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Impact of Sibling Rivalry on the Nutritional Status of Children: Evidence from Matlab, Bangladesh*

Short Title: Sibling rivalry and child health

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Abstract

This paper examines the impact of sibling rivalry for resources on health outcomes by studying the effect of sibling composition and birth order on the height for age of children below ten years. The paper further tests whether relaxing resource constraints reduces the impact of sibling rivalry. This paper also examines *sibling gender effect* on the health outcomes for young boys and girls.

JEL Codes: I1, J16, J18
Keywords: sibling rivalry, height for age, gender differential, rural Bangladesh

1. Introduction

Economic theory suggests that as more children are born in resource constrained households, parents face a tradeoff between equity and efficiency when it comes to allocating these resources amongst their children. Economic models of choice suggest that parents will invest in the child with greatest potential returns. In societies where sons are expected to look after their parents in old age, contribute to family income often from a very young age, get the lion's share of resources while daughters who marry and leave the family offer little incentive to their parents to invest in their human capital. This sort of pro-male bias in allocation of household resources then results in a significant gender gap in the wellbeing of children.

Pro-male bias and excess female mortality exist in many parts of the worlds but it particularly pronounced in parts of Asia, in countries such as Bangladesh and India. Studies have shown that children are subject to selective neglect in nutrition, morbidity, and health care access depending on their gender and birth order. Children with same sex older siblings have a higher probability of dying and this is worse for girls than for boys in India and Bangladesh (Dasgupta 1987, Muhuri and Preston 1991). Parents do not treat sons and daughters as perfect substitutes and seem to undertake a selective child survival strategy aimed at a balance between male and female children (Pande, 2003). Rahman and Davanzo (1993) have shown in the context of Bangladesh that parents have some preference for daughters only if they have managed to have one or two sons. This on the other hand would imply that for parents who can control their fertility choice perfectly, girls that are born will not be subject to post-natal discrimination.

Becker's pure investment model (1991) if generalized, suggests that siblings that have less competition from other siblings will tend to do better. In areas where there is pro-male bias, male siblings with sisters will likely fare better in the use of limited household resources at the expense of their female siblings. Parish and Willis (1993) show that Taiwanese children, particularly boys with older sisters are better educated. Despite evidence of unequal treatments, Behrman (1992) provides evidence from India that parents are mostly inequality averse. In the lean season however, parents would resort to a pure investment model which would leave the female children most vulnerable. Garg and Morduch (1998) using a survey from Ghana, have shown that children with all sisters (and no brothers) had better health status than if they had all brothers (and no sisters). In Garg and Morduch's paper, birth order did not seem to matter and the inequalities in health status amongst children according to gender stemmed from siblings being rivals for household resources. They also predicted that if time and credit constraints were lifted from the parents, rivalries would be reduced. Hence households with fewer constraints will not exhibit discriminatory behavior.

This paper uses a household survey data from Matlab, Bangladesh to test if there is any recent evidence of selective neglect and resultant impact on children's nutritional status in a rural area of Bangladesh. Earlier studies provided evidence of such selective neglect and gender differentials (Chen et al 1981, Bairagi 1986) but had concentrated on outcome variables such as mortality. More recent studies have examined gender differentials in surviving children's health status (Trapp et al 2004, Chaudhuri 2008) but more in the context of the impact of an ongoing health program. The main contribution of this paper to this existing body of literature is an examination of the impact of sibling rivalry and sibling composition on the long term nutritional status of surviving children. Long term nutritional status is measured in terms of age and sex standardized height for age. This measure is a good indicator of nutritional and health investments made by parents on their children. In this paper, I primarily investigate the effect of competition for constrained household resources among siblings on their health and nutritional status. Further, I examine if the impact of sibling rivalry differs by gender. If resource constraints are relaxed, does that alleviate the effects of sibling rivalry and are there any differential effects by gender? To examine this last question, we compare households by the amount of land they own to tease out the wealth effects on intra household allocation of resources.

Since 1977, there has been an ongoing randomized family planning experiment in Matlab where a treatment area was randomly chosen to get the benefits of a family planning (FP) program. An adjacent area comprising of a comparable number of villages was the control group. This control group however, had a government-aided fertility control program ongoing at the same time. In addition to the family planning program, the treatment area received an intensive maternal and child health (MCH) intervention program since 1982. All women in their childbearing ages and children below the age of five living in the treatment area were given nutritional and health supplements and advice as well as clinical attention whenever needed. The health advice and medicines were dispensed by community health workers through a door to door delivery mechanism. The control area did not get the benefit of this intensive MCH program.

Enormous literature exists that have evaluated various aspects of this MCH-FP program. The studies relevant for this paper concluded that the MCH-FP program altered contraceptive behavior, reduced fertility rates, improved the health of the targeted populations as well as had positive spillover effects on education, labor market and health outcomes of targeted and non-targeted populations (Chen, Huq, D'Souza 1981, Muhuri and Preston 1991, Rahman and Davanzo 1993, Foster and Roy, 1997, Trapp and Menken, 2004, Chaudhuri 2004, Sinha, 2005, Joshi and Schultz, 2007, Chaudhuri 2008).

The program most likely affected not only the budget constraints of the program area households through the in-kind transfer but also influenced their fertility preferences by reducing the cost of having children. It is beyond the scope of this paper to measure the effect of the program on constraints and preferences separately. However it is possible to investigate the effect of the program on the parent's choice of the nature of wellbeing for their children as a result of their changed preferences and constraints from being exposed to such a program. It is likely that the fertility patterns changed in the program area and hence household gender composition of children, because the intervention program reduced time costs for health care significantly and added health resources to the households (in the form of in-kind transfers) as well as helped in child survival strategies. These resources likely enhanced the budget set of the households and reduced competition amongst siblings for scarce resources. Lesser rivalry for resources as well as greater attention to quality of the surviving children is therefore likely to help reduce gender gap in the health status of children. In this paper, we look at the differential effect of sibling rivalry on health status according to a child's residence in the treatment or the control area. Hence, another contribution of the paper lies in identifying how the MCH-FP program could have influenced allocation of household resources for their children compared to their counterparts in the control area.

In addition to investigating the effect of sibling rivalry with and without household wealth and a public program, this paper also looks at a *sibling gender effect* (impact on girls with all boys or with all sisters or impact on boys with all female siblings or all male siblings) to derive some conclusions on parent's preferences regarding inequality aversion and provide some more recent evidence to add to the literature on impact of having a certain sibling composition (Dasgupta 1987, Pande 2003, Parish and Willis 1993).

Results show that higher number of siblings has an adverse effect on the health of children. Boys increase the competition for resources and have adverse effects on their siblings whereas girls have no significant impact on their siblings. Boys with all male siblings show more acute rivalry for household resources than boys with all female siblings. Households that are comparatively less resource-constrained do not exhibit such acute rivalry for resources.

The paper has been organized as follows. Section 1 is the introduction. Section 2 is a brief description of the theoretical underpinnings, Section 3 discusses the empirical methodology, Section 4 describes the data, Section 5 presents the results and Section 6 provides conclusions.

2. Theoretical context and predictions

In a pure investment model without resource constraints, parents would not differentially invest in the human capital of sons and daughters. However, when there are resource constraints and the constraints are binding, parents are likely to invest in the child that yields the greatest returns. Given the pro-male bias that exists in Bangladesh, we assume that parents will invest more in sons. This assumption makes sense because of the cultural context where investment in sons yield greater returns for parents in terms of co-residence, higher family income, old age support, amongst others. Hence the presence of siblings will increase competition for resources for boys, much more than for girls.

However, if parents are inequality averse, whether or not households are resource constrained, parents will treat sons and daughters equally. In that case, children in households with more boys than girls would have a higher level of parental investment than children in households that have more girls than boys.

Number of children and birth order would also matter, other than composition of children, in the health outcomes of boys and girls. Higher number of children will increase rivalry for resources within constrained households. Higher birth order children will fare worse if there is at least one same sex sibling.

Predicted Effects on the health investments in boys and girls

		More Boys than Girls		More Girls than Boys	
Model	Resource Constrained?	Boys	Girls	Boys	Girls
Pure Inv	Yes	-	-	?	-
Ineq Averse	Yes	+	+	-	-
Pure Inv	No	0	0	0	0
Ineq Averse	No	+	+	-	-

Hence the testable predictions are that

1) Number of siblings impact boys worse than girls because of more rivalry for resources.
2) Boys and girls with more male siblings will fare worse because of more competition for resources with girls faring worse relative to boys in these households. (row 1)
3) It is ambiguous as to whether boys will fare better or worse in households that have more girls than boys. Inequality aversion would mean children in more girl households will be worse off. On the other hand, more girls may reduce competition for resources making boys in such households better off. However, having more girls may make girls in such households worse off. Literature suggests than boys in such households tend to fare better (Parish and Willis) but girls of higher birth order in such households tend to fare worse (Dasgupta 1987).

4) Reducing resource constraints are likely to reduce sibling rivalry impacts and gender differentials. Under pure investment motives, there should be no significant sibling rivalry impacts. Under inequality aversion, children may be better off in more-boys households while children in more-girls households may be worse off. With less income constraints, one would expect parents to be both pure investors (ie invest until marginal benefit equals marginal cost) as well as inequality averse. The net effects hence are empirically testable. Whether pure investment effects are stronger or whether parents' inequality aversion is stronger will drive the empirical result.

The confounding factor in this exercise is that MCH-FP program was known to have resulted in a change in the number and composition of children in the program area, significantly compared to the control area. To avoid endogeneity bias as well as to control for any heterogeneity in choices, we use a GLS random effects model to carry out our empirical estimations. We group households according to their land ownership or treatment area residence to distinguish the impact of relaxing resource constraints.

3. Empirical model

A reduced form demand equation is used that is a function of prices, income, household, individual, and sibling characteristics. We are interested in the impact of sibling characteristics on the children's nutritional status under certain restrictions. For estimation purposes, we assume a linear form of the reduced form demand function.

[Equation 1]: $H_{ij}= \beta_0 +\beta_1 S_{ij} +\beta_3 Y_j+\beta_4 I_{ij} +\beta_5 J_j +\varepsilon_{ij}$

where i indexes the individual, j indexes the household, H denotes nutritional outcome, S_{ij} is sibling characteristics such as number of siblings and birth order, Y is the log of household per capita monthly expenditure, I is the observed individual characteristics such as sex and age, J is the observed parental characteristics such as mother's age, height and education, and ε is the disturbance term. We estimate this demand equation using generalized least squares random effects model at the household level. Wherever, sample size does not allow such estimations, ordinary least squares estimations are reported for which the standard errors are corrected for within-cluster correlation of error terms as well as for arbitrary heteroscedasticity.

Sibling characteristics are measured in terms of number of siblings and birth order of a child. The impact of number of siblings and birth order on nutritional status is estimated for various samples. Both OLS and GLS random effect models are estimated to test for sensitivity of these results. Chow tests help to determine differential impacts on different samples.

4. Data

This paper uses data from the Matlab Health and Socioeconomic Survey of 1996. Anthropometric information, individual and household characteristics are gathered from the Household and Community surveys. This sample consists of children up to 10 years of age. The *anthro* software (Center for Disease Control) has been used to calculate height for age Z scores. The children who have height for age Z scores that are 2 standard deviations below the median of the reference population (NCHS) are considered to be stunted. About 60% of children in this area are stunted compared to the reference population. This means that the children face chronic malnutrition in the long term (which is reflected by the high stunting rates).

In Table 1, a higher proportion of first born children are stunted and higher birth order girls are slightly more stunted than higher birth order boys. According to household composition, it is clear that presence of more boys increase rivalry for resources, rendering higher proportion of children in such households stunted.

Table 2 and Table 3 show the impact of having more sisters and more siblings on the height for age for children. Moving from left to right, for each row, it is evident that given the number of sisters, the higher the number of siblings, the worse off is the average height for age for children. However, for a given number of siblings, more sisters lead to better height-for-age for an average child.

Since price and income variables are complicated and require extensive imputation, per capita annual expenditure is used to proxy for prices and permanent incomes faced by the households. Other controls include age (in months) and sex of the children, mother's and father's education (years of schooling), mother's age (in years) to control for the stage of fertility completion, and mother's height to control for genetic endowments.

The distribution of the number of children by gender across the program and control area show that total number of boys and girls born in the program area were clearly lower than the control area (See Table 4 and Figure 1), confirming the evidence from prior studies of a change in fertility preferences across the two areas.

5. Results

5.1. Sibling Rivalry

Table 5 shows that the number of siblings negatively impacts nutritional outcome of children. Disaggregating the sample, negative impacts of sibling rivalry for resources are stronger in resource-constrained households that are less landed or are in the control area. Households that own less land are more likely to have farm workers and day laborers. In these households, boys are preferred because of their ability to contribute to household income hence households will invest in their boys. This would mean that having more siblings will increase competition for household's limited resources and have a negative impact on children's nutritional status in these households. Similarly, control area households do not have the benefit of extra health resources that treatment area households get. Hence, in the absence of any in-kind transfers to these households, there is more competition amongst siblings for limited resources. Birth order does not seem to matter for children's nutritional status in any of the examined samples. Table 6 provides GLS random effects results that report similar results that are statistically more robust. In the OLS results, number of siblings had a negative impact on the nutritional status of children in the more landed households but the result was not statistically significant. The GLS random effects results are statistically significant indicating that in more landed households too, there is a strong sibling rivalry impact on children's nutritional status.

5.2. Gender Differentials

OLS results from disaggregated samples by gender are presented in Table 7. Table 8 contains GLS random effects results of the impact of number of siblings and birth order on boys and girls separately. As predicted, having one more sibling has a greater impact on boys rather than girls but for both, having more siblings has a negative impact on their nutritional status. The most interesting and innovative result is that number of children seem to have a statistically significant and negative impact on boys in less landed households and on girls in more landed households. This suggests a threshold whereby boys in more landed households may have already attained a certain threshold of nutritional status beyond which an extra sibling does not have any significant impacts on the household's allocation of resources. However, competition amongst girls in landed households and amongst boys in less landed households is still severe enough to have a negative impact on their nutritional status.

5.3. According to sibling composition

In order to find out patterns of inequality aversion amongst parents, households are disaggregated into those that have more boys than girls and those that have more girls than boys. Table 9 contains results of impact of siblings and birth order on height for age for children in households that have more boys than girls. The marginal impact of an extra sibling is negative and statistically significant for children in such households whereas higher birth order children seem to have marginally better nutritional status. The third and the fourth column contain OLS results for girls (for girls, sample was too small to carry out GLS random effects estimation) and boys and the fifth column reports GLS random effects result for boys. Sibling rivalry is accentuated amongst boys in such households. An important result that emerges is that younger boys (of higher birth order) have better nutritional status in households that have more boys than girls.

Table 10 contains results for children in households that have more girls than boys. Interestingly, as one would predict, there is a statistically significant and negative impact of number of siblings on girls. There is however, a positive impact of siblings on boys (although statistically insignificant), and birth order has a negative impact on nutritional status of boys. The corollary of this result would be that older boys have better nutritional status, in households that have more girls than boys.

In terms of inequality aversion, girls in households with more boys would be expected to have better nutritional status. Number of siblings has a positive impact on such girls, although statistically insignificant. Boys in households with more girls than boys also exhibit a positive impact of siblings on their nutritional status. This is also statistically insignificant, however the direction suggests that pure investment in boys dominate inequality aversion for parents with boys in households that have more girls than boys.

To examine this further, we look at samples of boys and girls that live with either all same-sex siblings or all opposite-sex siblings to find a *sibling gender effect*. Table 11 contains results OLS estimation results as sample sizes did not permit GLS estimation. Girls living with all male siblings are negatively impacted by sibling size than girls living with all girls suggesting a dominant pure investment effect. Boys living with all boys are significantly worse off with higher sibling size compared to boys living with all girls.

6. Conclusion

The results consistently indicate that sibling rivalry for resources makes boys worse off than girls. There is also a differential effect of sibling rivalry by gender which is a result of differences in intra-household allocation of limited resources. Boys increase rivalry for resources and the impact is worse on boys than girls, especially in resource constrained households. In less resource constrained households such as those in the program area, there is no significant sibling impact on children. In more landed households, sibling or birth order has no impact on the health of boys and girls.

Girls living in households that have more boys are slightly better off than girls living in households that have more girls. This perhaps exhibits the fact that girls are not completely unwanted, they are in fact welcome in households that have more boys. The finding that the worst impact of greater number of siblings is on boys is a new finding and one that confirms the belief that parents are looking for a balance in the composition of children. Results indicate that younger boys in households with more boys than girls, and older boys in households with more girls than boys are better off in terms of their nutritional status.

This study has important implications. Studies such as this would help identify households that need to be carefully targeted, with gender and age specific transfers, to ensure survival and good health of their children and to achieve gender equality.

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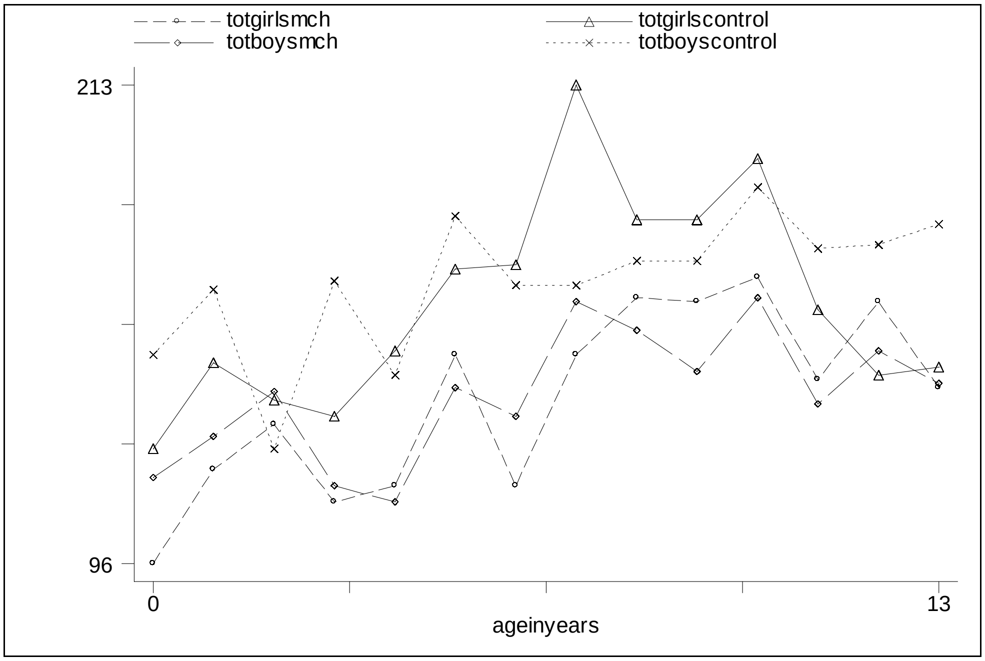

Figure 1. Distribution of male and female children (0-14 years) in the treatment (mch) and control areas

Table 1: Proportion of stunted children (%) below 10 years of age

	<2yrs	2-4	5-9
Program			
MCH intensive^	35.46	56.44	58.77
MCH	37.50	56.08	59.64
Comparison	39.36	62.04	63.14
Gender			
Female	41.70	63.79	59.29
Male	35.54	54.82	63.70
Birth order			
=1 & female	56.90	58.87	57.66
>1 & female	37.31	65.79	60.20
=1 & male	33.33	52.63	60.30
>1 & male	36.12	55.59	65.63
Religion			
Muslim	34.34	59.15	61.41
Hindu	40.00	60.23	61.96
Literacy			
Mother	36.16	56.45	55.85
Father	37.25	61.56	60.33
Size			
Hhsize4	40.83	57.69	60.12
Hhsize5-8	39.94	61.24	62.76
Hhsize9more	30.11	52.29	55.10
Assets			
Own house	38.03	59.53	61.25
Land<1acre	40.99	62.48	63.82
Land>=1acre	34.82	53.42	57.40
Households with			
More boys	34.70	55.45	64.82
More girls	40.98	61.51	59.48
Only boys	36.00	55.38	63.75
Only girls	44.54	61.36	53.70
At least 1 boy	37.11	60.44	64.77
At least 1 girl	36.67	61.47	61.07
Girls with only male sibs	38.24	58.73	63.60
Girls with only female sibs	36.36	65.66	54.85
Boys with only male sibs	38.81	58.82	66.95
Boys with only female sibs	38.46	56.78	58.48
All	38.46	59.26	61.46
N	546	864	1845

^ Intensive area encompasses Blocks A and C that received the intensive treatment first.

Table 2: Bivariate analysis of the impact of number of sisters and number of siblings on nutritional status of children below ten years in the treatment area

Sisters	Number of Siblings			
	one	two	three	four
Zero	-1.92	-2.02	-2.31	-2.44
One		-1.98	-2.18	-2.21
Two			-2.18	-2.12
Three				-2.02
Mean	-1.92	-2.00	-2.21	-2.17
Observations	328	896	535	233

Table 3: Bivariate analysis of the impact of number of sisters and number of siblings on nutritional status of children below ten years in the control area

Sisters	Number of Siblings			
	one	two	three	four
Zero	-1.95	-2.12	-2.37	-2.40
One		-1.98	-2.21	-2.11
Two			-2.18	-2.21
Three				-2.30
Mean	-1.95	-2.05	-2.24	-2.20
Observations	183	477	576	331

Table 4: Comparison of number and composition of siblings across treatment and control areas

	Treatment (std error)	Control (Std error)	T-C (p-value)
Number of siblings	2.83 (0.0248)	3.27 (0.0223)	-0.44 (0.00)
Number of boys	1.10 (0.0169)	1.27 (0.0164)	-0.17 (0.00)
Number of girls	1.11 (0.0179)	1.29 (0.0173)	-0.17 (0.00)
Number of siblings in all girl households	2.85 (0.0346)	3.28 (0.0325)	-0.43 (0.00)
Number of siblings in all boy households	2.81 (0.0355)	3.27 (0.0306)	-0.45 (0.00)

Table 5: OLS results of the Impact of siblings and birth order on height for age Z scores for children below age ten

	Pooled	More Landed	Less Landed	Treatment Area	Control Area
	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores
sibs	-0.0928**	-0.0917	-0.0978**	-0.0576	-0.0900*
	[2.41]	[1.46]	[1.97]	[0.88]	[1.79]
border	0.0521	0.0251	0.0708	-0.0063	0.0739
	[1.15]	[0.35]	[1.21]	[0.09]	[1.23]
log of expenditure per capita	0.0307	-0.0105	0.0471	0.0227	0.0373
	[1.32]	[0.26]	[1.64]	[0.71]	[1.10]
agemths	-0.0278***	-0.0214***	-0.0311***	-0.0263***	-0.0296***
	[8.93]	[4.04]	[8.05]	[5.91]	[6.78]
agemthssq	0.0002***	0.0001***	0.0002***	0.0002***	0.0002***
	[8.13]	[3.33]	[7.60]	[5.13]	[6.34]
female=1,male=0	-0.0317	-0.0221	-0.0372	-0.0265	-0.0307
	[0.66]	[0.28]	[0.62]	[0.39]	[0.45]
muslim	-0.1075	-0.1025	-0.1149	-0.1723*	0.1054
	[1.13]	[0.67]	[0.96]	[1.88]	[0.44]
mother's age in years	0.0015	0.0058	-0.0008	0.0039	0.0011
	[0.34]	[0.75]	[0.14]	[0.62]	[0.17]
mom's height in cms	0.0474***	0.0461***	0.0477***	0.0537***	0.0427***
	[10.36]	[5.78]	[8.46]	[8.22]	[6.70]
highest class attended by the mother	0.0758***	0.0849***	0.0691***	0.0611***	0.0910***
	[7.11]	[5.12]	[4.60]	[4.25]	[5.77]
highest class attended by the father	-0.0108	-0.0117	-0.0117	-0.0085	-0.0135
	[1.36]	[1.06]	[1.04]	[0.82]	[1.14]
Constant	-8.6177***	-8.3113***	-8.6696***	-9.4449***	-8.2334***
	[11.93]	[6.61]	[9.79]	[9.22]	[7.93]
Observations	2821	973	1848	1342	1479
Adjusted R-squared	0.12	0.12	0.11	0.11	0.12

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: GLS Random Effects results of the Impact of sibling rivalry on nutritional status of children under ten

	Pooled	More Landed	Less Landed	Treatment Area	Control Area
	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores
sibs	-0.1048***	-0.1066*	-0.1070**	-0.0682	-0.1063**
	[2.73]	[1.76]	[2.15]	[1.15]	[2.01]
border	0.062	0.0412	0.0736	0.0064	0.0846
	[1.34]	[0.55]	[1.24]	[0.09]	[1.34]
log of expenditure per capita	0.0337	-0.0102	0.0530*	0.0227	0.044
	[1.40]	[0.26]	[1.72]	[0.72]	[1.20]
agemths	-0.0284***	-0.0223***	-0.0315***	-0.0274***	-0.0296***
	[9.78]	[4.49]	[8.79]	[6.58]	[7.28]
agemthssq	0.0002***	0.0001***	0.0002***	0.0002***	0.0002***
	[8.63]	[3.70]	[7.93]	[5.59]	[6.57]
female=1,male=0	-0.0372	-0.0383	-0.0331	-0.0189	-0.0495
	[0.79]	[0.48]	[0.57]	[0.29]	[0.74]
muslim	-0.0971	-0.0957	-0.104	-0.1784*	0.1551
	[1.12]	[0.59]	[1.00]	[1.77]	[0.92]
mother's age in years	0.0011	0.0032	0.0006	0.0031	0.0008
	[0.23]	[0.43]	[0.10]	[0.47]	[0.12]
mom's height in cms	0.0468***	0.0456***	0.0472***	0.0538***	0.0417***
	[10.46]	[6.02]	[8.44]	[8.53]	[6.58]
highest class attended by the mother	0.0752***	0.0822***	0.0692***	0.0612***	0.0896***
	[7.36]	[5.10]	[5.06]	[4.40]	[5.99]
highest class attended by the father	-0.0105	-0.0119	-0.0108	-0.0079	-0.0134
	[1.33]	[0.98]	[1.03]	[0.74]	[1.15]
Constant	-8.5213***	-8.1181***	-8.6676***	-9.4105***	-8.1372***
	[12.03]	[6.78]	[9.75]	[9.59]	[7.91]
Observations	2821	973	1848	1342	1479
Wald Chi-squared	381.94***	136.15***	239.96***	183.64***	204.16***

Absolute value of z statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: OLS Results of Impacts of sibling rivalry on nutritional status of boys and girls

	Pooled Girls height-for-age Z-scores	Pooled Boys height-for-age Z-scores	Girls in Less Landed HH height-for-age Z-scores	Boys in Less Landed HH height-for-age Z-scores	Girls in More Landed HH height-for-age Z-scores	Boys in More Landed HH height-for-age Z-scores
sibs	-0.0938*	-0.1029**	-0.0653	-0.1503**	-0.1399	-0.0378
	[1.76]	[2.03]	[0.93]	[2.27]	[1.57]	[0.48]
border	0.068	0.0455	0.0629	0.0962	0.0773	-0.0327
	[1.03]	[0.74]	[0.73]	[1.24]	[0.74]	[0.32]
log of expenditure per capita	0.006	0.0498	0.0566	0.0339	-0.1024*	0.0667
	[0.19]	[1.55]	[1.45]	[0.83]	[1.84]	[1.25]
agemths	-0.0238***	-0.0313***	-0.0295***	-0.0320***	-0.0128*	-0.0305***
	[5.12]	[7.29]	[5.07]	[6.08]	[1.68]	[4.06]
agemthssq	0.0002***	0.0002***	0.0002***	0.0002***	0.0001*	0.0002***
	[5.18]	[5.96]	[5.17]	[5.28]	[1.68]	[2.95]
muslim	-0.07	-0.1389	-0.066	-0.1491	-0.0915	-0.1299
	[0.56]	[1.20]	[0.42]	[1.07]	[0.47]	[0.59]
mother's age in years	-0.001	0.0043	-0.0024	0.0008	0.0047	0.0106
	[0.16]	[0.71]	[0.29]	[0.12]	[0.46]	[0.91]
mom's height in cms	0.0537***	0.0401***	0.0549***	0.0385***	0.0492***	0.0425***
	[8.04]	[6.51]	[6.84]	[4.66]	[3.90]	[4.96]
highest class attended by the mother	0.0888***	0.0636***	0.0744***	0.0648***	0.1147***	0.0565**
	[5.80]	[4.50]	[3.30]	[3.33]	[5.38]	[2.47]
highest class attended by the father	-0.0118	-0.0086	-0.0127	-0.0108	-0.0135	-0.0046
	[1.08]	[0.78]	[0.83]	[0.68]	[0.92]	[0.30]
Constant	-9.6288***	-7.4721***	-10.0267***	-7.0450***	-8.5282***	-8.0419***
	[9.34]	[7.64]	[7.96]	[5.48]	[4.48]	[5.66]
Observations	1386	1435	913	935	473	500
Adjusted R-squared	0.11	0.13	0.1	0.11	0.12	0.13

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: GLS Random Effects results of the Impact of sibling rivalry on nutritional status of boys and girls

	Pooled Girls height-for-age Z-scores	Pooled Boys height-for-age Z-scores	Girls in less Landed HH height-for-age Z-scores	Boys in less landed HH height-for-age Z-scores	Girls in More Landed HH height-for-age Z-scores	Boys in More landed HH height-for-age Z-scores
sibs	-0.1064**	-0.1156**	-0.0872	-0.1756**	-0.1368*	-0.0382
	[2.03]	[2.08]	[1.27]	[2.46]	[1.68]	[0.43]
border	0.0852	0.0606	0.0846	0.1243	0.0809	-0.0321
	[1.30]	[0.92]	[1.00]	[1.49]	[0.77]	[0.30]
log of expenditure per capita	0.0086	0.0522*	0.0621	0.0393	-0.1028*	0.0667
	[0.25]	[1.65]	[1.42]	[0.96]	[1.78]	[1.31]
agemths	-0.0236***	-0.0318***	-0.0293***	-0.0323***	-0.0127*	-0.0305***
	[5.48]	[7.87]	[5.47]	[6.58]	[1.74]	[4.29]
agemthssq	0.0002***	0.0002***	0.0002***	0.0002***	0.0001*	0.0002***
	[5.28]	[6.42]	[5.25]	[5.64]	[1.67]	[3.12]
muslim	-0.0764	-0.1347	-0.067	-0.1458	-0.1076	-0.129
	[0.60]	[1.18]	[0.44]	[1.06]	[0.46]	[0.62]
mother's age in years	-0.0017	0.0032	-0.002	0.0001	0.003	0.0104
	[0.27]	[0.48]	[0.24]	[0.01]	[0.30]	[0.93]
mom's height in cms	0.0532***	0.0401***	0.0539***	0.0385***	0.0503***	0.0425***
	[8.58]	[6.46]	[6.89]	[4.91]	[4.79]	[4.14]
highest class attended by the mother	0.0878***	0.0626***	0.0724***	0.0642***	0.1139***	0.0563***
	[5.88]	[4.69]	[3.62]	[3.59]	[4.82]	[2.72]
highest class attended by the father	-0.0108	-0.0099	-0.011	-0.0128	-0.0132	-0.0046
	[0.96]	[0.94]	[0.74]	[0.91]	[0.74]	[0.29]
Constant	-9.5600***	-7.4434***	-9.9249***	-7.0388***	-8.6170***	-8.0377***
	[9.76]	[7.55]	[7.97]	[5.66]	[5.24]	[4.93]
Observations	1386	1435	913	935	473	500
Wald Chi-squared	178.29***	220.48***	110.99***	138.32***	71.87***	84.12***

Absolute value of z statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 9: Impact of sibling rivalry on children who live in households that have more boys than girls

	Pooled in HH with more boys than girls: OLS	Pooled in HH with more boys than girls: GLS^	Girls in HH with more boys than girls: OLS	Boys in HH with more boys than girls: OLS
	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores
sibs	-0.1035*	-0.1261**	0.2122	-0.1351**
	[1.71]	[2.11]	[1.40]	[2.35]
border	0.1017	0.1250*	0.0409	0.1085
	[1.52]	[1.73]	[0.18]	[1.54]
log of expenditure per capita	0.0940**	0.0964***	-0.0047	0.0984**
	[2.34]	[2.58]	[0.05]	[2.36]
agemths	-0.0303***	-0.0317***	-0.0344*	-0.0303***
	[6.38]	[6.91]	[1.85]	[6.14]
agemthssq	0.0002***	0.0002***	0.0003*	0.0002***
	[5.76]	[6.25]	[1.87]	[5.44]
female=1,male=0	-0.178	-0.1705		
	[1.36]	[1.28]		
muslim	-0.0993	-0.1019	0.5674	-0.1485
	[0.75]	[0.76]	[1.15]	[1.14]
mother's age in years	-0.001	-0.0025	-0.0373	0.0017
	[0.14]	[0.33]	[1.57]	[0.24]
mom's height in cms	0.0436***	0.0428***	0.0525**	0.0418***
	[5.53]	[5.78]	[2.34]	[5.12]
highest class attended by the mother	0.0735***	0.0721***	0.1265***	0.0669***
	[4.32]	[4.53]	[2.97]	[3.75]
highest class attended by the father	-0.0041	-0.0067	0.0105	-0.0053
	[0.31]	[0.53]	[0.33]	[0.37]
Constant	-8.4820***	-8.2954***	-9.9241***	-8.1882***
	[6.69]	[7.04]	[2.86]	[6.26]
Observations	1079	1079	103	976
Adjusted R-squared	0.14		0.22	0.13
Wald Chi-square		186.45***		

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

^robust z statistics in parentheses for GLS RE model

Table 10: Impact of sibling rivalry on children in households that have more girls than boys

	Pooled in HH with more girls than boys: OLS	Pooled in HH with more girls than boys: GLS^	Girls in HH with more girls than boys	Boys in HH with more girls than boys
	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores
sibs	-0.07	-0.0767	-0.0913	0.0901
	[1.38]	[1.48]	[1.62]	[0.79]
border	0.0061	0.0095	0.0457	-0.2334*
	[0.10]	[0.16]	[0.67]	[1.84]
log of expenditure per capita	-0.0108	-0.0078	0.0038	-0.058
	[0.39]	[0.25]	[0.11]	[1.23]
agemths	-0.0269***	-0.0268***	-0.0232***	-0.0359***
	[6.43]	[7.14]	[4.82]	[4.19]
agemthssq	0.0002***	0.0002***	0.0002***	0.0002***
	[5.85]	[6.15]	[4.79]	[2.61]
female=1,male=0	-0.0571	-0.0457		
	[0.86]	[0.70]		
muslim	-0.1271	-0.1058	-0.119	-0.1501
	[0.95]	[0.92]	[0.92]	[0.63]
mother's age in years	0.0036	0.0036	0.0009	0.014
	[0.63]	[0.62]	[0.14]	[1.27]
mom's height in cms	0.0495***	0.0489***	0.0532***	0.0390***
	[8.52]	[8.66]	[7.67]	[4.22]
highest class attended by the mother	0.0767***	0.0767***	0.0848***	0.0515**
	[5.57]	[5.73]	[5.20]	[2.24]
highest class attended by the father	-0.0151	-0.0129	-0.0136	-0.0191
	[1.52]	[1.26]	[1.17]	[1.16]
Constant	-8.6174***	-8.5819***	-9.5015***	-6.2631***
	[9.66]	[9.61]	[8.90]	[4.47]
Observations	1742	1742	1283	459
Adjusted R-squared	0.11		0.11	0.13

Robust t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

^robust z statistics in parentheses for GLS RE model

Table 11: Impact of sibling rivalry on boys and girls living with same sex or opposite sex siblings

	girls with only male sibs	girls with only fem sibs	boys with only male sibs	boys with only fem sibs
	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores	height-for-age Z-scores
sibs	-0.2447**	0.0809	-0.3336***	-0.0798
	[1.99]	[0.51]	[2.75]	[0.62]
border	0.1566	-0.1049	0.1093	-0.1237
	[1.17]	[0.66]	[0.82]	[0.94]
log of expenditure per capita	0.0394	-0.1509**	0.0381	0.0233
	[0.66]	[2.37]	[0.56]	[0.47]
agemths	-0.0153*	-0.0203**	-0.0358***	-0.0320***
	[1.81]	[2.13]	[4.50]	[3.61]
agemthssq	0.0001*	0.0001	0.0002***	0.0002***
	[1.76]	[1.55]	[3.94]	[3.04]
muslim	0.1581	-0.0584	-0.2106	0.0482
	[0.73]	[0.28]	[1.07]	[0.30]
mother's age in years	-0.009	0.0277	0.013	0.0061
	[0.81]	[1.56]	[0.93]	[0.53]
mom's height in cms	0.0504***	0.0646***	0.0317**	0.0373***
	[4.28]	[4.33]	[2.21]	[3.84]
highest class attended by the mother	0.0500**	0.1075***	0.0537*	0.0539**
	[2.00]	[2.77]	[1.82]	[2.23]
highest class attended by the father	-0.0072	-0.019	0.0201	-0.0312*
	[0.40]	[0.77]	[0.85]	[1.78]
Constant	-9.3019***	-10.9005***	-5.8874**	-6.6586***
	[4.96]	[4.53]	[2.41]	[4.77]
Observations	410	348	397	430
Adjusted R-squared	0.07	0.12	0.13	0.09

Robust t statistics in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%