Does Maternal Education Affect the Sex-Differential in Infant and Child Mortality? Evidence from 55 Low and Middle Income Countries.

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Introduction

In most populations, girls are more likely to survive the first years of life than boys. Especially in the first months of life, this sex-differential in mortality is very pronounced (Drevenstedt et al., 2008; Tabutin & Willems, 1998; Waldron, 1998). The advantage of girls after the first month is thought to be mainly driven by biological factors (Waldron, 1998) and the sex-differential in neonatal mortality to be affected mostly by epidemiological factors and medical technology (Drevenstedt et al., 2008; Waldron, 1998). Within regions, the sex-differential can be very stable over time. For example, Hill and Upchurch (1995) estimated the expected female-male ratio for infant mortality in historical data (1820-1964) for Western countries to range between 0.767 to 0.846. However, between countries and regions considerable variation can be observed. Whereas in most countries there is excess mortality of boys in young children, there are some regions where girls' mortality rate is higher than that of boys (United Nations Sectretariat, 1998).

A major cause of this excess female mortality can be found in external circumstances, which in some parts of the world are so detrimental to girls that their biological advantage over boys is completely overridden. Most studies on the sex-differential in infant and child mortality have focused on countries or regions with such absolute excess female mortality – India, Pakistan and Bangladesh in particular (Muhuri & Preston, 1991; Murthi, Guio, & Dreze, 1995; Rosenzweig & Schultz, 1982; Simmons, Smucker, Bernstein, & Jensen, 1982). The degree of male excess mortality, however, also differs substantially across societies and between regions and subgroups within societies. Even if female infant mortality is not higher in absolute terms, the sex-differential can indicate substantial disadvantage for either girls or boys.

Given the adverse consequences of this unfavorable situation for female infants and children, it is of great importance to gain insight into the factors that are responsible for the sex-differential. This paper aims to increase our understanding of the sex-differential by analyzing data for over 350,000 women living within 729 sub-national districts of 55 low and middle income countries. Our analyses focus on the role of mother's education, a factor that has a virtually universal negative association with infant and child mortality and is sometimes found to be associated with lower sex-differentials (Fuse & Crenshaw, 2006; United Nations Sectretariat, 1998). The findings for the relationship between maternal education and the sex-differential are not that clear-cut. In a

study in Matlab, Pakistan, Muhuri and Preston (1991) found no evidence for an effect of maternal education on the sex-differential in mortality. Also a study of a small sample (almost 2000 infants) born in Central Java (Wahab, Winkvist, Stenlund, & Wilopo, 2001) found no evidence for moderation of the sex-differential by maternal education. At least three other studies, on the other hand, do suggest that education at the household level decreases the sex-differential (Bourne & Walker, 1991; Rosenzweig & Schultz, 1982; Simmons et al., 1982). The most elaborate study to date is by Cleland and Harris (1998). They examine mortality between 6-60 months in 27 countries based on the first round of DHS data from the 1980s and 1990s. The usual positive association between maternal education and child survival is found, but no evidence is found for lower sex-differentials among mothers with more education.

We aim to update and extend previous studies in three ways. First, we update and extend the empirical evidence by analyzing the interaction between child's sex and maternal education for 55 countries using DHS data from the 2000s.

Second, we examine the effect of maternal education at three levels: household (the individual mother), sample clusters (the direct community of the children and mothers) and the region (the large social and socio-economic context). There are several ways in which maternal education is thought to affect the sex-differential. One important mechanism is gender power; i.e. the social position and power of women versus men in society that ultimately translates to the power of a woman vis à vis her husband and other males in her household. Maternal education at the household level is much more an indicator of individual knowledge and power irrespective of the context, whereas average female education at the cluster and region level (controlled for individual education) are indicators of the position of women in general, cultural context indicators. It is, therefore, important to examine at which level female's education affects the sex-differential. Of course it is important to control for wealth and health facilities at all levels in order to avoid mixing material effects of education with more cultural ones.

Third, the mixed results regarding the association between mother's education and the sex-differential might be taken to suggest that the effect of maternal education works differently under different circumstances. To find out whether this presumption is true, we analyze interactions of cultural, economic and health-related context factors with the effect of mother's education on the sex-differential.

Data

The data are derived from the Demographic and Health Surveys (DHS). We use recent surveys for 55 low and middle income countries. Within these countries we distinguish 729 sub-national districts and over 10,000 clusters. The combined dataset contained information on more than

350,000 women who gave birth to more than 760,000 children in the five years before the survey, of which about 60,000 had died by the time of interview.

We include the following characteristics of the child: sex, age, birth order, home delivery, and twin status. For the mother we include: educational level, age at birth, age at birth^2, living in a rural area, and whether the mother had a partner at the time of the interview, partner's education, partner's occupation (farm, lower non-farm, upper non-farm), and household wealth at the time of the interview. Maternal education was measured in years. Household wealth was measured by an index constructed on the basis of household assets.

Maternal education is aggregated at the cluster level and the regional level. Other ecological factors at the district level are: level of development, availability of health facilities and percentage of children who received a polio vaccination in the last 5 years. Level of development is measured by the percentage of households in the district owning a television. This is assumed to be a good district development indicator, because at the national level it has strong correlations with GDP per capita (r=.68) and the UNDP human development index (HDI) (r=.84). As indicator of the availability of health facilities at the district level we use the percentage of births in the last five years that took place in a clinical setting. GDP per capita at the country level is derived from (UNDP, 2004).

Methods

We employ multilevel logistic regression models to take into account the (Omariba & Boyle, 2007; Sear, Steele, McGregor, & Mace, 2002; Yamaguchi, 1991) nested structure of the data: clustering of children within mothers (level-2), within sample clusters, within districts, within countries. Random intercepts of the effect of the child's sex are estimated at the higher levels. Weights provided by DHS are applied. Models are estimated in MlwiN 2.18 (Rasbash, Browne, Healey, Cameron, & Charlton, 2004) using MCMC estimation. Because difference causes of death prevail at different ages and there a sex difference in susceptibility, we separately analyze whether a child died (1) in this first year of life (infant mortality), (2) in the second to fourth year (1-4 mortality) or (3) in any year during the first five or up to observation. Children are observed up to the year of survey, age five or year of death.

We performed several sensitivity checks. Firstly, we estimated the final model with fixed intercepts, once by n-1 dummies for the countries and once by including n-1 dummies for the districts. Secondly, we estimated the model for the three regions: Latin-America, Africa and South-Asia. Thirdly, we exclude each possible set of two countries. Fourth, we separately analyze India, Pakistan and Bangladesh.

To test the hypothesis that the (relative) advantage of girls is not constant across contexts but is increased by maternal education in particular, we tested for the existence of interaction effects

of child's sex with maternal education at the three levels and as controls we tested interactions with socio-economic household indictors and regional indicators. Each interaction was tested separately and significant ones were examined simultaneously with other interactions in the model.

Results

Two factors systematically showed significant interaction effects with child's sex: age of the mother at birth and maternal education at the household level. For the ecological factors no significant interactions with child's sex were found.

Regarding maternal age two observations can be made: Firstly, the overall pattern is similar for boys and girls. Mortality decreases with maternal age up to the early thirties and then starts to increase. Secondly, the difference between girls and boys is largest at the extremes of the maternal age ranges. Girls born to relative young and old mothers have less of an advantage than girls born to mother around age 30.

Regarding maternal education, the results indicate that the biological advantage of girls is smaller among lower educated women. Also when controlling for paternal education, household wealth and maternal education at higher levels the effect of maternal education at the household level persisted.

If maternal education is not controlled for, household wealth shows the same pattern as maternal education. If education and wealth are analyzed simultaneously, the effect of wealth is no longer significant, suggesting that maternal education trumps wealth and that the initial wealth effect actually runs through maternal education, at least partly.

(Differences between first year, 2-4 and under 5 mortality are addressed more elaborately in the paper.)

Conclusions

The relative advantage of girls regarding infant and child mortality is larger among higher educated mothers in low and middle income countries. In some countries this means that girl's absolute advantage is larger, in others it only means that their excess mortality (compared to boys) is lower. The effect of maternal education on the sex-differential seems to be located at the household level; no 'universal' pattern of contextual effects of higher female education at the cluster or regional level was found. The sex-differential is also non-linearly related to age. The difference between girls and boys is largest at the extremes of the maternal age ranges.