Child-specific son preference, birth order and cognitive skills in early childhood

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Abstract

We propose an innovative child-specific measure of son preference. It allows to explicitly address birth order and sex composition effects. We first establish that, when using this child-specific measure, son preference is more common among later born children and in families with fewer sons. We then study the son preference-specific girl-penalty in early cognitive and non-cognitive skills. Son preferences have adverse effects on cognitive and language skills of two-year-old girls at higher birth orders, for girls with sisters and for girls of mothers with a high number of desired sons.

Keywords: Son Preferences, Gender Discrimination, Early Childhood, Cognitive and Non-cognitive Skills

JEL Classification: I12, J13, J16, J24, O15

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1 Introduction

In India, son preference continues to be a well-documented phenomenon. The desire for having sons is rooted in cultural customs, religious and social beliefs, and economic incentives (Das Gupta, 1987; Das Gupta et al., 2003; Pande and Astone, 2007; Robitaille, 2013). The implications for women and girls are significant. Already early in life daughters are breastfed for less time, receive less childcare time, vaccinations, and vitamin supplements, are less likely to be hospitalized, are shorter, and suffer excess mortality via abortion, infanticide and neglect.[1] However, the notion of a general discrimination against all girls is rejected. Instead, we often think about discrimination in relation to desired fertility.[2] In families where the desired number of sons is unmet, daughters are increasingly more unwanted as birth order is rising and fewer birth trials remain. In order to satisfy son preferences, some parents engage in son-biased fertility behavior and exceed the planned family size to try again for a boy. Jayachandran and Kuziemko (2011) illustrate that the gender gap in breastfeeding increases with birth order because girls are weaned earlier to accelerate the birth of another son. Sex-selective abortion and female infanticide are alternatives to son-biased fertility and are also more commonly practised among laterborn children (Bhalotra and Cochrane, 2010; Jha et al., 2011). For Bangladesh, Muhuri and Preston (1991) find that compared to boys, the under-five mortality rate is 14.5 percent higher for girls without older sisters and 84.3 percent higher for girls with older sisters.

We propose an innovative child-specific measure of son preference, which explicitly allows to address birth order and sex composition effects, to study the son preference-specific girl-penalty in early cognitive and non-cognitive skills. Conventionally, son preference is measured by the ratio of the desired number of sons to all children.[3] By construction, family size is a direct component of the convential son preference measure. In consequence, birth order cannot be related to son preference in an isolated manner. Further, the conventional son preference measure does not correctly reflect the son preference for the observed child. It rather captures a preference for the sex composition of children. For example, when we are interested in the thirdborn child of a mother who wants three children and two boys, we would falsely code her as the disciminating type in the case when her two firstborns are boys. This leads to a downward bias in the discrimination coefficient. Palloni (2017) pointed out this concern using panel data from Indonesia, which is a low son preference context. He uses the sex ratio of *future* fertility which reduces the bias to some extent but not fully. Jayachandran and Kuziemko (2011) and Jayachandran and Pande (2017) rely on heterogeneous effects by the region's

[1] For evidence on differential treatnment see for example Asfaw, Lamanna and Klasen (2010), Bhalotra and Cochrane (2010), Barcellos, Carvalho and Lleras-Muney (2014), Jayachandran and Kuziemko (2011), Jayachandran and Pande (2017), and Oster (2009). For evidence on excess female mortality see for example Anderson and Ray (2010, 2012), Bongaarts and Guilmoto (2015), Jha et al. (2006), Jha et al. (2011), Klasen (1994), Klasen and Wink (2002, 2003), Klasen and Vollmer (2013), Sen (1989, 1990, 2003).

[2] See Clark (2000), Das Gupta (1987), Das Gupta et al. (2003), Jayachandran and Kuziemko (2011), Jayachandran and Pande (2017), Jensen (2003), Muhuri and Preston (1991), Klasen (2003).

[3] See Behrman and Duvisac (2017), Jayachandran (2017), Jensen (2003), Robitaille (2013), Pande and Astone (2007), Palloni (2017).

sex ratio and the mother's realized preference for the number of sons (i.e. the number of current sons equaling the number of currently desired sons) to proxy discrimination types.

We propose an innovative child-specific measure of son preference. We ask pregnant women about the preferred sex of the child they are pregnant with in one district of the Indian state of Bihar. Measured this way, son preference can be a consequence of birth order but the variable coding does not rely on it. Further, it allows us to measure son preference for the observed child, rather than a sex composition preference. Consequently, we can reconcile the relationship between son preference, birth order and sex composition.

To the best of our knowledge, this is the first study which investigates early cognitive and non-cognitive skills as an outcome of son-biased discrimination. A crucial argument for studying early skills is that they build the foundation for life-long learning (e.g., Attanasio, 2015; Heckman, 2000). Arguably more importantly, this evidence can contribute to shape the way we think about son preferences, precisely because the home environment is so important. Good health, reduced stress, responsive caregiving, positive experiences and learning opportunities are key for children to grow mentally and socially (Black et al., 2017; Walker et al., 2007, 2011). However, a stimulating home environment is difficult to substitute for by institutionalized care in a way that nutrition programs presumably can - e.g. institutionalized take-home food ratios or iron supplements. Child-specific son preference may affect parent's caregiving and the home enviornment crucially. When the preferred sex does not match the realized sex, parents' disappointment may result in a more stressful and less loving environment. The frustration is likely to increase with birth order because it results in either being short of sons, extending family size, or using sex selection. In addition, inadequate health due to differential investment into postnatal care, vaccinations, vitamin supplements, and alike reduces children's biological integrity for normal skill development.

Using the proposed child-specific son preference measure, we establish that son preference is much more common among laterborn children and in families with fewer sons. Next, we estimate the penalty in cognitive and non-cognitive skills faced by daughters of mothers who did not realize their child-specific son preference. We label this the son preference-specific girl-penalty in early skills. The structural model is a difference-in-differences type of specification which interacts son preference with the sex of the child of interest and controls for both indicators separately. The interaction term indicates the unrealized son preference and its coefficient measures the son preference-specific girl-penalty. It describes the disadvantage faced by daughters of son preferring mothers in comparison to daughters of non-son preferring mothers and sons of son preferring mothers. We estimate the son preference-specific girl-penalty by OLS and instrumental variables. In the OLS estimation, we adress in detail selection into the interaction of son preference and the child's sex, focussing on sex selection and son-biased fertility. We show that surviving children are not a selection of conceived children in our sample. Further, parents have limited time to have one more child in response to the child's sex given that the children in our sample are 16 months old on average. Yet, we control for newborn children and current pregnancies.

We further estimate the structural interaction model by instrumental variables estimation. If the OLS specification does not fully address selection into the interaction of son preference and sex, instrumental variables estimation can potentially resolve selection. For example, the unobserved number or sex composition of children that did not survive might matter for selection into the interaction of son preference and sex and might also correlate with overall caregiving quality or health. Therefore, the instrumental variables estimations substantiate the OLS results. We use the fact that families with firstborn boys are less likely to have a son preference for laterborn children. Precisely, the instrument is an interaction of the firstborn's sex with the sex of the child of interest. We exploit that the interaction of an exogenous variable (firstborn's sex) and the arguably endogenous variable (sex of the child of interest) is exogenous when controlling for the endogenous variable separately (Bun and Harrison, 2014; Nizalova and Murtazashvili, 2016). Given that the second stage interaction term varies by sex of the child of interest, any correlation between the instrument and the second stage error term would have to differ by the child's sex in order to violate the exclusion restriction.

We find a son preference-specific girl-penalty in cognitive skills, language and overall development of 0.77, 0.89, and 0.84 standard deviations, respectively (instrumental variables estimations). We show that the son preference-specific girl-penalty exists for high birth order daughters, for daughters with girl siblings, and for daughters in families who want many sons. Our results are suggestive that both discrimination against girls and preferential treatment of boys contribute to the son preference-specific girl-penalty in early skills.

These results urge to study how parents' attitudes can be altered. Das Gupta and colleague argue that changes in the modern political system, urbanization and industrialization unravel son preferences via their impact on social norms and therefore the perceived value of females (Chung and Gupta, 2007; Das Gupta, 2010). Only few studies have rigurously evaluated the impact of an increase in females' economic value, or government policies to promote gender equality via public representation, media campaigns, and financial incentives to have girls.[4] In this paper, we exploit the fact that a random subset of women in our sample was exposed to an empowering women's self-help group program targeted to improve sanitation, hygiene and health of females and children. We find that the program was not effective in reducing the son preference-specific girl-penalty in early skills. While academics and policy makers alike understand and agree that son preferences are harmful to females, societies and countries, our focus and that of funding agencies must shift to answering the question of how can we address gender attitudes of parents and reduce son preferences.

The paper is structured as follows. Section 2 establishes the association between birth order, sex composition and son prefence. Section 3 discusses our empirical strategy and section 4 the data. Section 5 presents the main results on the son preference-specific girl-penalty in early skills. Section 6 estimates heterogeneous treatment effects by birth order and sex composition and section 7 the mechanisms. Section 8 tests the effectiveness of

[4]See Carranza (2014) and Qian (2008) for evidence on the economic value of females. See Jensen and Oster (2009) and Ting, Ao and Lin (2014) for evaluations on television exposure. See (Beaman et al., 2012) for evidence on political representation. And see (Anukriti, 2018) for evidence of financial incentives.

a women's self-help group intervention to reduce the son preference-specific girl-penalty in early skills. Section 9 concludes.

2 Son preference and the role of birth order and sex composition

We surveyed pregnant women about the sex preference for the child they are pregnant with in one district of the northeast Indian state of Bihar in 2015. Bihar is the third largest state in India and has the lowest GDP per capita. Bihar is a state with high son preference, high fertility and a relatively high sex ratio at birth. In 2015/16 women in rural Bihar had 3.6 children on average versus 2.4 children in rural all India, 38 percent of Bihar's rural women wanted more sons than daughters versus 21 percent in rural all India, and the sex ratio at birth was 933 girls per 1000 boys versus 927 girls per 1000 boys in rural all India (Anderson and Ray, 2010, 2012; IIPS and ICF, 2017*b*,*a*; IIPS, 2017*c*,*b*).

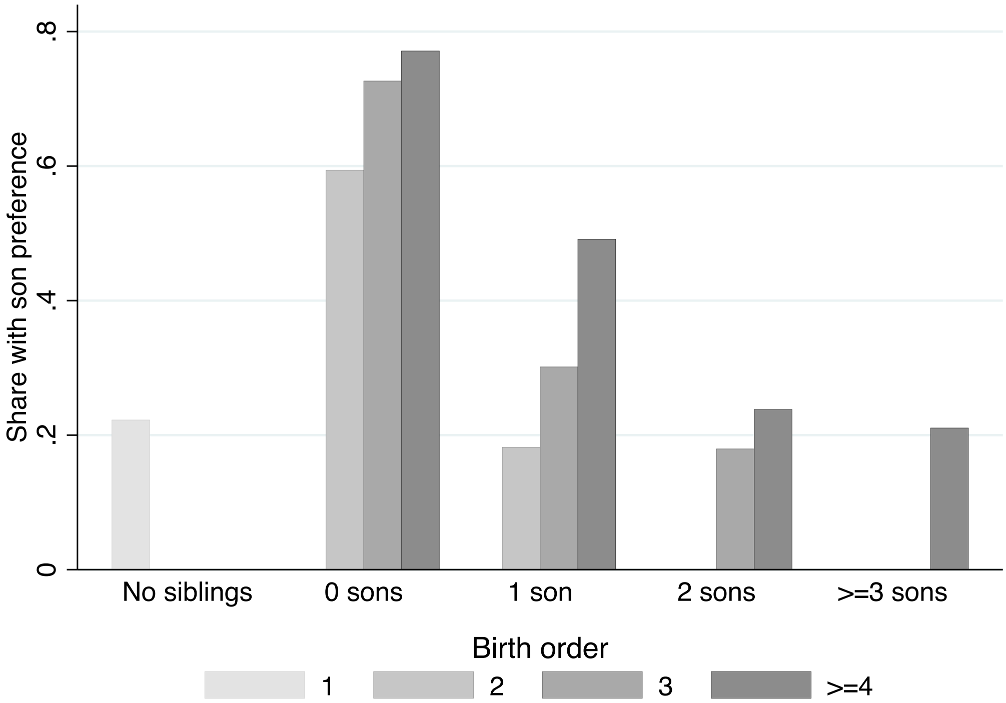


Figure 1: Share of son preferring mothers by birth order and sex composition

We asked pregnant women specifically about the child she was pregnant with whether she prefers a girl, a boy, whether it is up to god, or it does not matter. Thirty-five percent answered they prefer a boy (N=653), 4 percent answered they prefer a girl (N=76), 38 percent answered up to god (N=720) and 23 percent answered does not matter (N=430).[5] In figure 1, we depict the percentage of pregnant women with a child-

[5]These figures include all women, irrespective of whether they have taken an ultrasound and may know

specific son preference by birth order of the child she is pregnant with and number of alive sons. We define child-specific son preference as an indicator that is 1 if the mother prefers a son and 0 if she answered does not matter or up to god.[6] We exclude women that have a preference for a girl because the reference category is meant to be a neutral category. Throughout the paper, we are referring to this child-specific son preference measure as son preference. Note that the combination of birth order of alive children and number of alive sons results in the sex ratio of alive children. Figure 1 illustrates a number of stylized facts:

1. Son preference is most prevalent among mothers with no sons but daughters and is decreasing in the number of sons.

2. Son preference prevalence is increasing in birth order.

3. Son preference prevalence for the first born child is lower than in families with one son and two or more daughters (i.e. one son and birth order three or more).

4. A considerable share of mothers (28%) already have one, two or more sons and yet have a son preference for the next born child.

Stylized facts 1 to 2 are in line with a son preference which is interdependent with birth order and sex-composition. Stylized facts 3 and 4 are interesting because it suggests a preference for more sons than an eldest son among a large share of women. Stylized fact 4 implies that a considerable share of women whose familiy's sex-composition is skewed towards sons already prefer an even larger sex imbalance among their own children.

In table 1, we investigate the factors of child-specific son preference more formally in a linear probability model.[7] In column 1, we regress son preference on household level background characteristics (religion, caste, wealth quintile, below poverty line (BPL) card, highest grade completed in household, and household size) and maternal characteristics (highest grade completed, reading ability, and age), in column 2 on child sex-composition variables (birth order, number of sons alive and whether the mother wants another child), in column 3 we combine all characteristics and in column 4 we add subdistrict fixed effects. In column 5 we include the sex composition of children instead of the number of sons. The adjusted R^2 increases substantially with the inclusion of children's sex composition variables (column 2) and does not rise further when household and maternal characteristics are added (columns 3 to 5). It suggests that family composition is relevant for child-specific son preference and is more relevant than socioeconomic status. Socioeconomic characteristics are not child-specific and therefore rather affect child-specific son preference via a sex ratio preference. Among household socioeconomic characteristics, scheduled tribe and wealth quintile are significantly associated with having a child-specific son preference. Tribals often differ in cultural customs and rituals and are frequently found to have lower son preferences than castes (Pande and

the sex of their child already. If we retsrict the sample to women who reported not having taken an ultrasound yet by the time of the survey, the figures are almost identical.

[6]See sections 4.2 and 5.1 for a discussion on the definition on the son preference indicator.

[7]The results are identical when we use logit estimation instead.

Table 1: Associations with son preference

	(1) Son preference	(2) Son preference	(3) Son preference	(4) Son preference	(5) Son preference
HH characteristics					
Religion is Hindu	0.058		0.007	0.012	0.039
	(0.075)		(0.066)	(0.066)	(0.067)
Scheduled caste	−0.078*		−0.061	−0.064	−0.075*
	(0.046)		(0.041)	(0.041)	(0.042)
Scheduled tribe	−0.209***		−0.205***	−0.202**	−0.188**
	(0.070)		(0.077)	(0.077)	(0.078)
General category	−0.085		−0.074	−0.071	−0.068
	(0.069)		(0.056)	(0.057)	(0.058)
Wealth quintile					
2 (2nd poorest)	−0.073		−0.104**	−0.105**	−0.096**
	(0.047)		(0.044)	(0.045)	(0.044)
3	0.022		−0.010	−0.009	−0.011
	(0.047)		(0.044)	(0.043)	(0.044)
4	−0.017		−0.028	−0.025	−0.021
	(0.050)		(0.037)	(0.036)	(0.037)
5 (richest)	−0.086*		−0.094**	−0.092**	−0.085**
	(0.047)		(0.037)	(0.037)	(0.040)
BPL card	0.027		0.000	−0.004	−0.012
	(0.033)		(0.031)	(0.032)	(0.031)
Highest grade in HH	−0.001		0.001	0.000	−0.001
	(0.004)		(0.004)	(0.004)	(0.005)
Mother characteristics					
Highest grade	−0.002		0.000	0.001	0.000
	(0.009)		(0.008)	(0.008)	(0.008)
Can read	0.018		0.006	0.002	0.008
	(0.076)		(0.072)	(0.072)	(0.072)
Age	0.102***		0.066**	0.065**	0.063**
	(0.026)		(0.025)	(0.025)	(0.024)
Age^2	−0.002***		−0.001***	−0.001***	−0.001***
	(0.000)		(0.000)	(0.000)	(0.000)
Family size					
HH size		0.011	0.015	0.016	0.013
		(0.010)	(0.010)	(0.010)	(0.010)
> 2 adults in HH		−0.052*	−0.056*	−0.057*	−0.054*
		(0.029)	(0.031)	(0.031)	(0.030)
Wants another child					
Unsure		0.041	0.034	0.040	0.084
		(0.061)	(0.061)	(0.064)	(0.065)
Wants more		0.015	0.022	0.022	0.054
		(0.040)	(0.039)	(0.040)	(0.038)
Birth order					
2		0.323***	0.309***	0.310***	0.349***
		(0.051)	(0.050)	(0.052)	(0.050)
3		0.467***	0.449***	0.450***	0.437***
		(0.050)	(0.054)	(0.054)	(0.063)
≥4		0.564***	0.569***	0.576***	0.345***
		(0.062)	(0.066)	(0.065)	(0.062)
Sex composition					
No. of sons					
1		−0.403***	−0.403***	−0.403***	
		(0.049)	(0.048)	(0.048)	
≥2		−0.653***	−0.651***	−0.654***	
		(0.059)	(0.055)	(0.055)	
Boys=girls					−0.379***
					(0.079)
More boys					−0.474***
					(0.043)
Subdistrict fixed effects				✓	✓
Observations	894	894	894	894	894
Adjusted R^2	0.01	0.18	0.18	0.18	0.18

Note: All covariates as shown. Standard errors are clustered at the panchayat level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Astone, 2007; Bhat and Zavier, 2003). There is no wealth gradient; however, the second poorest (quintile 2) and the richest (quintile 5) quintiles are about ten percentage points less likely to have a son preference in comparison to the poorest quintile.

Son preference is much more common among later born children and in families with fewer sons. The probability of having a son preference at birth order two, three, or four or more is 31, 45, and 58 percentage points higher than at birth order one, respectively (column 4). At a given birth order, the probability of having a son preference is 40 and 65 percentage points lower for mothers who have one or two or more sons than in no son families, respectively. Figure 2 visualizes the relationship of son preference with birth order, the number of boys and their interaction. The number of sons segregates the linear prediction of son preference into different levels such that son preference is highest for no-son families and lowest for families with two or more sons. For mothers with no or one son, predicted son preference increases with birth order, while it remains stable for mothers with two or more sons. Yet, some mothers that have a son already have a son preference for the next born child.

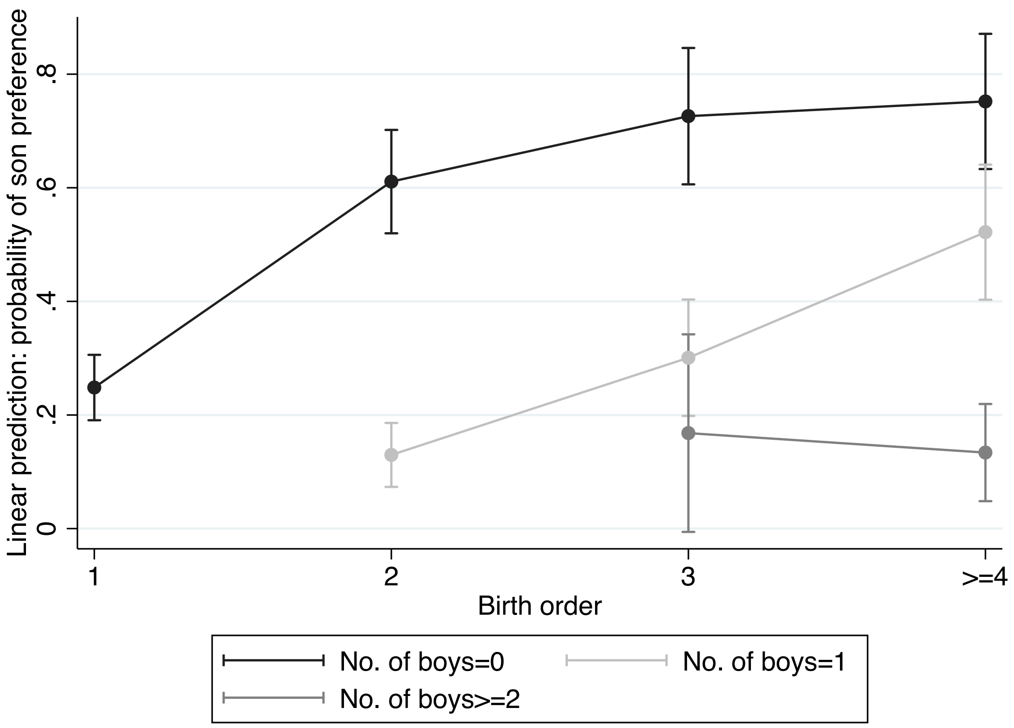


Figure 2: Predicted probability of son preference by birth order and number of older sons (margins plot

The results in table 1 and figure 2 confirm all four stylized facts and most relevantly stylized facts number one and two: son preference is increasing in birth order and decreasing in the number of sons. The coefficients are remarkably robust to the inclusion of socioeconomic indicators and subdistrict fixed effects. The analysis is informative about correlations, however, the direction of causality is unclear. Birth order and sex composition preferences can induce son preference, i.e. the same mother might not have a son preference at low birth order because she is confident about having a boy by chance in pending birth trials, but when she has three daughters only she has a strong preference for a boy. At the same time, son preference can also affect family size and hence birth order via son-biased fertility behavior. In the extreme case, son preference can affect the number of daughters and hence birth order and sex composition via sex-selective abortion. Therefore, the coefficients in table 1 make theoretically sense, but should be understood as associations and not as causal pathways. Subsequent analyses show a girl-penalty due to son preference in early cognitive and non-cognitive skills at high birth orders and for daughters with many girl siblings. It suggests that at least part of the correlation runs from sex composition to son preference.

3 Estimation strategy

3.1 Estimating the average girl-penalty due to son preference

Estimation strategy 1 - Interaction model

We measure the son preference-specific girl-penalty in early cognitive and non-cognitive skills. The structural model is a difference-in-differences type of specification which interacts son preference with the sex of the child of interest and controls for both indicators separately. The interaction term indicates the unrealized son preference and its coefficient measures the son preference-specific girl-penalty. It describes the disadvantage faced by daughters of mothers who did not realize their son preference in comparison to daughters of non-son preferring mothers and sons of mothers with a realized son preference. We estimate the following model by OLS:

$$D_i = \beta_0 + \beta_1 SP_i * Girl_i + \beta_2 SP_i + \beta_3 Girl_i + X_i \beta_4 + \epsilon_i, \tag{1}$$

where D_i is the standardized development score of child i, which is described in detail in section 4. SP_i is a dummy for mother's son preference during pregnancy with child i, which equals 1 if the mother wants a boy and 0 if the sex does not matter to her or she thinks the sex is up to god. $Girl_i$ is the sex of child i, which equals 1 for girls and 0 for boys. X_i is a vector of covariates. For comparisons of *girls* of mothers with a son preference ($\beta_0 + \beta_1 + \beta_2 + \beta_3$) to *boys* of mothers with a son preference ($\beta_0 + \beta_2$), the coefficients of interest are $\beta_1 + \beta_3$. For comparisons of girls of mothers *with a son preference* to girls of mothers *without a son preference* ($\beta_0 + \beta_3$), the coefficients of interest are $\beta_1 + \beta_2$. However, β_1 is the main coefficient of interest, because it measures the *son preference-specific girl-penalty* and reflects the relative discrimination component in the girl-boy comparison given son preference (gender-penalty) and the son preference-no son preference comparison given sex (son preference-penalty).

The difference-in-differences type of set-up controls for selection into son preference (SP_i) while children's sex ($Girl_i$) typically poses an exogenous shock to the family. If this is true, β_1 should recover the causal son preference-specific girl-penalty. However, in the presence of sex selection and son-biased fertility behavior, sex is not entirely exogenous or unconfounded and sex selection and son-biased fertility behavior interact with son preference. The vector of covariates X_i controls for sex composition, birth order, family size and socioeconomic variables. We discussed in section 2 that sex composition and birth order are strongly correlated with having a son preference and that socioeconomic status might reflect a general tendency to be of the discriminating type or not. Given X_i we control for selection into son preference, sex, and its interaction to a large extent already. The two subsections below, further argue why sex selection and son-biased fertility do not seem to play a big role in our sample.

An additional advantage of the interaction specification is that it captures potential biological differences in child development by sex. Girls in early childhood tend to perform better in language and socioemotional behavior while boys perform better in motor skills.[8]

Sex selection

With the rise of affordable prenatal sex detection technology since the 1980s, sex determination and hence sex selection became illegal in India under the Prenatal Diagnostic Techniques Act in 1994 (amended in 2003). Yet, sex ratios at birth indicate widespread sex selection (Bhalotra and Cochrane, 2010; Jha et al., 2011). Sex selection is confounding our analysis if families that abort are different to families that do not abort in characteristics that are corrleated with child development. Some analyses use data from a time where ultrasounds and abortions were less prevalent to avoid bias from sex selection (Barcellos, Carvalho and Lleras-Muney, 2014; Clark, 2000; Jayachandran and Pande, 2017; Jensen, 2003). Kugler and Kumar (2017) argue that sex-selective abortion is less severe in the period after the legal ban of fetal sex determination in 1994. Although sex-selective abortion received arguably more attention in the literature, sex selection might also occur after birth via female infanticide or neglect. As for abortion, the direction of bias from infanticide depends on whether it correlates with characteristics that favor or disadvantage mental development. In the case of neglect, we expect the son preference-specific girl-penalty to be biased towards zero, assuming that strong girls tend to survive and in consequence surviving girls perform better relative to boys than conceived girls to boys.[9]

Unborn children and children that died after birth are not an unobservable in our dataset. We are able to investigate whether children that were born constitute a selected sample of all children that were conceived. In appendix table A2, we regress (i) the sex of alive children and (ii) whether the child is dead on a number of pregancy related and family background characteristics.[10] One limitation is that we do not observe the sex of dead children. The results hint at some selection, but do not confirm each other's

[8]See for evidence on language skills, for example, Bornstein et al. (2000), Burman, Bitan and Booth (2008), Galsworthy et al. (2000), Roulstone et al. (2002); for evidence on motor skills see, for example, Goodway, Robinson and Crowe (2010), Spessato et al. (2013), Thomas and French (1985); and for motor development see, for example, DiPrete and Jennings (2012) and Owens (2016).

[9]The infant mortality rate in 2015/16 rural Bihar is 50 per 1000 livebirths and the under-five mortality rate is 60 per 1000 livebirths (IIPS and ICF, 2017*b*). At the same time, the all India infant mortality rate in 2001 to 2005 is higher among first and fourth or later born children (62 and 63) than among second and third born children (45 and 44) (Mishra et al., 2018). In 2005/06 the rural Bihar infant and under-five mortality rates are 62 and 85 per 1000 livebirths, respectively.

[10]Appendix table A2 shows results from a linear probability model. Results do not change when estimating probit or logit models instead.

predictions. For example, girls are more likely to be born into wealth quintile 3 or 5 than wealth quintile 1 and are less likely to be of birth order 3 than 1. However, the coefficients on child death are not consistent with selection into sex. Significant correlates with child death are having had an ultrasound (negative), wanting more children (positive), and having one son relative to no sons (negative and marginally significant). The negative coefficient on ultrasound signals higher survival chances for children that experienced improved prenatal care. The fact that children with an older boy sibling are less likely to die, potentially hints at some sex selection. However, the coefficient on having two or more sons is insignificant and smaller. Interestingly, son preference does not predict the child's sex or living status. Taken together, the evidence suggests that sex-selective abortion does not play a big role in our sample. The ratio of boys to girls in our sample is 1.041, which is at the lower bound of the biological normal range of 1.04 to 1.07 (Parazzini et al., 1998; Waldron, 1983, 1987). The result further corresponds to Anderson and Ray (2010)'s finding of Bihar's relatively low excess mortality at birth.

Son-biased fertility behavior

Another concern is son-biased fertility behaviour, which is the continuation of childbearing beyond the planned family size to reach the desired number of sons (Barcellos, Carvalho and Lleras-Muney, 2014; Clark, 2000; Jayachandran and Kuziemko, 2011; Jensen, 2003; Kugler and Kumar, 2017; Rosenblum, 2013). If son-biased fertility behavior is exercised, girls tend to live in larger families and according to the quanity-qualtity trade-off by Becker and Lewis (1973), receive fewer resources on average. In addition, son-biased fertility results in girls living in families with more girl siblings. Rosenblum (2013) points out that this sex composition effect penalizes investment into girls on top of the family size effect, because the more girls there are in one family the more dowries need to be paid and the less future income is expected. Further, son-biased fertility is likely to reduce birth spacing which can affect the child's mental development in a number of ways. First, it can lead to early weaning and hence reduce the child's health (Jayachandran and Kuziemko, 2011). Second, if mothers are pregnant they potentially have less capabilties for caregiving or more if they were working otherwise. Third, short birthspacing might affect the mother's health and therefore reduces the quality and quantity of caregiving. The resource allocation mechanism via family size and sex composition and to some extent the birthspacing mechanisms are in place independent of differential treatment of boys and girls within the household. Therefore, the differential treatment discrimination coefficient would be upward biased by those population level mechanisms (Jensen, 2003).

In this application, son-biased fertility bahavior can only affect the son preference-specific girl-penalty (i.e. the coefficient on the intercation term), if parents have another child *in response* to the sex of the child the mother was pregnant with in 2015. Previous son-biased fertility behavior would not affect the coefficient on *Girl x Son Preference*, but it is likely to affect the coefficient on *Son Preference*. At the time of the 2016 survey, 90 percent of the children in our sample are 18 months or younger. This gives parents very limited time to react to the child's sex by having another child. Similarly, Barcellos, Carvalho and Lleras-Muney (2014) argue that the bias from differential stopping behavior can be avoided when looking at very young children and select children below 16 months of age. Yet, in 2016 there are 54 families (6 % of the estimation sample) with a newborn already and 102 mothers (11 %) are pregnant again. Moreover, parents might anticipate to become pregnant again in response to having a girl and therefore wean girls early or adjust the resource allocation already. Such anticipatory behavior would have to take place sufficiently long before the conduct of the child developmnet test in order to affect test outcomes. Further, parents would have had to reduce resources immediately rather than reducing more costly expenses accruing in the future, for example, costs related to education. In the results section, we control for newborns and current pregnancy to account for realized son-biased fertility.[11] However, we expect the bias from anticipation to be neligible.

Estimation strategy 2 - Intsrumental variables

In addition to the OLS estimation, we follow an instrumental variables two-stage least squares estimation strategy. If the OLS specification does not fully address selection into the interaction of son preference and sex, instrumental variables estimation can potentially resolve selection. For example, the unobserved number or sex composition of children that did not survive might matter for selection into the interaction of son preference and sex and might also correlate with overall caregiving quality or health. Further, the sex selection analysis might miss confounding family characteristics because we do not observe the sex of conceived unborn chilren. Therefore, the instrumental variables strategy intends to confirm the OLS results and should convince the yet unconvinced reader.

The structural equation remains as in (1). We instrument the interaction of son preference with the child's sex and the son preference indicator in two first stages. The instruments we use are the interaction of the firstborn's sex with the sex of our child of interest and the firstborn's sex. The two first stages are:

$$SP_i * Girl_i = \gamma_0 + \gamma_1 FB_i * Girl_i + \gamma_2 FB_i + X_i\gamma_3 + \epsilon_i \tag{2}$$

$$SP_i = \delta_0 + \delta_1 FB_i * Girl_i + \delta_2 FB_i + X_i\delta_3 + \epsilon_i \tag{3}$$

where FB_i is the sex of the firstborn sibling of child i, which equals 1 if it is a boy and 0 if it is a girl. The second stage is as in equation (1) but using the two first stage predictions of $SP_i * Girl_i$ and SP_i.

The intuition of the firstborn boy instrument is that parents tend to be less likely to want their laterborn to be a boy if the firstborn is a boy than when the firstborn is a girl. This is because it is important to have at least one son in the context we study as it is evident from the results in section 2. The firstborn's sex is commonly used as an instrument for family size (e.g., Jensen, 2003; Kugler and Kumar, 2017; Lee, 2008). In a

[11] In a sample with adult children, Jensen (2003) shows that controlling for differential stopping behavior via family size, results in a downward bias in the coefficient of differential treatment on educational attainment because family size and differential treatment are correlated due to differential fertility behaviour. We cannot rule out that family size picks up some of the differential treatment effect, making our estimates lower bounds; however, due to the young age of the children in our sample we expect this bias to be small.

context with son-biased fertility behavior, the firstborn's sex affects your decision to try again for a son and therefore family size. The effect of the firstborn's sex on family size mediates through son preference, our endogenous variable. In our first stage, having a firstborn boy and its interaction with the sex of the child of interest significantly reduce the probability of son preference and its interaction with the child's sex by 39 and 33 percentage points (p-values of 0.00), respectively. The first stage Kleibergen-Paap rk Wald F statistic is 23. Therefore, the relevance restriction is satisfied.

Sex selection is rarely used among firstborns and therefore the firstborn's sex is good as random (Bhalotra and Cochrane, 2010; Jha et al., 2011; Kugler and Kumar, 2017; Poertner, 2015; Retherford and Roy, 2003; Rosenblum et al., 2013). We exploit the fact that the interaction of an exogenous variable (firstborn boy) and an endogenous variable (sex of the child of interest) is exogenous given that we control for the endogenous variable (Bun and Harrison, 2014; Nizalova and Murtazashvili, 2016). This useful feature of interactions with exogenous variables is increasingly used to generate a valid instrument for aid (Bluhm et al., 2016; Dreher and Langlotz, 2017; Gehring, Wong and Kaplan, 2018; Nunn and Qian, 2014). To confirm the exogeneity of the firstborn's sex, we regress firstborn boy on parental and family characteristics. Appendix table A1 shows that socioeconomic indicators are not associated with the firstborn's sex. Also, the F-statistic of joint significance of all socioeconomic characteristics does not reject the null hypothesis of no joint impact.

For the exclusion restriction to be satisfied, there must be no correlation between the instrument and the second stage error term. We can think of a number of potential links between firstborn's sex and characteristics or behavior that can affect child development. Having a firstborn boy can affect family size, investments into children, savings and work behavior for dowry payments, birth spacing and abortions and therefore maternal and children's health, and caregiving abilities and responsibilities of firstborns.[12] However, for the exclusion restriction to be violated, the instruments would have to affect laterborn boys and girls differently. Given that the endogenous variable - unrealized son preference - varies by sex, the son preference-specific girl-penalty informs us about differences and therefore we can think of our outcome variable in terms of differences. If the development of girls and boys were reduced by the same amount the son preference-specific girl penalty would remain constant. For example, the biological consequences of short birth spacing would have to affect the health of laterborn boys and girls differently in order to bias the son preference-specific girl-penalty. This neat feature of our set-up is limited to the extent that one of the two instruments also varies by sex - the interaction of the firstborn's and laterborn's sex. The instrument is 1 for girls with firstborn boy siblings but it is never 1 for boys with firstborn boy siblings. This would introduce a correlation between the instrument and the child's sex, however, the second stage controls for sex. In section 5.3, we test the validity of the exclusion restriction in an array of robustness checks. The robustness checks show that our results remain unaffected.

Compliers with the firstborn boy instrument are mothers who do not have a son prefer-

[12] Some of these mechanisms work via son preference. For example, if parents would stop child-bearing ealier if the first born is a boy or invest less in laterborn children when the firstborn is a boy then this is precisely because of son preferences.

ence for the child of interest because the firstborn is a boy but would have a son preference if the firstborn was a girl. This is different to a preference for sex balance because the alternative to having a son preference is not preferring a girl but being indifferent about the sex of the child. While this is obvious for mothers whose firstborn is a boy - mothers *don't care* about the sex of their next born child (opposed to having a girl preference) because the first born is a boy - it is difficult to disentangle a sex balance preference from a son preference for mothers whose first born is a girl. Jayachandran (2017) finds that in Haryana, a North-Indian state next to Delhi, the desired share of sons falls below 50 percent at family sizes four or higher and conclude a desire for eldest sons and a sex balance once this desire is satisfied. In our sample, 40 percent of families have firstborn boys but only five percent of mothers with at least one child want to have a girl. In the instrumental variables estimation sample (N=665, including girl preferring mothers and restricted to having at least one child already), there are 33 mothers who prefer to have a girl. Of those, 30 have only boys and 19 have only boys and the next born child is of birth order two. Ultimately, we are interested in whether the mother has a son preference or not. The reason for having a son preference may well be the number of girls exceeding the number of boys and thus the actual sex ratio does not equate the mothers preferred sex ratio.

One disadvantage of the instrumental variables strategy in comparison to the OLS intercation stratgey is sample size. The instrumental variables etimation excludes children that do not have an older sibling. Therefore, we focus on both identification strategies equally in the results section.

3.2 Estimating heterogeneous effects in the son preference-specific girl-penalty by birth order and sex composition

We build on *estimation strategy 1* to estimate the intensity of the son preference-specific girl-penalty by birth order, the number of older daughters and the number of older sons. We disregard the instrumental variables strategy for two reasons. First, because we are interested in firstborn children and the nature of the instrumental variables estimation is such that it only includes children of second or higher birth order. Second, the sex composition is part of the instrumental variables strategy's identifying assumption. Thus, including sex composition as a regressor in the instrumental variables estimation is like adding the instrument as a control variable and renders the first stage weak.[13] Therefore, we use *estimation strategy 1* and interact the interaction of sex and son preference once more with the family composition variable of interest, i.e. birth order, number of daughters and number of sons. At the example of birth order, the estimation model is:

$$D_i = \beta_0 + \sum_k \beta_{1k} SP_i * Girl_i * \mathbb{1}(BirthOrder_i = k) + \\ \beta_2 SP_i * Girl_i + \beta_3 SP_i + \beta_4 Girl_i + \sum_k \beta_{k+5} \mathbb{1}(BirthOrder_i = k) + X_i \beta_6 + \epsilon_i, \quad (4)$$

[13]Note, this does reject the exclusion restriction, because the effect of the intercation of sex and family composition on child development is caused by son preference.

where $\mathbb{1}(BirthOrder_i = k)$ is an indicator that equals 1 if the child is of birth order k. The sum of β_{11} and β_{1k} coefficients show the son preference-specific girl-penalties at different birth orders. Thus, they allow us to derive conclusions about the intensity of the penalty at different birth orders. For heterogenous effect estimations by number of daughters or sons, $\mathbb{1}(BirthOrder_i = k)$ will be replaced with the relevant variables.

4 The study population

4.1 Sample selection

We surveyed 1,961 households with pregnant women in the district of Madhepura in March and April 2015. A follow-up survey was conducted in November and December 2016, when the women's children were about 16 months of age. The sampling frame comprises six of Madhepura's thirteen subdistricts (blocks). In these six subdistricts, we randomly sampled 68 from a total of 95 gram panchayats, which comprise 180 villages. At the village level, we randomly sampled households from pregnancy registers in Anganwadi centers. In 2015/16, 76 percent of pregnant women in Madhepura had registered their pregnancies (IIPS, 2017*a*). Because in some villages lists of pregnant women were not made available to us, the sampling frame reduced to 140 villages and 56 gram panchayats, with a total of 1,961 households.[14] During the follow up survey in late 2016, we interviewed 1612 households and conducted 1325 child development tests. Attrition in the questionnaire and child development tests is mainly due to respondents' absence from home, migration and 166 children have died since 2015.[15]

The data were collected as part of baseline and endline surveys of a randomized controlled trial. The trial randomly assigned a participatory learning and action approach program conveyed via women's self-help groups at the gram panchayat level. The program aims at improving critical social indicators in the field of health, nutrition, water, sanitation, and hygiene (HNWASH) by changing attitudes and the behaviour of communities (Subramanyam et al., 2017). Sixty percent of pregnant woman households live in an intervention gram panchayat. Given random program assignment, we expect the intervention to be orthogonal to having a son preference.

In our estimations, we exclude mothers who already know the sex of their child. This reduces bias from incorrect preference reporting due to anchoring with the child's actual sex. First, we drop mothers who report not to be pregnant in 2015 and who also do not have children in the correct age range in 2016 (below 20 months). Second, we drop mothers who already had an ultrasound at the time of the 2015 survey and therefore potentially knew the sex of their child, which reduces our sample by 126 observations. In

[14] Appendix figure 4 shows the location of Madhepura within India and Bihar as well as the distribution of households across the six sub-districts.

[15] Attrition in the questionnaire is mainly due to respondents' absence from home mainly for agricultural work (45 percent), due to failure to locate the household (22 percent) or due to migration (8 percent). In Madhepura it is common that women stay at their maternal home during pregnancy and move to their husband's home after giving birth. Of the 1612 households interviewed in 2016, 166 children have died, 79 children were not home at the time of the development test and revisits, another 18 children were not living in the household. The remaining loss in the development tests is due to a variety of reasons, such as the child being sick or asleep.

appendix table A1 we show that selection into ultrasound by socioeconomic characteristics is small.[16] Despite the large loss in sample size, the sample restriction is important to reduce downward bias in our estimates. Let's consider a mother who initially had a son preference but does not state it because she already knows about having a girl. We would falsely categorize this mother as non-son preferring although she is the discriminating type. This wrongly reduces the difference in child outcomes by mothers' son preference. To ensure that the child's sex does not predict son preference after excluding mothers who potentially know the child's sex, we regress son preference on the child's sex, holding constant a number of background characteristics (see appendix table A1). We find that having a girl does not predict son preference.[17]

Given that the start of the 2015 survey and the end of the 2016 survey are 21 months apart, it is expected that the children are 10 to 21 months of age. The children in our sample are between 10 to 24 months old. We allow for some measurement error as 24 months is a value parents tend to round up to when reporting children's age. Most records for age in months are based on the date of birth stated in vaccination cards; however, when not available we relied on parental reports.

We restrict our estimation sample to one with non-missing covariates. This reduces the final sample from 1041 to 894 observations.[18] Appendix table A3 compares the estimation sample to observations outside the estimation sample (1067 households = 1961-894) using 2015 data. Judging by statistical significance of the difference in means, the estimation sample is worse off in mothers' educational attainment and literacy as well as in highest educational attainment in the household, having an improved toilet facility and finished walls. Further, there is some selection in subdistrict. We further look at standardized differences to get a feeling for the size of the difference in means. None of the standardized differences reaches the common threshold of 0.25. In fact, the highest standardized difference is 0.17 in mothers' educational attainment.

In table 2, we compare the 2015 sample of 1,961 households and our estimation sample to the NFHS-4 rural Bihar and rural Madhepura indicators reported in IIPS and ICF (2017*b*) and IIPS (2017*a*), respectively. The 2015 and estimation samples are fairly comparable to the NFHS-4 rural Madhepura indicators. However, Madhepura fares considerably worse than all Bihar according to both of our samples and the NFHS-4 indicators.

[16] Scheduled caste category members are less likely to have had an ultrasound in comparison to members of the other backwards classes category. When we include birth order and sex composition in the model, the richest wealth quintile is 5 percentage points more likely to have had an ultrasound in comparison to the poorest quintile. Further, ultrasound is more common among first born children than later born ones.

[17] If mothers knew the sex of their child, despite the presented evidence and their negative response to having had an ultrasound, and therefore adjusted their son preference statement, then our discrimination coefficient would be downward biased and presented a lower bound estimate. The same mechanism applies when the stated son preference does not correspond to the mothers actual behaviour, i.e. she is the discriminating type but does not reveal it. This downward bias would only affect the OLS estimates while the instrumental variables estimation tackles such measurement error.

[18] We allowed "don't know" as a response to most questions and coded it as missing. This coding causes the loss in sample size from 1041 to 894.

Table 2: Comparison of 2015 sample and estimation sample to NFHS-4 rural Bihar and rural Madhepura indicators.

	2015 sample			Estimation sample			NFHS4 rural Bihar	NFHS4 rural Madhepura
	Mean	SD	N	Mean	SD	N	Mean	Mean
Household profile								
Electricity	0.43	0.50	1961	0.44	0.50	894	0.54	0.51
Improved drinking water source	0.99	0.11	1961	0.99	0.11	894	0.98	1.00
Improved sanitation	0.12	0.33	1961	0.10	0.31	894	0.20	0.13
Clean cooking fuel	0.03	0.16	1960	0.02	0.12	894	0.11	0.05
Iodized salt	0.83	0.38	1809	0.82	0.39	828	0.93	0.96
Health insurance, any member	0.24	0.43	1938	0.23	0.42	884	0.13	0.09
Adult characeristics								
Literate women	0.31	0.46	1958	0.27	0.45	893	0.46	0.30
Women with YOS$\geq$10	0.14	0.34	1958	0.12	0.32	893	0.20	0.12
Nutritional status								
Woman's BMI$<$18.5kg/m^2	0.21	0.41	1915	0.22	0.41	880	0.32	0.34
Woman's BMI$\geq$ 25kg/m^2	0.06	0.24	1915	0.05	0.22	880	0.10	0.07
Anemia								
Pregnant women ($<$11 g/dl)	0.68	0.47	1865	0.71	0.45	860	0.58	0.58

Note: The summary statistics in the 2015 sample and estimation sample are based on data collected in 2015. We follow the indicator definitions of the NFHS-4 Bihar fact sheet (IIPS and ICF, 2017*b*). We measured the iodine content in salt and assume that the salt is iodized if the ppm value is $\geq$15. Because we only measure educational attainment in levels completed we assume that completion of the secondary school certificate is equivalent to ten or more years of schooling.

4.2 Data

To measure the development status of children in 2016, the German test "Fruehkindliche Entwicklungsdiagnostik fuer Kinder 0-3" (Maehler, Cartschau and Rohleder, 2016), short FREDI 0-3, was adapted to the Indian context by psychologists who also developed the test's original version. FREDI 0-3 tests cognitive, language, motor and socioemotional development. The test is similar to the Bayley Scales of Infant Development. It includes playful tasks administered to the child and interview questions posed to the mother. We administered different test versions for children younger or older than 15 months. We calculated standardized development scores using children of non-son preferring mothers as the reference group. In addition to cognitive, language, motor and socioemotional development, we use a composite index which equally weighs the four scales.

In 2015, we asked pregnant women "Would you prefer your child to be a girl or a boy or it doesn't matter?". The women's responses were coded in four categories: boy, girl, does not matter and up to god. The interpretation of the answer category "up to god" is ambivalent. If "up to god" correlates with the degree of religiousness and more religious people are generally more son preferring, then "up to god" at least partially indicates son preference. In the literature, "up to god" is sometimes interpreted as "does not matter" (Bongaarts, 2013) or is excluded from the analysis (Jayachandran, 2017). In a robustness check, we allow "up to god" to have a separate effect on child development. We find that girls of mothers who answer "up to god" are insignificantly worse off in language and socioemotional behavior because of their mother's son preference and much less so than girls of mothers who state unambiguously that they prefer to have a son. We take this as evidence that our coding of son preference is reasonable and conservative, because if anything, it would downward bias the son preference-specific girl-penalty.[19]

4.3 Sample characteristics

Table 3 shows summary statistics by combinations of sex of the child and son preference of the mother. Overall, 86 percent of the sample is Hindu and 13 percent muslim. Thirty-three percent are of caste category scheduled tribe and 55 percent of other backwards classes. The average highest grade completed in the household is 5.4 years and in 48 percent of houeholds the highest level of education is no completed education. Mothers' average highest grade completed is grade 2. The average household size is 5.8 members and the average number of own children including the child of interest is 2.4.

Columns (1) and (2) of table 3 hold son preference constant at no son preference and vary the child's sex. Columns (3) and (4) hold son preference constant at having a son preference and vary the child's sex. We compare summary statistics across sexes in columns (5) and (6) and son preferences in columns (7) and (8). Between sexes and holding son preference constant (columns (5) and (6)), differences tend to be small and statistically insignificant. There are no differences between boys and girls of mothers without a son preference, except for being currently pregnant. In families with son preferring mothers boys tend to have more older girl-siblings and are less likely to be firstborns. Additionally, their mothers are older and are less educated.

For comparisons between son preferences and holding sex constant (columns (7) and (8)), selection appears to be more common. Children of mothers with a son preference have significantly fewer older boy-siblings and significantly more older girl-siblings. This confirms our finding from section 2 about the relevance of sex composition of alive children for having a son preference. Son preferring mothers of boys have significantly more often knowledge about abortion than non-son preferring mothers of boys. Further, girls of son preferring mothers are more (less) likely to be of low (high) birth order. The latter two findings support the argument that son-preferring mothers who have a girl and abortion knowledge or were expecting a high birth order girl, dropped from the sample because they aborted their girls. There are few differences in socioeconomic background characteristics across son preferences. Surprisingly, families with boys and son-preferring mothers are more likely to be assigned to the randomized controlled trial treatment group than families with girls and son-preferring mothers. Given that participants were offered the treatment only after the baseline survey, this imbalance seems to occur by chance.[20]

We include three covariate groups in our analysis. First, socioeconomic status variables, which potentially pick up a general prefence for the number of sons or the sex ratio of

[19] The chosen son preference coding potentially renders our main OLS coefficients lower bound estimates. The instrumental variables estimates should be less affected by such measurement error in the endogenous variable.

[20] In robustness checks, we estimate the son preference-specififc girl-penalty controlling for treatment group assignment and the results do not change.

Table 3: Summary statistics

	No son preference		Son preference		Diff. across sex		Diff. across preference		
	Boys (Mean/SD)	Girls (Mean/SD)	Boys (Mean/SD)	Girls (Mean/SD)	(1)-(2) (β/SE)	(3)-(4) (β/SE)	(1)-(3) (β/SE)	(2)-(4) (β/SE)	N
HH characteristics									
Religion is Hindu	0.84	0.87	0.85	0.89	−0.03	−0.04	−0.01	−0.02	894
	0.36	0.33	0.36	0.31	(0.03)	(0.04)	(0.03)	(0.03)	
Scheduled caste	0.35	0.34	0.28	0.36	0.01	−0.08	0.07	−0.02	894
	0.48	0.47	0.45	0.48	(0.04)	(0.05)	(0.04)	(0.05)	
Scheduled tribe	0.05	0.06	0.04	0.01	−0.01	0.03	0.01	0.04**	894
	0.21	0.23	0.19	0.11	(0.02)	(0.02)	(0.02)	(0.02)	
OBC	0.52	0.54	0.60	0.58	−0.03	0.02	−0.09*	−0.04	894
	0.50	0.50	0.49	0.49	(0.04)	(0.05)	(0.05)	(0.05)	
General category	0.09	0.06	0.08	0.04	0.02	0.03	0.01	0.02	894
	0.28	0.24	0.27	0.21	(0.02)	(0.03)	(0.03)	(0.02)	
Wealth quintile									
1 (poorest)	0.22	0.18	0.22	0.22	0.04	0.00	0.00	−0.04	894
	0.42	0.39	0.42	0.41	(0.03)	(0.05)	(0.04)	(0.04)	
2	0.22	0.21	0.19	0.17	0.01	0.03	0.03	0.04	894
	0.42	0.41	0.40	0.37	(0.03)	(0.04)	(0.04)	(0.04)	
3	0.17	0.22	0.26	0.22	−0.04	0.04	−0.09**	−0.00	894
	0.38	0.41	0.44	0.41	(0.03)	(0.05)	(0.04)	(0.04)	
4	0.20	0.19	0.19	0.23	0.01	−0.04	0.01	−0.04	894
	0.40	0.40	0.40	0.42	(0.03)	(0.04)	(0.04)	(0.04)	
5 (richest)	0.18	0.20	0.14	0.17	−0.02	−0.03	0.04	0.03	894
	0.38	0.40	0.35	0.37	(0.03)	(0.04)	(0.04)	(0.04)	
BPL card	0.62	0.65	0.65	0.69	−0.03	−0.04	−0.03	−0.03	894
	0.49	0.48	0.48	0.47	(0.04)	(0.05)	(0.05)	(0.05)	
Highest grade in HH	5.61	5.35	5.50	5.03	0.26	0.47	0.11	0.33	894
	4.49	4.79	4.49	4.60	(0.39)	(0.50)	(0.43)	(0.47)	
Family size & composition									
HH size	5.70	5.79	6.03	5.76	−0.09	0.27	−0.33	0.04	894
	2.29	2.18	2.11	1.87	(0.19)	(0.22)	(0.21)	(0.21)	
$>$ 2 adults in HH	0.47	0.52	0.42	0.42	−0.05	−0.01	0.05	0.09*	894
	0.50	0.50	0.49	0.50	(0.04)	(0.05)	(0.05)	(0.05)	
No. of sons	0.62	0.59	0.34	0.30	0.03	0.04	0.28***	0.29***	894
	0.73	0.71	0.56	0.53	(0.06)	(0.06)	(0.06)	(0.06)	
No. of daughters	0.64	0.64	1.49	1.26	−0.00	0.23*	−0.85***	−0.61***	894
	0.91	0.92	1.21	1.18	(0.08)	(0.13)	(0.10)	(0.10)	
Birth order									
1	0.36	0.36	0.15	0.24	−0.01	−0.09**	0.20***	0.12**	894
	0.48	0.48	0.36	0.43	(0.04)	(0.04)	(0.04)	(0.05)	
2	0.28	0.29	0.32	0.33	−0.01	−0.01	−0.04	−0.03	894
	0.45	0.46	0.47	0.47	(0.04)	(0.05)	(0.04)	(0.05)	
3	0.19	0.17	0.26	0.19	0.02	0.07	−0.06	−0.02	894
	0.40	0.38	0.44	0.40	(0.03)	(0.05)	(0.04)	(0.04)	
$\geq$4	0.17	0.18	0.27	0.24	−0.01	0.03	−0.10***	−0.06	894
	0.37	0.38	0.44	0.43	(0.03)	(0.05)	(0.04)	(0.04)	
Wants more children									
Unsure	0.07	0.06	0.12	0.08	0.01	0.04	−0.05*	−0.02	894
	0.25	0.24	0.32	0.27	(0.02)	(0.03)	(0.03)	(0.02)	
Wants more	0.48	0.49	0.48	0.51	−0.01	−0.03	0.01	−0.01	894
	0.50	0.50	0.50	0.50	(0.04)	(0.05)	(0.05)	(0.05)	
Newborn	0.04	0.07	0.08	0.09	−0.02	−0.01	−0.03	−0.02	894
	0.21	0.25	0.27	0.29	(0.02)	(0.03)	(0.02)	(0.03)	
Currently pregnant	0.08	0.16	0.12	0.18	−0.08***	−0.06	−0.04	−0.02	894
	0.27	0.37	0.33	0.38	(0.03)	(0.04)	(0.03)	(0.04)	

Note: Table continues on next page.

Table 3 continued

	No son preference		Son preference		Diff. across sex		Diff. across preference		N
	Boys (Mean/SD)	Girls (Mean/SD)	Boys (Mean/SD)	Girls (Mean/SD)	(1)-(2) (β/SE)	(3)-(4) (β/SE)	(1)-(3) (β/SE)	(2)-(4) (β/SE)	
Mother characteristics									
Highest grade	2.23	1.96	1.52	2.30	0.27	−0.78*	0.71*	−0.34	894
	4.11	3.79	3.36	4.09	(0.34)	(0.41)	(0.37)	(0.39)	
Can read	0.23	0.23	0.18	0.26	0.00	−0.09*	0.05	−0.04	894
	0.42	0.42	0.38	0.44	(0.04)	(0.04)	(0.04)	(0.04)	
Worked past 12 months	0.92	0.90	0.92	0.92	0.01	0.01	−0.01	−0.01	894
	0.28	0.29	0.27	0.28	(0.02)	(0.03)	(0.03)	(0.03)	
Age	24.58	24.84	25.34	24.62	−0.26	0.71*	−0.76**	0.22	894
	3.99	4.48	3.76	3.34	(0.36)	(0.39)	(0.37)	(0.41)	
Child characteristics									
Child's age in months	15.89	15.89	15.82	15.61	−0.01	0.21	0.07	0.28	894
	2.00	2.15	2.22	2.02	(0.18)	(0.23)	(0.20)	(0.21)	
Pregnancy indicators									
Ultrasound taken (at endline)	0.21	0.18	0.23	0.21	0.03	0.03	−0.03	−0.03	883
	0.41	0.38	0.42	0.41	(0.03)	(0.05)	(0.04)	(0.04)	
Knows about abortion	0.54	0.57	0.73	0.65	−0.04	0.08	−0.20***	−0.08	848
	0.50	0.50	0.44	0.48	(0.04)	(0.05)	(0.05)	(0.05)	
Knows place for safe abortion	0.58	0.66	0.74	0.66	−0.07*	0.08	−0.16***	−0.00	828
	0.49	0.48	0.44	0.47	(0.04)	(0.05)	(0.05)	(0.05)	
Received antenatal care	0.52	0.47	0.55	0.52	0.05	0.03	−0.03	−0.05	883
	0.50	0.50	0.50	0.50	(0.04)	(0.05)	(0.05)	(0.05)	
Participatin in RCT									
HNWASH intervention	0.56	0.57	0.68	0.59	−0.02	0.09	−0.12**	−0.02	894
	0.50	0.50	0.47	0.49	(0.04)	(0.05)	(0.05)	(0.05)	

Note: * p < 0.1, ** p < 0.05, *** p < 0.01.

children as well as potential selection into realized son preference. These include caste category, wealth quintile, having a below poverty line card, highest grade completed in the household, highest grade completed of the mother and maternal reading abilities. Second, we include family size and fertility variables to control for son-biased fertility behavior. These include household size, the number of adult members exceeding two, birth order of the child of interest, the wish for more children, newborn children (children born after the child of interest), and current pregnancy.[21] Note, that the child of interest is the lastborn child in 86 percent of families and therefore birth order closely corresponds to the number of own children. Third, we include the number of older sons to control for sex composition. Together, birth order and the number of sons results in the sex ratio of children. In all specifications we include subdistrict fixed effects to avoid identification from regional variation in son preference and instead focus on idiosyncratic heterogeneity in son preferences.

[21] Unfortunately, we only observe the wish for more children during pregnancy in 2015. Yet, we include it as a proxy for desired family size.

5 Have girls of son preferring mothers lower cognitive and psychosocial skills?

5.1 Results from ordinary least squares estimations

Table 4 presents results for the average son preference-specific girl-penalty estimated by OLS. Each panel refers to one of the skill outcomes: cognitive, language, motor, and socio-emotional development, as well as a composite index which weighs all scales equally. The columns refer to different model specifications and vary the set of control variables included. The coefficient on *Girl x Son Preference* measures the average son spreference-specific girl-penalty. It is zero for motor development, large and negative for all other development scales and significant for language, socioemotional behavior and the composite index. The son preference-specific girl-penalty in language is about 0.30 of a standard deviation, in socioemotional behavior it is about 0.26.

The coefficients on *Girl* suggest that in the absence of son preference girls outperform boys in language and socioemotional skills and vice versa for motor skills. This finding is in line with the neuroscience and psychology literature, which finds exactly that girls tend to perform better in language and socioemotional behavior while boys perform better in motor skills; however, the study population in the referred to literature is typically no younger than two or three years.[22]

In models 2 to 6 of table 4, we add control variables for socioeconomic status, family size, son-biased fertility, and sex composition of older siblings separately and then all covariates together.[23] For each set of covariates added, the coeffiecients stay remarkably stable. In theory, families that have a son preference and a girl can differ in aspects that are relevant for early childhood development. For example, sex selective abortion was found to be more common in higher educated and wealthier families, which would lead to an upward bias in the son preference-specific girl penalty in absolute terms (Jha et al., 2011; Poertner, 2015). However, the coefficients are robust to the inclusion of socioeconomic status variables. This is in line with our findings on selection into death in section 3.1, which showed no selection by socioeconomic characteristics.

For son-biased fertility behavior to affect the child of interest, parents would have to continue child bearing in response to the child's sex. In model 3 of table 4, we add household size and birth order indicators and in model 4 we further add indicators for having a newborn and being pregnant. The coefficients on the son preference-specific girl-penalty are robust to the inclusion of son-biased fertility controls.

In model 5 of table 4, we add the number of older sons to the model. Together, birth order and the number of sons control for sex composition. Families that have many daughters and no sons might be more likely to practice sex selection or son-biased fertility than families with few daughters or some sons. Further, having many girl siblings might affect the number of stimulating toys at home or the mother's probability to work in

[22] See for evidence on language skills, for example, Bornstein et al. (2000), Burman, Bitan and Booth (2008), Galsworthy et al. (2000), Roulstone et al. (2002); for evidence on motor skills see, for example, Goodway, Robinson and Crowe (2010), Spessato et al. (2013), Thomas and French (1985); and for motor development see, for example, DiPrete and Jennings (2012) and Owens (2016).

[23] Table A4 in the appendix presents the results with all covariate coefficients shown.

Table 4: Results on child development - OLS estimations

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Cognitive						
Girl x Son preference	-0.122	-0.144	-0.144	-0.142	-0.144	-0.157
	(0.138)	(0.139)	(0.138)	(0.136)	(0.136)	(0.135)
Girl	0.031	0.040	0.032	0.024	0.028	0.034
	(0.081)	(0.082)	(0.083)	(0.082)	(0.083)	(0.085)
Son preference	0.017	0.040	0.073	0.074	0.059	0.068
	(0.106)	(0.110)	(0.114)	(0.112)	(0.118)	(0.121)
Adjusted R^2	0.010	0.019	0.027	0.030	0.028	0.034
Language						
Girl x Son preference	-0.265**	-0.291**	-0.274**	-0.273**	-0.285**	-0.300**
	(0.117)	(0.114)	(0.116)	(0.117)	(0.118)	(0.117)
Girl	0.178**	0.190***	0.171**	0.170**	0.178**	0.187**
	(0.070)	(0.070)	(0.069)	(0.070)	(0.070)	(0.073)
Son preference	0.110	0.143*	0.157*	0.154*	0.162*	0.180*
	(0.081)	(0.085)	(0.079)	(0.081)	(0.089)	(0.096)
Adjusted R^2	0.012	0.031	0.019	0.017	0.014	0.025
Motor						
Girl x Son preference	0.011	-0.002	-0.017	-0.016	-0.013	-0.024
	(0.139)	(0.142)	(0.141)	(0.141)	(0.137)	(0.141)
Girl	-0.175**	-0.167*	-0.178**	-0.180**	-0.173**	-0.166*
	(0.085)	(0.086)	(0.087)	(0.086)	(0.086)	(0.088)
Son preference	-0.141	-0.124	-0.076	-0.078	-0.086	-0.078
	(0.098)	(0.102)	(0.098)	(0.099)	(0.095)	(0.100)
Adjusted R^2	0.020	0.034	0.027	0.025	0.026	0.032
Socioemotional						
Girl x Son preference	-0.259*	-0.269*	-0.259*	-0.258*	-0.262*	-0.263*
	(0.132)	(0.139)	(0.134)	(0.135)	(0.134)	(0.142)
Girl	0.196**	0.204***	0.189**	0.186**	0.190**	0.195**
	(0.075)	(0.076)	(0.075)	(0.075)	(0.075)	(0.077)
Son preference	0.068	0.095	0.083	0.077	0.057	0.075
	(0.079)	(0.084)	(0.083)	(0.084)	(0.088)	(0.093)
Adjusted R^2	0.028	0.030	0.027	0.025	0.027	0.023
All development						
Girl x Son preference	-0.220	-0.245*	-0.241*	-0.239*	-0.244*	-0.259*
	(0.133)	(0.135)	(0.134)	(0.135)	(0.132)	(0.135)
Girl	0.080	0.092	0.074	0.070	0.078	0.086
	(0.080)	(0.081)	(0.080)	(0.081)	(0.080)	(0.083)
Son preference	0.028	0.061	0.091	0.088	0.078	0.096
	(0.092)	(0.097)	(0.096)	(0.097)	(0.097)	(0.102)
Adjusted R^2	0.024	0.043	0.034	0.032	0.035	0.041
Socioeconomic status		✓				✓
Family size			✓	✓		✓
Son-biased fertility				✓		✓
Sex composition					✓	✓
Subdistrict fixed effects	✓	✓	✓	✓	✓	✓
Observations	894	894	894	894	894	894

Note: Socioeconomic status: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, highest grade completed of the mother and maternal reading abilities. Family size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Son-biased fertility: controls for having a newborn and current pregnancy. Sex composition: controls for the number of sons. All estimations include subdistrict fixed effects. Standard errors clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

order to afford future dowry payments. However, when we control for sex composition our results remain robust. Model 6 collectively includes socioeconomic status, family size, son-biased fertility and sex composition variables. The results remain unchanged.

In appendix table A5, we check the robustness of our estimates to the inclusion of variables which were significantly imbalanced in table 3 and are not part of the main covariate set in table 4. These include age of mother and age of mother squared, an indicator for assignment to the HNWASH intervention, and mother's abortion knowledge. For abortion knowledge the sample size drops by 72 observations which decreases the coefficients on socioemotional and all development slightly and reduces precision. We further drop observations that are not in the exact age range of 10 to 21 months. Also here, the coefficient on socioemotional development reduces slightly and becomes insignificant. All other estimates and particularly those on language are robust. At last, appendix table A6 shows results for an alternate coding of the son preference variable in which we allow a separate impact of "up to god" (rather than coding it with "does not matter" as no son preference).[24] The coefficients on "up to god" are small and positive for cognitive, motor and all development. The coefficients on language and socioemotional development are negative and even sizable for language (-0.269). None of the coefficients on "up to god" are significant. The coefficients on son preference are now higher for language (-0.445) and socioemotional behavior (-0.330) but not statistically different from the coefficients in table 4. We take this as evidence that our coding of son preference is reasonable.

5.2 Results from instrumental variables estimations

Tables 5 and 6 present results from the instrumental variables estimations. Table 5 shows results from the two first stages. In the first first stage on the interaction of girl and son preference, the interaction coefficient of girl and firstborn boy is -0.33 and highly significant. The Sanderson-Windmeijer first stage F statistic for weak instruments is about 95. In the second first stage on son preference, having a firstborn boy significantly reduces the probability of having a son preference by about 40 percentage points. The Sanderson-Windmeijer first stage F statistic is about 55. The Kleibergen-Paap rk Wald F statistics for weak instruments of both first stages is 23. Therefore, the instruments are relevant.

Table 6 presents the second stage results. Model 1 includes subdistrict fixed effects and no other covariates. Model 2 includes all covariates used in model 6 of table 4. We find large and statistically significant son preference-specific girl-penalties in cognitive skills, language and composite development of 0.89, 0.77 and 0.84 standardized scores, respectively. Also motor and socioemotional development show sizeable effects of 0.32 and 0.35 standardized scores but are imprecisely measured. The precision of the estimates is reduced compared to the OLS estimations given that the sample excludes firstborns by nature of the instrument and instrumental variables estimation typically introduces additional uncertainty.

The instrumental variables estimates of the son preference-specific girl-penalty are

[24] We redo the standardization of outcome variables and use "does not matter" as a reference category.

Table 5: Results on child development - First stage IV estimations

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
					First stage				
Girl x Son Preference									
Girl x firstborn boy	-0.335***	-0.331***	-0.336***	-0.327***	-0.330***	-0.332***	-0.334***	-0.332***	-0.333***
	(0.049)	(0.048)	(0.048)	(0.047)	(0.049)	(0.048)	(0.049)	(0.048)	(0.049)
Firstborn boy	0.001	0.008	0.013	0.009	0.007	0.010	0.009	0.008	0.013
	(0.004)	(0.013)	(0.014)	(0.013)	(0.013)	(0.014)	(0.014)	(0.013)	(0.016)
SW first stage F-stat.	90	95	98	96	89	97	94	95	88
Son Preference									
Girl x firstborn boy	0.074	0.092	0.089	0.095	0.091	0.092	0.081	0.092	0.079
	(0.071)	(0.071)	(0.072)	(0.071)	(0.072)	(0.071)	(0.071)	(0.071)	(0.072)
Firstborn boy	-0.409***	-0.392***	-0.388***	-0.392***	-0.392***	-0.392***	-0.390***	-0.392***	-0.387***
	(0.055)	(0.057)	(0.059)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.059)
SW first stage F-stat.	60	55	54	57	57	54	56	55	59
Kleibergen-Paap rk Wald F statistic	22	23	23	22	23	22	23	23	23
Subdist. fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
SES & HH size & fertility		✓	✓	✓	✓	✓	✓	✓	✓
Previous birthspacing			✓						✓
Currently breastfed				✓					✓
Mother's health					✓				✓
Age difference						✓			✓
Saving assets							✓		✓
Mother worked								✓	✓
Observations	629	629	629	629	629	629	629	629	629

Note: All estimations include subdistrict fixed effects. SES: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, grade completed of the mother and maternal reading abilities. HH size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Fertility: controls for having a newborn and current pregnancy. Previous birth spacing: controls for the time between the birth of the child of interest and the previous birth. Currently breastfed: is an indicator for whether the mother is currently breastfeeding the child of interest. Mother's health: controls for an index based on mother's self-reported health.Age difference: controls for the difference in age between the firstborn and the child of interest. Saving assets: controls for having a watch, livestock and size of land. Mother worked: controls for whether the mother worked in the past 12 months. Standard errors clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

large in comparison to those from the OLS estimations in table 4. Some potential explanations are sample selection, measurement error in the OLS estimates, or the estimation of local average treatment effects. The exclusion of firstborn children in the instrumemtal variables stratgey (the child must have at least one older sibling) can lead to larger effect sizes if discrimination is more intensive among later born children (a hypothesis we explicitly test in section 6). However, when we restrict the OLS estimation to the instrumental variables sample, the coefficients are similar to those in table 4 (see appendix table A7). Unfortunately, we cannot test for measurement error. However, it seems reasonable to assume that son preference is measured with some error and that the instrumental variables estimation resolves attenuation bias. This would at least partially explain the increase in coefficient size. Further, the instrumental variables strategy identifies local average treatment effects. Compliers are mothers who don't care about the sex of the

Table 6: Results on child development - Second stage IV estimations

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
					Second stage				
Cognitive									
Girl x Son preference	-0.922**	-0.889*	-0.871*	-0.921**	-0.878*	-0.890*	-0.913*	-0.893*	-0.910*
	(0.469)	(0.473)	(0.463)	(0.463)	(0.480)	(0.471)	(0.472)	(0.477)	(0.464)
Girl	0.342	0.334	0.326	0.352*	0.331	0.334	0.342	0.336	0.342
	(0.213)	(0.211)	(0.208)	(0.208)	(0.213)	(0.211)	(0.213)	(0.212)	(0.208)
Son preference	0.327	0.354	0.330	0.351	0.350	0.358	0.364	0.358	0.348
	(0.274)	(0.262)	(0.254)	(0.260)	(0.267)	(0.258)	(0.263)	(0.264)	(0.261)
Language									
Girl x Son preference	-0.799*	-0.774*	-0.792*	-0.773*	-0.765*	-0.781*	-0.754*	-0.774*	-0.763*
	(0.455)	(0.430)	(0.430)	(0.434)	(0.422)	(0.429)	(0.439)	(0.430)	(0.429)
Girl	0.314	0.336*	0.345*	0.336*	0.336*	0.338*	0.315*	0.336*	0.321*
	(0.206)	(0.186)	(0.186)	(0.189)	(0.180)	(0.186)	(0.191)	(0.186)	(0.187)
Son preference	0.286	0.335	0.360	0.335	0.342	0.360	0.351	0.335	0.387
	(0.306)	(0.299)	(0.304)	(0.299)	(0.301)	(0.305)	(0.304)	(0.299)	(0.313)
Motor									
Girl x Son preference	-0.377	-0.314	-0.303	-0.296	-0.309	-0.308	-0.341	-0.308	-0.309
	(0.492)	(0.484)	(0.477)	(0.494)	(0.481)	(0.482)	(0.486)	(0.483)	(0.479)
Girl	-0.032	-0.059	-0.064	-0.069	-0.059	-0.061	-0.061	-0.062	-0.074
	(0.205)	(0.203)	(0.199)	(0.207)	(0.202)	(0.203)	(0.208)	(0.201)	(0.204)
Son preference	0.146	0.225	0.210	0.226	0.230	0.203	0.260	0.218	0.242
	(0.339)	(0.364)	(0.355)	(0.364)	(0.365)	(0.355)	(0.366)	(0.361)	(0.352)
Socioemotional									
Girl x Son preference	-0.361	-0.347	-0.337	-0.365	-0.347	-0.350	-0.318	-0.347	-0.318
	(0.359)	(0.356)	(0.356)	(0.359)	(0.355)	(0.357)	(0.372)	(0.356)	(0.375)
Girl	0.226	0.232	0.228	0.242	0.234	0.233	0.196	0.232	0.197
	(0.186)	(0.183)	(0.184)	(0.186)	(0.183)	(0.184)	(0.190)	(0.183)	(0.194)
Son preference	0.345	0.321	0.307	0.320	0.329	0.329	0.338	0.321	0.336
	(0.257)	(0.259)	(0.263)	(0.259)	(0.260)	(0.263)	(0.262)	(0.260)	(0.271)
All development									
Girl x Son preference	-0.888**	-0.840**	-0.835**	-0.847**	-0.832**	-0.842**	-0.843**	-0.839**	-0.835**
	(0.415)	(0.413)	(0.408)	(0.416)	(0.407)	(0.413)	(0.413)	(0.413)	(0.403)
Girl	0.313*	0.309*	0.306*	0.313*	0.308*	0.309*	0.293*	0.309*	0.291*
	(0.178)	(0.172)	(0.170)	(0.175)	(0.168)	(0.172)	(0.176)	(0.172)	(0.172)
Son preference	0.388	0.443	0.436	0.442	0.448	0.449	0.471	0.442	0.473
	(0.278)	(0.284)	(0.282)	(0.284)	(0.286)	(0.287)	(0.287)	(0.284)	(0.289)
Subdist. fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
SES & HH size & fertility		✓	✓	✓	✓	✓	✓	✓	✓
Previous birthspacing			✓						✓
Currently breastfed				✓					✓
Mother's health					✓				✓
Age difference						✓			✓
Saving assets							✓		✓
Mother worked								✓	✓
Observations	629	629	629	629	629	629	629	629	629

Note: All estimations include subdistrict fixed effects. SES: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, grade completed of the mother and maternal reading abilities. HH size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Fertility: controls for having a newborn and current pregnancy. Previous birth spacing: controls for the time between the birth of the child of interest and the previous birth. Currently breastfed: is an indicator for whether the mother is currently breastfeeding the child of interest. Mother's health: controls for an index based on mother's self-reported health.Age difference: controls for the difference in age between the firstborn and the child of interest. Saving assets: controls for having a watch, livestock and size of land. Mother worked: controls for whether the mother worked in the past 12 months. Standard errors clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

child because the firstborn is a boy but would have a son preference if the firstborn had been a girl. Non-compliers might be mothers who satisfied their son preference at births that occured between the firstborn and the child of interest, who do not have a son preference at the given birth order but would have for later births, or mothers who always or never want sons. If complier mothers are different to non-complier mothers in ways that increases the son preference-specific girl-penalty, then the local average treatment effect is larger than the average treatment effect from the OLS estimation. For example, compliance might be more common at high birth orders and at the same time discrimination might be stronger at high birth orders. It seems plausibile that attenuation bias in the OLS estimation and the estimation a local average treatment effect explain the difference in the OLS and instrumental variables estimations.

5.3 Robustness checks of the instrumental variables estimations

The son preference-specific girl-penalty measures differences and therefore the extent to which violations of the exclusion restriction can affect the son preference-specific girl-penalty is reduced. Yet, biological or social responses to certain factors which are induced by the firstborn's sex might differ across sexes. In models 2 to 8 of table 5, we conduct a number of robustness checks to investigate the sensitivity of our results to potential violations of the exclusion restriction.

Parents of a firstborn girl potentially involve in son-biased fertility behavior. Those families have fewer resources per child available which can negatively affect skill development. In model 2 of table 6, we control for family size, having a newborn and current pregnancy. Thereby, we control for son-biased fertility in response to the firstborn's sex which occurs before or after the birth of the child of interest. The son preference-specific girl-penalty in model 2 is comparable to that from the no-covariate specification in model 1.

Parents of a firstborn girl potentially reduce birth spacing to accelerate the birth of a boy (Jayachandran and Kuziemko, 2011). Reduced birth spacing can lead to increased morbidity and mortality in children and among mothers (Bhalotra and Van Soest, 2008; Milazzo, 2014), which in turn affects child development. Early weaning is a specific link from short birth spacing to child health (Jayachandran and Kuziemko, 2011). In model 3, we add birthspacing between the child of interest and the previous child to the model.[25] In model 4, we control for whether the child is currently breastfed or not. The son preference-specific girl-penalty remains robust in models 3 and 4.

The birth of a firstborn girl could lead to abortions of subsequent female fetuses. This affects the health of the mother when abortions are unclean and subsequently reduces caregiving capacities. In model 5, we control for self-reported health of the mother with respect to her health in general and whether she feels chronically tired.[26] Tiredness is a symptom of anemia, which has been found to occur more frequently among mothers with firstborn girls (Milazzo, 2014). The son preference-specific girl-penalty in early skills in

[25] The implications are the same whether we control for average birth spacing across all previous children or for birth spacing between the child of interest and the previously born child.

[26] We also observe the anemia status of the mother. However, it would reduce the estimation sample by 80 observations, so we rely on self-reported health.

model 6 is robust to the inclusion of maternal health indicators.

Older sisters might be better caregivers than brothers, which facilitates development. Indeed, in the study district we frequently sighted older sisters taking care of somewhat older children than ours. The age of the child of interest is below two and 90 percent are 18 months or younger. At this age, children are closely taken care of by their mothers or mothers-in-law and are typically not left to older siblings. Additionally, the age gap between our child of interest and its firstborn sibling must be sufficiently large. Both arguments make this channel unlikely to exist. Since we do not have data on caregiving abilities of children, we cannot support our argument empirically in an exhaustive way. Instead, in model 6 we control for the age gap between our child of interest and the firstborn and the coefficients remain stable.[27]

Parents of a firstborn girl might work or save more in order to accumulte sufficient resources for dowry payments. This may reduce caregiving time and investments that are relevant for child development. We are unable to observe savings directly and control for owning a watch, owning livestock and size of land owned as typical savings assets in model 7. In model 8, we add an indicator for whether the mother worked in the past 12 months. The results are robust to the inclusion of saving assets and mother's working status.

Our results are extremely robust to all potential threats to excludability tested in table 6. In fact, this makes sense given that our endogenous variable captures the differental impact across sons and daughters of son preferring mothers. While there are ways in which the firstborn's sex potentially affects child development other than through son preference, the impact of the violation of the exclusion restriction is presumably the same for boys and girls. For example, short birth spacing would affect girls' and boys' health equally and therefore the bias cancels out.

5.4 Is it discrimination against girls or preferential treatment of boys?

The son preference-specific girl-penalty can be caused by discrimination against girls or preferential treatment of boys or both. For example, the disappointment of bearing a girl may lead to discriminatory behavior against girls of son preferring mothers in comparison to girls of non-son preferring mothers. On the other hand, the joy of bearing a son may lead to pampering of boys of son preferring mothers in comparison to boys of non-son preferring mothers. We explicitly test the two alternatives. We split the sample by sex and estimate the causal effect of son preference within the same sex using firstborn boy as an instrument for son preference. Columns (1) to (3) of table 7 show the results for girls and columns (6) to (10) show the results for boys. For both sexes, we show three different model specifications. In model 1, we only control for subdistrict fixed effects. In model 2, we add socioeconomic status variables, family size and son-biased fertility indicators. In model 3, we check the robustness of our results controlling for birth spacing, breastfeeding, mother's self-reported health, the age difference to the firstborn child, savings assets, and whether the mother worked in the past year. The sample sizes

[27] We dropped age differences less than 6 months and therefore allow for some measurement error in the age gap.

Table 7: Results on child development - disentangling the effect into discrimination against girls and preferential treatment of boys

	Girls			Boys		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
First stage						
Son preference						
Firstborn boy	-0.334***	-0.312***	-0.307***	-0.411***	-0.390***	-0.392***
	(0.051)	(0.052)	(0.052)	(0.055)	(0.057)	(0.059)
SW first stage F statistic	43	37	35	56	47	45
Kleibergen-Paap rk Wald F statistic	43	37	35	56	47	45
Second stage						
Cognitive						
Son preference	-0.629*	-0.638*	-0.641*	0.346	0.429	0.422
	(0.341)	(0.345)	(0.339)	(0.286)	(0.307)	(0.313)
Language						
Son preference	-0.510	-0.359	-0.256	0.306	0.234	0.207
	(0.342)	(0.386)	(0.399)	(0.302)	(0.286)	(0.286)
Motor						
Son preference	-0.227	-0.087	-0.012	0.177	0.264	0.146
	(0.352)	(0.399)	(0.397)	(0.342)	(0.387)	(0.370)
Socioemotional						
Son preference	0.022	0.047	0.143	0.320	0.250	0.227
	(0.256)	(0.304)	(0.296)	(0.249)	(0.280)	(0.276)
All development						
Son preference	-0.495	-0.380	-0.290	0.403	0.429	0.375
	(0.315)	(0.332)	(0.329)	(0.279)	(0.310)	(0.307)
Subdist. fixed effects	✓	✓	✓	✓	✓	✓
SES & HH size & fertility		✓	✓		✓	✓
Previous birthspacing			✓			✓
Currently breastfed			✓			✓
Mother's health			✓			✓
Age difference			✓			✓
Saving assets			✓			✓
Mother worked			✓			✓
Observations	299	299	299	330	330	330

Note: All estimations include subdistrict fixed effects. SES: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, grade completed of the mother and maternal reading abilities. HH size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Fertility: controls for having a newborn and current pregnancy. Previous birth spacing: controls for the time between the birth of the child of interest and the previous birth. Currently breastfed: is an indicator for whether the mother is currently breastfeeding the child of interest. Mother's health: controls for an index based on mother's self-reported health. Age difference: controls for the difference in age between the firstborn and the child of interest. Saving assets: controls for having a watch, livestock and size of land. Mother worked: controls for whether the mother worked in the past 12 months. Standard errors clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

are now considerably smaller as we consider girls and boys separately, which results in a loss of precision.

The top of table 7 shows the first stage results. Having a firstborn boy significantly reduces the probability of having a son preference by about 31 percentage points for girls and 40 percentage points for boys (p-values$<$0.01). The first stage Kleibergen-Paap rk Wald F statistic is 35 or larger.

Comparing columns (1) to (3) to columns (4) to (6), we notice that all coefficients are negative for girls and positive for boys, except for socio-emotional development which is positive for girls and small. For girls of son preferring mothers, we find a significant penalty in cognitive skills of 0.64 standard deviations (models 3) in comparison to girls of non-son preferring mothers. The effects on language (-0.26 SD) and the composite score (-0.29 SD) are also sizeable, but imprecisely measured. Boys of mothers who have a son preference experience a large and insignificant development premium in comparison to boys of mothers who do not have a son preference. For example, the coefficient on cognitive skills is 0.42 and that on the composite score is 0.38. The results suggest that the son preference-specific girl-penalty is partially caused by discrimination against girls and partially caused by preferential treatment of boys - but more by discrimination against girls in language and more by pampering of boys in socioemotional development. However, most coefficients are imprecisely measured such that we cannot draw this conclusion with certainty.

6 The intensity of the son preference-specific girl penalty by birth order and sex composition

In section 2 we showed that son preference is strongly associated with birth order and sex composition of children. In this section, we test whether birth order and sex composition affect the intensity of the son preference-specific girl-penalty. This would imply a correlation between the *probability* of having a son preference and the *intensity* of discrimination by birth order and sex composition. We measure the discrimination *intensity* by estimating heterogeneous effects in the son preference-specific girl-penalty by birth order, number of older daughters, and number of older sons. We assume the following predictions:

1. *Birth order*: The girl-penalty due to mother's son preference increases with birth order. At high birth orders the costs of having another girl are higher for son-preferring mothers, as this may result in exceeding the planned family size in order to achieve the desired number of sons. Because of the increased pressure of having a son at high birth orders, the displeasure of having a girl and the pleasure of having a boy increases, and the intensity of the relative discrimination towards girls of son-preferring mothers rises.

2. *Number of older daughters*: The girl-penalty due to mother's son preference increases with the number of daughters at a given birth order. This is because girls are economically costly. Traditionally, sons are succeeding heirs and economically support their parents during old age, while economic contributions from daughters are low and dowry payments expensive. The more girls you have already, the less you can afford another girl and hence the greater the displeasure of having one

more.

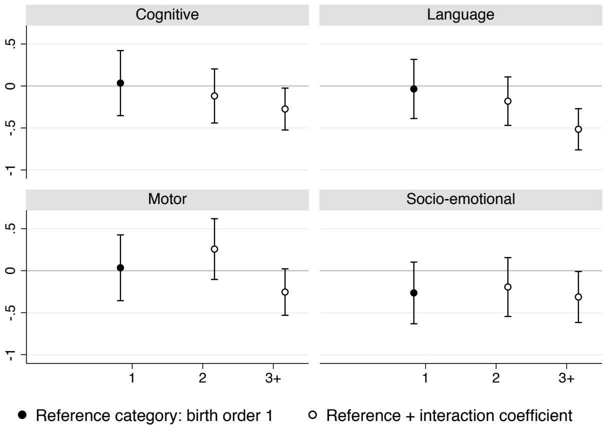
3. *Number of older sons*: The girl-penalty due to mother's son preference increases with the number of older boys at a given birth order. This is because mothers with a high number of desired sons (i.e. already have one or more sons and yet are son-preferring) are assumed to have stronger son preferences and therefore behave more discriminating.

Figure 3 depicts the β_{1k} coefficients from equation (4) on cognitive skills, language, motor and socioemotional development. Subfigure 3a shows the son preference-specific girl-penalty by birth order, controlling for socioeconomic status, other family size and fertility variables, and the number of sons. From left to right the graph corresponds to being the firstborn to being of birth order three or more. The results show a significant son preference-specific girl-penalty at birth order three or more in all skills except in motor development. For language, the son preference-specific girl-penalty totals 0.52 standard deviations at birth order three or more (p-value<0.01). For cognitive skills and socioemotional development, the son preference-specific girl-penalty at birth order three or more is 0.25 and 0.27 of a standard deviation, respectively. At lower birth orders, the coefficients are smaller and insignificant.

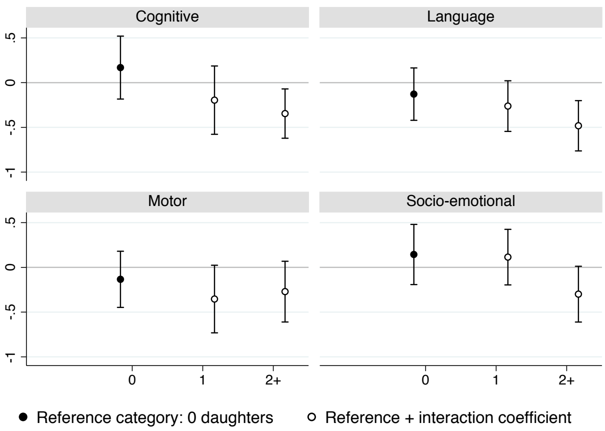
Subfigure 3b depicts the son preference-specific girl-penalty by number of older daughters, controlling for soecioeconomic status, family size, fertility, and birth order. From left to right the graph shows the effect of no daughter to two or more daughters. There is a significant son preference-specific girl-penalty at two or more daughters in cognitive skills and language of 0.35 and 0.48 standard deviations, respectively. The results from subfigures 3a and 3b confirm that it is not all girls that are discriminated against but particularly later born girls with girl siblings. We find no evidence that firstborns that are girls show adverse skill outcomes.

Subfigure 3c depicts the son preference-specific girl-penalty by number of older sons, controlling for socioeconomic status, family size, fertility, and birth order. From left to right the graph shows the effect for no son and one or one sons.[28] The results for language are in line with prediction 3. The son preference-specific girl-penalty for children with at least one older brother is 0.54 of a standard deviation (p-value<0.01), while it is 0.21 of a standard deviation (p-value=0.115) for children with no brothers; however, we cannot detect statistically significant differences across these effects. We do not observe a pattern coherent with prediction 3 for cognitive, motor and socioemotional skills. The results for language challenge the argument by Jayachandran and Pande (2017) that it is a preference for the eldest son (the firstborn son at any birth order) that drives the gender gap in height. Jayachandran and Pande (2017) show that there is no sex-specific difference in the birth order gradient in height in India in comparison to African countries and argue for the relevance of an eldest son preference opposed to a preference for any son.

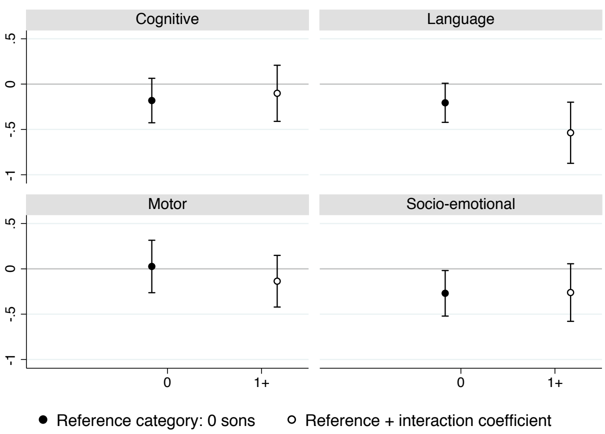
[28] We split the sample into no or one or more sons because the event of having a son and a son preference is rare in comparison to having a girl and a son preference as in subfigure 3b.



(a) By birth order



(b) By number of older daughters



(c) By number of older sons

Figure 3: Intensity of the son preference-specific girl-penalty by birth order and sex composition

Note: Graphs show β_{1k} plus β_2 coefficients based on equation (4). Control variable groups: all estimations include socioeconomic status, family size, son-biased fertility, and subdistrict fixed effects; in addition, subfigure a) number of sons, subfigures b) and c) birth order. Standard errors are clustered at the panchayat level. 90 percent confidence intervals.

7 Mechanisms: From son preference to skills

Throughout the analysis, the son preference-specific girl-penalty in cognitive and language skills is most obtrusive. The formation of synapses for cognitive skills and language occurs later than synapses formation for seeing and hearing (Thompson and Nelson, 2001). The later the synapses formation takes place the longer the region of the brain remains plastic (Tierney and Nelson, 2009). Therefore, these regions are typically more sensitive to experiences and the environment than other parts of the brain. Continuous opportunities to learn, hear and speak through singing, book reading, and playing are essential for cognitive and language development. Our results suggest a lack in such experiences among daughters of son preferring mothers or a more beneficial environment among sons of son preferring mothers. This is in line with findings of Barcellos, Carvalho and Lleras-Muney (2014) who show that mothers spend less childcare time with their daughters in comparison to their sons.

In this section, we look at potential mechanisms which mediate the effect from son preference to skills. First, we look at child health, which is an outcome of interest in itself and which, if impaired, can prevent healthy brain development (Prado and Dewey, 2014). Second, we investigate parental health and home environment inputs, which have been shown to be relatively lower among daughters in India (Asfaw, Lamanna and Klasen, 2010; Barcellos, Carvalho and Lleras-Muney, 2014; Jayachandran and Kuziemko, 2011; Oster, 2009). Third, we look at mothers' mental health. Maternal mental health presumably reflects the emotional stress in facing the disappointment of having a girl and has been shown to affect child development (Britto et al., 2017).

Table 8 estimates the son preference-specific girl-penalty in child health, parental inputs, and maternal mental health to establish a causal link from son preference to potenial mediators. The top panel of table 8 presents OLS estimates and the bottom panel IV estimates. Columns 1 to 3 show the son preference-specific girl-penalty in child health outcomes; specifically, stunting, anemia and a sickness index.[29] The sickness index relies on the mother's report about whether the child was sick in the past two weeks, whether it had loose motions in the past three months, whether the child received deworming drugs in the past six months, and whether the child suffered from pneumonia in the past three months. The sample sizes for stunting and anemia are low due to missing measurements. In the OLS estimation, we find a marginally significant son preference-specific girl-penalty in anemia of 12 percentage points. However, this is not confirmed in the instrumental variables estimation in a smaller sample. The coeffients on stunting and sickness go in the expected direction but are not statistically significant.

Columns 4 to 6 of table 8 show the son preference-specific girl-penalty in parental inputs; specifically, a health input index, whether the child is currently breastfed and a home environment index. The health input index relies on whether the child received iron supplements in the past three months, number of postnatal care visits, whether the child was fed colostrum after birth, and whether it received pre-lacteal feeding.[30] The

[29] The stunting indicator was standardized according WHO reference tables. Anemia is defined according to WHO guidelines for the respective age of the child.

[30] Among Hindus and Muslims it is often believed that the colostrum milk leads to adverse health outcomes while pre-lacteal feeding of sweets is healthy. So a health investment would be opposite to

Table 8: Mechanism analysis - The son preference-specific girl-penalty in potential mediators

	(1) Stunted	(2) Anemic	(3) Sick	(4) Health inputs	(5) Breast-feeding	(6) Home environment	(7) Mental health
OLS estimations							
Girl x Son preference	0.056	0.117*	0.087	0.070	0.048	0.138	-0.151
	(0.068)	(0.059)	(0.151)	(0.163)	(0.040)	(0.141)	(0.143)
Girl	-0.051	0.025	-0.036	-0.024	-0.020	-0.081	0.072
	(0.036)	(0.051)	(0.093)	(0.095)	(0.023)	(0.088)	(0.088)
Son preference	0.019	-0.057	0.055	0.165	-0.024	-0.118	0.074
	(0.053)	(0.054)	(0.115)	(0.133)	(0.035)	(0.113)	(0.105)
Socioeconomic status	✓	✓	✓	✓	✓	✓	✓
Family size	✓	✓	✓	✓	✓	✓	✓
Son-biased fertility	✓	✓	✓	✓	✓	✓	✓
Sex composition	✓	✓	✓	✓	✓	✓	✓
Child age fixed effects					✓		
Subdistrict fixed effects	✓	✓	✓	✓	✓	✓	✓
Observations	730	600	869	614	893	803	861
Adjusted R^2	0.038	0.035	0.040	0.052	0.179	0.004	0.006
Mean	0.67	0.67	-0.00	0.00	0.91	0.00	0.00
IV estimations							
Girl x Son preference	0.212	-0.009	0.545	0.431	0.133	0.070	-1.069**
	(0.215)	(0.230)	(0.454)	(0.637)	(0.120)	(0.494)	(0.460)
Child is girl	-0.127	0.064	-0.262	-0.274	-0.078	0.013	0.463**
	(0.101)	(0.125)	(0.204)	(0.288)	(0.050)	(0.227)	(0.199)
Son preference	-0.239*	0.110	0.420	0.447	0.001	0.393	0.417
	(0.137)	(0.136)	(0.294)	(0.399)	(0.058)	(0.306)	(0.317)
Socioeconomic status	✓	✓	✓	✓	✓	✓	✓
Family size	✓	✓	✓	✓	✓	✓	✓
Son-biased fertility	✓	✓	✓	✓	✓	✓	✓
Child age fixed effects					✓		
Subdistrict fixed effects	✓	✓	✓	✓	✓	✓	✓
Kleibergen-Paap F-stat.	21	13	22	8	23	15	21
Observations	513	429	613	440	629	561	607
Mean	0.67	0.67	-0.00	0.00	0.91	0.00	0.00

Note: Socioeconomic status: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, grade completed of the mother and maternal reading abilities. Family size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Son-biased fertility: controls for having a newborn and current pregnancy. Sex composition: controls for the number of older boys. Child age fixed effects: controls for age in months dummies. All estimations include subdistrict fixed effects. Standard errors are clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

sample size on the health inputs index is low and the first stage is weak, such that the IV estimate on health inputs is not reliable. In order to account for censoring in the breastfeeding indicator due to the young age of the children, in column 5 we also control for the age of the child with month fixed effects. The home environment index relies on whether the child plays with toys or home objects, whether five different activities are conducted with the child in the past days (e.g. telling stories or singing songs), and the type of educational measures typically applied (e.g. explaining wrong behavior or spanking). We find no son preference-specific girl-penalty in any of the parental inputs. In fact, the coefficients show signs that go in the opposite direction than what a penalty would suggest.

In column 7, we test the son preference-specific girl-penalty in maternal mental health. The mental health variable is an index that relies on whether the mother is frequently stressed, her satisfaction with her family life and her satisfaction with her life overall. We find a son preference-specific girl-penalty in maternal mental health which is significant in the instrumental variables estimation.

In table 9, we test whether reduced maternal mental health is a mediator from son preference to early skills by adding it to the main specification as a covariate. Additionally, we test the mediating role of anemia in the same way.[31] In columns 1 to 5 of table 9 we reestimate the main OLS and IV results with our regular set of covariates in a sample with non-missing anemia and mental health observations. The results in columns 1 to 5 are similar to our findings from tables 4 and 6, except that the first stage F statistic is now lower and the effect on language in the instrumental variables estimation is not significant. When we add anemia and mental health to the model in columns 6 to 10, the son preference-specific girl-penalty remains virtually identical. Anemia significantly and negatively affects motor development. This makes intuitive sense given that anemic children tend to be tired, less energetic and explorative. However, maternal mental health has no predictive power for any of the skills. The implications are the same when we control for anemia and mental health separately and restrict the sample to non-missing observations in each variable individually. Therefore, the mediators from son preference to skill development remain unclear. It is likely that social interactions and a loving environment are factors contributing to the son preference-specific girl-penalty in early skills, however, these factors are extremely difficult to measure and reliable empirical evidence remains lacking.

what is generally considered healthy according to medical research (McKenna and Shankar, 2009).

[31] This methodology is prone to introduce bias in the presence of intermediate confounders (Acharya, Blackwell and Sen, 2016). Intermediate confounders can introduce a spurious relationship between the interaction of son preference with the child's sex and child developmment, which leads to bias in the mediator and the son preference-specific girl-penalty net the mediator effect. However, we find zero effects of our mediators on child development (except for motor development) and the son prefernce-specific girl-penalty remains unaffected. Therefore, we conclude that our results do not suffer from such bias and the analysis is suffiecient to show that the investigated variables do not mediate the effect from son preference to early skills.

Table 9: Results on child development - OLS interaction estimation with closed mechanisms

	No mechanisms added					Anemia & mental health added				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Cognitive	Language	Motor	Socio-emotional	All development	Cognitive	Language	Motor	Socio-emotional	All development
OLS estimations										
Girl x Son preference	-0.322**	-0.474***	-0.172	-0.434***	-0.483***	-0.320**	-0.484***	-0.145	-0.427***	-0.474***
	(0.156)	(0.160)	(0.185)	(0.155)	(0.154)	(0.157)	(0.158)	(0.188)	(0.158)	(0.154)
Girl	0.117	0.270**	-0.100	0.222**	0.174*	0.116	0.271**	-0.099	0.223**	0.175*
	(0.102)	(0.105)	(0.106)	(0.086)	(0.098)	(0.102)	(0.104)	(0.107)	(0.086)	(0.098)
Son preference	0.059	0.196*	-0.097	0.087	0.100	0.058	0.201*	-0.108	0.085	0.097
	(0.140)	(0.117)	(0.128)	(0.103)	(0.115)	(0.141)	(0.115)	(0.130)	(0.104)	(0.116)
Child is anemic						0.021	0.001	-0.151**	-0.082	-0.073
						(0.093)	(0.068)	(0.075)	(0.104)	(0.080)
Mother's mental health						0.017	-0.042	0.043	-0.008	0.005
						(0.033)	(0.038)	(0.040)	(0.036)	(0.034)
Socioeconomic status	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Family size	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Son-biased fertility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sex composition	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subdistrict fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	584	584	584	584	584	584	584	584	584	584
Adjusted R^2	0.02	0.03	0.05	0.05	0.07	0.02	0.03	0.05	0.05	0.06
IV estimations										
Girl x son preference	-1.315**	-0.469	-0.012	-0.424	-0.812	-1.351**	-0.493	0.049	-0.415	-0.805
	(0.556)	(0.518)	(0.658)	(0.446)	(0.513)	(0.585)	(0.532)	(0.676)	(0.462)	(0.535)
Girl	0.510**	0.265	-0.198	0.198	0.290	0.518**	0.275	-0.210	0.203	0.293
	(0.221)	(0.242)	(0.291)	(0.217)	(0.218)	(0.227)	(0.247)	(0.292)	(0.223)	(0.226)
Son preference	0.518	0.551	0.505	0.679*	0.818*	0.525	0.566	0.493	0.691*	0.824*
	(0.326)	(0.416)	(0.445)	(0.377)	(0.424)	(0.329)	(0.417)	(0.456)	(0.380)	(0.434)
Child is anemic						0.125	-0.026	-0.226**	-0.187	-0.112
						(0.110)	(0.089)	(0.099)	(0.121)	(0.095)
Mother's mental health						-0.032	-0.024	0.055	0.005	0.004
						(0.046)	(0.048)	(0.062)	(0.042)	(0.049)
Socioeconomic status	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Family size	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Son-biased fertility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subdistrict fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kleibergen-Paap F-stat.	12	12	12	12	12	12	12	12	12	12
Observations	419	419	419	419	419	419	419	419	419	419

Note: Socioeconomic status: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, grade completed of the mother and maternal reading abilities. Family size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Son-biased fertility: controls for having a newborn and current pregnancy. Sex composition: controls for the number of older boys. Child age fixed effects: controls for age in months dummies. All estimations include subdistrict fixed effects. Standard errors are clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

8 How can policy interventions reduce son preference?

This paper identifies large adverse effects of son preference on daughters cognitive, language, and overall development. Others have shown detrimental effects of son preference on daughter's health and parental investments. While son preference and sex ratios have been declining in many regions, the yet high level of discrimination calls to accelerate this process.

Evidence from skewed sex ratios at birth or during childhood among South and East Asian families in the US and Canada illustrate two important factors (Abrevaya, 2009; Almond and Edlund, 2008; Almond, Edlund and Milligan, 2013). First, even when the gender unequal economic and legal environment is overcome (similar economic returns by sex, old age pensions, insurances, equal inheritance rights by sex etc.) son preferences embodied in sex ratios are not eliminated. Therefore, the extent to which improvements in the economic value of females can reduce son preference seems limited. Second, traditional gender norms are sticky and religious and cultural aspects of son preference are relevant (Jayachandran, 2015). For example, the historic labor divison across sexes and historic fertility behavior due to climate conditions have been linked to today's gender norms (Alesina, Giuliano and Nunn, 2013; Santos Silva et al., 2017).

A few studies give reason to believe that female economic empowerment can be effective in reducing son preferences in South and East Asia.[32] Carranza (2014) exploits exogenous regional variation in Indian land tillage and hence in the female labor share and finds that the female labor share in agriculture affects the sex ratio of children under six at the district level. Her results suggest that a 10 percentage point increase in the share of female agricultural labor increases the sex ratio by 54 girls per 1,000 boys in Northern India. Similarly, Qian (2008) exploits exogenous variation in income earned by females in teapicking in China and finds an increase in the female to male sex ratio due to an increase in the female share of household income.

Das Gupta (2010) argues that the partilinearly organized political system gave rise to the unprecedented son preferences in India, China, and Korea, which are now being unraveled due to changes in the modern political system, urbanization and industrialization. These processes have mainly impacted social norms and therefore the perceived value of females. In the case of Korea, a change in social norms in the 1990s explains almost three-quarters in the reduction of son preference whereas urbanization and education itself only explain one-quarter but mediate the change in social norms (Chung and Gupta, 2007).

Besides the ban of sex-selective abortions, Indian son preference-reducing policies focus on financial incentives, mass media campaigns and public representation of females (Das Gupta, 2010; MacPherson, 2007; Naqvi, 2006).[33] Unfortunately, few of these mea-

[32] The presented literature mostly uses sex ratios as the outcome of interest, which is a consequence of son preference. It is not unreasonable to assume that an increase in the economic value of women would also reduce differential treatment of daughters and sons at the housheold level.

[33] Media campaigns via billboards, radio and TV-shows are intended to raise knowledge about the sex-selection ban and its legal consequences, raise awareness about gender inequalities, promote empowerment and autonomy, and women's legal rights (Das Gupta, 2010; MacPherson, 2007; Naqvi, 2006). In addition India made an effort to increase females presentation in the public sphere such as that one third of local elected government positions must be held by women (Das Gupta, 2010).

sures have been rigorously evaluated. Jensen and Oster (2009) and Ting, Ao and Lin (2014) showed that television exposure is effective in reducing son preference among other female empowerment and autonomy outcomes. Beaman et al. (2012) study the impact of a village level randomized policy in rural West Bengal which reserves a female chief councilor in one-third of village councils. In comparison to villages with never reserved councils, female leadership over two election cycles closes parents' gender gaps in aspirations by 25 percent and eliminates the gender gap in educational attainment among adolescents. However, a cash transfer program that intended to increase the sex ratio directly via financial incentives failed severely (Anukriti, 2018). The Devi Rupak program pays lower transfers to families with two girls and one boy or only one boy than to one girl families. Both transfers are substantial and pay over twenty years. While the program is effetive in reducing fertility it worsens the sex ratio at birth through an increase in one son families.

We exploit the fact that a random subset of women in our sample was exposed to a female empowerment program and test the effectiveness of the program in reducing the son preference-specific girl-penalty in early skills. The program entailed 20 meetings in women's self-help groups and primarily focussed on health and hygiene issues among females and children in the community. Women were intended to act as agents of change who change their own attitudes and behavior as well as that of members of their households. The program was randomly offered in some subdistricts after the survey of pregnant women in 2015 and in the remaining subdistricts the program was introduced only after the 2016 survey. The program was uneffective in improving the main sanitation, hygiene, and health outcomes. However, it showed some improvements in female agency and empowerment (Subramanyam et al., 2017).[34] Most interestingly, adolescent girls in the treatment group were 15 percentage points less like to want a firstborn boy or nextborn boy if they were mothers already.[35]

The first two columns of table 10 show the effectiveness of the intervention using OLS. We estimate it once for the full sample and once in a smaller instrumental variables sample for comparison reasons. The estimation model is as in equation (4) but replacing an intervention indicator with birth order or sex composition indicators. The last two columns of table 10 show results from instrumental variables estimations in a no intervention group sample and an intervention group sample. This reduces the instrumental variables samples to 253 and 376 observations and the first stage Kleibergen-Paap rk Wald F statistic to 7 and 14 in the no intervention and intervention groups, respectively.[36] The results from the OLS and instrumental variables estimations are inclonclusive about the effectiveness of the HNWASH intervention. The OLS estimations suggest an increase rather than a decrease in the son preference-specific girl-penalty due to the intervention

[34]For example, it reduced whether husbands insisted on knowing whereabouts, reduced the instances in which the husband limits contact with the family and increased the believe that it is ok to refuse sexual intercourse. Note however, that these effects were found in a different sample which interviewed females in reproductive age and not specifically pregnant women.

[35]Note that attrition in the adolescent girl sample was large and the effects were not robust to multiple hypothesis testing. Yet, these findings are suggestive.

[36]The Sanderson-Windmeijer first stage F statistics of each first stage in the no intervention group are 17 and 31 and in the intervention group they are 34 and 56.

in all development dimensions but socioemotional behavior. However, the instrumental variables estimations suggest a smaller son preference-specific girl-penalty in the intervention than in the no intervention group, except for motor development. Given the low first stage F statistic in the no intervention group, the reliability of the estimates is questionable. If there is some correlation between the instrument and the second stage error term, then the weak first stage exacerbates this bias. In section 5.3, we find that our instrumental variables estimates are robust to an array of potential threats to excludability; potenially, because the effect of having a firstborn boy affects later born girls and boys in a very similar way. Therefore, we argue that the bias from a weak first stage is small. For both estimation methods, the effects for no intervention and intervention group observations do not differ from each other statistically. Overall, we find no convining evidence for the women's self-help group HNWASH intervention to have effectively reduced the son preference-specific girl-penalty. This result should be viewed against the

Table 10: Heterogeneous effects by women's self-help group HNWASH intervention

	OLS		Instrumental variables	
	OLS sample	IV sample	No intervention	Intervention
Cognitive				
Girl x Son preference x Intervention	-0.204	-0.101		
	(0.202)	(0.201)		
Girl x Son preference	-0.026	-0.143	-1.271	-0.483
	(0.191)	(0.204)	(0.892)	(0.560)
Girl	0.033	0.049	0.642**	0.084
	(0.085)	(0.114)	(0.325)	(0.300)
Son preference	0.058	0.039	-0.064	0.397
	(0.120)	(0.137)	(0.524)	(0.360)
Intervention	0.115	0.089		
	(0.094)	(0.109)		
Adjusted R^2	0.035	0.026		
Language				
Girl x Son preference x Intervention	-0.160	-0.150		
	(0.153)	(0.201)		
Girl x Son preference	-0.199	-0.190	-0.852	-0.674
	(0.135)	(0.161)	(0.772)	(0.484)
Girl	0.186**	0.132	0.391	0.343
	(0.073)	(0.083)	(0.312)	(0.243)
Son preference	0.174*	0.118	0.098	0.426
	(0.095)	(0.119)	(0.652)	(0.360)
Intervention	0.074	0.096		
	(0.088)	(0.094)		
Adjusted R^2	0.024	0.025		
Motor				
Girl x Son preference x Intervention	-0.129	-0.010		
	(0.176)	(0.191)		
Girl x Son preference	0.069	0.061	0.069	-0.474
	(0.193)	(0.197)	(1.172)	(0.493)
Girl	-0.167*	-0.218**	-0.232	0.067
	(0.087)	(0.099)	(0.437)	(0.254)
Son preference	-0.092	-0.157	0.059	0.358
	(0.100)	(0.120)	(0.730)	(0.466)
Intervention	0.173*	0.189*		
	(0.102)	(0.110)		
Adjusted R^2	0.035	0.031		

Note: Table continues on next page.

Table 10 continued

	OLS		Instrumental variables	
	OLS sample	IV sample	No intervention	Intervention
Socioemotional				
Girl x Son preference x Intervention	0.163	0.216		
	(0.209)	(0.243)		
Girl x Son preference	-0.353	-0.362*	-0.661	-0.036
	(0.212)	(0.214)	(0.691)	(0.467)
Girl	0.196**	0.177*	0.363	0.052
	(0.077)	(0.092)	(0.316)	(0.253)
Son preference	0.071	0.051	0.747	0.074
	(0.093)	(0.106)	(0.539)	(0.321)
Intervention	0.047	0.089		
	(0.116)	(0.138)		
Adjusted R^2	0.023	0.013		
All development				
Girl x Son preference x Intervention	-0.119	-0.025		
	(0.191)	(0.206)		
Girl x Son preference	-0.176	-0.214	-0.990	-0.605
	(0.192)	(0.173)	(0.809)	(0.530)
Girl	0.085	0.051	0.428	0.201
	(0.082)	(0.093)	(0.297)	(0.254)
Son preference	0.085	0.032	0.306	0.446
	(0.101)	(0.116)	(0.674)	(0.349)
Intervention	0.137	0.160		
	(0.116)	(0.129)		
Adjusted R^2	0.042	0.036		
Socioeconomic status	✓	✓	✓	✓
Family size	✓	✓	✓	✓
Son-biased fertility	✓	✓	✓	✓
Sex composition	✓	✓		
Subdistrict fixed effects	✓	✓	✓	✓
Observations	894	629	253	376
Kleibergen-Paap rk Wald F statistic			7	14

Note: Socioeconomic status: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, grade completed of the mother and maternal reading abilities. Family size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Son-biased fertility: controls for having a newborn and current pregnancy. Sex composition: controls for the number of older boys. All estimations include subdistrict fixed effects. Standard errors are clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

backdrop that there is no evidence that the HNWASH intervention improved the programs's target health care utilization indicators and health outcomes after the program had been running for about one year. In a similar analysis on female excess mortality of below five year old children in Bangladesh, Muhuri and Preston (1991) evaluate the effectiveness of a large scale home visiting program to promote maternal and child health. In line with our results they do not find differential program effects by children's sex. Yet, neither the HNWASH intervention nor the maternal and child health program in Bangladesh were designed with the specific objective to alleviate son preferences or mortality particular to females.

9 Conclusion

We propose an innovative measure of child-specific son preference to study the adverse effects of son preference on under two-year-olds' cognitive and non-cognitive skills in the Indian state of Bihar. With this child-specific measure of son preference we first establish the relevance of birth order and sex composition for wanting a son. We find that son preference is more common among later born children and in families with fewer sons. At birth order three the probability of having a son preference is 45 percentage points higher than at birth order one. At a given birth order, the probability of having a son preference is 40 percentage points lower for mothers that have one son in comparison to mothers without any sons.

We estimate the penalty for being a girl and born to a son preferring mother in cognitive, language, motor and socioemotional skills. We use a difference-in-differences type of model that interacts mother's son preference with the child's sex. The coefficient on the interaction term is the effect on early skills for girls who do not satisfy their mothers son preference. We label this coefficient the son preference-specific girl-penalty. We use OLS and instrumental variables estimations. We instrument the interaction of son preference and the child's sex with an indicator for having a firstborn boy interacted with the sex of the child of interest. We find large and robust adverse effects on cognitive skills, language, and overall development. The instrumental variables son preference-specific girl-penalty is 0.77 standard deviations in language, 0.89 in cognitive skills, and 0.84 in overall development. Our results suggest that both discrimination against girls and preferential treatment of boys in son preferring families contribute to the son preference-specific girl-penalty.

Our child-specific measure of son preference allows us to relate son preference to birth order and sex composition. In a heterogeneous effect analysis, we show that the son preference-specific girl-penalty in early skills only exists for high birth order children, for daughters with two or more girl siblings and for daughters of mothers with a high number of desired sons, which we interpret as mothers with a strong son preference.

Early cognitive and language skills are fundamentally shaped by the children's environment. Good health, reduced stress, responsive caregiving, positive experiences and learning opportunities are key for children to grow mentally and socially. We investigate child health, parental input, and maternal mental health indicators as potential factors which mediate the effect from son preference to early skills. We find a son preference-specific girl-penalty in anemia and maternal mental health, which is not robust across specifications and we find no evidence that anemia and maternal mental health mediate the effect from son preference to early skills.

This paper identifies large adverse effects of son preference on daughters early mental development. At the same time, our results refute a general discrimination against all girls and underline the relevance of birth order and sex composition. It suggests that discrimination against girls is a consequence of wanting at least some sons. Similarly, others have shown detrimental effects of son preferences on health and investment in daughters. Yet, few studies propose effective interventions to reduce son preference. Some suggest that increasing the economic value of females poses a promising way forward.

We exploit the fact that a random subset of women in our sample was exposed to an empowering women's self-help group program targeted to improve sanitation, hygiene and health of females and children. We find that the program was not effective in reducing the son preference-specific girl-penalty in early skills. This result should be viewed against the backdrop that there is no evidence that the HNWASH intervention improved the programs's target output and outcome indicators.

While academics and policy makers alike understand and agree that son preferences are harmful to females, societies and countries, the focus of researchers and funding agencies must shift to answering the question of how can we reduce son preference. This evidence on early cognitive and non-cognitive skills is relevant because it suggests that the home environment is a decisive factor which is difficult to substitute for by, for example, institutionalized distributions of take-home food ratios or iron supplements. It urges to study how parents' attitudes can be altered.

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Appendix

Table A1: Selection tests

	Firstborn boy	Ultrasound taken	Ultrasound taken	Son preference	Son preference
Preference & realization					
Child is girl		−0.029	−0.030	−0.045	−0.021
		(0.024)	(0.025)	(0.027)	(0.027)
Son preference		0.002	0.005		
		(0.032)	(0.034)		
Girl x Son preference		0.043	0.041		
		(0.039)	(0.039)		
HH characteristics					
Religion is Hindu	−0.065	−0.035	−0.036		0.013
	(0.064)	(0.034)	(0.032)		(0.067)
Scheduled caste	−0.005	−0.048**	−0.052**		−0.064
	(0.040)	(0.022)	(0.024)		(0.041)
Scheduled tribe	−0.072	−0.027	−0.034		−0.203**
	(0.097)	(0.047)	(0.048)		(0.077)
General category	−0.089	0.017	0.009		−0.073
	(0.078)	(0.046)	(0.044)		(0.057)
Wealth quintile					
2 (2nd poorest)	−0.063	0.003	0.007		−0.104**
	(0.060)	(0.028)	(0.028)		(0.045)
3	−0.095	−0.018	−0.015		−0.007
	(0.059)	(0.024)	(0.025)		(0.044)
4	−0.039	0.010	0.012		−0.023
	(0.072)	(0.031)	(0.030)		(0.037)
5 (richest)	−0.028	0.050	0.054*		−0.090**
	(0.069)	(0.035)	(0.032)		(0.038)
BPL card	−0.047	−0.004	0.006		−0.003
	(0.043)	(0.024)	(0.025)		(0.033)
Highest grade in HH	0.000	0.006	0.005		−0.000
	(0.005)	(0.004)	(0.005)		(0.004)
Mother characteristics					
Highest grade	0.003	0.009	0.008		0.001
	(0.011)	(0.006)	(0.006)		(0.008)
Can read	−0.051	−0.016	−0.016		0.004
	(0.096)	(0.057)	(0.057)		(0.072)
Age	−0.057	−0.023	−0.012		0.064**
	(0.037)	(0.015)	(0.015)		(0.025)
Age^2	0.001	0.000	0.000		−0.001***
	(0.001)	(0.000)	(0.000)		(0.000)
Family size					
HH size			−0.005		0.016
			(0.007)		(0.010)
> 2 adults in HH			0.010		−0.057*
			(0.022)		(0.031)
Wants more children					
Unsure			0.079*		0.038
			(0.047)		(0.064)
Wants more			−0.011		0.021
			(0.022)		(0.040)
Birth order					
2			−0.045*		0.308***
			(0.025)		(0.052)
3			−0.073**		0.447***
			(0.031)		(0.054)
≥4			−0.045		0.574***
			(0.034)		(0.066)
Sex composition					
Number of sons					
1			−0.014		−0.402***
			(0.028)		(0.048)
≥2			−0.023		−0.654***
			(0.046)		(0.055)
Subdistrict fixed effects	✓	✓	✓		✓
Observations	629	1016	1016	894	894
Adjusted R^2	0.00	0.06	0.06	0.00	0.18
F-statistic	1.48	5.74	6.63	2.72	20.22

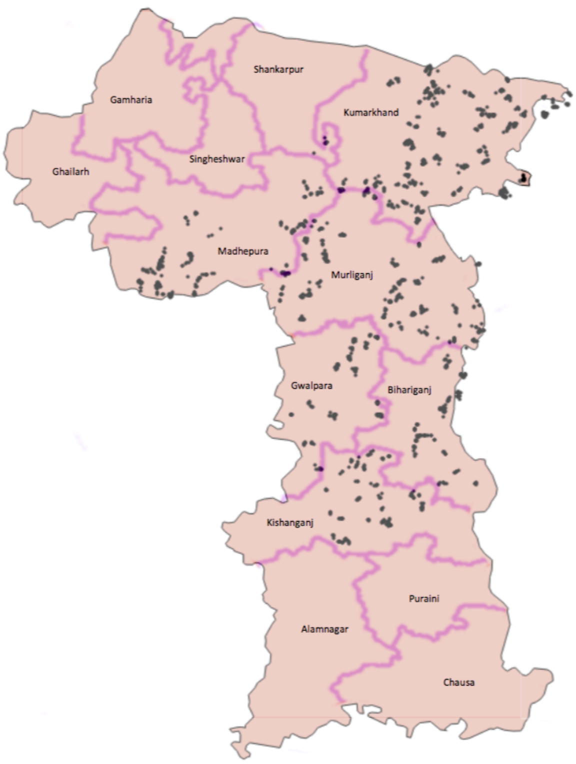
Note: All covariates as shown. All estimations include subdistrict fixed effects. Standard errors are clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Associations of child's sex and living status with household and maternal background characteristics

	Girl	Not alive	Died before birth	Died after birth
Pregnancy				
Son preference	−0.028	−0.029	−0.016	−0.013
	(0.034)	(0.023)	(0.014)	(0.017)
Number of ANC visits (2015)	−0.011	−0.014	−0.005	−0.006
	(0.018)	(0.013)	(0.008)	(0.009)
Ultrasound taken (at endline)	−0.049	−0.124***	−0.074***	−0.076***
	(0.043)	(0.018)	(0.014)	(0.014)
HH characteristics				
Religion is Hindu	0.066	−0.043	−0.038	−0.014
	(0.048)	(0.033)	(0.026)	(0.024)
Scheduled caste	−0.002	0.026	0.019	0.008
	(0.033)	(0.025)	(0.018)	(0.020)
Scheduled tribe	−0.064	−0.025	−0.028**	0.003
	(0.065)	(0.042)	(0.013)	(0.042)
General category	−0.089	0.006	0.004	−0.010
	(0.058)	(0.038)	(0.031)	(0.027)
Wealth quintile				
2 (2nd poorest)	0.033	−0.025	−0.009	−0.013
	(0.046)	(0.033)	(0.025)	(0.024)
3	0.077*	−0.047	−0.025	−0.021
	(0.044)	(0.030)	(0.020)	(0.025)
4	0.101	−0.013	0.004	−0.011
	(0.061)	(0.033)	(0.022)	(0.027)
5 (richest)	0.116*	0.035	0.039	−0.002
	(0.064)	(0.032)	(0.026)	(0.026)
BPL card	0.040	−0.001	0.015	−0.008
	(0.036)	(0.030)	(0.020)	(0.022)
Highest grade in HH	−0.009*	0.001	0.001	0.000
	(0.005)	(0.003)	(0.002)	(0.002)
Mother characteristics				
Highest grade	−0.001	−0.000	−0.002	0.001
	(0.008)	(0.005)	(0.004)	(0.004)
Can read	0.089	0.030	0.030	0.013
	(0.067)	(0.044)	(0.035)	(0.034)
Age	−0.010	−0.017	−0.028	0.016
	(0.028)	(0.016)	(0.019)	(0.010)
Age^2	0.000	0.000	0.001*	−0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Family size				
HH size	−0.008	0.001	−0.000	0.001
	(0.010)	(0.006)	(0.005)	(0.004)
$>$ 2 adults in HH	0.034	0.013	0.006	0.008
	(0.040)	(0.026)	(0.021)	(0.020)
Wants more children				
Unsure	−0.057	0.074*	0.032	0.055*
	(0.059)	(0.041)	(0.031)	(0.031)
Wants more	−0.020	0.046**	0.025*	0.026
	(0.042)	(0.021)	(0.015)	(0.020)
Birth order				
2	−0.056	−0.013	−0.012	−0.004
	(0.045)	(0.028)	(0.019)	(0.024)
3	−0.133**	0.023	−0.000	0.016
	(0.063)	(0.041)	(0.028)	(0.031)
≥4	−0.100	−0.011	−0.019	−0.005
	(0.070)	(0.039)	(0.030)	(0.031)
Sex composition				
Number of sons				
1	0.046	−0.046*	−0.010	−0.033
	(0.047)	(0.027)	(0.016)	(0.024)
≥2	0.015	−0.034	0.010	−0.043
	(0.076)	(0.045)	(0.032)	(0.036)
Subdistrict fixed effects	✓	✓	✓	✓
Observations	874	973	920	924
Adjusted R^2	0.009	0.024	0.024	0.000
F statistic	4.51	5.92	2.98	4.73

Note: All covariates as shown. All estimations include subdistrict fixed effects. All estimations are restricted to estimation sample plus children that have died in columns 2 to 4. Standard errors are clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

(a) Location of Madhpura district in India



(b) Distribution of households across six blocks

Figure 4: Study location and distribution of households.

Table A3: Representativeness of estimation sample in comparison to the attried sample

	Dropped sample			Estimation sample					
	Mean	SD	N	Mean	SD	N	Difference	p-value	Standardized difference
HH characteristics									
Religion is Hindu	0.84	0.36	1067	0.86	0.34	894	−0.02	0.218	−0.06
Scheduled caste	0.30	0.46	1062	0.33	0.47	894	−0.03	0.184	−0.06
Scheduled tribe	0.03	0.17	1062	0.04	0.20	894	−0.01*	0.086	−0.08
OBC	0.59	0.49	1062	0.55	0.50	894	0.03	0.123	0.07
General category	0.08	0.27	1062	0.07	0.26	894	0.01	0.520	0.03
Wealth quintile									
1 (poorest)	0.21	0.41	1067	0.19	0.39	894	0.02	0.255	0.05
2	0.19	0.39	1067	0.24	0.43	894	−0.05***	0.010	−0.12
3	0.20	0.40	1067	0.18	0.38	894	0.02	0.216	0.06
4	0.20	0.40	1067	0.22	0.41	894	−0.02	0.368	−0.04
5 (richest)	0.20	0.40	1067	0.18	0.38	894	0.02	0.221	0.06
BPL card	0.68	0.47	1067	0.71	0.45	894	−0.03	0.159	−0.06
Improved toilet	0.14	0.34	1067	0.10	0.31	894	0.03**	0.031	0.10
Finished walls	0.30	0.46	1067	0.26	0.44	893	0.04*	0.052	0.09
Level of education in HH	3.18	1.92	1067	2.96	1.73	894	0.22***	0.008	0.12
HH size	5.78	2.48	1067	5.83	2.51	894	−0.05	0.636	−0.02
Mother characteristics									
Education level	1.97	1.54	1065	1.73	1.31	893	0.25***	0.000	0.17
Can read	0.34	0.48	1065	0.27	0.45	893	0.07***	0.001	0.16
Age	23.63	4.76	1065	24.06	4.73	893	−0.44**	0.042	−0.09
Son preference	0.35	0.48	910	0.38	0.49	894	−0.03	0.174	−0.06
Subdistricts									
Block: Bihariganj	0.10	0.30	1067	0.09	0.29	894	0.01	0.428	0.04
Block: Gwalpara	0.09	0.28	1067	0.12	0.32	894	−0.03**	0.033	−0.10
Block: Kumarkhand	0.36	0.48	1067	0.39	0.49	894	−0.03	0.136	−0.07
Block: Madhepura	0.16	0.37	1067	0.14	0.34	894	0.02	0.179	0.06
Block: Murliganj	0.21	0.41	1067	0.16	0.37	894	0.05***	0.006	0.13
Block: Uda Kishunganj	0.08	0.27	1067	0.10	0.30	894	−0.02	0.123	−0.07

Note: The statistics are based on data collected in 2015. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: Results on child development - OLS estimation with all covariates shown

	Cognitive	Language	Motor	Socio-emotional	All development
Girl x Son preference	-0.157	-0.300**	-0.024	-0.263*	-0.259*
	(0.135)	(0.117)	(0.141)	(0.142)	(0.135)
Girl	0.034	0.187**	-0.166*	0.195**	0.086
	(0.085)	(0.073)	(0.088)	(0.077)	(0.083)
Son preference	0.068	0.180*	-0.078	0.075	0.096
	(0.121)	(0.096)	(0.100)	(0.093)	(0.102)
Scheduled caste	-0.000	0.138	-0.081	0.070	0.043
	(0.082)	(0.084)	(0.080)	(0.077)	(0.082)
Household characteristics					
Scheduled tribe	0.097	0.237	0.149	0.364**	0.275
	(0.161)	(0.217)	(0.189)	(0.152)	(0.185)
General category	0.040	0.034	-0.070	0.123	0.030
	(0.147)	(0.131)	(0.158)	(0.138)	(0.150)
Wealth quintile					
2 (2nd poorest)	-0.011	0.024	-0.058	0.050	-0.001
	(0.107)	(0.114)	(0.109)	(0.127)	(0.114)
3	-0.124	-0.038	-0.038	0.007	-0.063
	(0.112)	(0.113)	(0.130)	(0.138)	(0.132)
4	0.048	0.092	0.116	0.091	0.117
	(0.107)	(0.112)	(0.122)	(0.112)	(0.118)
5 (richest)	0.066	-0.018	0.054	0.038	0.037
	(0.101)	(0.124)	(0.123)	(0.134)	(0.124)
BPL card	0.109	-0.061	-0.100	0.009	-0.014
	(0.074)	(0.072)	(0.079)	(0.073)	(0.070)
Highest grade in HH	0.018	0.018*	0.011	0.004	0.016
	(0.012)	(0.010)	(0.011)	(0.011)	(0.011)
Mother characteristics					
Highest grade	0.004	0.010	0.012	0.021	0.016
	(0.014)	(0.020)	(0.015)	(0.018)	(0.016)
Can read	0.029	0.105	0.022	-0.088	0.023
	(0.120)	(0.131)	(0.132)	(0.132)	(0.119)
Family size					
HH size	0.016	0.011	-0.024	0.002	0.001
	(0.023)	(0.019)	(0.030)	(0.028)	(0.028)
$>$ 2 adults in HH	-0.122	0.065	0.044	0.059	0.022
	(0.086)	(0.098)	(0.089)	(0.074)	(0.090)
Wants more children					
Unsure	0.128	0.063	-0.161	0.107	0.020
	(0.131)	(0.126)	(0.123)	(0.161)	(0.139)
Wants more	0.038	-0.081	-0.036	0.008	-0.031
	(0.074)	(0.080)	(0.078)	(0.074)	(0.074)
Birth order					
2	-0.193*	-0.110	-0.118	-0.025	-0.148
	(0.098)	(0.111)	(0.109)	(0.105)	(0.105)
3	-0.205*	-0.169	-0.110	-0.103	-0.204
	(0.122)	(0.148)	(0.125)	(0.123)	(0.135)
$\geq$4	-0.414***	-0.225	-0.186	0.034	-0.275**
	(0.143)	(0.155)	(0.142)	(0.124)	(0.137)
Son-biased fertility					
Newborn	-0.208	0.067	0.046	0.094	-0.000
	(0.135)	(0.137)	(0.133)	(0.119)	(0.135)
Pregnant	0.139	-0.018	-0.007	-0.012	0.033
	(0.114)	(0.123)	(0.100)	(0.105)	(0.111)
1	-0.041	0.004	-0.044	-0.034	-0.037
	(0.095)	(0.098)	(0.086)	(0.072)	(0.080)
$\geq$2	-0.094	0.061	0.073	-0.130	-0.014
	(0.162)	(0.139)	(0.185)	(0.150)	(0.158)
Subdistrict fixed effects	✓	✓	✓	✓	✓
Observations	894	894	894	894	894
Adjusted R^2	0.034	0.025	0.032	0.023	0.041

Note: All covariates as shown. All estimations include subdistrict fixed effects. Standard errors areclustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: OLS robustness checks using additional controls

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Cognitive						
Girl x Son preference	-0.157	-0.153	-0.149	-0.101	-0.103	-0.137
	(0.135)	(0.135)	(0.135)	(0.136)	(0.132)	(0.135)
Girl	0.034	0.031	0.034	0.021	0.021	0.034
	(0.085)	(0.085)	(0.085)	(0.083)	(0.082)	(0.086)
Son preference	0.068	0.067	0.061	0.054	0.058	0.058
	(0.121)	(0.120)	(0.120)	(0.124)	(0.122)	(0.120)
Adjusted R^2	0.034	0.032	0.034	0.039	0.041	0.032
Language						
Girl x Son preference	-0.300**	-0.292**	-0.295**	-0.250**	-0.262**	-0.283**
	(0.117)	(0.114)	(0.115)	(0.120)	(0.116)	(0.116)
Girl	0.187**	0.182**	0.187**	0.132*	0.137**	0.180**
	(0.073)	(0.071)	(0.073)	(0.066)	(0.065)	(0.073)
Son preference	0.180*	0.182*	0.176*	0.153	0.167*	0.179*
	(0.096)	(0.096)	(0.094)	(0.093)	(0.090)	(0.096)
Adjusted R^2	0.025	0.025	0.025	0.025	0.026	0.026
Motor						
Girl x Son preference	-0.024	-0.013	-0.009	-0.023	-0.012	-0.026
	(0.141)	(0.141)	(0.142)	(0.133)	(0.134)	(0.140)
Girl	-0.166*	-0.175*	-0.166*	-0.209**	-0.213**	-0.171*
	(0.088)	(0.089)	(0.087)	(0.082)	(0.082)	(0.087)
Son preference	-0.078	-0.077	-0.090	-0.059	-0.071	-0.074
	(0.100)	(0.098)	(0.100)	(0.103)	(0.100)	(0.100)
Adjusted R^2	0.032	0.034	0.036	0.041	0.042	0.032
Socioemotional						
Girl x Son preference	-0.263*	-0.261*	-0.255*	-0.209	-0.206	-0.220
	(0.142)	(0.142)	(0.140)	(0.148)	(0.145)	(0.135)
Girl	0.195**	0.194**	0.195**	0.133*	0.130*	0.186**
	(0.077)	(0.076)	(0.076)	(0.074)	(0.074)	(0.077)
Son preference	0.075	0.073	0.069	0.038	0.040	0.059
	(0.093)	(0.094)	(0.092)	(0.101)	(0.098)	(0.092)
Adjusted R^2	0.023	0.021	0.023	0.017	0.019	0.024
All development						
Girl x Son preference	-0.259*	-0.251*	-0.247*	-0.208	-0.208	-0.236*
	(0.135)	(0.134)	(0.133)	(0.131)	(0.129)	(0.132)
Girl	0.086	0.080	0.086	0.029	0.028	0.079
	(0.083)	(0.083)	(0.082)	(0.074)	(0.072)	(0.082)
Son preference	0.096	0.096	0.086	0.079	0.082	0.088
	(0.102)	(0.101)	(0.101)	(0.103)	(0.101)	(0.102)
Adjusted R^2	0.041	0.041	0.042	0.042	0.044	0.041
SES & HH size & fertility	✓	✓	✓	✓	✓	✓
Sex composition	✓	✓	✓	✓	✓	✓
Subdistrict fixed effects	✓	✓	✓	✓	✓	✓
Age of mother		✓				
HNWASH intervention			✓			
Abortion knowledge				✓		
Sample restricted to model 4					✓	
Sample: 10-20m. old children						✓
Observations	894	894	894	822	822	889

Note: Additional controls: age and age squared of mother, treatment group assignment of HNWASH intervention, knowing about abortions and where to get safe abortion. Information is missing for 72 observations. Standard errors are clustered at the panchayat level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: OLS robustness checks allowing for separate effects of "up to god" and "does not matter"

	Cognitive	Language	Motor	Socio-emotional	All development
Girl x Up to god	0.030	-0.269	0.026	-0.139	0.124
	(0.210)	(0.175)	(0.187)	(0.160)	(0.391)
Girl x Son preference	-0.158	-0.445**	-0.006	-0.330**	-0.361
	(0.171)	(0.168)	(0.179)	(0.150)	(0.226)
Girl	0.029	0.351**	-0.200	0.259**	0.131
	(0.138)	(0.133)	(0.143)	(0.113)	(0.153)
Up to god	-0.021	0.142	-0.120	-0.084	-0.058
	(0.151)	(0.137)	(0.132)	(0.107)	(0.137)
Son preference	0.041	0.228	-0.161	-0.001	-0.215
	(0.161)	(0.139)	(0.134)	(0.123)	(0.284)
Adjusted R^2	0.030	0.027	0.031	0.024	0.035
Socioeconomic status	✓	✓	✓	✓	✓
Family size	✓	✓	✓	✓	✓
Son-biased fertility	✓	✓	✓	✓	✓
Sex composition	✓	✓	✓	✓	✓
Subdistrict fixed effects	✓	✓	✓	✓	✓
Observations	894	894	894	894	894

Note: Socioeconomic status: controls for caste category, wealth quintile, BPL card, highest grade completed in the households, highest grade completed of the mother and maternal reading abilities. Family size: controls for household size, the number of adult members exceeding two, birth order, and the wish for more children. Son-biased fertility: controls for having a newborn and current pregnancy. Sex composition: controls for the number of older sons. All estimations include subdistrict fixed effects. Standard errors are clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: OLS estimation in a sample restricted to the instrumental variables sample

	Cognitive	Language	Motor	Socio-emotional	All development
Girl x Son preference	-0.211	-0.288**	0.039	-0.241	-0.243*
	(0.158)	(0.128)	(0.160)	(0.154)	(0.144)
Girl	0.047	0.130	-0.224**	0.172*	0.046
	(0.113)	(0.083)	(0.101)	(0.093)	(0.094)
Son preference	0.046	0.126	-0.141	0.057	0.045
	(0.137)	(0.119)	(0.121)	(0.104)	(0.117)
Household characteristics					
Scheduled caste	-0.035	0.105	-0.138	0.122	0.021
	(0.098)	(0.102)	(0.092)	(0.092)	(0.098)
Scheduled tribe	0.018	0.409	0.192	0.456**	0.359*
	(0.155)	(0.280)	(0.196)	(0.190)	(0.202)
General category	0.041	-0.000	-0.209	0.141	-0.021
	(0.147)	(0.167)	(0.190)	(0.191)	(0.194)
Wealth quintile					
2 (2nd poorest)	0.015	0.070	0.016	0.029	0.039
	(0.141)	(0.125)	(0.127)	(0.159)	(0.134)
3	-0.123	-0.034	0.034	0.062	-0.017
	(0.139)	(0.128)	(0.162)	(0.153)	(0.153)
4	0.044	0.093	0.192	0.083	0.142
	(0.105)	(0.129)	(0.134)	(0.137)	(0.119)
5 (richest)	-0.023	-0.037	0.031	0.014	-0.009
	(0.123)	(0.141)	(0.157)	(0.162)	(0.152)
BPL card	0.133	-0.012	-0.083	0.014	0.023
	(0.103)	(0.083)	(0.106)	(0.081)	(0.084)
Highest grade in HH	0.016	0.022*	0.003	0.008	0.015
	(0.015)	(0.012)	(0.014)	(0.013)	(0.014)
Mother characteristics					
Highest grade	-0.010	0.017	0.001	-0.010	-0.001
	(0.019)	(0.028)	(0.022)	(0.018)	(0.020)
Can read	0.223	0.069	0.118	0.174	0.198
	(0.175)	(0.210)	(0.187)	(0.189)	(0.181)
Family size					
HH size	0.016	0.037	0.002	0.002	0.019
	(0.030)	(0.023)	(0.036)	(0.034)	(0.034)
$>$ 2 adults in HH	-0.067	0.024	0.026	0.050	0.013
	(0.108)	(0.123)	(0.100)	(0.083)	(0.109)
Wants more children					
Unsure	0.065	0.097	-0.144	0.036	-0.004
	(0.151)	(0.135)	(0.142)	(0.158)	(0.156)
Wants more	0.068	-0.107	-0.020	-0.011	-0.035
	(0.086)	(0.099)	(0.097)	(0.090)	(0.094)
Birth order					
3	0.001	-0.080	-0.012	-0.090	-0.072
	(0.109)	(0.132)	(0.100)	(0.093)	(0.107)
$\geq$4	-0.206**	-0.169	-0.112	0.052	-0.163
	(0.099)	(0.148)	(0.128)	(0.121)	(0.128)
Son-biased fertility					
Newborn	-0.482**	0.099	-0.051	0.036	-0.135
	(0.181)	(0.148)	(0.204)	(0.175)	(0.179)
Pregnant	-0.013	-0.145	-0.134	-0.199	-0.171
	(0.116)	(0.164)	(0.126)	(0.151)	(0.133)
Sex composition					
Number of sons					
1	-0.076	-0.026	-0.052	-0.040	-0.063
	(0.098)	(0.098)	(0.092)	(0.078)	(0.087)
$\geq$2	-0.136	0.017	0.047	-0.154	-0.060
	(0.169)	(0.152)	(0.190)	(0.151)	(0.163)
Subdistrict fixed effects	✓	✓	✓	✓	✓
Observations	629	629	629	629	629
Adjusted R^2	0.028	0.026	0.026	0.011	0.034

Note: All covariates as shown. All estimations include subdistrict fixed effects. Standard errors are clustered at the panchayat level and shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.