Parental Investments in Children: Are Families Gender-Biased in Bangladesh?

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Abstract

I investigate the incidence of gender-bias in prenatal care, postnatal investment and anthropometric outcomes in Bangladesh using microdata from Demographic and Health Survey. In the absence of sex-selective abortion, the sex of the child is exogenous, allowing me to compare parental investments for young children. I find that mothers are more likely to receive tetanus shots, to breastfeed and to provide vaccinations to girls rather than boys. However, parents show a preference for first born sons relative to other children for most investments. Compared to children in other developing countries, boys in Bangladesh are taller and weigh more than can be explained by biological advantages. My results are robust to anticipated and actual family size effects.

1 Introduction

In several developing countries, families show a preference for children based on their sex, particularly towards sons, due to several social and economic factors. Sons are more likely to participate in the labour market, earn higher wages, and assist parents in old-age, compared to daughters (Gangadharan and Maitra, 2003). On the other hand, daughters may have to move away to her husband's family after marriage, and her family may have to pay a dowry for the marriage to take place (Bharadwaj et al., 2014; Kabeer et al., 2014; Jayachandran and Pande, 2015). Son-preferences can affect the allocation of resources within the family. For example, parents were found to be more responsive to their son's illness compared to that of their daughters and provided more food to sons than daughters in Bangladesh (Chen et al., 1981).

Previous studies on the issue assumed that families with boys and families with girls are identical across all ages, when in fact it is not necessarily true due to sex-selective abortion and male-biased fertility stopping rules. I use the novel approach introduced by Barcellos et al. (2014) to identify the effect of son-preference among young children in Bangladesh, where the issue has received very little attention in recent years. I find that boys and girls who are 12 months or younger belong to families who are identical and therefore, can be compared. In estimating sex-selective investments, I address the two most important identification concerns: sex-selective abortion and male-biased fertility stopping rule.

The practice of sex-selective abortion implies that the sex of the child is not exogenous to parental investments. Families who undertake this procedure would probably be highly discriminatory towards girls, had they not been aborted, and as such, the results would be underestimates of the true effect. I examine the incidence of sex-selective abortions by comparing the average sex-ratio of sons to daughters with the natural sex-ratio, conditional on the sex composition of older children. I carry out this procedure on two samples: children born before the introduction of ultrasonograms in Bangladesh (when sex selective abortion is not possible) and those born later. My results show that there is no incidence of deviation from natural sex-ratio for children born up to the birth order of five. My estimates are also very similar for both sub-samples, further corroborating evidence against sex-selective abortion in Bangladesh.

The second issue concerns the male-biased fertility stopping rule.Barcellos et al. (2014) attribute the insignificance of gender-bias in some studies (e.g. Hariss, 1995; Deaton, 1989) on not considering this endogeneity. Such a rule indicates that the investment in daughters is reduced in two ways - once due to fertility stopping pattern and again due to son-preference. To overcome the effect of male-biased fertility stopping rule, I do not control for family size in my estimations and restrict my sample to the youngest children below 12 months of age. As a result, my estimates capture the effect of differences in family size (if any) and also only compare between boys and girls who are in families that cannot be differentiated based on predetermined characteristics. I also carry out robustness checks on the first-born, who are less prone to sex-selective abortion, by including controls for possible investment differences due to anticipated family size. I find no differences in this estimation either.

I identify the effect of son-preference in Bangladesh by estimating gender-bias in prenatal care, post-natal investments and gender-gaps in anthropometry. My results are the first of its kind in determining the absence of sex-selective abortions and identifying the lack of gender-bias in parental investments among young children in Bangladesh. Despite no particular preference for boys in terms of health care and investments, I find that boys are taller and weigh more compared to girls, even after accounting for possible biological differences. I also note that there is a clear gender-bias in parental investment and anthropometric outcomes towards first born sons compared to both first born daughters and children born in higher birth orders. My results show that there is a need to focus on factors other than basic prenatal and postnatal investments in young children in order to narrow the gap in anthropometry. For example, it is possible that mothers had better nutritional intake during pregnancies with sons than with daughters. Further, time spent in childcare may also effect anthropometric outcomes, as was the case in India (Barcellos et al., 2014).

The rest of my paper is structured as follows: Section 2 discusses the data and methods, Section 3 reports the main results, and, Section 4 presents the conclusions. All Tables and supporting Figures are included in the Appendix.

2 Data and Methods

2.1 Data Description

The source of data is the Demographic and Health Surveys (DHS) of Bangladesh, a nationally representative study conducted by USAID. The survey follows two-stage cluster sampling, where a cluster represents a group of adjacent households that serve as the primary sampling unit (DHS, 2012). The first stage consists of selecting stratified 'enumeration areas' (EA) based on probability to size. All households within the selected EA are listed. In the second stage, a fixed number of households are chosen from the list using equal probability systemic sampling. The DHS files contain information on ever-married women between 13 to 49 years, along with their entire birth histories.

The descriptive statistics of key variables are provided in Table A1. I used six waves of DHS conducted in 1993-94, 1996-97, 1999-2000, 2004, 2007 and 2011. I drop families (mother and all her children) with missing information on key variables. I also exclude twins to determine the sex of the child. Finally, unlike previous studies (Barcellos et al., 2014), I keep both rural and urban observations. Limitation of health care facilities in rural areas may falsely indicate no sex-selective abortion or no prenatal care bias. The final sample size consists of approximately 200,000 children from 61,000 families.

The average age of women in the sample was 35 years and about 18 percent had completed primary or secondary schooling. The majority were Muslims, married at the time of the interview and resided in rural areas. The unconditional sex-ratio of children in households closely follow the natural sex-ratio. Girls had one sibling more than boys on average. The large majority of children were alive, and there was no skewness in sex-ratio in child mortality.

Although the baseline sex-ratio shows no deviation from the natural sex-ratio (assuming no sex-selective abortion), it indicates male-biased fertility stopping rule.

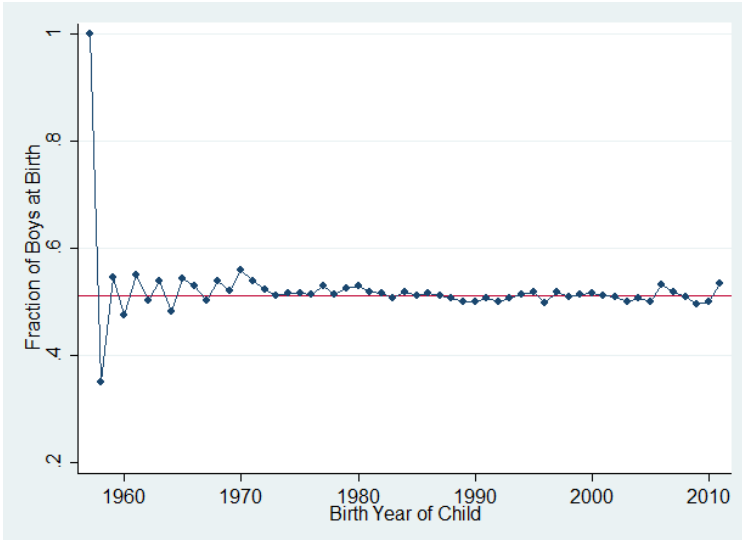
2.2 Testing for Sex-Selective Abortion

Sex-selective abortion is illegal in Bangladesh (Kabeer et al., 2014), and is therefore difficult to observe. The deviation of sex-ratio of male to female from the natural sex-ratio may be indicative of sex-selective abortions. Figure 1 shows that at birth, the unconditional sex ratio of children move closely around the natural sex ratio at 0.51 [1] (consistent with the findings of Kabeer et al. (2014); UNICEF (2011); Bairagi (2001)). The sample size for children born before 1960 was very small, leading to noisy estimates at the beginning of plot. It can also be noted that there is no significant change in the sex-ratio after 1990, when ultrasound technology was first introduced making it possible to selectively abort based on sex. The reported sex ratios do not control for any demographic characteristics and may hide sex-selective abortion conditional on sex-composition of older children in the family.

Select studies (Abrevaya, 2009; Brainderd, 2013) have relied on conditional sex ratios to find evidence of sex-selective abortion. A family, desiring a son, may be willing to undertake abortion in extreme cases only. If their ideal family size is two and they already have one daughter, they may opt for abortion if their second pregnancy is with a female child. However, if they have one son already, they may be less likely to consider abortion. Thus, the incidence of sex-selective abortion rises if their older children are mostly female, or if the birth parity is higher. The following framework assesses the likelihood of male birth

[1] In the overall population, (Figure A1) the sex-ratio is heavily biased towards men at the beginning of the series but declines with time. However, the two figures should not be compared together, as the population ratio is cumulative and not at birth.

Figure 1: Sex-Ratio of Children by Birth Year. DHS 1993-2011.



conditional on the sex-composition of older children:

$$Boy_{ih} = \alpha_0 + \alpha_1 NoBoy_{ih} + \alpha_2 OneBoy_i + u_i \quad (1)$$

where Boy_{ih} is a dummy variable equal to one if child i in family h is a boy and zero otherwise. $NoBoy_{ih}$ is also a dummy variable that takes value of one if previous child (or children) was (were) female. This variable is only valid for children born second or higher in the family. The final independent variable, $OneBoy_{ih}$, is also a dummy variable, and takes the value of one if at least one of the older children was male, but not all. This variable is created for children born third or higher in the family. For example, in a family with three children - one boy and two girls - $OneBoy_{ih}$ would indicate one. The coefficients of interest here are α_1 and α_2. If sex-selective abortion takes place, then the likelihood of giving birth to a boy is contingent on previous children's sex-composition. In the absence of sex-selective abortion, these coefficients should be insignificant, proving that the sex of the child is exogenous at birth.

Table A2 presents the estimation results of boy births for children born at birth parity two to five. Basic ultrasound was introduced to postgraduate medical courses in 1987 in the capital city in Bangladesh (Taher and Ali, 2007), and became prominent in the 1990s. Based on this, I divide my sample to children born on or before 1990, the period before ultrasonograms, and those born after. I restrict my analysis to birth parity of five as the average number of children prior to 1990s was about six, while that of after 1990 was four.

Having no boys in previous births is insignificant in determining that the current child is male for all birth parities. Having at least one boy in previous births positively affects the likelihood of male-birth of current child only for birth parity of four. All coefficients are roughly similar to both sub-samples. The unconditional sample mean for male-births is also similar for both periods, and hovers around the natural ratio of 51.2 percent. The results indicate that: a) there has been no change in sex-ratio of male-female births due to introduction of ultrasonograms, and b) sex-composition of previous children does not affect boy-birth likelihoods.

Additionally, I use data from Multiple Indicator Cluster Survey 3 conducted by UNICEF (2006) to confirm my findings. The dataset is much smaller with children born between 2000 and 2006 only. The average number of children in this sample was one, so I only consider children born in birth parity one and two. As expected, sex-composition of older children do not effect sex of current child. My results are also supported by Bairagi (2001), who conducted a smaller study of abortion practices in Matlab region of Bangladesh, where a randomized control trial to improve family planning was instituted in the 1980s. Thus, I can rule out sex-selective abortion for further estimations in Bangladesh.

2.3 Testing for Male-Biased Fertility Stopping Rule

The male-biased fertility stopping rule is the decision to not try for more children after having a son. This rule implies that the gender composition of children determines family size. For instance, if a family with one daughter desires a son, and would rather not have more than two children, they may selectively abort if they find their second pregnancy is also with a female child. With son-preference among families, girls are more likely to be in larger families on average and thus receive lower investments. Comparing girls with boys in families of the same size would then mean comparing investments among families that favour girls to families with no preference, leading to a biased estimation. The method established by Barcellos et al. (2014) addresses this endogeneity by excluding family size as a control and comparing among youngest children only.

Figure 2: Male-Biased Stopping Rule in Bangladesh. DHS 1993-2011.

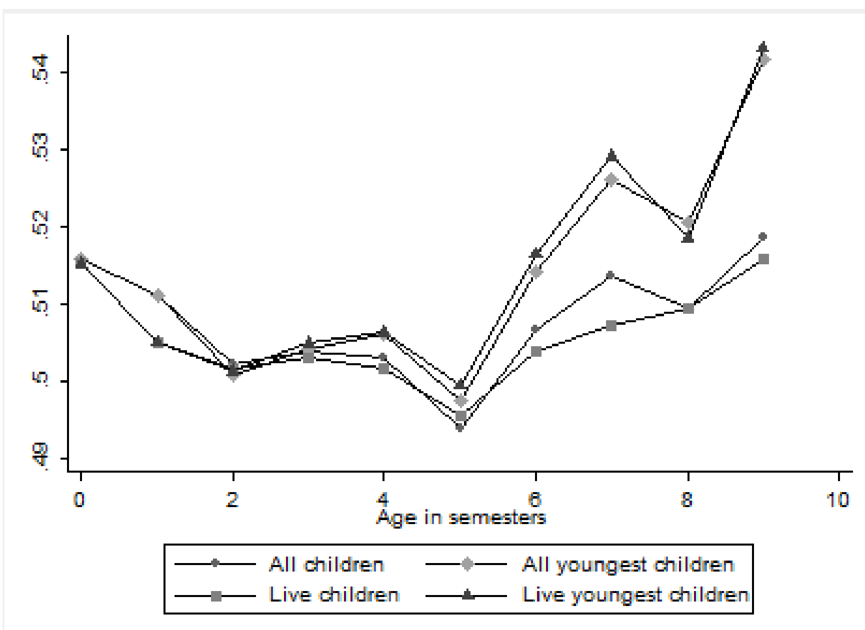


Figure 2 illustrates that boys comprise slightly above 50 percent of all children at birth as per the natural rate. Within a few semesters, the fraction of boys among youngest child increases, reaching its peak at slightly above 54 percent for children aged four and a half to five years (semester 9). Sons are more likely to be the last born than daughters, indicating that families on average stop having more children after a boy is born. The fraction of boys among youngest living is matched closely by all youngest ever born, suggesting no excess female mortality, a finding that is supported by UNICEF (2011) and Kabeer et al. (2014). I also carry the same analysis checked for male-biased fertility stopping rule in the sub-samples of before and after emergence of ultrasonograms. Figure A2 (in Appendix) reflect the same findings as suggested by the current figure, though the estimates are noisier for the period before 1991.

2.4 Testing Random Assignment

Parental investment in girls and boys can only be compared if families with female children and families with male children do not differ systematically. As the sex of child is exogenous at birth, Barcellos et al. (2014) argue that families who just gave birth to a son are identical to those who just gave birth to a daughter based on given characteristics. As a result, the differences (if any) in parental investment can be attributed to sex of the child under comparison. However, as the child grows older, families take different decisions based on the sex of the child. This allows certain characteristics to predict the sex of the child. For example, if the child is living with the father after his divorce, it is more likely that the child is male (Dahl and Moretti, 2008). Thus, there is a small age group within which families can be compared, as they do not differ systematically based on predetermined characteristics, X.

To establish that this assumption is true for Bangladesh, I estimate the following linear equation on different age cohorts of children and carry out a joint F-test on the set of predetermined characteristics:

$$I(boy_{ia} = 1) = X_i\beta_a + e_{ia} \tag{2}$$

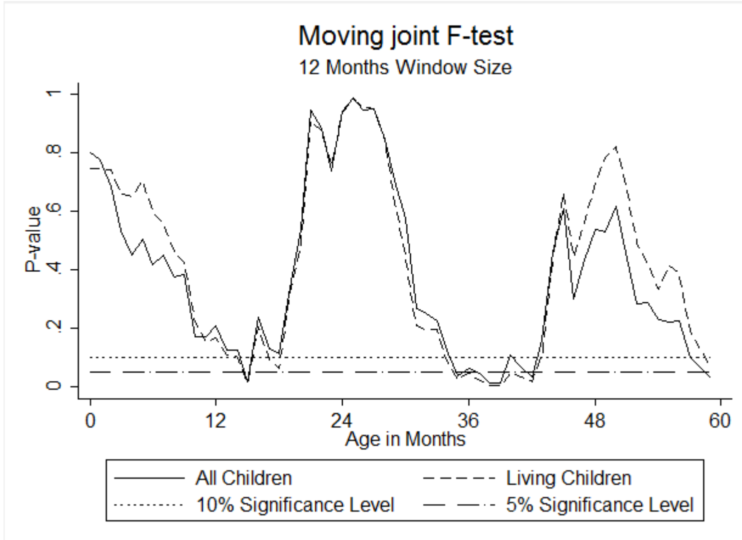
where, I is an indicator taking the value one for a given age cohort, $a.X_i$ comprises variables that are *predetermined* before birth for all children of all ages. Based on the data and past literature (Barcellos et al., 2014; Kabeer et al., 2014; Bharadwaj et al., 2014), these variables are categorized as maternal and child characteristics[2]. If β_a is not significantly different from zero, then X's cannot jointly predict the sex of child and the joint F-test will not reject the null hypothesis. Thus, we can compare parental investment within the age cohort where the joint F-test is not rejected.

In Table A3, I present the results of linear regression of equation (1) and also the sample means for three age cohorts for both youngest girls and youngest boys. Age cohorts of 13-48 months and 49-60 months are borderline significant, with certain characteristics individually significant. Individual statistics for the final age cohort are substantially different from the other two, indicating that families become very different as children grow older based on their sex. Figure 3 supports the findings and shows that the null hypothesis is first rejected at at approximately 15 months of age at the 5 percent significance level. Considering the relatively small sample size of each age cohort, I adopt the conservative approach and select the age cohort 0-12 months for further analysis.

There are two main caveats in the analysis for random assignment. Firstly, the test

[2] Barcellos et al. (2014) includes mother's education in X_i, which I drop due to its endogenous relation to fertility and child health. Moreover, as I estimate for differences in prenatal care in subsequent sections, I do not include such characteristics.

Figure 3: Joint F-test on Maternal and Child Characteristics in Bangladesh. DHS 1993-2011.



is imperfect as random assignment can only be tested on observable variables. Second, the sub-groups in my analysis are very small and may not precisely identify the cut-off age where the covariates become imbalanced.

2.5 Estimating Differential Parental Investment

Following the evidence for random assignment of the sex of the child, gender-bias in parental investment for children up to 12 months of age can be estimated by the following equation:

$$Invest_{ih} = \beta_0 + \beta_1 Boy_{ih} + X_{ih}\beta_2 + u_{ih} \tag{3}$$

where $Invest_{ih}$ is the investment in child i in household h, X_{ih} includes demographic characteristics and u_{ih} is the error term. The coefficient of interest here is β_1, which shows the additional (or under) investment in boy child compared to girl child. Exogeneity of the sex of the child at birth ensures the covariance of B_{ih} and u_{ih} conditional on X is zero and produces unbiased estimates using OLS. Finally, all regressions include year-of-interview fixed effects.

I also analyze the outcomes of parental investment by comparing anthropometric measures between girls and boys in Bangladesh with children from other countries. As boys are naturally taller and heavier than girls, comparing within Bangladesh only would falsely indicate gender-bias. Comparing these measurements across countries, however, can indicate gender-bias in outcomes. If boys in general are taller across all countries, but boys in Bangladesh are particularly taller, then there is a clear gender-bias in anthropometry in Bangladesh. As I restrict my sample to children below 12 months of age, anthropometric differences across countries do not come into effect. Disparities in height and weight measures reflect the outcomes of nutritional differences only.

The empirical framework is as follows:

$$Zscore_{ih} = \theta_0 + \theta_1(Boy * BD)_{ih} + \theta_2 Boy_{ih} + \theta_3 BD_{ih} + \theta_4 Y_{ih} + e_{ih} \tag{4}$$

where, $Zscore_{ih}$ represents the dependent variables - absolute and proportional height, height-for-age and, weight-for-age z-scores of child i in family h. BD_{ih} refers to the sample of children from Bangladesh, Y_{ih} control for the age of child (in months) and year of interview fixed effects, and, e_{ih} is the disturbance term.

3 Empirical Findings

3.1 Gender-Bias in Investments

Prenatal Care

Prenatal investment is directly associated with improvements in neonatal survival and birth weight (Bharadwaj et al., 2014). Panel A of Table A4 presents the results of gender-bias in prenatal investments, which include prenatal visits, tetanus shots and non-home delivery. These investments increase chances of neonatal survival of child and also safeguard maternal health. World Health Organization (WHO) recommends at least four prenatal care visits, to assist women in preparing for delivery and also understand warning sighs during pregnancy and childbirth (UNICEF, 2015). Tetanus shots are particularly important among the poor, whose limited access to health services increase chances of tetanus infections both during pregnancy and also during home-deliveries (WHO, 2008).

Gender differences appear for only two of the five selected dependent variables. Boys, on average, receive fewer tetanus shots compared to girls. Being a boy, however, decreases likelihood of non-home delivery compared to girls. However, this bias disappears when controls are added, suggesting that the differences can be easily explained by maternal and child characteristics.

Postnatal Care

In Panel B of Table A4 I present the effect of the sex of child on key parental inputs. Breast-feeding, an ideal source of nutrition, is an essential factor in improving child mortality in developing countries and also contributes to maternal health. Interestingly, boys are about three percent less likely to be breastfed than girls even though nearly 95 percent of children are breastfed. However, in terms of duration of breastfeeding, there is no gender-disparity. This is also accounting for a censored regression model that handle data truncation, as many children were still being breastfed at the time of the interview. Vitamin A supplements help protect against night blindness, measles and diarrhea(UNICEF, 2015). Malnutrition and regular flooding make children in Bangladesh particularly vulnerable to such diseases(UNICEF, 2015). Once again, no gender-based differences are detected.

Finally, I analyze if families are more likely to save vaccination cards for boys compared to girls and find a positive relation. Vaccination cards present the types of vaccination received, the date on which it is received and a signature of the medical administrator, making these records invulnerable to misreporting. I then assess if male children are more likely to receive vaccination using two sub-samples - all children (Panel C) and families with cards at the time of interview only (Panel B). These vaccines (3 DPT doses, 3 polio doses, tetanus and measles) are administered to the child within the first 9 months, implying that some children may not have received vaccination yet. However, controlling for child's age did not effect estimates.

Panel C estimates show that gender-differences in receiving at least one vaccination or the number of vaccinations disappear when controls are added. About 74 percent of children, on average, receive at least one vaccination. However, when the sample is restricted to families who held vaccination cards (Panel D), a very small bias towards girls is detected in receiving at least one vaccination. The discrepancy between the estimates of the two sub-samples highlight that families are more likely to provide ideal answers for boys compared to girls, even if their practice is not gender-biased. This may be indicative of declining gender-bias as described by Kabeer et al. (2014).

In short, the youngest sons have a higher likelihood of receiving more tetanus shots, belong to families that are more likely to hold onto their vaccination cards, but are breastfed less compared to daughters. My results are starkly different from the prenatal investment estimates for Bangladesh, China, India and Pakistan by Bharadwaj et al. (2014) and for postnatal investments (including vaccinations) for India by Barcellos et al. (2014). The former study (Bharadwaj et al., 2014) used a higher cutoff age (24 months) for Bangladesh. However, my analysis shows that families with children above 12 months appear to be systematically different for boys and for girls. This implies that the sex of the child is no longer exogenous and the corresponding estimates may be biased. My results are consistent with the conclusions drawn by Kabeer et al. (2014), and also reflect the strides Bangladesh has made in terms of children's well-being and maternal health since the beginning of Millennium Development Goals (UNICEF, 2015).

Effect of First Born

First born sons hold a special position in many families in Bangladesh. Parents may be biased towards the first born sons, even if they are indifferent between subsequent sons and daughters. This preference may be masked when estimating for boys on average. In Table A5, I estimate the effect of having a son as the first born in the family on investments. I also control for anticipated family size effects in addition to the controls used in Table A4.

Interestingly, first born sons are still more likely to receive more tetanus shots, but are also four percent more likely to be delivered outside homes on average. With regards to vaccinations, I only consider the more reliable sub-sample of holding vaccination cards (even though there is no statistical difference). Boys are more likely to receive full vaccination compared to girls, on average. Restricting my analysis to first born sons only show a stronger presence of son-preference than was otherwise noted.

Effect of Sons Born in Higher Birth Orders

I further analyze if boys born second or higher in the family and the sex composition of siblings affect parental investment. If son-preference is strong, and families have had only girls prior to the youngest, it is likely that the youngest son receives significantly more resources. The results are reported in columns (2), (3) and (4) of Table A6. Although first born sons have a distinctive edge over their female siblings, on average, the effect is removed for sons born later , controlling for having only sisters. However, parents are still more likely to hold vaccination cards for boys compared to girls to no later advantage. In Table A6, column (3) and (4) show that the effect is identical when controlling for mixed sex-composition of siblings.

3.2 Gender-Bias in Anthropometric Outcomes

A concern with measuring differentials in input is misreporting during interviews, as was evident in the discrepancy between all children and those with vaccination cards only (Table A4). The advantage of anthropometry is that it is objective in nature, being invulnerable to parental misreporting[3]. Anthropometric measures are becoming increasingly popular in understanding net nutritional intake of children and act as a marker for malnutrition (Jayachandran and Pande, 2015).

[3]Data enumerators measure height and weight of children during the interview for DHS.

Height disadvantages in childhood, in particular, are reflected in adult height, and are a good proxy of nutritional deficits. Shorter people have also been shown to perform worse in terms of productivity on average (Jayachandran and Pande, 2015). Malnutrition, or low weight in children, is a direct consequence of poor food quality, insufficient food intake, and severe and repeated infectious diseases, or some combinations of these three factors (WHO, 2015). However, comparing anthropometric differences between boys and girls will likely report a bias, as boys are naturally taller and heavier than girls. By using standardized measures and comparing across countries, I can identify if there is a gender-bias in Bangladesh relative to the bias that exists on average.

I follow the WHO standard of using children's height-for-age and weight-for-age z-scores. Children under five years of age have similar height distributions for most ethnic groups provided that they receive adequate nutrition (Jayachandran and Pande, 2015), making gender comparisons across countries plausible. The z-scores are calculated by normalizing the difference between the child's height (weight) and the median height (weight) of the population with the standard deviation of the reference population[4] for the same age and sex. A z-score of 0 represents the median of the gender and age-specific reference population and all other indicate a standard deviation change from the reference-population median. Children with z-scores below -2 standard deviations suffer from growth retardation, while those with z-scores above +2 are considered obese.

I consider two groups of countries for comparison, with all data taken from DHS. The first includes 71 developing countries with details on anthropometry (and my controls), and the

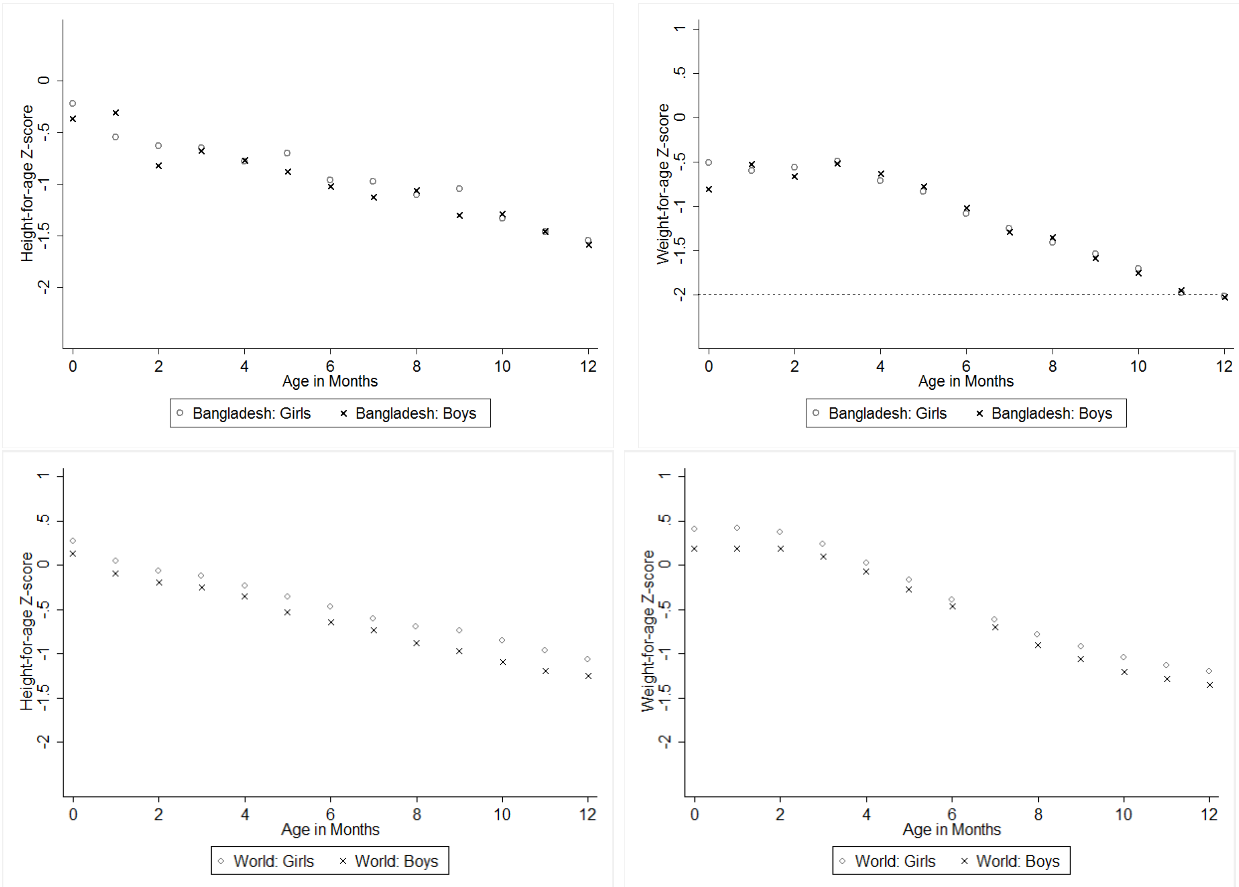
[4]DHS I, II and III use surveyed children from United States in the 1970s as the reference and DHS IV and V use children in well-fed populations in selected countries as the reference. I also create a second reference group, *Sample*, which includes all the countries in my estimation.

second includes the six South Asian countries. The first provides a holistic view of gender gap in anthropometry. The second allows comparison with countries, where the height and weight distributions are likely to be most similar to that of Bangladesh. However, son-preference has been documented in certain South Asian countries, e.g. India and Pakistan (Barcellos et al., 2014; Jayachandran and Pande, 2015). If there is a male-biased height-advantage due to son-preference, it may underestimate the gender-gap in Bangladesh.

Figure 4 illustrates the sex-specific age profile for average height-for-age z-score and the average weight-for-age z-score. The graphs in the top row present the results for Bangladesh only, and those at the bottom row include all 71 countries. It is difficult to identify a consistent gender gap in either height-for-age or weight-for-age z-scores in Bangladesh. However, the remaining countries exhibit a clear female advantage for both scores. This provides an indication of possible gender disparity in Bangladesh, where girls fare worse than boys. Although no stunting is prevalent in Bangladesh, there is evidence of wasting among children who are over 10 months. On both scores, Bangladesh performs worse than the median reference population (below 0 standard deviations).

Table A7 present a difference-in-difference analysis of gender-gaps in height and weight, using absolute and proportional scales, as well as z-scores. Panel A provides a comparison of anthropometric measures across all countries. The male-biased gender gap is 23 percent (0.289/1.27) more for absolute height and 13 percent (0.064/0.469) more for absolute weight in Bangladesh compared to the average male across all countries in my sample. A more reliable estimate, given by z-scores, also demonstrate this advantage for boys in Bangladesh. Boys score 0.12 standard deviations more for both height-for-age z-score and weight-for-age z-score, on average. Children in Bangladesh, on the other hand, are both shorter and weigh

Figure 4: Anthropometric Measures in Bangladesh. (All Available DHS)



less compared to other countries in DHS reference group or in my sub-sample.

Supporting the illustrations in Figure 4, male children are about 0.15 standard deviations lower in terms of height-for-age z-score and 0.10 standard deviations lower in terms of weight-for-age z-score compared to DHS reference group. However, there is no gender gap for male children in terms of height-for-age z-score compared to the 71 developing countries in my sample, although a very slight advantage for weight-for-age z-score is demonstrated.

Panel B of Table A7 highlights the gender-gap in anthropometry within South Asia. Compared to the neighbouring countries, the gender gap in height is only about seven percent greater in Bangladesh. This is expected as the estimates are likely to have a downward bias due to son-preference in at least two of the six countries in the sample. Male children do not show a height-disadvantage, unlike when compared to the rest of the world in Panel A. In addition, relative to their neighbours, children in Bangladesh show no significant difference in heights, although they exhibit significantly lower weight.

Effect of First Born Son in Anthropometry

I estimate the gender-bias in anthropometry by considering first born sons only, who had a clear resource preference. Table A8 reports the results for this analysis. The results show that first born sons display no height advantage but weigh more compared to first born daughters and other children born in higher birth orders in Bangladesh. However, first born sons across all other countries are clearly shorter and weigh less. This indicates that the advantageous investments on first born sons in Bangladesh have not only narrowed the gender gap that would otherwise exist, but have also reversed it for weight distributions.

Overall, it appears that although sons do not receive extra support from parents, they fare better in terms of anthropometry. First born sons in other countries show an anthropometric disadvantage compared to girls, although there is no such gap for Bangladesh. The disparity in height and weight statistics for boys compared to girls suggest that there maybe other factors that influence childhood outcomes, apart from the selected prenatal and parental investment studied here. Such factors could include time-use by parents, mother's diets during pregnancy, etc. However, due to data unavailability, I am unable to account for these issues.

3.3 Robustness Checks

Actual and Anticipated Family Size

Parental investments may be influenced by anticipated family size. Parents may limit spending on current children, in anticipation of having a larger family in future. Spending on the youngest child may be higher, on average, as parents have no further children to save for. In such cases, the above analysis conducted for youngest cohort may not find a gender gap, even if there is one among older children. These effects can be analysed by estimating an upper bound of birth order on postnatal investments.

First, the effect of the sex of child on investments due to actual family size is measured. This is done by restricting the sample to families with completed fertilities (where, mothers are above 38 years of age) and measuring the effect the of sex of first-born on family size. The results are then multiplied with the effect of family size on postnatal investments for all children[5] and reported in Table A9. There are 15 fewer children born for every hundred households with a son as the first born. The number of children positively effect duration of breastfeeding in absolute and relative terms. While there is also positive effects for choosing to breastfeed and giving vitamin A, the magnitudes are less than one percent. Additionally, an increase in the number of children has a slight negative effect on holding vaccination cards. The coefficient signs suggest that families learn better child rearing techniques as the number of children increases through trial and error. However, holding vaccination cards can be quite cumbersome as the number increases.

The net effect of having a male first child on parental investments, controlling for actual

[5] Prenatal investment data is only available for children below three years of age, and therefore had to be excluded from the analysis.

family size (last row on TableA9) is negative for breastfeeding duration and providing vitamin supplements, but positive for vaccination cards. However, all coefficients are very small. For example, a first born son reduces the number of months of breastfeeding for other children by 0.3 percent (or about two weeks, on average). The total fertility rate in Bangladesh has declined from about seven in 1970s to about two in recent years, indicating that the estimated effect of first born son on subsequent sibling is quite small. Given that the effects of actual family size overestimate the negative causal effect of family size on children's outcomes (Barcellos et al., 2014; Bharadwaj et al., 2014), we can conclude that results reported in Table A4 are consistent.

Table A10 estimates the effect of the sex of the child on investments controlling for anticipated family size using a dummy for being pregnant, a dummy for use of contraceptives, a dummy for sterilization, a dummy for desiring more children and the desired number of total children. Based on the results, it can be concluded that the coefficient estimates reported in Table A4 are robust to anticipated family size effects as the results are insignificant for all but holding vaccination cards, the magnitude of which is approximately the same. It should be noted, however, that anticipated family size may be incorrect in expectations, and can negatively bias the results.

4 Conclusion

Understanding the social preference for sons can directly assist in designing better policies in childcare, education and family planning, all of which are focus areas for the government of Bangladesh. If parents are gender-biased towards children, development projects might achieve more by targetting women or girls specifically. In this paper, I investigated the effect of son-preferences in Bangladesh by estimating the gender-bias in parental investments on the youngest child in the family. As there was no evidence of sex-selective abortions and predetermined characteristics could not predict the sex of children below 12 months of age, my estimations did not suffer from endogeneity or bias.

There was a sharp contrast in my results for gender-bias in general, and in comparisons between first born sons and other children. Mothers were less likely to take tetanus shots when pregnant with a boy, unless it was her first pregnancy with a boy. A similar relation was also found for the likelihood of breastfeeding and receiving required vaccinations. First born sons were also more likely to complete all vaccination doses than other children. However, no gender gap was found when comparing between boys and girls born second, third or higher in the family. Anthropometric outcomes highlighted that boys - both in general and first borns - performed significantly better than girls, more so than their inherent abilities would allow.

Compared to the evidence for son-preferences in the 1980s (Chen et al., 1981; Chowdhury and Bairagi, 1990; Bairagi, 2001), my results support the conclusion of Kabeer et al. (2014) that there has been a decline in gender-bias in Bangladesh. The large scale efforts to improve education and family planning by the government and partners in Bangladesh has possibly contributed to the change. My results, however, do not agree with those of Bharadwaj et al. (2014). The main reason for the inconsistency is the selection of the cut-off age. I found that children above 12 months belonged to systematically different families, creating a bias in estimates of parental investment. However, Bharadwaj et al. (2014) compared prenatal investments only among children below 24 months of age, which possibly overestimated the gender-bias.

My results further establish the importance of other factors in explaining children's performances and also highlight the complexity in family dynamics in Bangladesh. Further research is required to identify the reasons why boys are taller and weigh more than girls, in spite of not receiving additional investment in terms of prenatal visits, tetanus vaccine for mothers, breastfeeding, vitamin A supplements and vaccinations for children. For example, Barcellos et al. (2014) showed that parents spend more time in childcare with boys than with girls, which may also be true for Bangladesh. Moreover, there may also be a difference in the nutritional intake of mothers during pregnancy which affects children's outcomes.

More importantly, I showed that parents clearly prefer first born sons to all other children (both girls and boys). This was expected from the patrilocal customs of Bangladesh and the absence of social welfare systems. Parents may consider first born sons a particular blessing as they are more likely to join the labour force and provide support to the family. The same is not true for subsequent sons, as parents would have already provided for their elder daughters before the son was born. Jayachandran and Pande (2015) also note a similar preference for eldest sons, as reported by height measures, in India.

Development policies in Bangladesh should not only consider the gender dynamics but also the family dynamics. If the strict preference for first born sons is due to their potential value in the labour market, education policies should target first born sons specifically to prevent them from joining the labour market ahead of time. Further, the practice of breastfeeding and completing full vaccination needs to be promoted. Although most children are breastfed, there is a gender-bias in Bangladesh, which is not prevalent in India where son-preference is much stronger.

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Appendices

Table A1: Descriptive Statistics

Variable	Mean
Mother's Characteristics	
Age in Years	35
Completed Primary (0/1)	0.18
Muslim (0/1)	0.90
Currently Married (0/1)	0.93
Currently Urban Resident (0/1)	0.26
Child's Characteristics	
Boy (0/1)	0.51
No. of Siblings (Boy)	4
No. of Siblings (Girl)	5
Total No. of Children	6
Sample Size	
No. of Households	61,274
DHS 1993-94	32,142
DHS 1996-97	28,808
DHS 2000	31,356
DHS 2004	33,061
DHS 2007	30,011
DHS 2011	45,051
Total	**200,429**

Table A2: Evidence Against Sex-Selective Abortion: Boy-Birth Regressions

Birth Year	Parity	0 Boy		At least 1 Boy		Mean	Observations
1957-1990 (DHS)	2nd Child	0.002	[0.007]			0.516	24,162
	3rd Child	-0.014	[0.011]	-0.002	[0.010]	0.508	17,161
	4th Child	0.015	[0.019]	0.028	[0.015]*	0.521	11,642
	5th Child	0.003	[0.032]	0.024	[0.024]	0.509	7,561
1991-2011 (DHS)	2nd Child	0.003	[0.007]			0.509	24,255
	3rd Child	0.017	[0.012]	-0.001	[0.011]	0.507	16,487
	4th Child	0.008	[0.020]	0.037	[0.016]**	0.504	10,592
	5th Child	-0.038	[0.037]	-0.001	[0.028]	0.507	6,705
2000 - 2006 (MICS)	2nd Child	-0.009	[0.013]			0.515	5,522
	3rd Child	-0.053	[0.064]	-0.048	[0.055]	0.552	500

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. No controls. All estimations for the periods 1957-1990 and 1991-2011 use survey weights and correct the standard errors for survey design (DHS 1993-2011). Estimations for 2000-2006 use robust standard errors and does not correct for survey design (MICS 3, 2006).

Table A3: Mean Differences by Gender among the Youngest Child Alive

Sample	Age 0-12 months		Age 13-48 months		Age 49-60 months	
	Mean (Female)	Male	Mean (Female)	Male	Mean (Female)	Male
(1) Child Characteristics						
No. of siblings ever born	2	-0.002	3	0.043	5	0.121
		[0.066]		[0.044]		[0.099]
No. of brothers ever born	1	0.016	1	0.019	2	-0.010
		[0.038]		[0.026]		[0.057]
No. of sisters ever born	1	-0.019	1	0.024	2	0.132
		[0.039]		[0.026]		[0.060]**
Birth month	6.841	-0.058	6.808	-0.126	6.707	0.030
		[0.085]		[0.060]**		[0.119]
(2) Maternal Characteristics						
Age (years)	24	0.024	26	-0.021	36	-0.082
		[0.137]		[0.100]		[0.218]
Religion (Islam)	0.903	-0.004	0.899	-0.004	0.895	-0.010
		[0.007]		[0.005]		[0.009]
Age at first marriage (years)	15	0.031	15	-0.060	14	0.116
		[0.065]		[0.044]		[0.093]
Age at first birth (years)	18	-0.017	18	-0.108	17	0.022
		[0.069]		[0.048]**		[0.105]
Obs.	8,238		18,726		4,286	
p-value for (1) & (2)	0.9023		0.1193		0.1056	

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. All estimations corrected for survey and use survey weights. DHS 1993 - 2011.

Table A4: Gender Bias in Parental Investment in Youngest Child (Age 0-12 Months)

Dependent Variable	Child is Male				Mean	Model	δy/δx	Obs.
	No Control		*Control*					
A: Prenatal Investment								
At least 1 Prenatal Visit	-0.065	[0.050]	-0.140	[0.127]	0.504	Logit	-0.035	8,238
No. of Prenatal Visits	0.073	[0.087]	-0.070	[0.145]	1.657	OLS		8,228
At least 1 Tetanus Shot	0.053	[0.055]	0.053	[0.138]	0.731	Logit	0.01	8,232
No. of Tetanus Shots	0.013	[0.024]	-0.105	[0.056]*	1.292	OLS		8,232
Non Home Delivery	0.125	[0.070]*	-0.258	[0.205]	0.138	Logit	-0.186	8,234
B: Postnatal Investment								
Ever Breastfed	-0.037	[0.106]	-0.700	[0.238]***	0.948	Logit	-0.033	8,214
No. of Months Breastfed	-1.271	[1.452]	1.543	[4.069]	6.253	Censored		7,774
log(No. of Months Breastfed)	-0.256	[0.204]	0.090	[0.521]	1.606	Censored		7,774
Vitamin A	-0.034	[0.078]	0.194	[0.200]	0.234	Logit	0.034	4,256
Vaccination Card	0.083	[0.049]*	0.243	[0.118]**	0.522	Logit	0.061	8,215
C: Vaccinations (All)								
At least 1 Vaccination	0.019	[0.010]*	0.009	[0.014]	0.744	OLS		8,198
No. of Vaccinations	0.178	[0.071]**	-0.018	[0.169]	4.157	OLS		8,198
Full Vaccination	0.040	[0.068]	-0.191	[0.169]	0.136	Logit	-0.022	8,198
D: Vaccinations (Cards)								
At least 1 Vaccination	-0.002	[0.001]	-0.004	[0.002]**	0.999	OLS		4,374
No. of Vaccinations	0.016	[0.066]	-0.135	[0.157]	5.812	OLS		4,374
Full Vaccination	-0.038	[0.081]	-0.031	[0.200]	0.188	Logit	-0.005	4,374

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables listed in left most column. All estimations use survey weights and correct standard errors for survey design. Controls include a dummy for urban residence, number of siblings ever born, ratio of number of brothers ever born to number of sisters ever born, birth month among child characteristics; age, age at first birth, age at first marriage, and religion among maternal characteristics; and year of interview fixed effects. Full vaccination includes 3 DPT doses, 3 polio doses, 1 tetanus shot and 1 measles shot. Questions for Vitamin A not available before DHS 2004. DHS 1993-2011.

Table A5: Effect of First Born Son on Parental Investment

Dependent Variable	First Born Son		Mean	Model	$\delta y/\delta x$	Obs.
A: Prenatal Investment						
At least 1 Prenatal Visit	0.130	[0.087]	0.522	Logit	0.032	7,894
No. of Prenatal Visits	0.147	[0.099]	1.778	OLS		7,894
At least 1 Tetanus Shot	0.158	[0.093]*	0.729	Logit	0.029	7,894
No. of Tetanus Shots	0.168	[0.036]***	1.289	OLS		7,894
Non-Home Delivery	0.503	[0.110]***	0.157	Logit	0.039	7,894
B: Postnatal Investment						
Ever Breastfed	0.321	[0.190]*	0.947	Logit	0.010	7,873
No. of Months Breastfed	0.075	[0.127]	6.264	OLS		7,451
log(No. of Months Breastfed)	0.010	[0.026]	1.607	OLS		7,451
Vitamin A	-0.195	[0.122]	0.245	Logit	-0.034	4,188
Vaccination Card	0.034	[0.080]	0.532	Logit	0.009	7,873
C: Vaccination (Cards)						
At least 1 Vaccination	0.027	[0.015]*	0.745	OLS		7,860
No. of Vaccination	0.298	[0.003]***	4.171	OLS		7,860
Full Vaccination	0.211	[0.109]*	0.142	Logit	0.022	7,860

Standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All estimations use survey weights and correct standard errors for survey design. Estimations and controls are same as Table A4 with the addition of a dummy for being pregnant at the time of interview, dummy for using contraceptive methods, dummy for desiring more children and desired ideal number of children. Mean values are for first born sons only. DHS 1993-2011.

Table A6: Effect of Sibling Sex-Composition by Birth Order

Dependent Variable	Child is Male						Child is Male			
	2 children		*3 children*		*4 or more*		*3 children*		*4 or more*	
	(1)		(2)		(3)		(4)		(5)	
Panel A: Prenatal Investment										
At least 1 Prenatal Visit	-0.015	[0.028]	-0.023	[0.033]	-0.017	[0.020]	-0.019	[0.031]	-0.026	[0.020]
No. of Prenatal Visits	0.128	[0.139]	0.209	[0.283]	0.109	[0.166]	0.224	[0.274]	0.106	[0.184]
At least 1 Tetanus Shot	-0.012	[0.025]	0.000	[0.032]	0.010	[0.021]	0.016	[0.030]	-0.001	[0.022]
No. of Tetanus Shots	-0.046	[0.055]	-0.013	[0.069]	0.002	[0.042]	0.015	[0.063]	-0.045	[0.043]
Non-Home Delivery	-0.021	[0.021]	-0.016	[0.021]	0.009	[0.009]	-0.005	[0.019]	0.003	[0.009]
Panel B: Postnatal Investment										
Ever Breastfed	-0.007	[0.016]	-0.002	[0.015]	-0.008	[0.010]	-0.002	[0.014]	-0.004	[0.010]
No. of Months Breastfed	-0.22	[0.212]	0.073	[0.252]	0.249	[0.185]	0.086	[0.223]	0.155	[0.198]
log(No. of Months Breastfed)	-0.042	[0.045]	0.023	[0.054]	0.020	[0.033]	0.027	[0.048]	-0.008	[0.034]
Vitamin A	-0.032	[0.034]	0.042	[0.045]	-0.002	[0.032]	0.034	[0.042]	-0.005	[0.032]
Vaccination Card	-0.055	[0.030]*	0.050	[0.033]	0.049	[0.021]**	0.053	[0.030]*	0.035	[0.021]*
Panel C: Vaccinations (With Cards)										
No. of Vaccination	0.069	[0.168]	-0.072	[0.224]	-0.098	[0.133]	-0.057	[0.191]	-0.176	[0.138]
At least 1 Vaccination	-0.004	[0.008]	-0.005	[0.005]	-0.003	[0.005]	-0.008	[0.005]	-0.003	[0.005]
Full Vaccination	-0.042	[0.031]	-0.027	[0.036]	0.000	[0.026]	-0.034	[0.032]	-0.013	[0.027]

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. All estimations use survey weights, correct standard errors for survey design and controls are the same as Table A4. Columns (1), (2) and (3) also control for all-girl sibling sex-composition, and columns (4) and (5) for mixed sex-composition. Observations vary from 1,00 to 2,600 for investments and between 600 to 1,300 for vaccinations. DHS 1993-2011.

Table A7: Gender Gap in Anthropometrics: Across All Countries

Dependent Variable	Male * Bangladesh		Male		Bangladesh		Obs.
A: All Countries							
Height	0.289	[0.034]***	1.270	[0.078]***	-1.088	[0.143]***	213,016
log(Height)	0.005	[0.001]***	0.020	[0.001]***	-0.017	[0.002]***	213,016
Height Z-Score (DHS)	0.122	[0.012]***	-0.153	[0.025]***	-0.450	[0.054]***	213,016
Height Z-Score (Sample)	0.096	[0.008]***	0.016	[0.017]	-0.303	[0.038]***	213,016
Weight	0.064	[0.010]***	0.469	[0.020]***	-0.626	[0.050]***	212,038
log(Weight)	0.016	[0.002]***	0.069	[0.003]***	-0.100	[0.008]***	212,038
Weight Z-Score (DHS)	0.129	[0.015]***	-0.104	[0.021]***	-0.765	[0.058]***	212,038
Weight Z-score (Sample)	0.099	[0.011]***	0.027	[0.015]*	-0.565	[0.043]***	212,038
B: South Asian Countries							
Height	0.108	[0.035]**	1.634	[0.095]***	0.040	[0.112]	35,547
log(Height)	0.002	[0.001]**	0.025	[0.001]***	0.001	[0.002]	35,547
Height Z-Score (DHS)	0.066	[0.010]***	-0.055	[0.053]	-0.052	[0.029]	35,547
Height Z-Score (Sample)	0.056	[0.008]***	0.052	[0.033]	-0.007	[0.026]	35,547
Weight	0.031	[0.010]**	0.569	[0.025]***	-0.029	[0.009]**	35,547
log(Weight)	0.004	[0.002]	0.092	[0.005]***	-0.004	[0.003]	35,547
Weight Z-Score (DHS)	0.042	[0.013]**	0.034	[0.047]	-0.079	[0.010]***	35,547
Weight Z-score (Sample)	0.048	[0.009]***	0.075	[0.038]	-0.038	[0.009]**	35,547

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered over countries. All countries include 205 DHS surveys across 71 developing countries that included anthropometry details (DHS 1986-2014). South Asia includes Bangladesh, India, Maldives, Nepal, Pakistan and Sri Lanka (DHS 1987-2013). Controls are the same as Table A4, with the exception of including birth month of child fixed effects.

Table A8: Effect of First Born Son in Anthropometry

Dependent Variable	1st Born Son, BD		1st Born Son		1st Born, BD		Obs.
A: All Countries							
Height	0.018	[0.038]	-0.084	[0.040]**	-0.016	[0.061]	213,016
log(Height)	0.001	[0.001]	-0.001	[0.001]**	0.000	[0.001]	213,016
Height Z-Score (DHS/WHO)	0.004	[0.015]	-0.03	[0.015]*	0.003	[0.023]	213,016
Height Z-Score (Sample)	0.005	[0.010]	-0.023	[0.010]**	-0.001	[0.016]	213,016
Weight	0.023	[0.013]*	-0.019	[0.013]	-0.027	[0.017]	212,038
log(Weight)	0.004	[0.002]*	-0.004	[0.002]*	-0.004	[0.003]	212,038
Weight Z-Score (DHS/WHO)	0.029	[0.016]*	-0.018	[0.016]	-0.025	[0.018]	212,038
Weight Z-score (Sample)	0.023	[0.011]**	-0.020	[0.011]*	-0.023	[0.014]	212,038

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. BD stands for Bangladesh. Standard errors are clustered over countries. DHS 1986-2014.

Table A9: Effect of Parental Investment Controlling for Actual Family Size

	Child is Male (1)		No. of Children (2)		Actual Family (1 x 2)	Mean	Obs.
No. of Children	-0.145	[0.056]***				0.519	16,401
Ever Breastfed			0.001	[0.000]***	0.000	0.984	34,071
No. of Months Breastfed			0.254	[0.026]***	-0.037	20.659	33,490
log(No. of Months Breastfed)			0.021	[0.002]***	-0.003	2.766	33,490
Vitamin A			0.009	[0.002]***	-0.001	0.676	20,018
Vaccination Card			-0.013	[0.001]***	0.002	0.424	35,475

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. All estimations use survey weights and correct standard errors for survey design. Dependent variables listed in columns. Sample restricted to mothers 38 years and above, not currently pregnant, for column (1). Sample contains all children of all ages for column (2). DHS 1993-2011.

Table A10: Effect of Parental Investment Controlling for Anticipated Family Size

	Child is Male				
	No Controls		*Controls*		Obs.
Ever Breastfed	-0.002	[0.005]	-0.001	[0.005]	7,887
No. of Months Breastfed	0.063	[0.092]	0.058	[0.091]	7,464
log(No. of Months Breastfed)	0.005	[0.018]	0.003	[0.018]	7,464
Vitamin A	-0.006	[0.014]	-0.011	[0.014]	4,191
Vaccination Card	0.021	[0.012]*	0.020	[0.012]*	7,887

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. All estimations use survey weights and correct standard errors for survey design. Controls are same as Table A5. DHS 1993-2011.

Figure A1: Sex Ratio of Population

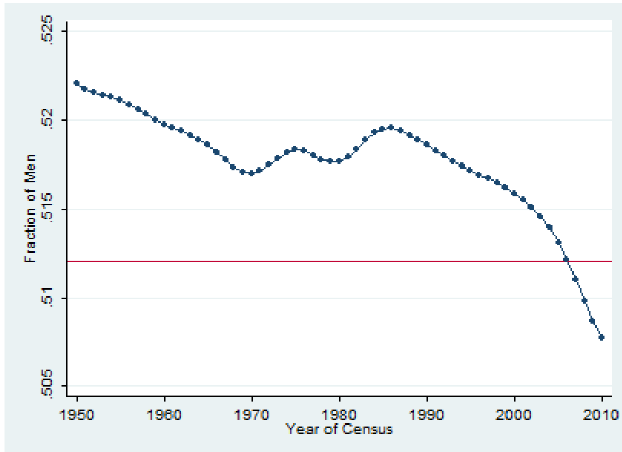

Figure A2: Fertility Stopping Rules in Bangladesh. DHS 1993-2011.