The Tradeoff between Family Size and Child Health in Rural Bangladesh

by

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Abstract

Most of the work testing the quantity-quality model has concentrated on the tradeoff between family size and educational attainment. We argue that child health is a plausible measure of quality that has not been fully explored in the empirical literature. Using data from the Matlab Health and Socioeconomic Survey (MHSS), we estimate the effect of family size on child mortality and several measures of child health. Our results suggest that even in rural Bangladesh there is little evidence of a tradeoff between child quantity and health.

The problem is no longer that with every pair of hands that comes into the world there comes a hungry stomach. Rather it is that, attached to those hands are sharp elbows.

--Paul A. Samuelson

I. Introduction

Numerous studies have documented a negative relationship between family size and educational attainment (Liebowitz 1974, Rosenzweig and Wolpin 1980, Blake 1981, Downey 1995, Guo and Vanwey 1999, Hanushek 1992, Cáceres-Delpiano 2006, Lee 2008, Li et al. 2008; Rosenzweig and Zhang 2009). Among economists, this result is viewed as evidence in support of the quantity-quality model in which parents face a tradeoff between number of children and the level of expenditures that can be devoted to each child (Becker 1960, Becker and Lewis 1973).[1] Although most researchers interested in testing the quantity-quality model have focused on educational attainment or academic achievement, if parents derive utility from other dimensions of child quality then we might expect to see a tradeoff between family size and measures of child health.

To date, empirical studies investigating the relationship between family size and child health have produced mixed results. For instance, studies have shown that children from larger families are more likely to suffer injury or death from accidents (Cummings et al. 1994, Scholer et al. 1997, Schwartz et al. 2005), but there is also evidence that they are less likely to be to be obese (Edwards and Grossman 1983, Kruger et al. 2006), less likely to suffer from diarrhea or a respiratory infection (Jenson and Ahlburg 2002), and less likely to have asthma or hay fever

[1] Among non-economists, the quantity-quality tradeoff is often referred to as the dilution model in which children compete for limited family resources (Blake 1981).

(Ponsonby et al. 1998, Rona et al. 1997). Only a handful of studies have examined the relationship between family size and child health treating family size as endogenously determined. Most notably, Schultz and Mwabu (2003) found that an increase in family size resulting from a twin birth led to substantial decreases in the weight-to-height ratio among Kenyan children; Sarin (2004) found no evidence that plausibly exogenous increases in family size led to reductions in the weight-to-height ratio among children in India; and Rosenzweig and Zhang (2009) found that an increase in family size resulting from a twin birth led to a decrease in the probability of good or excellent health among Chinese children.

This paper examines the effect of family size on child health using data from the Matlab Health and Socioeconomic Survey (MHSS), conducted in Bangladesh in 1996. The advantage of using these data is that we can exploit a much richer set of health measures than were available to Schultz and Mwabu (2003), Sarin (2004), and Rosenzweig and Zhang (2009). The MHSS contains detailed information on the fertility history of women living in participating households, the height and weight of all surviving children in the household, and whether these children suffered from diarrhea, respiratory infections, eye infections, and colds. It also contains information on the number of days in the past month each child was sick and whether the child was attending school.[2] Because of data limitations, neither Schultz and Mwabu (2003) nor Sarin (2004) were able to examine effect of family size on educational outcomes such as school attendance.

[2] Diseases largely absent from developed countries are important determinants of school absenteeism in the developing world. For instance, in Kenya malaria is related to over 10 percent of elementary-school absences and over 4 percent of secondary-school absences (Leighton and Foster 1993).

Our results do not provide support for the quantity-quality model. Standard ordinary least squares estimates (OLS) are statistically insignificant and often of the opposite sign expected if there were a tradeoff between child health and family size. Instrumenting for family size using the mother's age at menarche produces a similar pattern of results. We conclude that even among families in a severely resource-constrained environment such as rural Bangladesh, there is little evidence of a tradeoff between child quantity and quality.

II. Background

A positive relationship between family size and infant health could be the result of parents trading off between quantity and quality, but could also be spurious. It is well known that family size is negatively related to measures of socio-economic status such as parental education (Graff 1979), and plausibly related to other, more difficult to measure, determinants of psychological and physiological health. Therefore, the estimated effect of family size on the health outcomes of children is potentially a reflection of one or more omitted variables. It is also possible that a positive relationship between family size and child health is due to reverse causality: parents who are successfully raising a healthy child may be more inclined to have an additional child as compared to parents whose first child suffers from a psychological or physiological problem.

A number of previous authors interested in estimating the quantity-quality tradeoff have attempted to account for these potential sources of endogeneity. For instance, Angrist et al. (2005) used Israel Census data to explore the tradeoff between family size and child quality. Exploiting twin births and the sex composition of siblings to obtain exogenous variation in family size, they found no evidence that being raised in a larger family leads to lower educational attainment or earnings, although there was evidence of a positive relationship between family size and the probability of being married by the age of 21. Using Norwegian data and a similar research design, Black et al. (2005) also found that, controlling for birth order, there was little evidence of a tradeoff between family size and educational attainment. Although the results of Black et al. (2005) and Angrist et al. (2005) may be explained by changes in parental consumption patterns or labor supply in response to having an additional child (Angrist et al. 2005, p. 27), they raise the question of whether it is appropriate to think of parents as trading off quantity for quality, at least in the developed world.

Could the quantity-quality tradeoff be more pronounced in the developing world, where resources are presumably more constrained? Qian (2004) used differences across regions in the implementation and timing of the one-child policy in China to estimate the effects of family size on school enrollment in China. She found that first-born children were more likely to go to school if their parents were allowed to have a second child, the opposite of what one would expect according to the quality-quality tradeoff model. Li et al. (2008) and Rosenzweig and Zhang (2009) also used data from China. Instrumenting for family size with the birth of twins, these authors found that an additional child was associated with decreased educational attainment. However, Li et al. (2008) found that this effect was present only in rural areas; in urban areas there was little evidence of a quantity-quality tradeoff.

To our knowledge, only three papers have examined the tradeoff between family size and child health treating family size as an endogenously determined variable. All three used data from developing countries. Specifically, Schultz and Mwabu (2003) used data from the Kenyan Welfare Monitoring Surveys II and III, which were administered in 1994 and 1997, respectively. Their results strongly support the quantity-quality tradeoff model: an increase in family size resulting from the birth of a twin was associated with a "substantial" decrease in the weight-to-height ratio of the children in the household, a measure of nutritional inputs. Schultz and Mwabu (2003, p. 18) argued that the height to weight ratio, "tends to be positively associated in many studies with a child's chances of survival, later health status, subsequent performance in school, productivity as an adult worker, and chronic health problems as an older person."

Sarin (2004) used data from the National Family Health Survey, which was administered to ever-married women living in India in 1992-93 and again in 1998-99. OLS produced evidence of a negative relationship between family size and the weight-to-height ratio of children in the household. However, instrumenting for family size using the sex of the first born child and multiple births, this relationship became positive (although it was not statistically significant at conventional levels). Counter-intuitively, when the sample was divided based on wealth, Sarin (2004) found evidence of a tradeoff between family size and health for girls in households whose assets were above the median, but no evidence of such a tradeoff for girls in poorer households.[3]

Finally, Rosenzweig and Zhang (2009) used data from the Chinese Child Twins Survey, which were collected in late 2002 and early 2003. These authors used the birth of twins to estimate the effect of family size on the probability that a child was reported to be in good or excellent health, weight, height, and BMI. They found that an increase from two to three siblings was associated with a 5.5 to 11 percent decrease in the probability that the first-born

[3] Schultz and Mwabu (2003, p. 12) found a positive relationship between family size and child mortality, but noted that child morality could affect fertility decisions. Sarin (2004) assigned children who had died the lowest height-to-weight ratio observed in the data. Using data from the Indian state of Uttar Pradesh, Bhargava (2003) explored the relationship between infant mortality and family size. He found evidence to suggest that unwanted girls were less likely to survive to past infancy than their wanted counterparts.

child was reported to be in good or excellent health. However, they found no evidence that of a tradeoff between family size and their other health outcomes.

The analysis below is one of only a handful to examine the effect of arguably exogenous increases in family size on measures of child health in a developing country. Following Ribar (1994) and Klepinger et al. (1999), we instrument for fertility using age at menarche. In contrast to Schultz and Mwabu (2003), Sarin (2004) and Rosenzweig and Zhang (2009), we are able to exploit a rich set of health outcomes that include whether a child suffered diarrhea, respiratory infections, eye infections, and the child's body mass index (BMI). Using these detailed measures of child health and an alternative identification strategy, our goal is to add to the literature begun by Schultz and Mwabu (20030, Sarin (2004), and Rosenzweig and Zhang (2009).

III. The Data and Measures

Approximately 55km southeast of Dhaka, the Matlab district of Bangladesh contains 148 villages in an isolated agricultural area, and is flooded regularly from July to September. The district is part of a demographic surveillance area run by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B). The 200,000 residents of this rural area are poor, subsisting off fishing, agricultural labor, and sharecropping. Almost 90 percent of the population in the Matlab district is Muslim; 10 percent is Hindu (Fauveau 1994).

The data used in this study come from the Matlab Health and Socioeconomic Survey (MHSS). In 1996, the MHSS was administered to a random sample of 4,364 Matlab households.[4] Women ages 15 and over in participating households were asked about their fertility history, including their age at menarche and if any of their children had died prior to the survey being administered. An adult member of each participating household was responsible for answering a more general set of questions, including questions with regard to the health of the children in the household, their education, and medical care history.

The MHSS contains information on 5,082 women 15 years of age and over who had experienced at least one live birth. These women reported having had a total of 26,598 children, 23,234 of whom either died before the age of 5 or were at least 5 years of age at the time of the MHHS survey. We can observe mother's characteristics, number of siblings born, and date of birth for the majority of these children (n = 20,333). Morbidity information is available for 6,146 children who were under the age of 15 and living in a participating household. Approximately 18 percent of the these children were not living with their biological mother when the MHSS was administered, but for 4,181 children we can observe mother's characteristics, school attendance, number of siblings born, birth order, and the following morbidity variables:

1. *BMI*, equal to a child's body mass index (weight in kilograms over the square of height in meters). The height and weight of children under the age of 15 was measured by a MHSS field worker.

2. *Sick Days*, equal to the number of days a child was sick in the month prior to the administration of the MHSS survey due to any illness.

[4] These households were divided among 2,687 baris, a group of households living and working closely together. The individuals who make up a bari are often related by marriage or by blood. See Rahman et al. (1999) for a detailed description of the MHSS design and codebooks.

3. *Cold*, equal to 1 if the child suffered from a cough, fever, cold, or fever with chills in the prior month, and equal to 0 otherwise.

4. *Respiratory Problem*, equal to 1 if the child suffered from breathing or asthma problems in the year prior to the administration of the MHSS survey, and equal to 0 otherwise.

5. *Stomach Problem*, equal to 1 if the child suffered from diarrhea, stomach, vomiting, or stool problems in the prior month, and equal to 0 otherwise.

6. *Eye Infection*, equal to 1 if child suffered from an eye infection in the prior month, and equal to 0 otherwise.

Table 1 shows the means of the outcome variables to be used in the analysis by family size (as measured by number of siblings ever born) and gender. It provides very little evidence of a negative relationship between family size and health as predicted by the quantity-quality model. In fact, it is often the case that the children with the most siblings were healthier than their counterparts with fewer siblings.

For instance, over half of male children who had either no sibling or one sibling died by the age of 5. In contrast, about 7 percent of male children with 6 or more siblings died before the age of 5. Almost 9 percent of female children who had either no siblings or one sibling suffered from a respiratory problem, whereas 4.1 percent of female children with 6 or more siblings suffered from a respiratory problem; over 20 percent of male children who had either no siblings or one sibling suffered from a stomach problem, whereas approximately 17 percent of male children with 6 or more siblings suffered from a stomach problem.

IV. Methodology

The negative relationship between health and family size documented in Table 1 could reflect readily observable factors such as parental education. In order to test this hypothesis, our formal empirical analysis begins by estimating the following "baseline" equation by *i*'s gender[5]:

$$(1) \qquad H_i = \pi_0 + \boldsymbol{\pi}_1^{'} \mathbf{X}_{\mathbf{i}_i} + \pi_2 Siblings_i + \varepsilon_i ,$$

where H_i measures the health of child *i* in 1996 when the MHSS survey was administered or whether child *i* survived to the age of 5; $\boldsymbol{X_i}$ is a vector of controls that includes *i*'s age at the time of the MHSS survey, mother's age when *i* was born, mother's height, a set of indicator variables for mother's educational attainment, and 141 village indicator variables[6]; $Siblings_i$ is equal to the total number of live births (minus one) reported by *i*'s mother; and ε_i is a random error term.

Although the MHSS contains a fairly rich set of potential controls, the estimation strategy described above is nevertheless subject to the problem of unobservables. If, for instance, the

[5] In Matlab, as in most of Bangladesh and many other developing countries, girls tend to have higher mortality rates than boys, due, at least in part, to their receiving a smaller portion of the family's food resources (Fauveau and Chakraborty 1994). Moreover, although they have similar rates of illness, young boys are more likely to be taken to health clinics for treatment than young girls (Chen et al. 1981, Fauveau and Chakraborty 1994). The empirical model is estimated by gender in order to allow family size to have different effects on the health of boys as compared to girls.

[6] A large and successful health and family planning program has been operating in Matlab since 1977 (the Matlab Maternal and Child Health and Family Planning Program), providing maternal and child health services such as vaccinations, hydration therapy, vitamins, and health care to several villages. The village dummies are intended to control for the effects of this program on health and fertility. See Joshi and Schultz (2007), Fauveau and Chakraborty (1994), and Bhatia et al. (1980) for descriptions of the Matlab Maternal and Child Health and Family Planning Program and its effects.

choice to have an additional child is associated with difficult-to-measure factors at the family level, then the identification assumption of the above model, $E(\varepsilon_i|H_i) = 0$, will be violated.

One method of accounting for the potential endogeneity of family size is to identify an instrument, Z_i, that predicts number of siblings but is uncorrelated with the error term of (1), ε_i. Specifically, if

$$(2) \qquad Siblings_i = \alpha_0 + \boldsymbol{\alpha}_1^{'}\mathbf{X}_i + \alpha_2 Z_i + u_i,$$

then an alternative estimate of π_2 can be obtained using two-stage least squares (2SLS). 2SLS will produce a consistent estimate of the effect of family size on child health provided that we can identify an appropriate instrument.

Following Ribar (1994) and Klepinger et al. (1999), we use the age at which *i*'s mother had her first period as an instrument for fertility.[7] There is evidence to suggest that the age at which a woman experiences her first period is largely determined by what has been labeled "random genetic variation" as opposed to environmental factors, making age at menarche a potentially suitable instrument for our purposes.[8]

Specifically, age at menarche can be excluded from (1) if its relationship to the health of *i* is only through family size. Because the late onset of sexual maturation is associated with malnutrition (Chowdhury et al. 2000, Striegel-Moore et al. 2001), which could in turn impact

[7] Using data from the National Longitudinal Survey of Youth, Ribar (1994) and Klepinger et al. (1999) were interested in the effect of teenage fertility on educational attainment.

[8] This phrase is from Field and Ambrus (2008, p. 10). These authors cited Kaprio et al. (1995) who found evidence that genetic factors explain almost three quarters of the observed variance in age of menarche.

child health, we include mother's height in centimeters as a control in all of the estimations discussed below. Height has been shown to be a good proxy for childhood wellbeing, especially in developing countries (Cole 2003).[9] In addition, we experiment with including mother's weight at the time of the MHSS survey and measures of *i*'s birth weight in the vector $\boldsymbol{X}_i$. Birth weight is closely tied to nutritional intake during the second and third trimesters of pregnancy (Lunney 1998).

The educational attainment of *i*'s mother represents another potential path through which age at menarche could be related to unmeasured determinants of H_i. There is evidence that parental education is an important determinant of child health, and, using data from the MHSS, Field and Ambrus (2008) found that age at menarche was associated with age at first marriage and, through marriage, educational attainment.[10] The vector $\boldsymbol{X}_i$, contains 5 indicators for mother's educational attainment in years. In addition, the vector $\boldsymbol{X}_i$ includes controls for her age when *i* was born, her literacy level and her numeracy level, all of which could potentially impact child health.

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[9] In a review of the literature on secular trends in height, Cole (2003, p. 162) noted:

> [a] principle underlying anthropometric history is that adult stature is a powerful proxy for childhood living conditions, with adverse conditions leading to impaired growth. Nutritionists and human biologists recognise that growth is affected by the interplay of diet and nutrition on the one hand, and morbidity—particularly infection—on the other.

In 1999, 10.7% of the rural Bangladeshi population suffered from malnutrition (Shahabuddin et al. 2000). Field and Ambrus (2008) also used height to control for "early nutritional status."

[10] See Currie and Moretti (2003), Breierova and Duflo (2004), McCrary and Royer (2006), and Chou et al. (2007) for estimates of the influence of parental educational attainment on child health. It is also possible that there is a direct link between age of menarche and educational attainment in rural Bangladesh. Mobarak et al. (2008) used the MHSS data to examine the effect of a river embankment finished in 1989 on conditions of marriage. In fieldwork leading to this study, these authors found that Bangladeshi parents often reported withdrawing their girls from school when they showed signs of becoming sexually mature or being attractive to males.

Finally, it is possible that age of menarche is associated with the attributes of *i*'s father, perhaps through the preferences of potential mates in the marriage market. In order to account for this possibility, we experiment with adding controls for father's age at *i*'s birth and father's educational attainment. These variables are only available for a subset of the sample whose father was living in the household when the MHSS survey was administered. If the father was dead or had moved out of the household, then we do not observe his personal characteristics. Likewise, because we cannot identify the father of children who did not survive until the age of 5, these additional controls are not included in the mortality estimations presented below.
We also experiment with controlling for the income and landholdings of the household. Land is the primary form of wealth for most Matlab households, and when a rural Bangladeshi girl marries she typically moves into her husband's household. As a consequence, household income and land are potentially correlated with age of menarche through the preferences of potential mates in the marriage market.

V. The Results

Regression results are presented in Tables 2-5. They are based on unweighted data and the reported standard errors are corrected for clustering at the bari level.[11] Our focus is on π_2, the coefficient of $Siblings_i$, although the estimated coefficients of selected control variables are shown in Tables 2 and 3.[12]

[11] A bari is a set of households whose residents live in close proximity, are typically related, and cooperate with regard to household and work responsibilities.

[12] They are available upon request for the remaining tables.

OLS Estimates

Table 2 presents baseline OLS estimates of the relationship between family size and child health. In Panel I of Table 2 the sample is restricted to male children; in Panel II the sample is restricted to female children.

There is very little evidence that families face a tradeoff between child quantity and quality. In fact, when statistically significant, the coefficient of $Siblings_i$ is always of the opposite sign to that predicted by the quantity-quality model. Among male children, having an additional sibling is associated with a 0.059 decrease in the probability of having died before reaching 5 years of age; among female children, it is associated with a 0.068 decrease in the probability of having died before 5 years of age, 0.161 fewer sick days, and a 0.011 decrease in the probability of having suffered from a stomach problem.

The remaining estimates of β_2 are not statistically significant at conventional levels, although, as predicted by the quantity-quality model, the relationship between family size and having suffered from an eye infection is positive for children of both sexes. Similarly, the relationship between family size and having suffered from a cold is positive for male children, as is the relationship between family size and having suffered from a respiratory infection for female children.

Because *i*'s birth weight and mother's weight could, in theory, be affected by family size, they are not used as controls in the baseline regressions. However, their inclusion, along with father's personal characteristics, family income and wealth, has very little impact on the OLS estimates discussed above (Table 3). This pattern of results suggests that the estimates in Table 2 are not driven by mother's nutritional intake during pregnancy, maternal health as measured by weight, the personal characteristics of the father, or the availability of household resources.

In summary, OLS estimates do not provide a great deal of evidence to support the hypothesis that parents face a tradeoff between number of children and the level of expenditures that can be devoted to each child. In fact, if naively interpreted, they suggest that increases family size will lead to improvements in the health of children, especially females. However, OLS estimates could potentially be biased due to the influence of family-level unobservables correlated with both fertility and child health. Below we attempt to control for the influence of unmeasured family-level factors through focusing on what can be thought of as exogenous variation in fertility.

2SLS Estimates

The top panel of Table 4 presents 2SLS estimates of the effect of family size on child health restricting the sample to male children. The bottom panel of Table 4 presents the 2SLS estimates for female children. In both sets of regressions, the baseline controls are employed.

Consistent with the findings of Ribar (1994) and Klepinger et al. (1999), age at menarche is negatively related to fertility. In the male mortality sample, a one-year increase in mother's age at menarche is associated with a 0.188 decrease in family size, and the F-statistic for the null hypothesis that age of menarche is unrelated to $Siblings_i$ clearly meets the instrument relevance standards proposed by Staiger and Stock (1997). In the female mortality sample, a one-year increase in mother's age at menarche is associated with a 0.150 decrease in family size, and again the F-statistic is well above 10, the cutoff proposed by Staiger and Stock (1997). If the sample is restricted to children for whom we observe health at the time of the MHSS survey, a one-year increase in mother's age at menarche is associated with somewhat smaller decreases in family size, but the F-statistic never falls below 10.

The second-stage results are generally consistent with the OLS estimates reported above. That is, when statistically significant, they are always of the opposite sign to that predicted by the quantity-quality tradeoff model; when insignificant, they tend to be quite small in terms of absolute magnitude, although they are occasionally of the "correct" sign.

Among male children, an additional sibling is associated with a 0.024 decrease in the probability of death before the age of 5. The remaining second-stage estimates in the top panel of Table 4 are not statistically significant, and only one is of the sign predicted by the quantity-quality tradeoff model. If taken at face value, it would suggest that, on average, an additional sibling is associated with a 0.012 increase in the probability of suffering from an eye infection, or 8 percent of a standard deviation.

Among female children, the 2SLS estimates are never statistically significant, but five out of seven are of the sign predicted by the quantity-quality tradeoff model. If taken at face value, these five estimates would suggest that an additional sibling is associated with a 0.013 increase in the probability of death by age 5, a 1.441 decrease in BMI, 0.218 more sick days, a 0.017 increase in the probability of a having had a cold, and a 0.019 increase in the probability of having had an eye infection. The 1.441 decrease in BMI is approximately 40 percent of a standard deviation, but the other estimates are not large as compared to the natural variation observed in the data. In fact, none represent more than 13 percent of a standard deviation.[13]

When controls for birth weight, mother's weight, father's personal characteristics, family income and wealth are added to the vector $\boldsymbol{X}_i$, the second-stage results for male children are

[13] An additional sibling is associated with a .019 increase in the probability of eye infection, which represents 12.7 percent of a standard deviation (.019/.150 = 12.66). Even at the upper bound of the 90% confidence interval, an additional child is associated with a .059 increase in the probability of eye infection, or 39.3 percent of a standard deviation.

qualitatively similar to those already reported (Table 5). An additional sibling is associated with a statistically insignificant 0.012 increase in the probability of suffering from an eye infection. Otherwise the second-stage estimates are of the opposite sign to that predicted by the quantity-quality model, and in fact the estimated coefficient of $Siblings_i$ is negative and significant at the 10 percent level in the stomach ailment equation.

Among female children, the inclusion of the additional controls produces 2SLS estimates that offer marginally more support for the quantity-quality model. An additional sibling is associated with statistically insignificant increases in number of sick days, the probability of having had a cold, and the probability of having had an eye infection. These estimates, although of the "correct" sign, are generally quite small as compared to the natural variation in the data.[14] However, an additional sibling is also associated with a statistically insignificant decrease in BMI of 1.773, or approximately one half of a standard deviation.[15] Although imprecise, the 2SLS estimates in Table 5 prevent us from ruling out the possibility that competition among siblings for limited household resources may have a modest impact on the health of the average rural Bangladeshi girl.

Extensions

As noted, previous research has shown that malnutrition can delay age of menarche. Up to now, we have addressed this issue by controlling for mother's height and other factors. An

[14] An additional child is associated with 0.952 more sick days, a 0.088 increase in the probability of having had a cold, and a 0.028 increase in the probability of having had an eye infection. None of these estimates represent more than 20 percent of a standard deviation.

[15] Median BMI for 5 year old children in our sample is under 15, and median BMI for 14 year-old children is 15. In comparison, the U.S. median BMI for 5 year-old children is 15 and increases to 20 for 15 year-old children. Thus, while a decrease in childhood BMI may in fact be desirable for the developed world, higher BMI is a sign of health among Matlab children.

alternative method of addressing this issue is to restrict the sample to children whose mother's age of menarche was between 11 and 16 (Field and Ambrus 2008).

Table 6 reports OLS and 2SLS estimates of the effect of family size on child health restricting the sample to the 90 percent of children whose mothers did not experience an extreme age of menarche. The results are consistent with those reported in Tables 2 and 4: when significant, the estimated effect of family size is always of the opposite sign predicted by the quantity-quality model; when insignificant, the estimates are small in magnitude and tend are often of the opposite sign predicted by the quantity-quality model. We view this pattern of results as further evidence that malnutrition is not driving the estimates in Tables 2 and 4.

Black et al. (2005) found that the relationship between family size and educational attainment could be explained almost entirely by birth order. In an effort to explore the role of birth order in the determination of child health, we re-estimate our 2SLS models adding the following controls for birth order:

1. *Only Child* is equal to 1 if the respondent was an only child, and equal to 0 otherwise.
2. *Oldest* is equal to 1 if the respondent was the firstborn, and equal to 0 otherwise.
3. *Last* is equal to 1 if the respondent was born last, and equal to 0 otherwise.

The omitted category is composed of respondents who were born between the first- and last-born children.

Although the birth order variables are not jointly significant, their inclusion produces more precise 2SLS estimates of the relationship between family size and child health for males (Table 7). Specifically, an additional sibling is associated with 2.360 fewer sick days in the previous month, a 0.104 decrease in the probability of having had a cold, and a 0.072 decrease in the probability of having had a stomach ailment. The other 2SLS estimates for males are not significant, but only one is of the sign predicted by the quantity-quality model. It suggests that an additional sibling is associated with a very small increase in the probability of having had an eye infection.

Finally, in Table 8 we focus on respondents from families in the lower half of the Matlab income distribution, where competition among siblings for family resources should be the greatest. The 2SLS results do not provide much additional support for the quantity-quality model, although the power of the instrument in the first stage is noticeably diminished. Among male respondents, an additional sibling is associated with a lower probability of having had a cold; among female respondents, none of the 2SLS estimates are statistically significant at conventional levels, and only 2 out of 6 are in the “correct” direction.

VI. The Effect of Family Size on School Attendance

The literature on the relationship between family size and educational outcomes is more extensive than the literature on family size and health, but studies using data from developing countries are nevertheless fairly scarce. In fact, to our knowledge, there have been only a handful of studies on family size and education that have drawn on data from the developing world and that have treated family size as an endogenously determined variable. Moreover, these studies have come to quite different conclusions. While Dayioglu et al. (2009) found no relationship between plausibly exogenous increases in family size and subsequent educational attainment, Qian (2004) found that increases in family size actually led to firstborns receiving more education. Li et al. (2008), Rosenzweig and Wolpin (1980), and Rosenzweig and Zhang (2009) found evidence to support the quantity-quality tradeoff model.

In Table 9 we report OLS and 2SLS estimates of the effect of family size on school attendance. The OLS results offer some support for the hypothesis that larger families are more likely to send their children to school. Among males, controlling for *i*'s birth weight, mother's weight, the father's personal characteristics, family income and wealth, an additional sibling is associated with a 0.012 increase in the probability of attending school, or 4 percent of a standard deviation. Among females, an additional sibling is associated with a 0.009 increase in the probability of attending school, but this estimate is not significant. The 2SLS estimates are positive and quite large for males, and positive but smaller and insignificant for females.

VII. Conclusion

Until recently, few economists challenged the notion that there exists a tradeoff between family size and child quality. Although a large number of studies have estimated the effect of family size on educational attainment, only a handful attempted to estimate its relationship with child health.

This study uses data from the Matlab Health and Socioeconomic Survey (MHSS), conducted in Bangladesh in 1996. The advantage of using these data is that we can exploit a much richer set of health measures than were available to previous authors. Our results provide little evidence in support of the tradeoff hypothesis. OLS estimates of the relationship between family size and child health outcomes are typically small and insignificant; when the estimated relationship is statistically significant, it is of the opposite sign to that predicted by the quantity-quality model.

Using mother's age at menarche to instrument for family size, 2SLS estimates produce a similar pattern of results. When statistically significant, our 2SLS estimates suggest that increases in family size result in *better* health outcomes for children. When the sign of an estimated coefficient is consistent with the existence of a quantity-quality tradeoff, the magnitude of the coefficient is typically too small to be considered significant in an economic sense. This pattern of results suggests that the quantity-quality tradeoff may not be as strong as is often assumed by economists and other social scientists.

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Table 1. Summary Statistics

Panel I: Males	0-1 sibling	2-3 siblings	4-5 siblings	6 or more siblings	Full Sample
death	0.607	0.220	0.116	0.066	0.162
	(0.49)	(0.41)	(0.32)	(0.25)	(0.37)
	[1021]	[2127]	[2765]	[4675]	[10588]
bmi	15.132	14.557	14.767	14.768	14.772
	(7.49)	(2.67)	(3.90)	(8.30)	(5.59)
	[463]	[759]	[535]	[410]	[2167]
sickdays	3.743	2.797	3.071	2.193	2.952
	(5.70)	(4.77)	(5.07)	(4.24)	(4.99)
	[487]	[809]	[560]	[430]	[2286]
cold	0.434	0.358	0.330	0.311	0.359
	(0.50)	(0.48)	(0.47)	(0.46)	(0.48)
	[488]	[810]	[560]	[431]	[2289]
respiratory	0.100	0.052	0.054	0.051	0.062
	(0.30)	(0.22)	(0.23)	(0.22)	(0.24)
	[488]	[810]	[560]	[431]	[2289]
stomach	0.219	0.164	0.177	0.165	0.179
	(0.41)	(0.37)	(0.38)	(0.37)	(0.38)
	[488]	[810]	[560]	[431]	[2289]
eye infection	0.025	0.022	0.030	0.009	0.022
	(0.16)	(0.15)	(0.17)	(0.10)	(0.15)
	[488]	[810]	[560]	[431]	[2289]

Standard deviations are shown in parentheses. The number of observations is in brackets.

Table 1 (continued). Summary Statistics

Panel II: Females	0-1 sibling	2-3 siblings	4-5 siblings	6 or more siblings	Full Sample
death	0.678	0.237	0.134	0.078	0.180
	(0.47)	(0.43)	(0.34)	(0.27)	(0.38)
	[913]	[1845]	[2628]	[4359]	[9745]
bmi	14.212	14.418	14.401	14.713	14.434
	(4.14)	(3.81)	(2.16)	(2.72)	(3.33)
	[407]	[728]	[525]	[430]	[2090]
sickdays	3.718	2.691	2.891	2.220	2.849
	(5.70)	(4.76)	(4.96)	(4.06)	(4.90)
	[432]	[768]	[551]	[441]	[2192]
cold	0.404	0.329	0.357	0.303	0.346
	(0.49)	(0.47)	(0.48)	(0.46)	(0.48)
	[433]	[768]	[552]	[442]	[2195]
respiratory	0.088	0.066	0.049	0.041	0.061
	(0.28)	(0.25)	(0.22)	(0.20)	(0.24)
	[433]	[768]	[552]	[442]	[2195]
stomach	0.231	0.155	0.167	0.133	0.169
	(0.42)	(0.36)	(0.37)	(0.34)	(0.37)
	[433]	[768]	[552]	[442]	[2195]
eye infection	0.030	0.026	0.022	0.020	0.025
	(0.17)	(0.16)	(0.15)	(0.14)	(0.15)
	[432]	[768]	[552]	[442]	[2194]

Standard deviations are shown in parentheses. The number of observations is in brackets.

Table 2. OLS Estimates of the Relationship between Family Size and Child Health

Panel I: Males	death (1)	bmi (2)	sick days (3)	cold (4)	respiratory (5)	stomach (6)	eye infection (7)
siblings	-0.059**	0.010	-0.032	0.0006	-0.004	-0.005	0.001
	(0.002)	(0.045)	(0.071)	(0.007)	(0.003)	(0.006)	(0.002)
	[-0.063 – -0.056]	[-0.063 - 0.084]	[-0.145 - 0.085]	[-0.011 - 0.012]	[-0.010 - 0.002]	(-0.015 - 0.005]	(-0.002 - 0.005]
age		-0.020	-0.197**	-0.022**	-0.004**	-0.009**	-0.002*
		(0.036)	(0.031)	(0.003)	(0.001)	(0.003)	(0.001)
mother's age at birth	0.006**	-0.016	0.006	-0.001	0.00003	0.004*	-0.0009
	(0.001)	(0.017)	(0.024)	(0.002)	(0.001)	(0.002)	(0.001)
mother can read	0.018	-0.584	0.143	-0.014	-0.049*	0.006	-0.013
	(0.020)	(0.484)	(0.362)	(0.043)	(0.022)	(0.034)	(0.017)
mother can write	0.008	0.44	-0.533	0.051	0.037+	0.024	-0.02
	(0.020)	(0.432)	(0.394)	(0.044)	(0.021)	(0.037)	(0.013)
mother can add	-0.001	0.464+	0.22	-0.069*	-0.007	0.014	0.017
	(0.018)	(0.262)	(0.288)	(0.033)	(0.016)	(0.026)	(0.014)
mother can multiply	-0.018	-0.141	-0.45	0.005	-0.015	-0.019	-0.002
	(0.015)	(0.345)	(0.324)	(0.032)	(0.013)	(0.024)	(0.011)
mother's height (cm)	-0.005**	-0.023	0.002	0.001	-0.002*	0.0004	0.0005
	(0.001)	(0.020)	(0.020)	(0.002)	(0.001)	(0.002)	(0.001)
Muslim	-0.053**	0.268	0.187	0.013	0.032	0.093**	0.028*
	(0.018)	(0.341)	(0.492)	(0.042)	(0.020)	(0.026)	(0.012)
born monsoon season	0.003	0.162	-0.198	0.0153	-0.002	-0.004	0.008
	(0.009)	(0.210)	(0.310)	(0.027)	(0.015)	(0.022)	(0.009)
born winter	0.103**	0.011	-0.351	0.03	-0.0007	-0.007	-0.002
	(0.009)	(0.195)	(0.293)	(0.026)	(0.015)	(0.022)	(0.008)
Constant	0.886**	18.443**	6.772+	0.87*	0.493**	0.127	-0.01
	(0.147)	(3.539)	(3.708)	(0.403)	(0.190)	(0.388)	(0.089)
Observations	10588	2167	2286	2289	2289	2289	2289
R-squared	0.19	0.21	0.12	0.13	0.08	0.11	0.1

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include village fixed effects.
+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 2 (continued). OLS Estimates of the Relationship between Family Size and Child Health

Panel II: Females	death	bmi	sick days	cold	respiratory	stomach	eye infection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
siblings	-0.068**	0.066	-0.161*	-0.008	0.0002	-0.011*	0.001
	(0.002)	(0.042)	(0.076)	(0.007)	(0.004)	(0.005)	(0.003)
	[-0.071 - -0.065]	[-0.004 - 0.135]	[-0.287 - -0.036]	[-0.020 - 0.004]	[-0.006 - 0.006]	[-0.020 - -0.002]	[-0.003 - 0.006]
age		0.029	-0.116**	-0.017**	-0.005**	-0.007**	-0.002*
		(0.034)	(0.036)	(0.003)	(0.002)	(0.002)	(0.001)
mother's age at birth	0.007**	-0.01	0.042+	0.005*	-0.001	0.003	-0.001
	(0.001)	(0.016)	(0.025)	(0.002)	(0.001)	(0.002)	(0.001)
mother can read	-0.016	-0.123	0.237	0.002	0.009	0.066*	-0.007
	(0.019)	(0.202)	(0.414)	(0.038)	(0.019)	(0.026)	(0.014)
mother can write	0.022	0.016	-0.729	0.006	-0.046+	-0.072**	0.008
	(0.017)	(0.195)	(0.515)	(0.045)	(0.025)	(0.028)	(0.016)
mother can add	-0.03*	-0.278+	0.117	-0.004	-0.007	0.048+	-0.005
	(0.015)	(0.155)	(0.340)	(0.031)	(0.019)	(0.025)	(0.009)
mother can multiply	0.036*	0.475	0.516	-0.001	0.034	-0.007	0.003
	(0.016)	(0.325)	(0.431)	(0.030)	(0.023)	(0.024)	(0.009)
mother's height (cm)	-0.004**	-0.008	0.007	-0.002	0.001	0.0003	-0.0006
	(0.001)	(0.012)	(0.018)	(0.002)	(0.001)	(0.001)	(0.001)
Muslim	-0.058**	0.31	0.113	0.108*	0.028	0.092**	0.029**
	(0.019)	(0.323)	(0.465)	(0.045)	(0.023)	(0.033)	(0.011)
born monsoon season	-0.007	0.116	0.445+	0.001	0.019	0.047*	0.006
	(0.011)	(0.198)	(0.268)	(0.029)	(0.014)	(0.023)	(0.009)
born winter	0.084**	-0.121	0.31	0.021	0.006	0.01	0.003
	(0.010)	(0.152)	(0.256)	(0.030)	(0.014)	(0.022)	(0.009)
Constant	0.801**	14.974**	4.004	0.999**	0.165	-0.018	0.093
	(0.150)	(1.652)	(4.593)	(0.371)	(0.203)	(0.287)	(0.095)
Observations	9745	2090	2192	2195	2195	2195	2194
R-squared	0.21	0.07	0.1	0.12	0.08	0.11	0.1

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include village fixed effects.
+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 3. OLS Estimates of the Relationship between Family Size and Child Health with Additional Controls for Birth Weight, Mother's Weight, Father's Personal Characteristics, Family Income and Wealth

Panel I: Males	bmi	sick days	cold	respiratory	stomach	eye infection
	(1)	(2)	(3)	(4)	(5)	(6)
siblings	-0.039	-0.026	-0.004	-0.005	-0.001	0.001
	(0.052)	(0.080)	(0.008)	(0.004)	(0.007)	(0.002)
	[-0.125 - 0.046]	[-0.157 - 0.106]	[-0.018 - 0.009]	[-0.012 - 0.001]	[-0.013 - 0.010]	[-0.002 - 0.005]
age	0.005	-0.163**	-0.02**	-0.004*	-0.01**	-0.002
	(0.037)	(0.034)	(0.003)	(0.002)	(0.003)	(0.001)
mother's age at birth	-0.022	0.009	0.002	0.0002	0.004+	-0.001
	(0.020)	(0.026)	(0.003)	(0.001)	(0.002)	(0.001)
mother can read	-0.266	0.115	-0.025	-0.042+	0.01	-0.023
	(0.535)	(0.391)	(0.047)	(0.024)	(0.038)	(0.015)
mother can write	0.381	-0.372	0.076	0.034	0.001	-0.001
	(0.499)	(0.446)	(0.050)	(0.024)	(0.042)	(0.009)
mother can add	0.695*	0.339	-0.068+	0.01	0.028	0.005
	(0.299)	(0.331)	(0.036)	(0.014)	(0.030)	(0.008)
mother can multiply	-0.297	-0.45	0.013	-0.018	-0.013	0.003
	(0.389)	(0.361)	(0.036)	(0.015)	(0.029)	(0.007)
mother's height (cm)	-0.034+	0.036	0.001	0.002	0.001	0.0004
	(0.019)	(0.025)	(0.002)	(0.002)	(0.002)	(0.001)
mother's weight (kg)	0.005	-0.034+	0.0005	0.0003	0.001	0.0002
	(0.026)	(0.020)	(0.002)	(0.001)	(0.002)	(0.000)
Muslim	0.104	-0.114	-0.038	0.025	0.094**	0.02+
	(0.401)	(0.565)	(0.049)	(0.024)	(0.032)	(0.012)
born monsoon season	0.105	-0.578	-0.002	0.006	-0.042+	-0.003
	(0.257)	(0.353)	(0.031)	(0.017)	(0.026)	(0.008)
born winter	-0.242	-0.631+	0.009	0.004	-0.03	-0.002
	(0.210)	(0.338)	(0.031)	(0.017)	(0.026)	(0.009)
father can read	-0.203	-0.252	-0.022	0.011	0.012	-0.033+
	(0.412)	(0.638)	(0.052)	(0.024)	(0.041)	(0.020)
father can write	-0.691	-0.500	0.004	0.006	-0.024	0.049*
	(0.597)	(0.830)	(0.063)	(0.027)	(0.047)	(0.023)
father can add	0.237	0.753*	0.052	0.006	0.076**	0.003
	(0.289)	(0.314)	(0.035)	(0.020)	(0.027)	(0.008)
father can multiply	0.464	-0.166	-0.028	-0.008	-0.071*	-0.012
	(0.440)	(0.524)	(0.045)	(0.024)	(0.031)	(0.012)
much bigger than avg at birth	-0.14	2.006	0.084	0.008	0.1081	0.018
	(0.519)	(1.553)	(0.116)	(0.077)	(0.103)	(0.048)
bigger than avg at birth	-0.228	-0.527	0.049	-0.024	0.055	-0.001
	(0.409)	(0.875)	(0.080)	(0.054)	(0.061)	(0.028)
similar to average at birth	0.375	-0.239	0.091	-0.019	0.016	-0.017
	(0.476)	(0.907)	(0.082)	(0.055)	(0.063)	(0.028)
smaller than avg at birth	0.275	-0.349	0.048	-0.037	0.031	-0.012
	(0.419)	(0.874)	(0.079)	(0.054)	(0.061)	(0.028)
log of land owned	0.109	-0.04	-0.0004	-0.003	-0.001	-0.003
	(0.066)	(0.073)	(0.008)	(0.004)	(0.006)	(0.002)
log of household income	0.234	0.072	0.0004	-0.004	0.012	0.004
	(0.149)	(0.108)	(0.011)	(0.006)	(0.009)	(0.003)
Observations	1740	1817	1819	1819	1819	1819
R-squared	0.21	0.15	0.15	0.1	0.13	0.12

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include village fixed effects.
+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 3 (continued). OLS Estimates of the Relationship between Family Size and Child Health with Additional Controls for Birth Weight, Mother's Weight, Father's Personal Characteristics, Family Income and Wealth

Panel II: Females	bmi	sick days	cold	respiratory	stomach	eye infection
	(1)	(2)	(3)	(4)	(5)	(6)
siblings	0.084*	-0.062	-0.003	0.00003	-0.011+	0.002
	(0.042)	(0.071)	(0.008)	(0.005)	(0.006)	(0.003)
	[0.016 - 0.153)	[-0.179 - 0.056]	[-0.016 - 0.011]	[-0.008 - 0.008]	[-0.021 - -0.001]	[-0.002 - 0.007]
age	0.017	-0.156**	-0.019**	-0.005**	-0.007*	-0.002+
	(0.032)	(0.038)	(0.004)	(0.002)	(0.003)	(0.001)
mother's age at birth	-0.003	0.028	0.005+	-0.001	0.003	-0.001
	(0.015)	(0.027)	(0.003)	(0.002)	(0.002)	(0.001)
mother can read	-0.191	-0.013	-0.022	0.006	0.069*	-0.006
	(0.199)	(0.440)	(0.044)	(0.023)	(0.028)	(0.014)
mother can write	0.055	-0.218	0.026	-0.051+	-0.064*	0.018
	(0.202)	(0.505)	(0.051)	(0.029)	(0.030)	(0.019)
mother can add	-0.255	0.335	0.015	0.002	0.048+	-0.01
	(0.179)	(0.392)	(0.042)	(0.027)	(0.029)	(0.014)
mother can multiply	0.211	-0.022	-0.006	0.029	-0.021	0.002
	(0.164)	(0.297)	(0.033)	(0.029)	(0.024)	(0.010)
mother's height (cm)	-0.039**	0.006	-0.002	0.0004	0.003	-0.0004
	(0.012)	(0.019)	(0.002)	(0.001)	(0.002)	(0.001)
mother's weight (kg)	0.048**	0.012	0.0003	0.0002	-0.004**	0.001
	(0.011)	(0.019)	(0.002)	(0.001)	(0.002)	(0.001)
Muslim	0.312	0.265	0.085+	0.036	0.066+	0.025+
	(0.292)	(0.472)	(0.049)	(0.025)	(0.039)	(0.013)
born monsoon season	0.121	0.624*	-0.016	0.024	0.059*	0.011
	(0.209)	(0.286)	(0.032)	(0.016)	(0.025)	(0.009)
born winter	-0.11	0.364	0.019	0.005	0.026	0.008
	(0.160)	(0.259)	(0.033)	(0.017)	(0.025)	(0.010)
father can read	-0.015	0.881	0.019	-0.003	0.035	-0.009
	(0.225)	(0.583)	(0.052)	(0.020)	(0.038)	(0.009)
father can write	-0.271	-1.132+	-0.059	0.031	-0.089*	0.006
	(0.258)	(0.610)	(0.060)	(0.025)	(0.041)	(0.010)
father can add	0.136	-0.435	0.005	0.007	0.045	0.018+
	(0.144)	(0.420)	(0.044)	(0.019)	(0.036)	(0.010)
father can multiply	0.408*	0.77+	0.023	-0.032	0.028	-0.008
	(0.169)	(0.419)	(0.049)	(0.022)	(0.038)	(0.011)
much bigger than avg at birth	0.027	0.085	0.013	0.001	0.065	0.014
	(0.507)	(1.274)	(0.115)	(0.063)	(0.091)	(0.039)
bigger than avg at birth	0.045	-0.678	-0.037	-0.025	0.005	0.012
	(0.399)	(0.931)	(0.079)	(0.040)	(0.064)	(0.011)
similar to average at birth	-0.055	-0.262	-0.013	-0.004	0.029	0.018
	(0.419)	(0.928)	(0.080)	(0.041)	(0.063)	(0.013)
smaller than avg at birth	0.119	-0.459	-0.032	0.001	0.039	0.020+
	(0.469)	(0.915)	(0.077)	(0.039)	(0.062)	(0.012)
log of land owned	-0.029	0.065	-0.001	-0.007	0.006	-0.006+
	(0.070)	(0.074)	(0.008)	(0.004)	(0.006)	(0.003)
log of household income	-0.011	-0.15	-0.009	-0.0001	-0.002	0.005
	(0.064)	(0.123)	(0.014)	(0.008)	(0.008)	(0.003)
Observations	1678	1747	1748	1748	1748	1747
R-squared	0.13	0.13	0.14	0.1	0.15	0.14

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include village fixed effects.
+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 4. 2SLS Estimates of the Relationship between Family Size and Child Health

Panel I: Males	death	bmi	sick days	cold	respiratory	stomach	eye infection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
First Stage							
Age at Menarche	-0.188**	-0.097**	-0.094**	-0.094**	-0.094**	-0.094**	-0.094**
	(0.017)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
F-test	40.41	12.59	12.6	12.66	12.66	12.66	12.66
Second Stage							
siblings	-0.024+	0.258	-2.500	-0.088	-0.017	-0.076	0.012
	(0.014)	(0.451)	(1.571)	(0.070)	(0.035)	(0.051)	(0.017)
	[-0.047 - -0.001]	[-0.483 - 1.00]	[-5.084 - 0.085]	[-0.203 - 0.028]	[-0.075 - 0.041]	[-0.159 - 0.007]	[-0.017 - 0.040]
Observations	10588	2167	2286	2289	2289	2289	2289

Panel II: Females	death	bmi	sick days	cold	respiratory	stomach	eye infection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
First Stage							
Age at Menarche	-0.150**	-0.088**	-0.088**	-0.088**	-0.088**	-0.088**	-0.088**
	(0.017)	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
F-test	21.280	12.600	13.340	13.240	13.240	13.240	13.240
Second Stage							
siblings	0.013	-1.441	0.218	0.017	-0.018	-0.041	0.019
	(0.022)	(1.325)	(0.715)	(0.071)	(0.038)	(0.057)	(0.025)
	[-0.024 - 0.050]	[-0.362 - 0.074]	[-0.958 - 1.393]	[-0.099 - 0.133]	[-0.081 - 0.045]	[-0.135 - 0.053]	[-0.022 - 0.059]
Observations	9745	2090	2192	2195	2195	2195	2194

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include the controls shown in Table 2 and village fixed effects.
+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 5. 2SLS Estimates of the Relationship between Family Size and Child Health with Additional Controls for Birth weight, Mother's Weight, Father's Personal Characteristics, Family Income and Wealth

Panel I: Males	bmi	sick days	cold	respiratory	stomach	eye infection
	(1)	(2)	(3)	(4)	(5)	(6)
First Stage						
Age at Menarche	-0.092**	-0.091**	-0.091**	-0.091**	-0.091**	-0.091**
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
F-test	11.28	11.53	11.58	11.58	11.58	11.58
Second Stage						
siblings	0.353	-2.573	-0.046	-0.019	-0.097+	0.012
	(0.515)	(1.821)	(0.085)	(0.041)	(0.056)	(0.015)
	[-0.494 - 1.120]	[-5.569 - 0.423]	[-0.185 - 0.094]	[-0.086 - 0.048]	[-0.188 - -0.006]	[-0.012 - 0.037]
Observations	1740	1817	1819	1819	1819	1819

Panel II: Females	bmi	sick days	cold	respiratory	stomach	eye infection
	(1)	(2)	(3)	(4)	(5)	(6)
First Stage						
Age at Menarche	-0.104**	-0.108**	-0.108**	-0.108**	-0.108**	-0.108**
	(0.025)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
F-test	13.71	14.58	14.59	14.59	14.59	14.58
Second Stage						
siblings	-1.773	0.952	0.088	-0.021	-0.010	0.028
	(1.268)	(0.631)	(0.065)	(0.036)	(0.049)	(0.023)
	[-3.858 - 0.312]	[-0.086 - 1.991]	[-0.019 - 0.195]	[-0.081 - 0.038]	[-0.092 - 0.071]	[-0.010 - 0.067]
Observations	1678	1747	1748	1748	1748	1747

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets. All regressions include the controls shown in Table 3 and village fixed effects.

+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 6. Estimates of the Relationship between Family Size and Child Health. Sample is Restricted to Children whose Mother's Age of Menarche was between 11 and 16.

Panel I: Males	death	bmi	sickdays	cold	respiratory	stomach	eyeinfection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OLS							
siblings	-0.059**	0.005	-0.002	0.004	-0.004	-0.005	0.0001
	(0.002)	(0.047)	(0.073)	(0.007)	(0.004)	(0.006)	(0.002)
	[-0.062 – -0.056]	[-0.073 - 0.082]	[-0.123 - 0.119]	[-0.009 - 0.016]	[-0.010 - 0.002]	[-0.015 - 0.006]	[-0.003 - 0.004]
R-squared	0.19	0.19	0.13	0.13	0.08	0.11	0.12
2SLS							
siblings	-0.0254	0.560	-1.318	-0.110	-0.012	-0.180*	0.002
	(0.022)	(0.607)	(0.822)	(0.075)	(0.039)	(0.074)	(0.023)
	[-0.062 - 0.011]	[-0.438 - 1.558]	[-2.669 - 0.034]	[-0.233 - 0.013]	[-0.077 - 0.052]	[-0.302 - -0.058]	[-0.035 - 0.039]
F-test	22.08	17.83	15.62	15.82	15.82	15.82	15.82
Observations	10015	1999	2110	2113	2113	2113	2113

Panel II: Females	death	bmi	sickdays	cold	respiratory	stomach	eyeinfection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OLS							
siblings	-0.069**	0.021	-0.185*	-0.010	0.001	-0.014*	0.002
	(0.002)	(0.039)	(0.081)	(0.008)	(0.004)	(0.006)	(0.003)
	[-0.072 - -0.065]	[-0.042 - 0.084]	[-0.318 - -0.052]	[-0.023 - 0.002]	[-0.005 - 0.008]	[-0.023 - -0.004]	[-0.002 - 0.006]
R-squared	0.21	0.08	0.11	0.13	0.09	0.12	0.12
2SLS							
siblings	0.004	-0.130	-0.712	-0.103	0.024	-0.107	-0.001
	-0.0283	-0.4764	-0.9954	-0.0909	-0.0461	-0.0778	-0.0375
	[-0.043 - 0.050]	[-1.064 - 0.803]	[-2.349 - 0.926]	[-0.253 - 0.046]	[-0.052 - 0.100]	[-0.235 - 0.021]	[-0.062 - 0.061]
F-test	21.94	8.35	8.99	8.73	8.73	8.73	8.73
Observations	9222	1926	2018	2021	2021	2021	2020

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include the controls shown in Table 2 and village fixed effects.
+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 7. Estimates of the Relationship between Family Size and Child Health Controlling for Birth Order

Panel I: Males	death	bmi	sickdays	cold	respiratory	stomach	eyeinfection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OLS							
siblings	-0.019**	0.060	-0.189*	-0.021**	-0.009*	-0.014*	-0.0009
	(0.001)	(0.059)	(0.077)	(0.007)	(0.003)	(0.006)	(0.002)
	[-0.022 - -0.017]	[-0.038 - 0.158]	[-0.316 - -0.063]	[-0.033 - -0.009]	[-0.014 - -0.003]	[-0.024 - -0.004]	[-0.004 - 0.002]
R-squared	0.42	0.21	0.11	0.1	0.08	0.11	0.1
2SLS							
siblings	-0.019	0.221	-2.360+	-0.104+	-0.017	-0.072+	0.008
	(0.014)	(0.390)	(1.276)	(0.056)	(0.029)	(0.041)	(0.015)
	[-0.041 - 0.004]	[-0.420 - 0.862]	[-4.453 - -0.258]	[-0.196 - -0.011]	[-0.065 - 0.030]	[-0.139 - -0.004]	[-0.016 - 0.032]
F-test	40.13	11.76	11.98	12.03	12.03	12.03	12.03
Observations	10588	2167	2286	2289	2289	2289	2289

Panel II: Females	death	bmi	sickdays	cold	respiratory	stomach	eyeinfection
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OLS							
siblings	-0.025**	0.164**	-0.148*	-0.010	-0.005	-0.014*	-0.001
	(0.002)	(0.036)	(0.069)	(0.007)	(0.004)	(0.006)	(0.003)
	[-0.028 - -0.022]	[0.104 - 0.224]	[-0.260 - -0.035]	[-0.022 - 0.002]	[-0.012 - 0.001]	[-0.023 - -0.005]	[-0.005 - 0.003]
R-squared	0.45	0.07	0.1	0.12	0.07	0.11	0.1
2SLS							
siblings	0.001	-1.289	0.252	0.017	-0.024	-0.040	0.015
	-0.0156	-1.2949	-0.7251	-0.0718	-0.039	-0.0574	-0.0242
	[-0.024 - 0.027]	[-3.419 - 0.841]	[-0.941 - 1.445]	[-0.101 - 0.135]	[-0.088 - 0.040]	[-0.134 - 0.055]	[-0.025 - 0.055]
F-test	28.22	12.85	13.11	13.05	13.05	13.05	13.06
Observations	9745	2090	2192	2195	2195	2195	2194

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include the controls shown in Table 2 and village fixed effects.

+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 8. Estimates of the Relationship between Family Size and Child Health. Sample is Restricted to Households with Below-Average Income

Panel I: Males	bmi (1)	sick days (2)	cold (3)	respiratory (4)	stomach (5)	eye infection (6)
OLS						
siblings	-0.002	-0.059	-0.0007	-0.001	-0.009	0.002
	(0.047)	(0.078)	(0.009)	(0.005)	(0.007)	(0.003)
	[-0.079 - 0.075]	[-0.187 - 0.068]	[-0.015 - 0.013]	[-0.009 - 0.006]	[-0.021 - 0.002]	[-0.003 - 0.006]
R-squared	0.31	0.16	0.15	0.12	0.13	0.1
2SLS						
siblings	0.172	-2.989	-0.125+	0.009	-0.044	0.02
	(0.490)	(1.977)	(0.074)	(0.041)	(0.051)	(0.019)
	[-0.635 - 0.978]	[-6.241 - 0.264]	[-0.247 - -0.003]	[-0.058 - 0.077]	[-0.128 - 0.039]	[-0.012 - 0.052]
F-test	9.75	9.96	10.02	10.02	10.02	10.02
Observations	1571	1662	1665	1665	1665	1665

Panel II: Females	bmi (1)	sick days (2)	cold (3)	respiratory (4)	stomach (5)	eye infection (6)
OLS						
siblings	0.067	-0.175*	-0.014	0.0004	-0.012+	-0.002
	(0.064)	(0.088)	(0.009)	(0.005)	(0.007)	(0.003)
	[-0.039 - 0.173]	[-0.320 – -0.031]	[-0.028 - 0.001]	[-0.007 - 0.008]	[-0.023 - -0.001]	[-0.007 - 0.003]
R-squared	0.09	0.13	0.15	0.09	0.13	0.1
2SLS						
siblings	-2.323	-0.071	-0.031	-0.025	-0.054	0.014
	(2.236)	(1.005)	(0.097)	(0.056)	(0.079)	(0.03)
	[-6.001 - 1.354]	[-1.723 - 1.581]	[-0.190 - 0.129]	[-0.116 - 0.067]	[-0.184 - 0.076]	[-0.035 - 0.063]
F-test	7.46	7.78	7.61	7.61	7.61	7.61
Observations	1491	1569	1571	1571	1571	1570

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets.
All regressions include the controls shown in Table 2 and village fixed effects.
+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level

Table 9. Estimates of the Relationship between Family Size and School Attendance

Panel I: Males	OLS (1)	OLS, broader set of controls (2)	2SLS (3)	2SLS, broader set of controls (4)
First Stage				
Age at Menarche	.	.	-0.094**	-0.091**
	.	.	(0.020)	(0.027)
F-test	.	.	12.68	11.63
Second Stage				
siblings	0.012*	0.015**	0.056	0.090+
	(0.005)	(0.006)	(0.045)	(0.053)
	[0.004 - 0.020]	[0.006 - 0.024]	[-0.018 - 0.129]	[0.003 - 0.177]
Observations	2285	1815	2285	1815

Panel II: Females	OLS (1)	OLS, broader set of controls (2)	2SLS (3)	2SLS, broader set of controls (4)
First Stage				
Age at Menarche	.	.	-0.088**	-0.108**
	.	.	(0.024)	(0.028)
F-test	.	.	13.350	14.610
Second Stage				
siblings	0.009*	0.004	0.032	0.028
	(0.005)	(0.005)	(0.043)	(0.038)
	[0.002 - 0.017]	[-0.005 - 0.012]	[-0.038 - 0.102]	[-0.034 - 0.090]
Observations	2189	1742	2189	1742

Standard errors are in parentheses and corrected for clustering at the bari level. 90% confidence intervals are presented in brackets. In columns (1) and (3) regressions include the controls shown in Table 2 and village fixed effects. In columns (2) and (4) regressions include the controls shown in Table 3 and village fixed effects.

+ Statistically significant at the 10% level; * at the 5% level; ** at the 1% level