption. If in a household, where there are surviving male and female children but *mmort* is 0, *Exmort* will be undefined. But there is excess female mortality in this household. Therefore, in order to include such observations, we assume that for such a household, $\text{Exmort}=(\text{fmort}/\text{fsuv}) \text{msuv}$, thereby implying that $\text{mmort}=1$. This understates the level of excess female mortality, but since only 1643 out of 90,000 observations have this nature, it would not compromise the quality of the coefficients.

Number of Observations	90,009	89,995	89,995
Intercept	-.0119** (.0056)	-.0138** (.0057)	-.0129*** (.0057)
Mother's Age	.0027*** (.0001)	.0029*** (.0002)	.0029*** (.0002)
Mother's Education	-.0025*** (.0003)	-.0021*** (.0003)	-.0018*** (.0004)
Mother's Autonomy	—	-.1051* (.0575)	-.1084* (.0575)
Mother's Information	—	—	-.0083*** (.0026)
Father's Education	-.0023*** (.0003)	-.0023*** (.0003)	-.0023*** (.0003)
Residence (Urban=0/Rural=1)	.0057** (.0025)	.0041 (.0027)	.0035 (.0027)
North	.0331*** (.0031)	.0319*** (.0032)	.0313** (.0032)
South	-.0042*** (.0030)	-.0035 (.0036)	-.0020 (.0036)
Muslim	.0042 (.0030)	.0030 (.0031)	.0026 (.0031)
Christian	.0010 (.0047)	.0025 (.0047)	.0039 (.0048)
Sikh	-.0182** (.0063)	-.0146** (.0066)	-.0144** (.0066)
SC	.0161*** (.00231)	.0174*** (.0026)	.0175*** (.0026)
ST	.0106*** (.0033)	.0111*** (.0038)	.0111*** (.0033)
Asset Index	-.0021*** (.0017)	-.0208*** (.0019)	-.0200*** (.0019)

*** $p < .001$, ** $p < .005$, * $p < .01$

For India as a whole, maternal education appears to have a strong negative influence on excessive female child mortality. This indicates that at the country level, the negative direct effects of female education on post natal discrimination against girls outweigh the positive effects. I find the direct effects of education significant, even after we control for autonomy and information effects. In model 2.3, both maternal education and maternal information index are negatively and significantly (at the 1% level) related to the dependent variable. In addition, maternal autonomy also appears to have a negative and significant (at the 5% level) impact on excess female child mortality. This seems to

suggest that for post natal discrimination against girls, all three proposed pathways, viz. education, education-autonomy and education-information, are important. It is interesting to note that working status of mother, a variable often considered an important indicator of female agency, is not significant in this regression. The strong causal relationship between education and decline in discrimination is also reinforced by looking at the father's education variable. It is negatively and significantly related to post natal discrimination against girls in all the three regressions.

It is interesting to note that belonging to scheduled caste (SC) and scheduled tribes (ST) significantly increases the likelihood of post natal discrimination against girls. These variables were not significant in the child mortality regression. This is in correspondence with what is known of caste dynamics in India. SC and ST are perceived to be low castes, and within these the female disadvantage is exacerbated. These women face multiple exclusions both because of their gender and their castes and constitute the most vulnerable section of Indian population.

Excessive female child mortality is significantly higher in north India, reinforcing the notion that patriarchal kinship structures increase female disadvantage. Residence in rural areas is negatively and significantly related to post natal discrimination only in model 2.1, once we control for maternal autonomy levels, this variable loses its significance. Standard of living is also negatively and significantly related to excess female child mortality, indicating that post natal discrimination might be a part of survival strategy for households in time of hardship rather than a generalized cultural phenomenon.

7 Conclusions

Education of mothers is expected to reduce not just infant and child mortality rates on the whole but also reduce the gap between mortality rates of boys and girls within households. However, some empirical evidence shows that in certain parts of India mother's education actually exacerbates excess female child mortality. This paper attempts to understand the influence of mother's education on child mortality and excessive female child mortality.

In this analysis, it is proposed that mother's education can affect child health outcomes in three ways; a) autonomy effects of education, b) information effects of education and c) other direct effects of education. Once the autonomy and information effects are isolated from the other direct education effects, some interesting results emerge. First, we see that mother's education influences child health primarily through direct education and information effects and mother's autonomy does not have much predictive power in this relationship. In the excessive female child mortality regression however, women's autonomy has a negative and significant influence. The fact that female autonomy variable is not significant in the child mortality regression in India runs counter to theoretical literature that emphasizes the education-autonomy link as a major pathway through which maternal schooling influences child mortality. Instead, it is the information effects that stand out as being highly significant, indicating that effective information dissemination is a crucial channel for reducing child mortality.

These results also show that mother's education affects child mortality on the one hand and excessive female child mortality on the other hand in very different ways. Women's autonomy is an important pathway through which mother's education can improve relative survival probabilities of girls. This has important policy implications in that instead of simply relying on female education attempts should be made to enhance female autonomy in a broader sense. Information and other direct effects of education are also important in decreasing post natal discrimination against girls. The relevance of education even after controlling for information and autonomy remains strong. This implies that there are other more direct channels through which education influences child health outcomes. These other channels have not received much attention in literature so far and need to be understood better. Further, quality of female education needs to be evaluated and complimentary policies need to be designed to make most of the education-autonomy and education-information links.

References

- Altekar, A. S. 1962. *The Position of Women in Hindu Civilization*. Delhi: Motilal Banarsidas.
- Bardhan, Pranab K. 1984. *Land, Labor and Rural Poverty*. Delhi: Oxford University Press.
- Basu, Alaka M. 1992. *Culture, the Status of Women and Demographic Behaviour*. Oxford : Clarendon Press.
- Basu, Alaka M. 1989. "Is discrimination in food really necessary in explaining sex differentials in childhood mortality?". *Population Studies* 43, no. No. 2:193-210.
- Basu, Alaka M. and G.B. Koolwal. 2005. *Two Concepts of Female Empowerment: Some Leads From DHS Data on Women's Status and Reproductive Health*.
- Behrman, J. R. 1988. Intrahousehold allocation of nutrients in rural India: Are boys favored? Do parents exhibit inequality aversion? *Oxford Economic Papers* 40, no. no. 1:32-54.
- Brahman, G. N. V., and J.G.Sastry and N.P. Rao. 1988. Intra family distribution of dietary energy. *Ecology of Food and Nutrition* 22, no. 2:125-130.
- Caldwell John C. and P. McDonald. 1982. Influence of maternal education on infant and child mortality: levels and causes. *Health Policy Education* 2, 251-267.

- Caldwell, J. 1979. Education as a factor in mortality decline. *Population Studies* 33, no. 3:395-413.
- Chowdhury, A. 1982. Factors influencing infant survival in rural Bangladesh. *Glimpse* 4, 9-10.
- Dandekar, K. 1975. Why has the proportion of women in India's population been declining? *Economic and Political Weekly* 10, no. 42:1663-1667.
- Das Gupta, Monica. 1987. "Selective discrimination against female children in rural Punjab, India". *Population and Development Review* 13, no. no. 1:77-100.
- Das Gupta, Monica and P.N. Mar Bhat. 1997. Fertility decline and increased manifestation of sex bias in India. *Population Studies* 51, no. 3:307-315.
- Dyson, Tim. and Mick Moore. 1983. "On kinship structure, female autonomy and demographic behavior in India". *Population and Development Review* 9, no. no. 1:36-60.
- Filmer D. and L.H. Pritchett. 2001. Estimating Wealth Effects without Expenditure Data - Or Tears: An Application to Educational Enrollments in States of India. *Demography* 38, no. 1:115-132.
- Gopalan, C. 1987. Gender bias in health and nutrition care. *NFI Bulletin: Bulletin of the Nutrition Foundation of India* 8, no. 4:.
- Haddad, L., and Hodinott, J. and Harold Alderman. 1997. *Intrahousehold Resource Allocation in Developing Countries: Models, Methods and Policy*. Baltimore: Johns Hopkins University Press.
- IIPS (International Institute of Population Sciences) and ORC Macro. 2000. National Family Health Survey, India, 1998-99, Bombay, India.
- Jeffery P. and R. Jeffery. 1996. "Whats the benefit of being educated: Women's autonomy and fertility outcomes in Bijnor". In *Girl's Schooling, Women's Autonomy and Fertility Change in South Asia*, edited by Jeffery, Roger and Alaka M. Basu. New Delhi: Sage.
- Jeffery, Roger and Alaka M. Basu, ed. 1996. *Girls' Schooling, Women's Autonomy and Fertility Change in South Asia*. New Delhi: Sage.

- Karve, Irawati. 1965. *Kinship Organization in India*. Bombay: Asia Publishing House.
- Mayer, P. 1999. India's falling sex ratios. *Population and Development Review* 25, 323-343.
- Miller, Barbara D. 1981. *The Endangered Sex: Neglect of Female Children in Rural North India*. Ithaca: Cornell University Press.
- Mitra, A. 1978. *India's Population: Aspects of Quality and Control*. New Delhi: Abhinav Publications.
- Mosely, W.H. and L.C. Chen. 1984. "An analytical framework for the study of child survival in developing countries". *Population and Development Review Supplement* to vol.10, 25-45.
- Muhuri, P.K. and S.H. Preston. 1991. Effects of Family Composition on Mortality Differentials by Sex Among Children in Matlab, Bangladesh. *Population and Development Review* 17, no. 3:415-434.
- Murthi, M., A-C. Guio, and J. Dreze. 1995. Mortality, fertility, and gender bias in India: A computer simulation. *Population and Development Review* 21, 745-782.
- Pal, S. 1999. An analysis of childhood malnutrition in rural India: Role of gender, income and other household characteristics. *World Development* 27, no. 7:1151-1171.
- Pebley, A.R. and S. Amin. 1991. The impact of public health interventions on sex differentials in childhood mortality in rural Punjab in India. *Health Transition Review* 1, no. 2:143-170.
- Pelletier, D. L. 1998. Malnutrition, morbidity and child mortality in developing countries. In *Too Young to Die: Genes or Gender?*. New York: United Nations.
- Pettigrew, J. 1986. Child neglect in rural Punjabi families. *Journal of Comparative Family Studies* 17, no. no. 1:63-85.
- Rao, K. S. J. 1987. *Undernutrition Among Adult Indian Males*. Nutrition Foundation of India.
- Schultz, T. P. 1993. Investments in the Schooling and Health of Women and Men: Quantities and Returns. *The Journal of Human Resources* 28, no. no. 4, Special

Issue: Symposium on Investments in Women's Human Capital and Development:694-734.

Sen, Amartya K. 1989. Women's Survival as a Development Problem. *Bulletin of American Academy of Arts and Sciences* 43, no. 2:14-29.

Sen, Amartya K. 1987. *Gender and Cooperative Conflict*. Helsinki: World Institute for Development Economics Research.

Srinivas, M. N. 1956. A Note on Sanskritization and Westernization. *The Far Eastern Quarterly* 15, no. 4:481-496.

Tabutin, D. and M. Willems. 1995. Excess Female Child Mortality in Developing World During 1970's and 1980's. *Population Bulletin of United Nations* 39, 45-78.

Visaria, P. M. 1971. *Sex Ratio of the Population of India*. New Delhi: Ministry of Home Affairs.