# CHILD MORTALITY IN INDIA: INDIVIDUAL AND COMMUNITY EFFECTS OF WOMEN'S EDUCATION AND AUTONOMY

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**Abstract**

When assessing health benefits of increased education in developing countries, many researchers have been concerned about the omission of important determinants of education from the models. This study illustrates that one should also be concerned about the limitations of the individual-level perspective. According to a model based on NFHS II data, the average education among women (but not men) in the census enumeration area has a strong impact on child mortality, net of the mother's own education. The relatively low child mortality associated with women's autonomy explains some of this community education effect. In addition, it operates partly through health knowledge, reproductive behavior and more proximate determinants of mortality, such as the use of maternity and other preventive health services, the child's nutrition, and the mother's care for a sick child.

A large number of studies from many developing countries have shown a strong negative association between mother's educational level and child mortality. Nevertheless, there is still considerable uncertainty about how strong the total impact of education actually is, let alone the underlying mechanisms and the variations between different settings. One important reason for the uncertainty, as pointed out by many authors (e.g. Hobcraft 1993), is that a woman's education is determined by various socio-demographic factors that may also have a bearing on mortality, and that are often unavailable or inadequately measured in the data that are used. However, this is not the only measurement issue that deserves attention. One should also be concerned about the possibility that an individual-level analysis may fail to reveal the entire impact of education. Perhaps there is a beneficial effect of the education of other women in the community, above and beyond that of the mother's own education? In that case, an expansion of education would reduce mortality not only because more women enter into an educational category associated with lower mortality, but also because everyone, including those who themselves remain uneducated, take advantage of the generally higher level of education in the community. Such a community-level contribution was seen in recent analyses of fertility from Africa (Kravdal 2002) and India (McNay, Cassen and Arokiasamy 2003). It has also been reported in some studies of health and mortality in developed countries that education and other socioeconomic resources in the community are influential (e.g. Pickett and Pearl 2001), but the possible importance of community education has been ignored in the literature on child mortality in developing countries.

The otherwise excellent paper by Desai and Alva (1998) may serve as an interesting illustration of the lack of attention to the community education effect. Their goal was to show that the effect of mother's education may be severely biased in the simple models that are often estimated. They first included a rural/urban indicator and various individual variables linked with (although not necessarily determinants of) education, and found that the effect was substantially weakened. Realizing that also a number of unobserved factors at the community level might be linked with both education and mortality, their next step was to include village fixed-effects instead of the rural/urban indicator, which further reduced the education effect. This would be very smart, if it were not for the possibility that one particular community factor, namely other people's education, might influence mortality. In this fixed-effects approach it is essentially thrown out with all other community factors (but it was implicitly touched in the concluding discussion).

The objective of this study is to find out whether the education of other women in the community is substantially important for child mortality in India, taking various possible determinants of education into account. There are still as many as 68 per 1000 of the Indian children who die before their first birthday and 95 per 1000 who die before their fifth, as a national average for 1994-1999 (International Institute for Population Sciences and OCR Macro 2000). Moreover, the general educational level is rather low. For example, 57% of the women of reproductive age in the late 1990s had less than three years of education, and only 14% had ten or more years. In this situation, a better assessment of the health benefits of school investments should be welcome.

The main focus is on the deaths to children less than five years old, but models for health and health care variables that are presumably important for mortality are also estimated. Indicators of women's autonomy are included as potentially mediating or confounding factors. Women's lack of autonomy, which is particularly pronounced in South Asia, has been suggested by many authors as an important reason for high

child mortality (for early contributions, see e.g. Caldwell 1986; Dyson and Moore 1983; Mason 1984). However, there is still not much solid statistical evidence for such effects, and little is known about the role women's autonomy plays in the education-mortality relationship. Besides, the importance of two other possible mediators, women's health knowledge and reproductive behaviour, is checked.

The analysis is based on data from the National Family Health Survey of 1998-1999. This survey has a very large, clustered sample of about 90 000 respondents and includes more questions on women's autonomy than most other Demographic and Health Surveys.

## THEORETICAL CONSIDERATIONS

### Why Should We Expect Community Education to be Important for Mortality?

While it is widely recognized that a child's mortality is influenced by its mother's education, little explicit attention has been paid to the possibility that also the education of *other* women in the community may be of importance. Three main causal channels are relevant: social learning, social influence, and indirect mechanisms (e.g. Bongaarts and Watkins 1996; Kohler, Behrman and Watkins 2001; Montgomery and Casterline 1996). Social learning means that knowledge and attitudes are transmitted directly from others by communication and observation, whereas social influence refers to a more passive imitation of behavior, driven by a desire to gain other people's approval or avoid sanctions. The indirect mechanism is that others' ideas, resources, or behavior can influence society and social institutions and thereby individual behavior or events.

More specifically, women who live in communities where many others have some education may have more knowledge about good health behavior and be more generally well-informed and less fatalistic than women at the same educational level elsewhere. This may lead to better nutrition of the children, higher prevalence of vaccination, a more hygienic environment, and more appropriate home care in case of disease, and it may make it easier to get professional help and communicate with health workers. Whereas this particular mechanism perhaps seems most plausible for women who themselves have little education, it is not necessarily irrelevant for the better-educated, who may benefit from having a larger group of women with whom they can discuss ideas that they have been exposed to at school or through reading.

Another possible effect is that a rise in women's education may contribute to undermine old ideas about women's rights and obligations compared to men. An improvement of women's autonomy as a contextual phenomenon, and the concomitant changes in women's individual position, may influence child mortality for a number of reasons. These mechanisms, as well as the possibly reverse effect *from* women's autonomy *to* education, are dealt with in more detail below.

Moreover, broader economic transformations may take place as a result of a better-educated work force. In particular, the community may become wealthier and thus have better opportunities to establish, for example, good sanitation systems and health care facilities. Also a change in political attitudes may follow from a higher general level of education in the community and foster a growth in such public services. As further discussed below, however, the causal effects may also run in the opposite direction, for example *from* wealth *to* education, or there may be a spurious

relationship between the general educational level and the existence of health care facilities.

For similar reasons, women who live in areas where the average educational level is relatively high may have lower fertility than others (Kravdal 2002). This may be favorable from a child health perspective. In particular, short spacing has repeatedly been reported to increase mortality (e.g. Hobcraft 1992; Muhuri and Menken 1997; Whitworth and Stephenson 2002). In spite of their strong effects, the reproductive factors appear to be responsible for only a very small part of the association between child mortality and the mother's own education (e.g. Bicego and Boerma 1993; Cleland and van Ginneken 1988), but a larger contribution might be seen when the community level also is considered.

A quite different mechanism is that a higher proportion of educated women in the community will contribute to making *other* children less sick, which will reduce the chance of seeing the child die from a contagious disease.

On the other hand, education may also contribute to *increase* child mortality. Many investigations have shown that educated women tend to breastfeed for a shorter period than others (e.g. United Nations 1995), which may have serious implications for the child's health. A similar relationship can perhaps be found at the community level. When many other women in the community are educated, attitudes toward women's work may have become more liberal and jobs in the modern sector that are attractive to and suitable for women, and where they cannot bring their children with them, may have been created. This may have consequences both for breastfeeding and child care more generally (see e.g. Tulasidhar (1993) and Basu and Basu (1991) for discussion of the importance of women's labor force participation). In addition, a generally high educational level may produce negative attitudes to breastfeeding regardless of any labor market transformations.

Also the educational level among *men* in the community may influence child mortality. For example, a woman who is surrounded by many educated men, and for that reason perhaps also has an educated husband herself, may have more knowledge than others about the advantages of seeking help from the modern health sector. Some of the other arguments above may also be relevant. Because of the possible effect of men's general educational level and its close correlation with that of women, it should be included in statistical models intended to shed light on the implications of specific efforts to stimulate girls' schooling.[1]

Many of the possible effects of community education discussed above may depend on the child's sex or age. For example, the mother's education or literacy have often been found to be less important for infants than older children (e.g. Bicego and Boerma 1993; Cleland and van Ginneken 1988; Pandey et al. 1998), and a similar pattern might be seen for community education. However, these issues are largely ignored in this study.

**Level of Aggregation**

In principle, the influential "other women" may be close neighbours, other women in the village, or even women in other parts of the country, and they may have the same or a different age. In this study, it is the education of other women of reproductive age in the same village or in an area of a similar size (see below) that is in focus.

Whereas each woman certainly does not interact directly with all other women within such an area, she may interact with a sub-group that can be considered

randomly selected. Besides, those with whom she interacts directly may themselves be part of interaction chains that in total include the entire female population. Because there are also indirect mechanisms, it is theoretically reasonable to include indicators of the overall situation, such as the average length of education among all women in the area, as community variables in statistical models.

**Determinants of Education**

As mentioned above, the relationships between education and various other factors are causally ambiguous. For example, economic strength is not only a result of education, but also a determinant (see e.g. Filmer and Pritchett 1999 for an example of such an effect at the individual level). Moreover, the statistical association between community education and access to health care facilities may reflect both a causal and a spurious effect. As an example of the latter, the political attitudes and the efficiency of the administrative authorities may be key factors behind both education, the existence of health care facilities in the village, and the quality of these facilities. In this study, it is only the proximity of the facilities that is included, not their quality, and it is considered an indicator of factors that are also important for education.

Urbanization is largely a determinant of education (although education may fuel urbanization in the long run, and a woman's own education may be one factor behind her move from a rural to an urban area). Having a large population in a small area facilitates educational expansion, and a modern, non-agricultural sector calls for an educated labor force. On the whole, urbanization also tends to reduce mortality because of, for example, better developed preventive and curative health services and water and sewage systems.

Also the religious attitudes in the community may be important for the willingness to invest in schools, in addition to influencing mortality for other reasons. The reverse causality, *from* education *to* religion, seems less plausible. Besides, the percentage of people in scheduled castes or tribes may be a determinant of education.

**The Importance of Women's Autonomy for Child Mortality**

Women's autonomy is another factor that is thought to be closely linked with education, one way or the other (see below), and that may have a substantial impact on child mortality. Using Jejeebhoy's (1995) terminology, women's "decision-making autonomy" (opportunity to take part and be heard in discussions with parents, husbands, or in-laws) and "physical autonomy" (freedom of movement) are probably particularly important for mortality. These factors might, for example, operate through such factors as the use of preventive health services, as shown by Bloom, Wypij and Das Gupta (2001), the child's nutrition, as suggested by Miles-Doan and Bisharat (1990), or the treatment of sick children, as suggested by e.g. Caldwell (1986) and Das Gupta (1990).

The "economic autonomy" has been considered another aspect of women's autonomy, and refers to their ability to fend for themselves economically, which depends on their skills, their rights to land and inheritance, their access to credit, whether they are allowed to keep the money they earn, and other political and socio-cultural factors. Some authors have argued that economic autonomy may be important

for fertility (e.g. Mason 1987, 1997). In that case, it may also have a bearing on mortality. Besides, the possibility of a more direct effect cannot be excluded.

These three aspects of women's autonomy are, of course, difficult to separate. They affect each other mutually and definitions will necessarily be blurred. In addition, Jejeebhoy (1995) has suggested another closely related dimension, "emotional autonomy", which refers to the closeness between husband and wife. This also may have a bearing on child mortality (Jejeebhoy 1998). Indicators of all these four dimensions of women's autonomy are included in this study.

### The Reciprocal Link Between Women's Education and Their Autonomy

Community norms and institutional structures are strong determinants of the individual woman's autonomy, but there are also individual variations caused by such factors as the woman's own age, education, economic resources, religion, and position in the life cycle. However, there is no unambiguously positive relationship between women's education and autonomy (e.g. Basu 1996). For example, some studies have shown that better-educated women may have no more freedom of movement than others, and perhaps even less (e.g. Balk 1997). It has also been argued that the influence of education and other individual characteristics on women's autonomy is highly context-dependent. For example, Jejeebhoy and Sathar (2001) found that education was an unimportant determinant in the north of India, but that it had significant impact in the south.

In addition to the possible impact of a woman's schooling on her individual autonomy, there may be corresponding effects at the community level: As already mentioned, an expansion of education may tend to reduce men's dominance more generally. Moreover, the inverse relationship is indeed plausible: Poor parents would see little need to educate their daughters if they reckon that community norms about women's position would not allow them to make use of it for paid work anyway, and that their in-laws perhaps will put their hands on any income they might earn. In fact, women's expectedly poor productivity because of low autonomy is also an argument for many families, along with the kinship and (still informally existing) dowry system and the need for sons to perform religious acts, for not wanting to have many daughters at all.

## DATA AND METHODS

### Data

The analysis is based on data from the National Family Health Survey of 1998-1999 (NFHS II), in which about 90000 ever-married women aged 15-49 were interviewed. The restriction to ever-married women is unproblematic because of the low out-of-wedlock fertility in India. There is supposed to be little underreporting of deaths (International Institute for Population Sciences and OCR Macro 2000). Besides, the age heaping at multiples of six months should be no concern in this study that is focused on educational differentials and mortality over a five-year period.

The survey has a clustered sample. Within each state, a number of census enumeration areas ("primary sampling units"; PSUs) were selected on the basis of certain criteria. In total, there were 3215 such areas in the survey, each typically

spanning one or a few villages, or part of a town or city. On average, about 30 households in each area were randomly chosen, and all women of reproductive age in these households were selected for interview. Weights specific to a small group of PSUs were defined to make the survey nationally representative.

In this study, averages of educational level and various other variables are calculated for these approximately 30 women (or, for the autonomy indicators, those who are married). These averages can be considered proxies for the corresponding PSU averages. For education, the measurement error introduced by using such a proxy was shown in a simulation experiment by Kravdal (2002) to be unimportant. Further evidence of the appropriateness of basing the community-level variables on so small sub-samples is provided below. Exclusion of the woman in focus before calculating the averages does not influence the effect estimates, of course.

In addition to the individual data, the survey includes characteristics of each village within the rural PSUs. The information on distance to health care facilities is used in this study.

**Models**

Discrete-time hazard models for mortality of children born within the five years before interview are estimated in the aML software (Lillard and Panis 2000). Each child contributes a series of six-month observation intervals up to a maximum of five years. Tests showed this to be sufficiently short intervals. Twins are excluded. The sample includes 3996 child deaths.

Besides, logistic models for 15 health and health care indicators are estimated for children who were less than three years old and still alive at interview and who had no more than one younger sibling. The women were only interviewed about the health and health care of the two youngest children below about age three (born after 1 January 1995 in states where the fieldwork started in 1998 and after 1 January 1996 in states where it started in 1999), and most of the questions were further restricted to the survivors. Besides, some children are left out of the analysis because of missing information on the dependent variable in focus.

More specifically, models for the following probabilities are estimated:

- whether the mother had moderate or severe anemia (Hb < 10g/dl)
- whether the mother had received antenatal care from a health worker (physician, nurse, midwife, other health professional, or home health worker)
- whether the mother had received at least one tetanus injection before birth
- whether the child had been fully vaccinated (restricted to children who were 12-23 months old at interview, because the children should be fully vaccinated at the time of their first birthday, according to international and Indian guidelines)
- whether the child had ever received vitamin A supplementation (restricted to children older than 12 months, because the current Programme on Prevention of Blindness prescribes doses every six months starting at the age of nine months)
- whether the child had suffered from diarrhoea the last two weeks before interview
- whether the child had suffered from cough accompanied by fast breathing

(symptoms of acute respiratory infection) the last two weeks

- whether a child with diarrhoea had been taken to a health facility or provider for advice or treatment.
- whether a child with diarrhoea had been given oral rehydration
- whether a child with cough and fast breathing had been taken to a health facility or provider for advice or treatment.
- whether a child younger than four months received only breast milk, i.e. no solid food, no plain water, and no other liquid (in accordance with recommendations, which have been criticized by Anandaiah and Choe (2000))
- whether a child aged 6-11 months was given both breastmilk and solid or semi-solid food (as recommended)
- whether the child had moderate or severe anemia (Hb < 10g/dl)
- whether the child was stunted (height less than two standard deviations below the median for the international reference population at that age, which indicates chronic undernutrition)
- whether the child was wasted (weight less than two standard deviations below the reference median for that height, which indicates acute undernutrition)

Individuals in the same PSU may share some unobserved characteristics. Generally, failure to account for such factors gives too small standard errors of the community-effect estimates. In this study, a random term at the PSU level is included in all models, but has no importance for the conclusions. (It would also have been relevant, although even less important substantially, to include random terms at lower levels. Some variables are measured for a household, from which there may be more than one woman in the sample, and many women have had more than one child during the five-year period.)

**Various Methodological Problems**

It is the characteristics of the PSU in which the woman lived at interview that are included in the models, which is not ideal. The child mortality experienced by a woman early in the five-year period is influenced by the situation in the community at that time, which may be different, and community education is determined by the situation even further back in time. Besides, many women have not even lived in the area throughout the five-year period. Fortunately, excluding children whose mothers had moved to the area after the child was born turned out to give very similar results.

An additional problem arises with the mother's own education and other individual characteristics, which, in principle, may be a result of mortality or health events during the five years before interview. However, this cannot be a major concern. Few women take education after having become mothers, regardless of the children's health and survival, and the autonomy indices and most of the other individual variables are probably also largely unaffected by such factors.

Many variables that may influence the educational level are included, but the estimates may, of course, nevertheless be biased. As an illustration, let us compare an uneducated woman who lives in an area with a generally high educational level and another uneducated woman who lives in an area where the average educational level is much lower, but where other observed community characteristics are the same.

These women may differ in many ways, for example in general wealth or gender norms that are not captured by the included variables, or in factors that are not considered at all in this study. In addition to these differences between the communities in which the two women live, there may be unobserved differences between the women themselves. For example, if one of the two areas is economically better developed than the other, the woman who lives in that area may also herself be richer than the other woman. If there had been two or more surveys in the same PSUs, one might have pooled the samples and included fixed-effects at the PSU level, which would have picked up at least the persistent unobserved community-level factors. However, different PSUs were used in the NFHS-2 and NFHS-1 surveys, so this approach could not be used.

Another methodological problem lies in the modelling of health and health care among children below age three who are still alive at interview. There may be correlated unobserved factors behind survival up to interview and the health and health care reported at that time. To check the size of this selection bias, probit models were estimated jointly for (i) health or health care and (ii) the probability of being alive and having non-missing data for the corresponding variable, with individual error terms that were allowed to be correlated. This was done for five different health or health care variables, and the education effects were always similar to those obtained in the corresponding separate models.

Some of the variables are fairly strongly correlated, so one might perhaps suspect a multicollinearity problem. However, the standard errors in the most complex models are not much larger than in simple models that were estimated at a preliminary stage. Besides, the estimates in all models are very robust toward exclusion of observations. For example, when 15% of the respondents were taken out at random, either initially or only when calculating averages, very small changes in the estimates were seen. This is also an additional argument for the appropriateness of basing the analysis on averages from such small sub-samples.

**Definition of Independent Variables**

The definition of the independent variables should be sufficiently clear from the short labels in the tables, but a few words about wealth and autonomy may be needed. A wealth index is constructed by summing ownership of the following consumer goods: radio, television, bicycle, motorcycle, and car. According to Bollen, Glanville and Stecklov (2002), this should be a fairly good proxy for economic status. Electricity in the household is included as an additional indicator of wealth and modernization.

A simple index of women's physical autonomy is constructed by summing over the following two 0/1 variables: whether the woman needs permission to go to the market, and whether she needs permission to visit relatives or friends. Similarly, an index of decision-making autonomy is formed on the basis of information about whether the woman takes decisions herself, or at least jointly with her husband or others, on the following: what to cook, whether to obtain health care for herself, whether to purchase jewellery or other major household items, and whether to stay with her parents or siblings.

Two variables that cannot be summed up to an index are chosen as main indicators of economic autonomy. One of them is whether the woman is allowed to have some money set aside that she can use as she wishes. The other is whether she participates in the decisions on how the money she earns will be used, provided that

she earns cash at all. A cash-earning variable is also included in the models, but not considered an autonomy indicator on par with the others.[2]

When forming a community variable for women's access to the money they earn, a missing value indicator is set to 1 for the areas where no women in the interviewed households earned cash (which included 7% of the women), and is otherwise 0.

An index of emotional autonomy is defined as the sum of responses to questions about whether, generally, a husband is justified in beating his wife in three different situations: if her family does not give him or his family the expected amount of money, if she goes out without telling him, or if she neglects the house or the children. Because this does not refer to the woman's own situation, it is included only as a community-level variable.

A 0/1 dummy for whether the woman wants more sons than daughters and a corresponding community-level variable are included as additional autonomy indicators.

Because much of the data on decision-making is relevant primarily for those who are married at interview, the analysis of the importance of women's autonomy is restricted to that group (see below).

The knowledge index is defined as the sum of three 0/1 indicators of whether the woman had heard of oral rehydration therapy, whether she had heard about AIDS, and whether she knew at least one important way to prevent HIV infection.

## RESULTS

### The Effect of Community Education on Child Mortality and Its Contribution to the Total Impact of Educational Expansion

Model 1 in Table 1 includes only the woman's education and the child's age. Model 2 also includes some individual-level variables particularly likely to lie causally prior to education: caste/tribe membership, consumer item index and electricity. Education effects are weaker in this model.

When also the corresponding community variables, including average length of education, are entered into the model, along with a combined variable for rural/urban and distance to health center, the effects of individual education are further reduced (Model 3). On the other hand, the effect of average education is itself very strong[3], so the total impact of education is much larger according to this model. This can be illustrated by calculating overall five-year child mortality as a weighted average of predicted education-specific mortality probabilities, with different educational distributions as weights. More specifically, let us see how this five-year mortality changes if the educational distribution among all women of reproductive age is changed from the current Indian national average to that in Kerala, which is the state with the highest average educational level, and if we assume that the distribution among mothers of children younger than five is the same (i.e. disregard differential fertility and thus get a "purer" mortality influence).[4] Using the estimates from the model with only individual education and child's age (Model 1), this hypothetical educational expansion would reduce five-year mortality by 0.030. The corresponding change calculated from the estimates from Model 2 would be 0.024. According to the more complex Model 3, which includes average education, the change would be 0.040, of which 0.018 is an individual-level contribution (obtained by using the all-

India average educational level in all predictions of education-specific mortality, but change the weights in accordance with the changes in the educational distribution) and the remaining 0.022 a community-level contribution. The change would be almost the same if no other community variables than education had been included (not shown). Thus, Model 2, which includes the woman's own education but not community education, picks up the "true" individual-level contribution (0.018) and part of (0.006), but far from the entire (0.022), community-level contribution (as illustrated mathematically for simpler models in Kravdal 2001).

**Table 1. Effects (with Standard Errors) of Education and Other Variables on Child Mortality in India**[a]

| Independent Variable | Model 1 | Model 2 | Model 3 | Model 4 (same as Model 3, but restricted to the married ) |
|---|---|---|---|---|
| MOTHER'S EDUCATION | | | | |
| 0-2 years[b] 0 | 0 | 0 | 0 | |
| 3-6 years | -0.52*** (0.05) | -0.40*** (0.05) | -0.31*** (0.05) | -0.31*** (0.05) |
| 7-9 years | -0.69*** (0.06) | -0.52*** (0.06) | -0.36*** (0.06) | -0.36*** (0.06) |
| 10+ years | -1.14*** (0.07) | -0.87*** (0.08) | -0.61*** (0.08) | -0.61*** (0.08) |
| AVERAGE EDUCATION AMONG WOMEN (years) | | | -0.086*** (0.014) | -0.088*** (0.014) |
| POSSIBLE DETERMINANTS OF EDUCATION | | | | |
| Caste/tribe membership | | | | |
| Scheduled caste | | 0.04 (0.05) | 0.07 (0.05) | 0.09* (0.05) |
| Scheduled tribe | | 0.19*** (0.06) | 0.23*** (0.06) | 0.24*** (0.07) |
| Other backward castes | | 0.05 (0.04) | 0.04 (0.04) | 0.04 (0.04) |
| Other[b] | | 0 | 0 | 0 |
| Religion | | | | |
| Hindu[b] | | 0 | 0 | 0 |
| Muslim | | -0.21*** (0.05) | -0.13** (0.06) | -0.13** (0.06) |
| Sikh | | 0.01 (0.16) | 0.02 (0.16) | -0.01 (0.16) |
| Christian | | -0.27** (0.13) | -0.14 (0.13) | -0.11 (0.13) |
| Other | | -0.15 (0.16) | -0.09 (0.16) | -0.08 (0.16) |
| Consumer items index | | -0.09*** (0.02) | -0.09*** (0.02) | -0.09*** (0.02) |
| Electricity (no=reference) | | -0.20*** (0.04) | -0.07 (0.05) | -0.06 (0.05) |
| Proportion scheduled caste/tribe | | | -0.17* (0.09) | -0.17* (0.09) |
| Proportion Muslim | | | -0.17* (0.10) | -0.16 (0.10) |
| Rural/urban*health care | | | | |
| Rural, health care centre within 3 km | | | -0.09* (0.05) | -0.10** (0.05) |
| Rural, health care centre in village | | | -0.10** (0.05) | -0.11** (0.05) |
| Rural, other[b] | | | 0 | 0 |
| Urban | | | -0.07 (0.06) | -0.08 (0.06) |
| Consumer items index for community | | | 0.10** (0.05) | 0.10** (0.05) |
| Proportion with electricity in the household | | | -0.17*** (0.08) | -0.16*** (0.08) |
| Standard deviation of PSU-level heterogeneity term | 0.36*** (0.03) | 0.34*** (0.03) | 0.33*** (0.04) | 0.33*** (0.04) |

[a] Constant term and effects of child's age (6 categories) are not shown.
[b] Reference category
* p< 0.10; ** p< 0.05; *** p< 0.01

Leaving individual education out of Model 3 would have given a community education effect of –0.135 (not shown). According to this estimate, an educational expansion to the level in Kerala would have reduced mortality by 0.040, just as found with Model 3. In other words, we capture the whole effect of education by such an

approach (also in accordance with Kravdal 2001), but cannot identify the individual and community contributions.

The estimates are strongly dominated by the pattern among infants. In a model for children who were 13-60 months, effects of individual education were markedly sharper, whereas that of community education was essentially the same (the difference was less than 0.005; not shown).

At this stage, it may be instructive to revisit the fixed-effects model estimated by Desai and Alva (1998). As explained in the Appendix, the individual education effects in Model 3 are actually the same as one would get if community fixed-effects were included (one dummy for each of the PSUs except one that is chosen as a reference) instead of the other community variables. In that sense, the two approaches are similar. However, the fixed-effects approach ignores the effect of other women's education, and thus understates the total impact of investments in education considerably.

Some of the effects of other variables in Model 3 are difficult to understand. For example, women from scheduled tribes experience high child mortality, whereas low mortality is indicated for those who live in communities where relatively many are members of scheduled castes or tribes (where mortality was found to be low also by Murthi, Guio and Dreze 1995). Besides, the effect of community wealth is positive, whereas the expected negative effect is estimated for the corresponding individual-level variable and the proportion with electricity. The effects of religion are more consistent, however: Muslims experience lower child mortality than Hindus, as reported also by others (e.g. Pandey et al. 1998), and there are indications of low mortality in areas with many Muslims. Living in an urban area is not particularly advantageous according to these models with many other variables (as also seen by Pandey et al.), but within the rural areas, having a health care centre or sub-centre in the village reduces mortality significantly. There are also indications that a center within a few kilometers is advantageous.

As explained above, the causal position of wealth and economic modernization is particularly unclear. Fortunately, exclusion of the electricity variables and the consumer-item indices would have had a modest impact on individual education effects, which would become 0.05-0.10 sharper, and hardly any impact on the community education effect. Ignoring the distance to a health care center would have made the community education effect only 0.003 sharper.

Some of the theoretical arguments about the importance of other women's education that were reviewed above are perhaps not generally relevant for all children, regardless of their own mother's education. However, the cross-level interactions that were included in additional models were far from significant (not shown).

There is considerable unexplained variation in mortality between the different communities even in the most complex model. Inclusion of many individual and community variables reduces the standard error of the random term only from 0.36 to 0.33 (and further to 0.29 when more variables are added; see below).

**The Role Played by Women's Autonomy**

The remaining analysis of mortality is restricted to those who are married at interview, which seems unproblematic in this particular case. The large majority of

children have a mother who is still married at interview, and exclusion of the others has no influence on the estimates (compare Models 3 and 4, Table 1).

**Table 2**. **Effects (with Standard Errors) of Education and Autonomy on Mortality Among Indian Children with a Married Mother**[a]

| Independent Variable | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| MOTHER'S EDUCATION | | | |
| 0-2 years[b] | 0 | 0 | 0 |
| 3-6 years | -0.29*** (0.05) | -0.28*** (0.05) | -0.24*** (0.05) |
| 7-9 years | -0.34*** (0.07) | -0.32*** (0.07) | -0.24*** (0.07) |
| 10+ years | -0.59*** (0.08) | -0.58*** (0.08) | -0.39*** (0.09) |
| AVERAGE EDUCATION AMONG WOMEN (years) | -0.071*** (0.014) | -0.051*** (0.014) | -0.064***(0.018) |
| AUTONOMY | | | |
| Individual decision-making autonomy index | -0.04*** (0.01) | -0.04*** (0.01) | -0.04*** (0.01) |
| Individual physical autonomy index | -0.05* (0.03) | -0.05* (0.03) | -0.05* (0.03) |
| Individual economic autonomy | | | |
| Allowed to set money aside (no=reference) | -0.01 (0.04) | -0.01 (0.04) | -0.01 (0.04) |
| Earn cash (no=reference) | 0.04 (0.06) | 0.04 (0.07) | 0.04 (0.07) |
| Allowed to spend cash earnings freely (no=reference) | 0.05 (0.07) | 0.07 (0.07) | 0.07 (0.07) |
| Individual boy preferences | | 0.02 (0.04) | 0.01 (0.04) |
| Community decision-making autonomy index | -0.01 (0.04) | 0.01 (0.04) | 0.01 (0.04) |
| Community physical autonomy index | -0.22*** (0.06) | -0.16** (0.07) | -0.16** (0.07) |
| Community emotional autonomy index | -0.09** (0.03) | -0.10** (0.04) | -0.10** (0.04) |
| Community economic autonomy | | | |
| Proportion allowed to set money aside | 0.05 (0.10) | 0.03 (0.10) | 0.03 (0.10) |
| Proportion who decide how to spend earnings, given that they earn cash | 0.11 (0.07) | 0.08 (0.06) | 0.08 (0.06) |
| Community boy preferences | | 0.62*** (0.12) | 0.61*** (0.13) |
| HUSBAND'S EDUCATION | | | |
| 0-2 years[b] | | | 0 |
| 3-6 years | | | -0.03 (0.05) |
| 7-9 years | | | -0.17*** (0.05) |
| 10-11 years | | | -0.17** (0.06) |
| 12-14 years | | | -0.20** (0.08) |
| 15+ years | | | -0.65*** (0.11) |
| AVERAGE EDUCATION AMONG HUSBANDS (years) | | | 0.025* (0.014) |
| Standard deviation of PSU-level heterogeneity term | 0.31*** (0.04) | 0.29**** (0.04) | 0.29**** (0.04) |

[a] In addition, the same variables as in Model 3 in Table 1 are included, plus a missing-value indicator for areas where no women earn cash.
[b] Reference category
* p< 0.10; ** p< 0.05; *** p< 0.01

Women with a high score on the decision-making autonomy index experience lower child mortality than those with a low score. The effects of the other individual autonomy indices are not significant, but there are indications that physical autonomy reduces child mortality. Among the community-level indices, those for emotional and decision-making autonomy have a significant negative effect. Thus, the only dimension of women's autonomy that is not found to be negatively related to mortality at any level is the economic autonomy.

Effects of individual education are hardly changed when the autonomy indicators are included[5], whereas the community education effect is reduced from –

0.088 (Table 1, Model 4) to –0.071 (Table 2, Model 1). Inclusion of a more general autonomy indicator, women's preferences for boys, has slightly more impact. Whereas the mother's own boy preferences exert no effect on mortality (in this study where the child's sex is not considered), living in an area where a high proportion wants more boys than girls reduces mortality significantly (Model 2). In these models, effects of individual education are the same, but the effect of community education is further reduced to –0.051.

If the different aspects of women's autonomy, including their boy preferences, are primarily determinants of women's education, rather than consequences, the estimate of -0.051 is a better assessment of the community-level effect of investments in schooling than the estimate of –0.088. However, the total impact of a hypothetical educational expansion up to the level in Kerala would nevertheless be 0.031, which is just as large as it would seem from even the simplest model (Model 1, Table 1) and 1/4 higher than the estimate of 0.024 from the individual-level model with some possible determinants of education included.

**Husband's Education**

Before including the variables that are obviously mediators, the education of the woman's own husband (five categories[6]) and the average education of other husbands in the PSU are entered into the models. This should leave a better estimate of the importance of investing in girls schooling in particular. At the individual level, it is especially the effect of a secondary education that is reduced (Model 3). The effect of the husband's own education is itself significant, but, on the whole, weaker than that of the woman's education. This fits well with conclusions from other studies (see e.g. review by Hobcraft 1993).

Husbands' average education is, of course, closely correlated with women's average education (correlation coefficient 0.84), but it seems that the effects can be separated (see paragraph on multicollinearity). The result is interesting: Husbands' education has no significant beneficial effect on mortality. In fact, there are indications of the opposite, so the effect of women's average education is sharper (-0.064) in this model. One possible interpretation is that a high average education for men, given women's average education, signals that women have generally little autonomy, and that this more than outweighs the true education effect and any mortality advantage stemming from a higher level of socio-economic modernization in these areas.

According to this model, an educational expansion up to the level in Kerala will reduce mortality by 0.030, which is almost exactly as found without including husbands' education (i.e. the changes in the individual- and community-level estimates outbalance each other completely).

**Two Possible Mediating Factors: The Reproductive Pattern and the Woman's Health Knowledge**

Well-known effects of reproductive variables are confirmed with these Indian data (Table 3, Model 1). The highest child mortality is experienced by young and old mothers, those who have had another child shortly before, and those who bear a child afterwards.[7] When the reproductive variables are included, the individual education

effects change very little. This accords with some studies mentioned above, which showed that reproductive factors were completely unimportant mediators. However, the effect of women's average education is markedly weaker in these models (down from -0.064 to –0.051). In consistence with this, logistic and linear models for some important reproductive factors revealed that community education had a much stronger effect than individual education (not shown).

The index of the woman's knowledge has significant effect, which explains part of the lower child mortality experienced by women who themselves have some education or who live in areas where the average educational area is relatively high (Table 3, Model 2).[8] Reproductive factors are included in these models. The additional effect of knowledge operating through these factors is very small (not shown).

It should be noted that the knowledge effects may be biased, in either direction, because of a reverse causation. For example, a fatal diarrhoea episode may have made the woman aware of oral rehydration therapy, or, conversely, processes linked with child *survival* may have given the mother this knowledge.

**Education Effects in Models for Health and Health Care Indicators**

Estimates from models for various health and health care indicators are shown in Table 4. In these models, religion, wealth, urbanization, health care facilities, caste/tribe membership, and the child's age are included along with education (just as in Model 3 in Table 1). Besides, month of interview is included as a control variable, because the fieldwork took place in different seasons in different states, and because of the seasonal variation in some of the diseases considered.

Obviously, community education operates through many different channels: A high average education improves the mother's own health, increases her use of preventive services during pregnancy, makes it more likely that the child is vaccinated and given vitamin A supplementation, reduces the risk of diarrhoea, makes treatment of children with diarrhoea more appropriate, and makes her more inclined to give the child both solid food and breast milk at age 6-11 months. In consistence with this, the child has a lower risk of becoming stunted, wasted or anemic.

However, children in areas with a relatively high general educational level have not to a particularly large extent suffered from symptoms of acute respiratory infection the two weeks before interview, and have not particularly often been brought to a health worker in the latter case or if they have had diarrhoea. These children do not have an advantage with respect to breastfeeding either.

Inclusion of indicators of women's autonomy reduces the effects of community education on antenatal care, tetanus vaccination, solid food supplement, diarrhoea incidence and stunting by 1/3 – 1/2, and removes the effect on child vaccination. (These models, restricted to married mothers, are not shown).

Inclusion of husbands' education sharpens some effects of women's average education (not shown), just as in the mortality model. However, very small changes are seen when also reproductive factors are entered into the models (not shown). Inclusion of the knowledge indicator reduces some effects of individual education markedly, but community education effects are virtually unaffected, except in the model for tetanus vaccination, where it is reduced by 1/4 (not shown).

**Table 3. Effects (with Standard Errors) of Education, Reproductive Factors, and Health Knowledge on Mortality Among Indian Children with a Married Mother**[a]

| Independent Variable | Model 1 | Model 2 |
|---|---|---|
| MOTHER'S EDUCATION | | |
| 0-2 years[b] | 0 | 0 |
| 3-6 years | -0.25*** (0.05) | -0.22*** (0.05) |
| 7-9 years | -0.27*** (0.07) | -0.20*** (0.07) |
| 10+ years | -0.40*** (0.09) | -0.30*** (0.10) |
| AVERAGE EDUCATION AMONG WOMEN (years) | -0.051*** (0.018) | -0.043** (0.019) |
| HUSBAND'S EDUCATION | | |
| 0-2 years[b] | 0 | 0 |
| 3-6 years | -0.03 (0.04) | -0.03 (0.04) |
| 7-9 years | -0.16*** (0.05) | -0.15*** (0.05) |
| 10-11 years | -0.18*** (0.06) | -0.16** (0.06) |
| 12-14 years | -0.18** (0.08) | -0.16** (0.08) |
| 15+ years | -0.63*** (0.11) | -0.61*** (0.12) |
| AVERAGE EDUCATION AMONG HUSBANDS (years) | 0.021 (0.014) | 0.016 (0.014) |
| PARITY | | |
| 1 | 0 | 0 |
| 2 | -0.34*** (0.06) | -0.34*** (0.06) |
| 3 | -0.40*** (0.06) | -0.40*** (0.06) |
| 4 | -0.26*** (0.07) | -0.26*** (0.07) |
| 5+ | -0.26*** (0.08) | -0.27*** (0.08) |
| MOTHER'S AGE AT BIRTH | | |
| -19 years | 0.25*** (0.05) | 0.25*** (0.05) |
| 20-24 years | 0 | 0 |
| 25-29 years | -0.03 (0.05) | -0.03 (0.05) |
| 30-34 years | -0.08 (0.07) | -0.08 (0.07) |
| 35+ years | 0.42*** (0.08) | 0.42*** (0.08) |
| PREVIOUS BIRTH INTERVAL | | |
| 0-12 months | 1.01*** (0.07) | 1.01*** (0.07) |
| 13-24 months | 0.51*** (0.05) | 0.51*** (0.05) |
| 25-36 months, or first birth | 0 | 0 |
| 37-60 months | -0.37*** (0.06) | -0.38*** (0.06) |
| 60+ months | -0.08 (0.09) | -0.08 (0.09) |
| ANOTHER CHILD BORN AFTERWARDS | | |
| No | 0 | 0 |
| Yes | 0.73*** (0.12) | 0.71*** (0.12) |
| HEALTH KNOWLEDGE INDEX FOR MOTHER | | -0.11*** (0.02) |
| Standard deviation of PSU-level heterogeneity term | 0.26*** (0.04) | 0.26*** (0.04) |

[a] In addition, the same variables as in Table 2 are included
[b] Reference category
* p< 0.10; ** p< 0.05; *** p< 0.01

**Table 4. Effects of Education on Health and Health Care Factors of Relevance for Child Mortality in India[a]**

| | MOTHER'S HEALTH | ANTENATAL CARE | | PREVENTIVE CHILD CARE | |
|---|---|---|---|---|---|
| | Mother has anemia | Mother prenatal care by health worker | Tetanus vaccine | Child aged 12-23 months fully vaccinated | Vitamin A by age 12 months |
| MOTHER'S EDUCATION | | | | | |
| 0-2 years[b] | 0 | 0 | 0 | 0 | 0 |
| 3-6 years | -0.02 | 0.82*** | 0.80*** | 0.61*** | 0.47*** |
| 7-9 years | -0.17*** | 1.12*** | 1.25*** | 0.72*** | 0.69*** |
| 10+ years | -0.53*** | 1.49*** | 1.75*** | 0.71*** | 0.59*** |
| AVERAGE EDUCATION AMONG WOMEN (years) | -0.05*** | 0.22*** | 0.15*** | 0.11*** | 0.07*** |
| Sample size: | 29827 | 30898 | 30846 | 9823 | 19828 |

| | DISEASES | | TREATMENT | | |
|---|---|---|---|---|---|
| | Diarrhoea last two weeks | ARI symptoms last two weeks | Brought to health worker if diarrhoea | Got ORS if diarrhoea | Brought to health worker if ARI symptoms |
| MOTHER'S EDUCATION | | | | | |
| 0-2 years[b] | 0 | 0 | 0 | 0 | 0 |
| 3-6 years | 0.03 | -0.01 | 0.02 | 0.19*** | 0.24*** |
| 7-9 years | 0.04 | 0.07 | 0.46*** | 0.26*** | 0.52*** |
| 10+ years | -0.15*** | -0.30*** | 0.55*** | 0.42*** | 0.36*** |
| AVERAGE EDUCATION AMONG WOMEN (years) | -0.09*** | 0.02* | -0.03 | 0.08*** | 0.01 |
| Sample size: | 31608 | 31548 | 6083 | 6054 | 5944 |

| | NUTRITION | | CHILD HEALTH AND NUTRITION INDICATORS | | |
|---|---|---|---|---|---|
| | Only breast milk first 4 months | Breast milk + solid food 6-11 months | Child has anemia | Child is stunted | Child is wasted |
| MOTHER'S EDUCATION | | | | | |
| 0-2 years[b] | 0 | 0 | 0 | 0 | 0 |
| 3-6 years | -0.18* | 0.44*** | -0.10*** | -0.26*** | -0.07 |
| 7-9 years | -0.29** | 0.37*** | -0.25*** | -0.47*** | -0.14*** |
| 10+ years | -0.03 | 0.46*** | -0.40*** | -0.67*** | -0.21*** |
| AVERAGE EDUCATION AMONG WOMEN (years) | -0.02 | 0.17*** | -0.07*** | -0.10*** | -0.03** |
| Sample size: | 4520 | 5072 | 24752 | 24249 | 25094 |

[a] In addition, the same variables as in Model 3 in Table 1 are included, plus month at interview.
[b] Reference category
* p< 0.10; ** p< 0.05; *** p< 0.01

The effects of community education are very similar to those of individual education, which in turn accord well with the patterns reported elsewhere (e.g. Hobcraft 1993). The most notable exceptions are that women who themselves have education tend to bring children with diarrhoea or ARI symptoms more often to a health worker than the uneducated, whereas community education has no such effect. On the other hand, significant community-level effects show up for vaccination and vitamin A supplementation, so one should not reject the idea that a generally high educational level may increase the individual woman's awareness of the importance of modern medical health services and her willingness to make use of them.

## SUMMARY AND CONCLUSION

It is widely recognized that education effects in many previous studies of child mortality in developing countries may have been seriously biased because of omitted factors, and one should, of course, continue the efforts to establish good indicators of characteristics that are linked with education, with a special eye to those that are likely to be confounders rather than mediators. However, one should also be concerned about the limitations of the individual-level perspective. This analysis has revealed a sharp effect of other women's education, at any level of the mother's own education, which is not adequately captured in an individual-level model.

Moreover, the results support the idea that women's autonomy is important for child mortality. Significant effects of decision-making, physical and emotional autonomy appear, either at individual or community level, but no effects of the two indicators of economic autonomy. There is also an effect of women's boy preferences, which, in addition to being a general autonomy indicator, may capture other social factors such as dowry and kinship systems, which not necessarily should be reckoned as aspects of women's autonomy. Effects of community education are reduced when the specific indicators of women's autonomy are included, and even more so when also the boy preferences are included. The interpretation is not obvious, however. Women's autonomy may be a result of their education, in which case we would underestimate the total impact of investments in schooling by including these indicators, or it may be a determinant, which means that they definitely should be included.

A number of other characteristics that may be determinants of education are also included in the models, but the estimated effects of community education may, of course, nevertheless be biased. A woman who lives in an area with a relatively high average educational level may be surrounded by people who, for example, also score high on some important unobserved socio-economic factors. There is plenty of room for such factors, as much community variation is left unexplained by the model.

According to the most conservative estimate, a hypothetical expansion of the educational level in India up to that currently found in Kerela would reduce the probability of death before the age of five by 0.031, of which 0.014 is a community-level contribution. This is considerably higher than the 0.024 calculated from an individual-level model that includes some possible determinants of education (and much higher than one would get from a model with community-level fixed-effects, which would leave only the individual-level contribution of 0.017).

The direction of the bias is not obvious. One cannot be sure about the consequences of including more determinants of education, although a smaller community education effect seems most plausible, and the factors that *are* included

may actually tap out some of the effect. Anyway, also the individual-level effects are biased (even in these models with many potential confounders included), so this uncertainty in the assessment of the community-level contribution should not be a reason for continuing to ignore it.

It seems that it is the general educational level among *women* that is important, not that among men. The husband's own education has some importance for child mortality, but there is no beneficial effect of husbands' average educational level. Inclusion of the latter variable, which probably also picks up additional aspects of modernization and women's autonomy, actually strengthens the effect of women's average education.

Significant effects of women's average education are estimated in models for various indicators of the mother's own health, the preventive efforts she makes, the use of supplementary nutrition, the child's disease risk, and the mother's care for a sick child. Such factors probably have considerable impact on child mortality, but could unfortunately not be included in the mortality models. Therefore, the relative importance of these causal pathways could not be estimated. Fertility is an unimportant mediating factor in these models for various proximate determinants of mortality, but is nevertheless responsible for part of the community education effect in the child mortality model. This contrasts with some individual-level models estimated in previous studies, where reproductive factors turned out to be completely unimportant as a causal channel.

There are many possible reasons why community education has a substantial impact on children's health and mortality, through reproductive factors or otherwise. For example, there may be more knowledge about or other attitudes to health care in areas where the average educational level is high, there may be more public and private resources allocated to sanitation, there may be fewer sick children to spread diseases, or the health facilities may be better. The analysis does not shed light on these mechanisms, except indicating that the mother's health knowledge, as measured by a very simple index, is indeed responsible for some of the community education effect.

**REFERENCES**

Anandaiah, R. and M.K. Choe. 2000. "Are the WHO Guidelines on Breastfeeding Appropriate for India?" National Family Health Survey Subject Reports 16. International Institute for Population Sciences (Mumbai, India) and East-West Center (Honolulu, U.S.A)

Balk, D. 1997. "Defying Gender Norms in Bangladesh: A Social and Demographic Analysis." *Population Studies* 51: 153-72.

Basu, A. 1996. "Girls Schooling, Autonomy and Fertility Change- What do These Word Mean in South Asia." In *Girls Schooling, Autonomy and Fertility Change in South Asia*, edited by R. Jeffrey and A. Basu. New Dehli: Sage Publications.

Basu, A. and K. Basu. 1991."Women's Economic Roles and Child Survival: The Case of India." *Health Transition Review* 1: 83-103.

Bloom, S.S, D. Wypij, and M. Das Gupta. 2001. "Dimensions of Women's Autonomy and the Influence on Maternal Health Care Utilization in a North Indian City." *Demography* 38: 67-78.

Bollen, K.A., J.L. Glanville, and G. Stecklov. 2002. "Economic Status Proxies in Studies of Fertility in Developing Countries." *Population Studies* 56: 81-96.

Bongaarts, J. and S. C. Watkins. 1996. "Social Interactions and Contemporary Fertility Transitions." *Population and Development Review* 22: 639-82.

Caldwell, J. 1986. "Routes to Low Mortality in Poor Countries." *Population and Development Review* 12: 171-220.

Cleland, J.C and J.K van Ginneken. 1988. "Maternal Education and Child Survival in Developing Countries. The Search for Pathways of Influence." *Social Science and Medicine* 27: 1357-68.

Das Gupta, M. 1990. "Death Clustering, Mother's Education, and the Determinants of Child Mortality in Rural Punjab, India." *Population Studies* 44: 489-505.

Desai, S. and S. Alva (1998). "Maternal Education and Child Health: Is There a Strong Causal Relationship?" *Demography* 35: 71-81.

Dyson, T. and M. Moore. 1983. "On Kinship Structure, Female Autonomy, and Demographic Behavior in India." *Population and Development Review* 9: 35-60.

Filmer, D. and L. Pritchett. 1999. "The Effect of Household Wealth on Educational Attainment: Evidence From 35 Countries." *Population and Development Review* 25:85-120.

Hobcraft, J. 1992. "Fertility Patterns and Child Survival: A Comparative Analysis." *Population Bulletin of the United Nations* 33: 1-31.

__. 1993. “Women’s Education, Child Welfare and Child Survival: A Review of the Evidence.” *Health Transition Review* 3: 159-75.

International Institute for Population Sciences (IIPS) and ORC Macro. 2000. *National Family Health Survey (NFHS-2), 1998-1999: India*. Mumbai:IIPS.

Jejeebhoy, S. 1995. *Women’s Education, Autonomy and Reproductive Behavior: Experience From Developing Countries*. Oxford: Clarendon Press.

__. 1998. “Associations Between Wife-beating and Fetal and Infant Death: Impression From a Survey in Rural India.” *Studies in Family Planning* 29: 301-308.

Jejeebhoy, S. and Z. Sathar. 2001. “Women’s Autonomy in India and Pakistan: The Influence of Religion and Region.” *Population and Development Review* 27: 687-712.

Kohler H.-P., J. R. Behrman, and S.C. Watkins. 2001. “The Density of Social Networks and Fertility Decisions: Evidence From South Nyanza District, Kenya.” *Demography* 38: 43-58.

Kravdal, Ø. 2001. “The Importance of Education for Fertility in sub-Saharan Africa is Substantially Underestimated When Community Effects are Ignored”, Memorandum, March. Department of Economics, University of Oslo. Available at http://www.oekonomi.uio.no/memo/memopdf/memo0301.pdf.

__. 2002. “Education and Fertility in sub-Saharan Africa: Individual and Community Effects.” *Demography* 39: 233-50.

Lillard, L.A. and C.W.A. Panis . 2000. aML Multilevel Multiprocess Statistical Software, Release 1.0. Econware, Los Angeles, California.

Mason, K.A. 1984. “The Status of Women: A Review of its Relationships to Fertility and Mortality.” New York: Rockefeller Foundation.

__. 1987. “The Impact of Women’s Social Position on Fertility in Developing Countries.” *Sociological Forum* 2: 718-45.

__. 1997. "Gender and Demographic Change. What Do We Know?", In *The Continuing Demographic Transition*, edited by G. W. Jones, R. M. Douglas, J. C. Caldwell, and R.M. D’Souza. Oxford: Clarendon Press.

McNay, K., R. Cassen, and P. Arokiasamy. 2003. “Why are Uneducated Women in India Using Contraception? A Multilevel Analysis.” Forthcoming in *Population Studies*.

Miles-Doan, R. and L. Bisharat. 1990. “Female Autonomy and Child Nutritional Status: The Extended Family Residential Unit in Amman, Jordan.” *Social Science and Medicine* 31: 783-89.

Montgomery, M. R. and J. B. Casterline. 1996. "Social Learning, Social Influence and New Models of Fertility." *Population and Development Review* 22 Suppl:

151-75.Muhuri, P.K. and J. Menken. 1997. “Adverse Effects of Next Birth, Gender, and Family Composition on Child Survival in Rural Bangladesh.” *Population Studies* 51: 279-94.

Murthi, M., A.-C. Guio, and J. Dreze. 1995. “Mortality, Fertility, and Gender Bias in India: A District-level Analysis.” *Population and Development Review* 21: 745-82.

Pandey, A., M.K. Choe, N.Y. Luther, D. Sahu, and J. Chand. 1998. “Infant and Child Mortality in India.” National Family Health Survey Reports 11. International Institute for Population Sciences (Mumbai, India) and East-West Center (Honolulu, U.S.A)Pickett, K.E. and M. Pearl. 2001. “Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review.” *Journal of Epidemiology and Community Health* 55: 111-22.

Tulasidhar, V.B. 1993. “Maternal Education, Female Labour Force Participation and Child Mortality: Evidence From the Indian Census.” *Health Transition Review* 3: 177-90.

United Nations.1995. *Women’s Education and Fertility Behaviour*. ST/ESA/SER.R/137 Population Division. New York.

Whitworth A. and R. Stephenson. 2002. “Birth Spacing, Sibling Rivalry and Child Mortality in India.” *Social Science and Medicine* 55: 2107-19.

**APPENDIX**

The sample is restricted to eight states, containing 1132 PSUs, when it is compared with the fixed-effects approach. Numerous attempts to estimate the fixed-effects model from a full sample, which requires more than 3000 parameters, failed.

When average education is already entered into the model, further inclusion of other community variables changes the individual education effects very little (compare Models 3,4 and 6 in Table A1), and if the proportions in the four educational categories had been included instead of the average education, there would have been no difference at all. This can be intuitively explained as follows: The effect of individual education when X is included as the only additional variable is essentially estimated by comparing the child mortality experienced among women with different education who have the same value of X. Inclusion of another variable Y will change the education effect only if Y has an impact on mortality and the following is the case: Among women with the same value of X, those with high education tend to have another value of Y than those with low education, or, more precisely, the educational distribution differs by Y given X. If X is the educational distribution in the community and Y is another community variable, such a correlation cannot exist: Among communities with the same educational distribution, those with high and those with low level of the Y variable have, very trivially, the same educational distribution. (However, the effect of *community* education (X) may well change considerably if one or more other community variables (Y) are included. Community variables that are thought to determine education should, of course, be entered into the model to achieve as good assessment of the community education effect as possible.)

A community fixed-effects model captures all community variation and thus corresponds to a model that includes a large number of characteristics of the communities. In accordance with this, and because the latter model gives the same individual education effects as a simpler model with no other community variables than education, one should expect individual education effects in Model 7 to be very similar to those in Models 3,4 and 6. This is precisely what is seen. (By contrast, individual education effects in a fixed-effects model are different from those in a model with a few community effects included, but not community education, such as Model 5.)

**Appendix Table A1. Effects (with Standard Errors) of Education on Child Mortality Among Women Living in Rajasthan, Sikkim, Tamil Nadu, West Bengal, Uttar Pradesh, New Dehli, Arunachal Pradesh or Tripura (the Eight States with the Highest Codes in NFHS II).**

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| MOTHER'S EDUCATION | | | | |
| 0-2 years[a] | 0 | 0 | 0 | 0 |
| 3-6 years | -0.57*** (0.08) | -0.49*** (0.08) | -0.41*** (0.08) | -0.38*** (0.08) |
| 7-9 years | -0.75*** (0.10) | -0.64*** (0.10) | -0.49*** (0.11) | -0.47*** (0.11) |
| 10+ years | -1.18*** (0.12) | -0.97*** (0.13) | -0.69*** (0.14) | -0.68*** (0.14) |
| AVERAGE EDUCATION AMONG WOMEN (years) | | | -0.083*** (0.016) | -0.104*** (0.016) |
| Other variables included: | Child's age | Child's age + Individual determinants of education[b] | Child's age + Individual determinants of education[b] | Child's age + Individual determinants of education[b] + Community determinants of education[c] |

| | Model 5 | Model 6 | Model 7 |
|---|---|---|---|
| MOTHER'S EDUCATION | | | |
| 0-2 years[a] | 0 | | |
| 3-6 years | -0.47*** (0.08) | -0.38*** (0.08) | -0.37*** (0.09) |
| 7-9 years | -0.61*** (0.10) | -0.47*** (0.11) | -0.46*** (0.11) |
| 10+ years | -0.91*** (0.13) | -0.69*** (0.14) | -0.71*** (0.14) |
| AVERAGE EDUCATION AMONG WOMEN (years) | | -0.068*** (0.017) | |
| Other variables included: | Child's age + Individual determinants of education[b] + Community determinants of education[c] | Child's age + Individual determinants of education[b] + Community determinants of education[c]+ Community indices for women's autonomy[d] | Child's age + Individual determinants of education[b] + One dummy for each community |

[a] Reference category
[b] Caste/tribe membership (scheduled caste or tribe, other backward castes, all others), religion (Hindu, Muslim, Christian, Sikh, other), consumer item index, and electricity.
[c] Proportion from scheduled caste or tribe, proportion Muslim, average consumer item index, proportion with electricity, and a combined variable for urban/rural and distance to primary health care
[d] Indicators of decision-making, physical, emotional and economic autonomy. See text for details.
* p < 0.10; ** p< 0.05; ***p< 0.01

## NOTES

[1] A direct effect is relevant at the individual level, where a competition aspect is involved: A woman's education may improve her opportunities in the marriage market (although the choice of a partner and her education also are jointly influenced by the resources and attitudes of her family). However, an expansion of women's education cannot operate through an aggregation of such effects to produce a higher general level of education among husbands. There must be other reasons for an effect of women's education on men's education, or the two may be spuriously related, perhaps because they are both determined by such factors as wealth and women's autonomy in the community. This spurious relationship seems most plausible.

[2] Paid work may give a woman respect and more freedom and signal a relatively high physical autonomy, but it may also be primarily linked with poverty. Besides, her work situation at the time of interview may have been affected by her number of live children, and thus child mortality in recent years.

[3] It should be noted that the community education effects in Model 3 and other models are not a result of too broad categories for individual education. The same effects were estimated with 14 categories for the woman's own education.

[4] These inferences about changes over time should be treated with special caution because they are based on estimates from a static model. Mortality may in reality depend not only on the current educational level in the community but also on the change compared to levels in the past, which is not considered in the model. Stated differently and more generally, a socio-economic improvement or deterioration does not necessarily have the same impact on the incidence of a demographic event as suggested by the corresponding cross-sectional difference between those who have enjoyed a persistently high socio-economic level and those who have been at a low level. (This idea has, for example, had some influence on the discussion of the importance of income for fertility.)

[5] In consistence with the general argument above, inclusion of community-level autonomy indicators will not influence the individual education effect estimates, but inclusion of individual autonomy indicators might, in principle, do so.

[6] A finer categorization is more appropriate for men because of their generally higher educational level. The impact on the effect of mother's education is only half as strong with a three-category variable for husband's education.

[7] For simplicity, distinction is not made between a subsequent birth shortly afterwards and one that occurs later in the follow-up period, which may last up to five years. According to additional model runs, this has no consequence for education effect estimates.

[8] Without husbands' education included, the effects of women's average education in Models 1 and 2 would have been 0.005-0.009 weaker, but still significant (not shown).