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Seema Jayachandran
Rohini Pande

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Why Are Indian Children So Short? The Role of Birth Order and Son Preference*

Seema Jayachandran
Northwestern University

Rohini Pande
Harvard University

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Abstract

Stunting due to malnutrition is widespread in India, such that Indian children are shorter than their counterparts in poorer regions like Sub-Saharan Africa. Using data on over 174,000 children from demographic and health surveys, we show that Indian firstborns are actually taller than African firstborns, and that the Indian height disadvantage emerges with the second child and then increases with birth order. India's steep birth order gradient persists when we compare siblings. Several factors suggest that the culture of eldest son preference underlies India's high rate of stunting: the Indian firstborn height advantage only exists for sons, and the drop-off varies with siblings' gender – as well as by religion and region within India – in ways consistent with the hope for a male heir determining Indian parents' fertility decisions and their allocation of resources among their children.

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1 Introduction

One in four children under age five worldwide is so short as to be classified as stunted (UNICEF, 2014). Child stunting – a key marker of child malnutrition – casts a long shadow over an individual's life: on average, people who are shorter as children are less healthy, have worse cognitive skills, and earn less.[1]

Half of the world's stunted children live in Asia and one third in Africa. In sharp contrast to the experience of western countries during the last two centuries (Floud, Fogel, Harris, and Hong, 2011), recent economic growth in Asia and Africa has only modestly impacted height (Deaton, 2007). India, in particular, stands out: Between 1992 and 2005, India's economic growth exceeded 6 percent per year, yet stunting declined by just 0.6 percentage points (1.3 percent) per year (Tarozzi, 2012) and close to 40 percent of Indian children remain stunted (IIPS, 2010). Figure 1 graphs average child height-for-age for Sub-Saharan African (SSA) countries and Indian states against income. Both regions demonstrate a positive correlation between income and child height, but the intercept for India is significantly lower. Given that India performs better than SSA countries on most health and development indicators, this contrast is striking and forms the focus of this paper.[2]

We begin by showing that the height drop-off for later-born children in India exceeds that in Africa: Height-for-age for firstborn children is *higher* in India than in Africa. The Indian height disadvantage materializes for second-born children and increases for third and higher order births, at which point mean height-for-age for Indian children is lower than that of African children by 0.3 standard deviations of the worldwide distri-

[1]Stunting is defined as having a height-for-age that is 2 standard deviations or more below the worldwide reference population median for one's gender and age in months. Taller people have greater cognitive skills (Glewwe and Miguel, 2007), fewer functional impairments and better immunocompetence (Barker and Osmond, 1986; Barker et al., 1993; Falkner and Tanner, 1989), and higher earnings (Strauss and Thomas, 1998; Case and Paxson, 2008). A 30-year study of a cohort of Guatemalan children found that taller children received more schooling and demonstrated better cognitive skills, increased household per capita expenditure and a lower probability of living in poverty (Hoddinott et al., 2013). Data from 15 European countries show that the positive correlation between height and cognitive function exists for individuals across countries (Guven and Lee, 2011). An individual's adult and child height are highly correlated (Tanner et al., 1956).

[2]A partial list of indicators on which India outperforms SSA countries include maternal mortality, life expectancy, food security, poverty incidence, and educational attainment. (Gwatkin et al., 2007). In contrast, UNICEF (2013) finds that India has the fifth highest stunting rate among 81 low-income and low middle-income countries with comparable child height data, despite being in the middle of the group (rank 43) for GDP per capita. India accounts for roughly 30 percent of stunted children worldwide.

bution. We observe the same pattern when the estimation only exploits between-sibling variation, demonstrating that birth order is not proxying for other differences between smaller and larger families. Finally, the steeper drop-off with birth order in India than Africa also holds for an array of prenatal and postnatal health inputs.[3]

We propose that a preference for eldest sons in India – encompassing both a desire to have at least one son and for the eldest son to be healthy – leads to parents' allocating resources unequally across children and, therefore, to the steep birth order gradient in height. Eldest son preference can be traced to at least two aspects of Hindu religion. First, Hinduism prescribes a patrilocal and patrilineal kinship system: aging parents typically live with their eldest son and bequeath property to him (Dyson and Moore, 1983; Gupta, 1987). Second, Hindu religious texts emphasize post-death rituals which can only be conducted by a male heir. These include lighting the funeral pyre, taking the ashes to the Ganges River, and organizing death anniversary ceremonies (Arnold et al., 1998).

The data support several testable predictions afforded by our hypothesis. First, the Indian height advantage for firstborns only exists among boys while, averaged across birth orders, the Indian height deficit only holds among girls.

Second, the degree of the birth order gradient depends on sibling composition. Eldest son preference and birth order preference are difficult to disentangle in families with just boys (since a lower birth order son is more likely to be the family's first son). Variation in sibling composition is informative on this: Among boys, a son born at birth order 2 is taller in India than Africa if and only if he is the family's eldest son.[4]

Turning to girls, sibling composition affects the resources they receive in two ways, both of which disfavor later-born daughters compared to earlier-born ones. First, a girl born at later birth order has (by definition) more older siblings, so her family is more likely to have an eldest son when she is born, and he will receive a large share of the

[3] Child hemoglobin levels and weight-for-age also exhibit a steeper birth order drop-off in India.

[4] We show that our results are robust to gender being potentially endogenous due to sex-selective abortions. Other papers examining gender variation in height in India include Mishra, Roy, and Retherford (2004) and Pande (2003) who used earlier National Family Health Survey (NFHS) rounds to show that stunting in India varies with the gender composition of siblings. We differ from this work by showing how the gender composition effects are rooted in fertility behavior and how they generate a birth order gradient (and also by analyzing India relative to a comparison group). Tarozzi and Mahajan (2007) show that child height improved more for boys than girls between the first two NFHS waves. Also related is Coffey, Spears, and Khera (2013) who compare first cousins living in the same Indian joint household and show that children born to the younger brother in the household do worse, potentially due to their mother having lower status within the household.

family resources. This phenomenon of girls being disadvantaged when they compete with brothers has been dubbed the "sibling rivalry" effect (Garg and Morduch, 1998; Pande, 2003).

Second, a later-born daughter is disadvantaged even if she does not have any older brothers. The reason relates to fertility stopping rules. When a daughter is born into a family with only girls, her parents are likely to keep having children in their quest for a son, exceeding their originally desired family size. Thus, the birth of a late-parity girl is akin to a negative income per capita shock for the family, and fewer resources are expended on her.

Through these mechanisms, eldest son preference generates a birth order among girls, and it is theoretically ambiguous whether having an older brother helps or hurts a girl. For the India-Africa height gap, we find that girls without an older brother do worst of all, pointing to the importance of the fertility-stopping mechanism. One can also see how son-biased stopping rules hurt later-born daughters by comparing prenatal and postnatal investments. Sibling rivalry affects both types of investments in girls, but the fertility effect – where parents realize they need to try again for a son – only kicks in at the postnatal stage. We find that, relative to Africa, girls in India experience a larger drop-off in resources postnatally if their family does not yet have an eldest son.

Finally, religious and regional variation in the birth order gradient within India also points to a role for eldest son preference. Consistent with Islam placing less emphasis on having a son, when we compare Indian Hindu and Muslim families we only observe the steep birth order gradient in height for Hindu families. In addition, the height gradient is absent in Kerala, an Indian state with strong matrilineal traditions.

Explanations for the Indian birth order patterns that are unrelated to son preference – such as genetics – are unlikely to explain the observed patterns by child and siblings' gender (Panagariya, 2013).[5] At the same time, our results do not rule out a role for genetics or other explanations for why Indian children are short: A back-of-the-envelope calculation suggests that the mechanism we highlight—parents' unequal allocation across their children—explains half of the puzzle of India's high stunting. Our results are silent on what explains the other half and are potentially complementary to other research

[5] Even an epigenetic explanation – where interaction between environmental factors and the genome affects gene expression – seems implausible given that the same Indian children who are stunted also receive fewer prenatal and postnatal inputs. In any case, to cause the observed height patterns by birth order and gender composition in India, the environmental factor interacting with genetics would still likely need to be eldest son preference.

that relates environmental factors and child height, such as Spears (2013) who focuses on open defecation as a cause of the Indian height disadvantage.[6]

A large literature examines how cultural gender preferences and gender gaps in perceived returns to investment cause unequal resource allocation across siblings (Rosenzweig and Schultz, 1982; Behrman, 1988; Garg and Morduch, 1998; Oster, 2009). Our contribution is to show how gender preferences, by accentuating birth order gradients, can explain a significant fraction of child stunting in India. To the best of our knowledge, ours is also the first paper to examine how cultural norms of son preference influence birth order effects.[7] Finally, we contribute to the literature on the unintended consequences of son preference by demonstrating how dynamic fertility decisions cause inequality in health outcomes between genders, among brothers, and even among sisters (Sen, 1990; Clark, 2000; Jensen, 2003; Jayachandran and Kuziemko, 2011).

The remainder of the paper is organized as follows. Section 2 describes the data and presents descriptive statistics for the sample. Section 3 presents evidence on the birth order gradient in the Indian height disadvantage, and Section 4 presents evidence on eldest son preference as the root cause. Section 5 tests alternative explanations for the within-family patterns. Section 6 concludes.

2 Background and Data Description

Net nutritional intake in childhood – the nutrients consumed less those lost due to the disease environment – is reflected in child height and subsequently in adult height. The established link between child stunting and adverse long-term outcomes, as well as the relative ease of measuring child height (versus, say, keeping a comprehensive food diary for a child) has led to the widespread use of height as a marker of child malnutrition. However, and especially for cross-country comparisons, it is important to account for the other key factor determining height: genetic potential. A common norm, and one we follow, is to create the child's height-for-age z-score based on the

[6]Coffey et al. (2013) discuss several pieces of evidence against a role for genetics in explaining India's height deficit. One way researchers have tested for a genetic explanation is to examine whether wealthy and well-fed Indian children are short by international standards. The findings are mixed (Bhandari et al., 2002; Tarozzi, 2008; Panagariya, 2013). Another approach is to examine the height of Indian children who migrate to rich countries; most authors find that the gap between Indian-born children and worldwide norms narrows but does not close (Tarozzi, 2008; Proos, 2009).

[7]Several studies document birth order gradients in outcomes as varied as IQ, schooling, height, and personality (Behrman and Taubman, 1986; Sulloway, 1996; Black, Devereux, and Salvanes, 2007; Belmont, Stein, and Susser, 1975; Horton, 1988).

World Health Organization (WHO) growth standard for children aged 0 to 5 years. The WHO standard is designed as a universally applicable standard, describing how children should grow if they receive proper nutrition and health care. It is premised on the fact that the height distribution among children under age five who receive adequate nutrition and health care has been shown to be similar in most ethnic groups (de Onis et al., 2006; WHO, 2006). The WHO constructs the distribution of height using a sample of children from six affluent populations across five continents (children from Brazil, Ghana, India, Norway, Oman and the United States with no known health or environmental constraints to growth and who were given recommended nutrition and health inputs) (WHO Multicentre Growth Reference Study Group, 2006b). A z-score of 0 represents the median of the gender- and age-specific reference population, and a z-score of -2 indicates that the child is 2 standard deviations below that reference-population median, which is the cutoff for being considered stunted.

The 2005-06 National Family Health Survey (NFHS-3) is our data source for Indian children; it is the most recent large Indian survey that collects child height data and employs the same sampling methodology and survey instrument as the internationally-used Demographic and Health Surveys. Following the previous literature on the puzzle of Indian malnutrition, we use Sub-Saharan African children as the comparison group for Indian children (Ramalingaswami, Jonsson, and Rohde, 1996). Sub-Saharan Africa's level of development is similar to (but, on average, lower than) India. The comparison group comprises the 25 Sub-Saharan African countries where Demographic and Health Surveys collected child anthropometric data and occurred between 2004 and 2010 (to ensure a comparable time period to NFHS-3). Throughout this paper, the "DHS sample" refers to the set of 27 Demographic and Health Surveys for 25 Sub-Saharan African countries plus India's NFHS-3. Our robustness checks also use DHS surveys from other regions.

The DHS interviews 15 to 49 year old women, and measures height for their children age five and under. Our sample comprises the 174,157 children with anthropometric data. Table 1 provides summary statistics, and the Data Appendix provides other survey details.

The average child age in our sample is 30.1 months in India and 28.1 months in Africa. The average height-for-age z-scores in India and Africa are -1.58 and -1.44, respectively. We define child birth order based on all children ever born to a mother, currently alive or deceased. As African women have more children (3.9) than their Indian counterparts (2.7), the mean birth order Africa (3.7) is higher than in India (2.6). Lower total fertility in India implies that despite similar mothers' age at first birth (on average, 20 years old in India and 19 years old in Africa), the mother's average age at birth for children in our sample is lower in India (25 years) than Africa (27 years). The average spacing between births is similar in India (36 months) and Africa (39 months).

We also use data on prenatal and postnatal health-related behaviors. Prenatal behavior includes the number of prenatal care visits, whether the pregnant woman received tetanus shots and iron supplementation, and delivery at a facility; India typically outperforms Africa on these measures. (For example, 69 percent of the time, pregnant women in India took iron supplements, compared to 62 percent in Africa.) Data on health inputs for young children include whether he or she had a medical checkup within the first two months of life, whether he or she was given iron supplementation, and the total number of vaccinations. India has higher vaccination rates, while postnatal checkups and child iron supplementation are more common in Africa. Two additional child health outcomes we examine are blood hemoglobin and weight-for-age. Child hemoglobin is higher in India, while weight-for-age is higher in Africa.

Table 1 also summarizes our control variables including maternal literacy, which is higher in India, and living in a rural area, which is more common in Africa. The DHS wealth index measures a household's relative wealth within its country, so the level is not comparable across countries. The Data Appendix describes additional outcomes examined in the Appendix Tables and variables used for heterogeneity analysis.

3 Birth Order and Child Outcomes

In this section we examine the birth order gradient in child height across India and SSA countries, and then do the same for parental inputs that might influence child health outcomes, including height.

3.1 Child height

Figure 2 plots the average child height-for-age (HFA) z-scores for India and SSA countries, separately by birth order. Among firstborn children, height in India exceeds that in Africa. An Indian deficit emerges at birth order 2 and widens for birth order 3 and higher.

Table 2 examines this pattern via regression analysis. In column (1) we show the average India-Africa gap, pooling all children. Indian children are, on average, 0.11 standard deviations shorter than African children.

In column (2) we disaggregate this height disadvantage by birth order. The outcome variable remains HFA for child i born to mother m in country c.

$$\begin{aligned} HFA_{imc} &= \alpha_1 I_c + \alpha_2 I_c \times 2^{nd}Child_{imc} + \alpha_3 I_c \times 3^{rd+}Child_{imc} + \beta_1 2^{nd}Child_{imc} \\ &\quad + \beta_2 3^{rd+}Child_{imc} + \gamma X_{imc} + \epsilon_{imc} \end{aligned} \quad (1)$$

I_c is an indicator for Indian children. α_1 is the India gap for firstborn children (omitted birth order category), and α_2 and α_3 capture how the gap differs for second-born children and third-and-higher birth order children. X_{imc} is a vector of controls that always includes linear, quadratic and cubic terms for a continuous survey month-year variable (to control for differences in survey timing) and child age dummy variables (in months, to control for sampling differences between India and Africa and to improve precision). In some specifications it also includes mother's age, child's age and household covariates interacted with the India dummy (plus main effects). Throughout, standard errors are clustered at the mother level.[8]

The India main effect shows that Indian firstborns are significantly taller than African firstborns. The Indian height disadvantage opens up at birth order 2: The interaction of India and being second-born is −0.17 and highly significant. The Indian disadvantage then increases, with third and higher births having a height z-score gap of −0.32 compared to African children (sum of main effect and interaction term).

India is richer than Africa, so even the height of Indian firstborns is below that predicted by India's GDP. Using Appendix Figure 1, an accounting exercise shows that if all Indian children received the same resources as firstborns do, then half the gap between India and Africa would be closed. Our results do not speak to what explains the rest of the gap, but the several possibilities proposed in the literature include genetics, sanitation and dietary patterns.

Households where a second- or third-born child is observed in the data, on average, have a larger family size than households where a firstborn child is observed, and higher-

[8] The standard errors are similar if we cluster by primary sampling unit (PSU) instead. For Table 2, column (2), the standard error (s.e) for $India$ becomes 0.028 instead of 0.023, the s.e. for $India \times 2^{nd}Child$ remains 0.030, and the s.e. for $India \times 3^{rd+}Child$ becomes 0.030 instead of 0.029.

fertility households differ along several dimensions. Thus, a key omitted variable concern is that the birth order variable in between-household comparisons could be proxying for high-fertility families (Black, Devereux, and Salvanes, 2007). The DHS sampling strategy restricts our ability to directly control for family size. Specifically, a large fraction of interviewed women have yet to complete their fertility, and we only have height data for children age 5 and younger. Birth order and family size are collinear for households where we only observe height for one (the youngest) child, which is most of our sample. Given this, we address the family size concern in multiple ways.

First, in column (3) we control for household covariates that predict completed fertility. Specifically, we include three household covariates and their interactions with the India dummy: a household wealth index, whether the mother is literate, and whether the household is rural. These characteristics are highly correlated with observed fertility among women in the DHS who have likely completed their fertility (i.e., are aged 45 and above). Literate women have one fewer child than illiterate women, fertility is higher by 0.5 children in rural areas, and a 1 standard deviation change in the wealth index is associated with 0.4 fewer children. Addition of these control variables reduces the magnitude but not significance of the $I_c \times 2ndChild$ and $I_c \times 3rd{+}Child$ coefficients.

Next, we control for maternal and child age. Conditional on current family size, maternal age is predictive of eventual total fertility. Moreover, higher birth order children are born to older mothers, so the birth order gradient might reflect an India-Africa gap in the effect of maternal age at birth on child height. Meanwhile, child age is correlated with birth order; among siblings, the higher birth order child will, by definition, be younger. Column (4) shows that the coefficients on $I_c \times 2^{nd}Child$ and $I_c \times 3^{rd+}Child$ are essentially unchanged when we control for $I_c \times MotherAge$ and $I_c \times ChildAge$, where both mother's age at birth and child's age are measured continuously (we continue to control for child age dummies).[9]

Finally, in column (5) we report regressions which include mother fixed effects and therefore only use within-family variation for identification. This allows us to fully control for family size differences by making within-family comparisons. Because birth order and child's age are strongly correlated within a family, we continue to control for $I_c \times ChildAge$. The effective sample size is much smaller: the birth order coefficients

[9]We are *de facto* also controlling for mother's current age, which is a linear combination of child's age and mother's age at birth.

are identified off the 42,524 children (13,550 for India and 28,974 for Africa) with one or more siblings in the sample with a different birth order than them (i.e., not simply multiple births) and where at least one sibling is birth order 1 or 2 (so that not all siblings fall in our $3^{rd+}Child$ category). The Indian birth order gradient remains statistically significant, and the results are similar to the unadjusted results in column (2). The larger magnitude of the India birth order gradient in column (5) relative to columns (3) and (4) suggests that, conditional on the household covariates, unobserved differential selection of Indian households into higher fertility is positive. We also observe a negative birth order gradient in Africa (the coefficients on $2^{nd}Child$ and $3^{rd+}Child$ are negative and significant), consistent with findings in many settings that low-parity children have better outcomes. The key finding is that the birth order gradient in child height is twice as large in India as in Africa.

Height data are available only for children under age 5, raising the concern of shorter birth spacing among the siblings that identify the mother fixed effects estimates. Reassuringly, average birth spacing in this subsample is reasonably high and similar across India and Africa (26 months versus 29 months). Moreover, as the mother fixed effects specification includes child age (in months) dummies we are *de facto* controlling for birth spacing between siblings.

Column (6) presents the mother fixed effects results using stunting (HFA z-score ≤ -2), which is used to calculate malnutrition prevalence, as the outcome. Relative to their African counterparts, the disadvantage for Indian second borns is 11 percentage points, and for third borns, 14 percentage points. Thus, the high birth order penalty for stunting is two to three times as large in India as in Africa. Appendix Table 1, column (1) shows a similar pattern using height in centimeters as the outcome. In addition, we report robustness checks related to concerns about polygyny and our definition of birth order based on ever-born children.[10]

We also test whether our findings are robust to accounting for differences in average fertility rates across India and Africa. First, in Appendix Table 2 we show that

[10]Polygamy and polygyny are more common in Africa than India. If a woman is polygynous, then a second or third birth could be her first child with a particular husband, and birth order among the father's children could be what matters for investment levels. (By the same reasoning, polygamy would work against our findings.) Appendix Table 1, column (2) shows similar results when we restrict the sample to mothers who have only had children with one partner. Column (3) shows our results are robust to considering an alternative (but more endogenous) definition of birth order, namely birth order among currently living children.

differentially steep birth order gradients in India hold up for subsamples that hold family size constant. Column (1) considers the sample of children from families where the mother has given birth to exactly two children. (This sample construction implies that the regression excludes $3^{rd+}Child$ coefficients.) Column (2) shows the results for family size of 3. We lack statistical power to examine family size of 4 or higher because almost all surveyed children in these families fall in the $3^{rd+}Child$ category. Columns (3) and (4) provide results for family size of 2 and 3 for the subset of children with a sibling in the sample. Finally, we use mother fixed effect specifications for two robustness checks: restricting the sample to children who are birth order 4 and below (column 5) and excluding African countries with fertility that is above the median of our full African sample (column 6). While these various sample restrictions imply less precisely estimated coefficients, the point estimates remain similar to our main results.

Appendix Table 3 reports a placebo test to examine whether India truly is an outlier in terms of its birth order gradient. We compare each country in our sample to the remaining countries grouped together. India is the only country with a significantly steeper birth order gradient than the rest of the sample. This holds up even when, to account for India's relatively larger sample size, we aggregate African countries to regions. As a second placebo test, we use the 25 African countries and 29 Indian states in our sample, randomly select 29 countries or states to comprise a placebo "India," and estimate the differential "Indian" birth order gradient, repeating the exercise 500 times. Appendix Figure 2 shows that the actual $India \times 2^{nd}Child$ and $India \times 3^{rd+}Child$ coefficients are in the bottom 1 percent of the distribution of estimates, i.e., have a p-value < 0.01.

To examine whether what we interpret as an abnormally steep birth order gradient in India is actually an abnormally shallow gradient in Africa, Appendix Table 4 considers alternative comparison groups. In columns (1)-(3) we define the comparison group economically rather than geographically. The comparison group comprises 23 country surveys (between 2004 and 2010) for which country GDP per capita in the survey year was within 50 percent (either higher or lower) of India's 2005-06 GDP per capita. India exhibits a stronger birth order gradient than this alternative comparison group. In column (4) we replace India by Sub-Saharan Africa and find that, unlike India, the relative birth order gradient in Africa is statistically indistinguishable from this comparison group. In columns (5)-(8) we define the comparison group in terms of (relative) genetic similarity. Recent genome studies that use modern-day genetic distance between ethnic groups to reconstruct prehistoric migration patterns find evidence of Indo-European migration and genetic similarity between India, Europe, Central Asia, and West Asia (Cavalli-Sforza, Menozzi, and Piazza, 1994). We use 16 European and Central and West Asian countries with DHS surveys as the comparison group, and again find a stronger birth order gradient in India than in the comparison group (columns 5-7).[11] In column (8) we show that there is no differential birth order gradient between our Sub-Saharan African sample and the European comparison group.

3.2 Child investments

The steeper birth order gradient in height in India relative to Sub-Saharan Africa (and other comparison groups) – that persists even when we only make comparisons within families – suggests that take-up of services, not access *per se*, underlies the Indian height deficit. We now directly examine birth order gradients in prenatal and postnatal investments in children.

In Table 3, columns (1) to (4), the outcome variables are based on retrospective information about inputs *in utero* and at childbirth, typically only for the youngest child in the family (rendering the sample smaller and mother fixed effect specifications infeasible). To address selection concerns, all regressions include household covariates (wealth index, female literacy, and rural residence), child's and mother's age, and their interactions with the India dummy (i.e., same specification as Table 2, column 4). On average, Indian women are more likely to obtain prenatal care, take iron supplements, and receive tetanus shots during pregnancy but are less likely to deliver at a health facility. However, for all outcomes other than tetanus shots, we observe a sharper decline with birth order in India than in Africa. The gradient magnitudes are large enough that for two of the three inputs where the India average exceeds the Africa average (prenatal visits and iron supplementation), later-born Indian children get fewer inputs than their African counterparts.[12]

Columns (5) to (7) consider three postnatal investments. The prevalence of postnatal checkups is much lower in India than Africa (reflecting an Indian social norm of

[11] One difference is the absence of a firstborn advantage in India, which is unsurprising given that these comparison groups are significantly richer than the Sub-Saharan Africa comparison group.

[12] As we control for household covariates interacted with India, the tables do not report the gap among firstborns (i.e., the main effect for India). The comparison of absolute levels is based on a specification without household covariates.

maternal home confinement for forty days after birth) and child iron pill consumption is also lower. However, Indian children are more likely to get vaccinated. There is no differential birth order gradient across India and Africa for postnatal checkups and iron pill consumption. In contrast, vaccinations show a strong negative India birth order gradient.[13] Next, we create indicator variables representing the columns (1) to (7) inputs (for more details, see Data Appendix). In column (8) we estimate an input-level regression, and continue to observe a steeper birth order gradient for India.

To the extent that child health inputs affect child height, this birth order gradient in health inputs is consistent with a behavioral basis for the height birth order gradient. Columns (9) and (10) show that the steeper birth order gradient in India is also present for two other dimensions of child health: children's weight-for-age and hemoglobin level.

Finally, we examine the concern that mortality selection may underlie India's strong birth order gradient. Specifically, since infant mortality in India is lower than Sub-Saharan Africa we might expect that relatively weak (and short) children are more likely to survive through childhood in India than Africa. This, in turn, would lower observed average child height among later borns in India relative to Africa. However, consistent with later-born Indian children being relatively more malnourished, we observe the opposite pattern in column (11): later birth order children exhibit significantly higher infant mortality in India relative to Africa. This militates against the possibility that mortality selection underlies the steeper height gradient in India.

4 Culture and Height Deficits

Roughly four fifths of India's population is Hindu. Hinduism is a religion that emphasizes the importance of male heirs – for propagating the bloodline, for inheritance, for old-age care of parents, and for cremation rituals. This, in turn, causes many Hindu families to invest differentially in their male heir (i.e., eldest son) and to follow son-biased fertility stopping rules to ensure they have a male heir.

We argue that the prevalence of this preference for eldest sons in India, but not Africa, underlies India's especially steep birth order gradient and can thus partially explain India's relative height deficit. Below, we first develop and test the implications of eldest son preference for gender gaps in child height and birth order gradients. Next,

[13] We do not examine breastfeeding as an outcome because the choice of how long to breastfeed is determined both by its health benefits and subsequent fertility (Jayachandran and Kuziemko, 2011).

we exploit variation in child gender by birth order to test predictions about how sibling composition influences child investments. We conclude by discussing the robustness of our results to endogenous child gender (due to sex-selective abortions).

4.1 Favoritism toward eldest sons and birth order gradients

Eldest son preference generates a birth order gradient among boys in a straightforward way: Among boys, the oldest one will, by definition, have the lowest birth order, and he will be favored over his siblings.

Among girls, eldest son preference disfavors later-born girls in two ways. First, a later born girl, by virtue of having more older siblings, is more likely to be born into a family with an eldest son and be in competition with him for resources.

Second, parents' desire for an eldest son affects their fertility decisions. The birth of a girl into a family with only daughters is associated with parents having a greater desire for additional children. For parents without a son, each additional daughter's birth causes an upward revision of fertility plans and reduced expenditure on the most recently born daughter (in order to save for their prospective eldest son).

Consider a family with fixed resources with a desired fertility of two children that wants at least one son.[14] *Ex ante* the preferences are compatible because the likelihood of any child being male is (very close to) 50 percent. If the firstborn child is a daughter, the parents realize that they may need to exceed their desired fertility to ensure a son. They will decide how much to spend on this daughter given their available resources and an expected family size of three. Now suppose their second child is also a girl. The parents now certainly need to exceed their desired fertility of two in order to have a son. Consequently, the second daughter will receive fewer early-life resources than her older sister because the expected family size has increased from three to four.

Moreover, parents might only fully update their fertility plans when it becomes certain that they will need to exceed their desired fertility. Such myopia would amplify the extent to which the birth of a second or later daughter is a positive shock to expected family size and thus to future expenses. Hence, even absent any parental preference for the eldest daughter relative to later-born daughters, updating of fertility plans combined with fixed household resources imply fewer investments in later-born daughters.

To show how eldest son preference differentially affects fertility decisions in India

[14]In our data, the majority of Indian mothers report an ideal family size of 2 children.

and Africa, we examine mothers' desire to have additional children using our sample of women. Specifically, denoting this outcome as Y, we estimate:

$$\begin{aligned} Y_{icm} &= \alpha_1 I_c + \alpha_2 I_c \times 2^{nd}Child_{imc} + \alpha_3 I_c \times 3^{rd+}Child_{imc} + \delta_1 I_c \times Girl + \delta_2 I_c \times NoElderBro \\ &+\delta_3 I_c \times Girl \times NoElderBro + \beta_1 2^{nd}Child_{imc} + \beta_2 3^{rd+}Child_{imc} + \delta_4 Girl \times NoElderBro \\ &+\delta_5 Girl_{imc} + \delta_6 NoElderBro_{imc} + \gamma X_{imc} + \epsilon_{imc} \end{aligned} \quad (2)$$

This is an expanded form of equation (1), where the key additional regressors are the interaction of the India dummy with a dummy for having no older brother ($NoElderBro$) and the triple interaction between India, having no older brother, and being a girl ($I \times Girl \times NoElderBro$).

Column (1) of Table 4 reports the results. The negative India dummy indicates lower desired fertility among Indian mothers relative to their African counterparts. The negative coefficient on $I_c \times NoElderBro$ indicates that the desire for additional children is even lower among Indian mothers who have had their eldest son. In contrast, the coefficient on $I_c \times Girl \times NoElderBro$ is large, positive, and statistically significant – the birth of a girl in a family with only daughters increases Indian mothers' relative desire for additional children. As the specification controls for birth order and its interaction with India, this is not simply a recast of the birth order patterns: Conditional on birth order, the gender composition of children strongly influences Indian mothers' preferences over fertility continuation. These findings are robust to controlling for household covariates, child's age, and mother's age interacted with India (column 2).

Thus, on average, Indian families follow a fertility stopping rule that is sensitive to child gender. A corollary is that households that have daughters at low birth parity are more likely to exceed their desired fertility. Thus, daughters in India often belong to larger-than-planned families that lack adequate resources for their children (Clark, 2000; Jensen, 2003). This leads to a first prediction.

Prediction 1. *The India-Africa height gap will be more pronounced among girls.*

Table 4, column (3) summarizes the average gender bias in the Indian height deficit. The India dummy is small and insignificant and the coefficient on $India \times Girl$ is -0.18. Thus, overall, only Indian girls show a child height disadvantage relative to Sub-Saharan Africa. In column (4) we include household covariates and in column (5) we estimate a regression with mother fixed effects. Across columns, the coefficient of $India \times Girl$ decreases somewhat but remains significant.

Fertility stopping behavior engendered by son preference - and relatedly, higher investments in the eldest son – implies a gender gap in child outcomes, but is not the only explanation for it. Data shows that, even conditional on family size, Indian parents invest relatively more in their sons. For example, boys who are not the eldest son fare relatively better in India than girls born after the eldest son, indicating that son preference extends beyond the eldest son. Thus, while consistent with eldest son preference, India's relative gender gap in height is a weaker test of our specific hypothesis than the predictions below.

The second prediction is that son preference accentuates birth order gradients, both because of later-born children's need to compete for resources with the eldest son and because of son-biased fertility stopping rules:

Prediction 2. *Relative to African counterparts, both boys and girls in India will exhibit a steeper birth order gradient.*

To test this prediction we estimate:

$$\begin{aligned} Y_{icm} \quad = \quad & \alpha_1 I_c + \delta_1 I_c \times Girl + \delta_2 I_c \times Girl \times 2^{nd}Child_{imc} + \delta_3 I_c \times Girl \times 3^{rd+}Child_{imc} \\ & + \beta_1 2^{nd}Child_{imc} + \beta_2 3^{rd+}Child_{imc} + \beta_3 Girl \times 2^{nd}Child_{imc} + \beta_4 Girl \times 3^{rd+}Child_{imc} \\ & + \beta_5 Girl_{imc} + \alpha_2 I_c \times 2^{nd}Child_{imc} + \alpha_3 I_c \times 3^{rd+}Child_{imc} + \gamma X_{imc} + \epsilon_{imc} \qquad (3) \end{aligned}$$

This is an expanded form of equation (1), where the key additional regressors are the triple interaction between India, birth order and being a girl. We are interested in δ_2 and δ_3, noting that these effects are conditional on birth order.

Column (6) of Table 4 shows a similarly steep birth order gradient for Indian boys and girls; the triple interactions of India, higher birth order, and the girl dummy, while negative, are statistically insignificant. However, unlike with boys, the firstborn height advantage is absent for Indian girls (relative to their African counterparts). Specifically, the main effect for India implies that, on average, firstborn Indian sons are 0.15 z-score points taller than their African counterparts. This effect is absent for girls.

In column (7) we include household covariates, child's age, and mother's age and their interactions with India. The birth order gradient patterns remain similar but the significance of the $India \times Girl$ coefficient decreases. In column (8), we include mother fixed effects and therefore compare children within the same household. While the coefficients are fairly similar, the standard errors increase considerably; we lack statistical power to examine the interaction of gender and birth order within families.

Next, we examine whether, within India, the birth order gradient in height varies with the strength of son preference norms.

Prediction 3. *Within India, the birth order gradient will be muted for social groups and regions that exhibit lower son preference.*

Compared to Hinduism, Islam places less emphasis on needing a son for religious ceremonies, and Islamic inheritance rules disfavor women less. Several papers provide evidence that son preference, in turn, is weaker among Muslims; for example the sex ratio is less skewed among Muslims than Hindus (Borooah and Iyer, 2005) and the gender gap in child mortality is smaller (Bhalotra, Valente, and Soest, 2010). In Table 5, column (1) we see that, relative to Indian Hindus, Indian Muslims have a much more muted birth order gradient.[15]

Next, we compare Kerala and the rest of India. Historically, a distinctive feature of Kerala's social organization has been the prevalence of matrilineality, which has been linked to an absence of son preference (Oommen, 1999). Indeed, according to the 2001 census, Kerala had a male-to-female ratio among children six and younger of 1.04, which is less skewed than any other Indian state (the nationwide average is 1.08) and in line with the naturally occurring ratio. Strikingly, the birth order gradient in height observed in the rest of India is absent for Kerala (column 2). Consistent with this, Figure 1 shows that Kerala is a positive outlier relative to other Indian states and, in fact, child height in Kerala is very similar to that in Africa. Finally, we examine heterogeneity by the child sex ratio, calculated for each state-by-urban cell (which is the finest administrative level at which we can match census sex ratio data to the DHS). The sex ratio, as defined, is increasing in the proportion male. Thus, the prediction is that low-sex-ratio regions should have a smaller birth order gradient, or positive interaction terms, but we do not observe significant evidence of such heterogeneity.[16]

[15]The puzzle of Indian stunting is often framed as a broader South Asian puzzle. Because Bangladesh and Pakistan are majority Muslim, the mechanism we highlight would predict less stunting in Bangladesh and Pakistan than in India. The Pakistan DHS does not have height data, but using Bangladesh data, we find that it is less of an outlier than India in terms of child height; Bangladesh would be below the best-fit line for Africa in Appendix Figure 1 but by roughly half as much as India would be (results available from the authors).

[16]The sex ratio is a poor proxy for eldest son preference because the need to sex-select to obtain one

In columns (4) to (6) we examine heterogeneity within India in child investments, using our pooled sample of prenatal and postnatal inputs. Again, Muslim families exhibit less steep investment drop-offs with birth order than Hindu families, and Kerala has a less steep gradient than other Indian states. States with less skewed sex ratios have a smaller relative disadvantage for birth order 2, as predicted, but not for birth order 3 and higher.

Finally, in columns (7)-(9) we consider infant mortality as the outcome in order to check that differential infant mortality selection does not drive the cross-group differences. If anything, higher birth order children born to Indian Muslims and in low sex-ratio regions show relatively lower infant mortality rates.

4.2 Son-biased fertility and the effects of having a brother

To evaluate the two mechanisms through which later-born girls are disadvantaged – competing with an eldest son and endogenous fertility – we examine how health inputs and height vary with sibling gender composition. The first mechanism is that having a brother worsens outcomes for a girl because she has to compete with him for resources; this is the sibling rivalry mechanism, modified to give special status to one particular brother, namely the eldest son (Garg and Morduch, 1998). The second mechanism is that the birth of a girl with no older brothers causes her parents to exceed their intended fertility to try again for a son, reducing the resources spent on her. Thus, a girl born at late birth order is disadvantaged whether or not she has an older brother.

We test for the existence of the two mechanisms by exploiting their different timing. At the prenatal stage, a girl without an older brother benefits from the absence of sibling rivalry. A further prenatal advantage for a brother-less girl is that her parents will invest in her while she is *in utero* given the 50 percent chance that they are investing in their eldest son.[17] Post-birth, the negative effects of being born a daughter in a family with no sons materialize as the parents re-optimize fertility and expenditure decisions. Thus, at the postnatal stage, not having an older brother disadvantages girls:

Prediction 4. *Relative to African counterparts, later parity girls with no older brothers*

son decreases sharply with desired fertility; the sex ratio thus measures a mixture of son preference and desired fertility (Jayachandran, 2014).

[17] Specifically, relative to postnatal investments, prenatal investments for a daughter will be better (in a family that has no son) as it will be based on expected not realized gender. Later in this section, we discuss robustness to prenatal sex determination.

in India will face larger disadvantages in postnatal than prenatal investments.

To test this, we estimate an input-level regression for the sample of girls (using the pooled input data). Consistent with the negative effect of having no older brother materializing after birth, columns (1) and (2) of Table 6 show a positive and significant coefficient on $I_c \times PrenatalInputs \times NoElderBro$.

Next, we directly examine how height deficits vary with the gender of elder siblings. Among girls, if the fertility stopping mechanism dominates, then Indian daughters with only sisters as elder siblings should do relatively worse than their African counterparts, and vice versa.

Among boys, while eldest sons in India should typically do well, those born at very late parity may suffer as their parents expended resources on a more-than-planned number of daughters. A family with desired fertility of two children and an eldest son born at birth order 1 or 2 need not exceed its desired fertility. By contrast, while an eldest son born at birth order 3 might fare better than his sisters and better than any subsequent sons, across families, he might be disadvantaged relative to eldest sons born at earlier birth order because his family expended resources on his two older sisters and exceeded their desired fertility.

To summarize,

Prediction 5. *Relative to African counterparts, outcomes for Indian children will vary with sibling composition and birth order as follows:*

a. *If fertility stopping effects dominate sibling rivalry effects, then later parity girls with no older brothers will show larger height deficits.*

b. *High birth order eldest sons fare worse than eldest sons born at lower birth order.*

To test (a), we estimate the model described in equation (3), with height as the outcome. The coefficient on $I_c \times NoElderBro$ captures the differential outcome for a family's eldest son in India, and the coefficient on $I_c \times Girl \times NoElderBro$ captures the differential outcome for a girl in India who either only has sisters as older siblings or is the firstborn. In column (3) we observe a positive and significant coefficient on $I_c \times NoElderBro$: relative to his African counterpart, an Indian eldest son enjoys a 0.12 z-score height advantage. The coefficient on $I_c \times Girl \times NoElderBro$ shows that the opposite is true for girls: having no older brother is worse than having an older brother. The net effect for girls of having an elder brother is lower in India than Africa ($I_c \times NoElderBro + I_c \times Girl \times NoElderBro$), but insignificant. The addition of controls in column (4) weakens the significance of these interaction coefficients, but the pattern of lower height for girls in India who only have sisters as elder siblings remains reasonably strong. Thus, the son-biased fertility mechanism appears to slightly dominate, such that not having an older brother on net disadvantages girls.

Column (3) of Table 6 also allows us to examine whether eldest sons born at later parity are still favored, as long as they are born within their family's desired family size. $I_c + I_c \times 2^{nd}Child + I_c \times NoElderBro$, which gives the relative Indian advantage for an eldest son at birth order 2, is positive and significant. Meanwhile, an eldest son born at birth order 3 does worse in India than Africa (p-value of 0.004) which is consistent with Prediction 5(b), assuming that families want two children (the modal preference in India).

In unreported results, we observe a birth order gradient even between the family's second and third sons suggesting that our model cannot explain all birth order patterns across siblings. Nonetheless, taken together the observed patterns in the data point strongly to eldest son preference being an important determinant of resource allocation across siblings and fertility stopping behaviors – and consequently child height – in India.

4.2.1 Robustness to sex-selection

Sex-selective abortions are more common in India than Africa. In this subsection, we discuss how sex selection abortions – which render observed child gender, especially among later parity children, endogenous – could affect our results.

A first concern is differential selection of households into high fertility. For instance, sex-selective abortion appears to be more common among literate mothers in India, who are both more likely to use ultrasound and have more skewed sex ratios for their children. If literate mothers use sex-selection to ensure a son within their desired family size, while illiterate mothers instead adjust family size, then sex selection could cause relative overrepresentation of poorer families at high birth order in India. This selection could cause bias because mother's literacy likely has direct effects on child height. However, Table 2 already showed that our results are not driven by differential household selection into high fertility: the India-Africa gap in the birth order gradient is robust to allowing for differential effects of maternal literacy (and other family characteristics potentially correlated with use of sex selection) in India, and importantly to the inclusion of family fixed effects.

The type of selection problem that remains unaddressed relates to differential selection by child gender. Girls at birth order 2 or 3, for example, might belong to relatively less educated households in India. The selection bias may be exacerbated when we condition on older siblings' gender. For example, more educated Indian households could be overrepresented in the group with a first-born daughter and second-born son.

We therefore conduct multiple robustness checks for Table 6 regressions, which exploit variation in child's gender and siblings' gender. One of the strongest predictors of sex-selection in India is maternal education (Pörtner, 2014). In addition, sex-selection is higher in urban areas.[18] It would be worrisome if the literate or urban subsamples – where the assumption of exogenous child gender is tenuous – drives our results. Appendix Table 5 re-examines the specifications from columns (3) and (4) in Table 6 – how does height vary with whether you have an older brother. We do this first for the subsamples of illiterate women and literate women, followed by rural and urban subsamples in columns (5) to (8). Reassuringly, in both cases the coefficient on $I_c \times Girl \times NoElderBro$ is very similar across the two subsamples.

Finally, consistent with the prediction that the fertility-stopping mechanism that makes having an older brother advantageous is pertinent for the families most likely to use fertility continuation to obtain their eldest son, we observe a stronger negative effect of having no older brother on girls' height when we restrict the Indian subsample to PSUs with very low ultrasound usage (columns 9 and 10). At the same time, since the majority of Indian families use fertility continuation, it is unsurprising that the patterns, while more muted, also hold up for higher sex-selection subsamples.

To further allay sex selection concerns, we consider earlier Indian NFHS rounds, as access to ultrasound and the practice of sex selective abortion have increased over time. Appendix Table 6 uses the pooled NFHS-1 (1992-3) and NFHS-2 (1998-9) samples, with our standard African comparison group.

First, we show that the differential birth order gradient across India and Africa holds up for this sample, though less starkly.[19] Next, we turn to analyses that condition

[18] Self-reported ultrasound use during pregnancy is 47 percent among literate women but only 12 percent among illiterate women in India. The sex ratio in our Indian subsample at birth order 2 is 1.13 for literate women and 1.06 among illiterate women. Ultrasound use in urban versus rural areas is 51 percent versus 20 percent. The sex ratio at birth order 2 is 1.14 in urban areas and 1.08 in rural areas.

[19] NFHS-1 and NFHS-2 collect height data for children up to age 4 and age 3 years, respectively, so especially for within-family comparisons, we have less statistical power.

on child gender, where sex-selection concerns are most applicable. Appendix Table 7 reproduces the Table 6 results using NFHS-1 and NFHS-2 for India. Not having an older brother continues to have negative implications for girls' height (columns 1 and 2), and the hit to health inputs experienced by a girl without a brother is stronger at the postnatal stage when parents know her gender and have revised their fertility plans upwards (columns 3 and 4). This latter pattern is, in fact, somewhat stronger for this earlier Indian sample, which may reflect more families using fertility continuation (as opposed to sex selection) to obtain a son in the 1990s.

In short, although child gender, at least beyond birth order 1, is endogenous for several Indian families, the key empirical patterns that we document – both the birth order gradient in child height and the additional patterns pointing to eldest son preference as the underlying cause – do not seem to be an artifact of selection bias caused by sex-selective abortions. Reassuringly, the evidence supporting some of our predictions is stronger in samples with relatively more "try again" families and fewer "sex select" families, consistent with one mechanism behind the effects being families continuing their fertility to obtain a son.

5 Alternative Explanations

We conclude our analysis by examining the empirical support for three classes of alternative explanations for the birth order gradient in height: other health-related explanations, economic conditions, and other norms related to child-rearing practices.

Health conditions

Maternal health. Indian mothers are on average six centimeters shorter than African mothers. This suggests a lower health endowment among Indian mothers at the beginning of their childbearing years and raises the possibility that their health deteriorates more rapidly across successive childbirths to the detriment of infant health.[20] To test whether the mother's health endowment has differential effects on child height by birth order, column (1) of Appendix Table 8 presents our basic birth order regression adding in interactions between mother's height and birth order. This allows us to see whether the effect of maternal height varies by child's birth order and can "knock out" the

[20] This possibility is related to Deaton and Drèze's (2009) gradual catch-up hypothesis which posits that it could take generations to close the height gap in India if a mother's poor nutrition and health as a child, in turn, affect her children's size.

stronger birth order gradient in India. While positively signed, the key coefficients on $Mother'sHeight \times BirthOrder$ dummies are small, statistically insignificant and leave the coefficients on India interacted with higher birth order dummies unaffected.

Disease environment. Another possibility is that later born Indian children face a worse disease environment, related to poor sanitation. The likelihood that a household reports open defecation is 46 percent in India and 32 percent in Sub-Saharan Africa. Spears (2013) highlights the high rate of open defecation in India as a contributor to the prevalence of child stunting. Even if a household's sanitation infrastructure does not change over time, later-born children may have more exposure to disease because older siblings expose them to pathogens or they receive care from inferior caregivers. Appendix Table 8, column (2) examines whether there is a stronger birth order gradient for diarrhea in India. Indian mothers' responses suggest an increase in the likelihood that third and later-born children have had diarrhea in last two weeks, but the effect size is small. Column (3) directly examines whether open defecation can (statistically) explain the India birth order gradient. The point estimates suggest that the prevalence of open defecation has, if anything, smaller consequences for height for higher birth order children. Controlling for the rate of open defecation does not diminish the magnitude of the India-Africa birth order gradient in child height. Needless to say, open defecation may well contribute to low child height in India; absent open defecation, the intercept term for India could be higher.

Economic conditions

If households cannot perfectly smooth consumption over time, then resources per child will vary with the time profile of household income. If Indian parents have relatively less income than Sub-Saharan African parents when later parity children are born, then these children may receive relatively fewer resources and have worse outcomes.

As we lack time-varying measures of household income or wealth, we provide an indirect test: holding constant number of children born, we compare maternal nutritional inputs and outcomes across pregnant and not-pregnant women. If Indian households have less income over time, then women's food consumption should decline in India relative to Africa, independent of their pregnancy status. In contrast, our preference-based explanation suggests that later-in-life declines in women's nutrition and health should be concentrated among pregnant women.

We examine women's food consumption (specifically, dietary diversity) and hemoglobin levels.[21] The regression specification tests how these outcomes vary by a woman's pregnancy status, family size, and their interaction. Appendix Table 9, column (1) shows a greater drop-off in food consumption across successive pregnancies for Indian women (the omitted category) such that Indian mothers who are pregnant with their third or higher birth order child are disadvantaged nutritionally.[22] We observe a much smaller relative decline in consumption among non-pregnant Indian mothers (positive triple interaction term for India, has two or more children, and not pregnant), which weighs against different time profiles of income. In column (2) we similarly observe a differential Indian gradient in women's hemoglobin levels as they have more children. And as with food consumption, this gradient varies with a woman's pregnancy status. Specifically, across successive pregnancies the drop-off for Indian mothers exceeds that for African mothers (negative coefficients for India interacted with number of children), but the gradient among non-pregnant women is much smaller (positive triple interactions). This further points against the hypothesis that a steeper decline in Indian household resources over the lifecycle relative to African counterparts underlies the observed birth order patterns.[23]

Other cultural norms

Communal child-rearing. Parental time is another constrained resource. The presence of older siblings may reduce the time parents can devote to later-born infants. The strong norm of relatives and neighbors helping raise children in Sub-Saharan Africa (Goody,

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[21]Food consumption data was collected for Indian and African mothers who have given birth in the last three years and hence, excludes women with no children or pregnant with their first child. Our consumption index averages five indicator variables for whether the mother reports consuming specific food items during the recall period. Nearly everyone consumed starchy foods, so we consider categories with variation (and which are important sources of protein and vitamins), namely leafy vegetables, fruit, dairy, and meat/fish/eggs.

[22]See Coffey (2015) for related work documenting that Indian women have lower weight gain during pregnancy than African women.

[23]As a complementary test, we use the sample of Indian couples where we observe consumption outcomes for both spouses. (The male consumption module is, unfortunately, fielded in very few SSA surveys.) A few caveats are that nutritional needs vary by gender, and differentially so when a woman is pregnant, and the age profile of hemoglobin differs between even healthy men and women and is affected by pregnancy. The results, shown in columns (3) and (4), are noisy but the pattern of coefficients mirrors that in columns (1) and (2). Declines in food consumption in India as family size increases are concentrated among pregnant women and do not extend to their husbands. The fact that the gender gap in consumption widens specifically during pregnancies is consistent with differential investment in children rather than a general decline in the way women are treated over time. We do not see the same pattern for hemoglobin, however.

1982; Akresh, 2009) may make this constraint more acute in India. We create a PSU-level "communal child-rearing" proxy, namely the proportion of women's children under 10 years in age who are non-resident in their household. While higher in Africa (9.8 percent) than India (2.3 percent), it does not explain the India-Africa differential birth order gradient. Appendix Table 8, column (4) shows that while the extent of communal child-rearing does indeed dampen the birth order gradient, the effect size and gap in this practice between Africa and India are much too small to explain the stronger birth order gradient in India.

Land scarcity. A final possibility we consider is that the high relative investment in earlier born children in India reflects historical land scarcity. In Africa, where land is more abundant, later born children could have been (and could still be) more valuable in helping with agriculture. We test this idea by using the 1961 ratio of population to land area as a proxy for historical land scarcity. By this metric, land is indeed more scarce in India than Africa. However, as shown in Appendix Table 8, column (5), this factor cannot explain why height drops off so steeply with birth order in India.

In sum, we find limited evidence that these alternative explanations can cause a differential birth order gradient in height across India and SSA. Moreover, they do not predict several other patterns observed: how height varies with older siblings' gender, how health inputs vary with birth order and gender, and how having an older brother differentially impacts girls' prenatal versus postnatal inputs. In this sense, eldest son preference is likely unique in offering a parsimonious explanation for not just the birth order gradient but also a suite of other facts.

6 Conclusion

This paper sheds light on the puzzlingly high rate of stunting in India by comparing child height-for-age in India and Sub-Saharan Africa. We present several facts that point to intra-family allocation decisions as a key factor underlying child malnutrition in India. First, among firstborns, Indians are actually taller than Africans; the height disadvantage appears with the second child and increases with birth order. The particularly strong birth order gradient in height in India is robust to including family fixed effects, which helps rule out most selection concerns. Second, investments in successive pregnancies and higher birth order children decline faster in India than Africa. Third, the India-Africa birth order gradient in child height is larger for boys if the family has a son already; Indian parents seem to disinvest in their subsequent children once their eldest son is born. Meanwhile, for Indian girls, second-borns are relatively disadvantaged by having no elder brothers, consistent with the family conserving resources in anticipation of having another child to try for a son. Finally, within India the birth order gradient in height is significantly diminished for religions and regions – Muslims and Kerala - that exhibit lower son preference. A back of the envelope calculation suggests that parental preferences – specifically, a strong desire to have and invest in an eldest son – can explain up to half of India's child stunting.

One might expect unequal allocation in the household to matter less as India develops. With greater financial resources, all children might be well nourished enough to achieve their height potential. However, the Indian birth order gradient in height is actually larger among wealthier households. India appears to still be far from the level of wealth at which, despite unequal allocation, children are all sufficiently nourished. Thus, as India develops, the problem of malnutrition might be slow to fade unless policies are put in place that influence or counteract the intrahousehold allocation decisions that parents are making. Moreover, eldest son preference leads parents to invest in their children unequally in ways that extend beyond malnutrition. If any of these investments in children have diminishing returns, the skewed parental decisions that we have shown could be depressing India's total human capital and economic growth – as well as creating within-family inequality.

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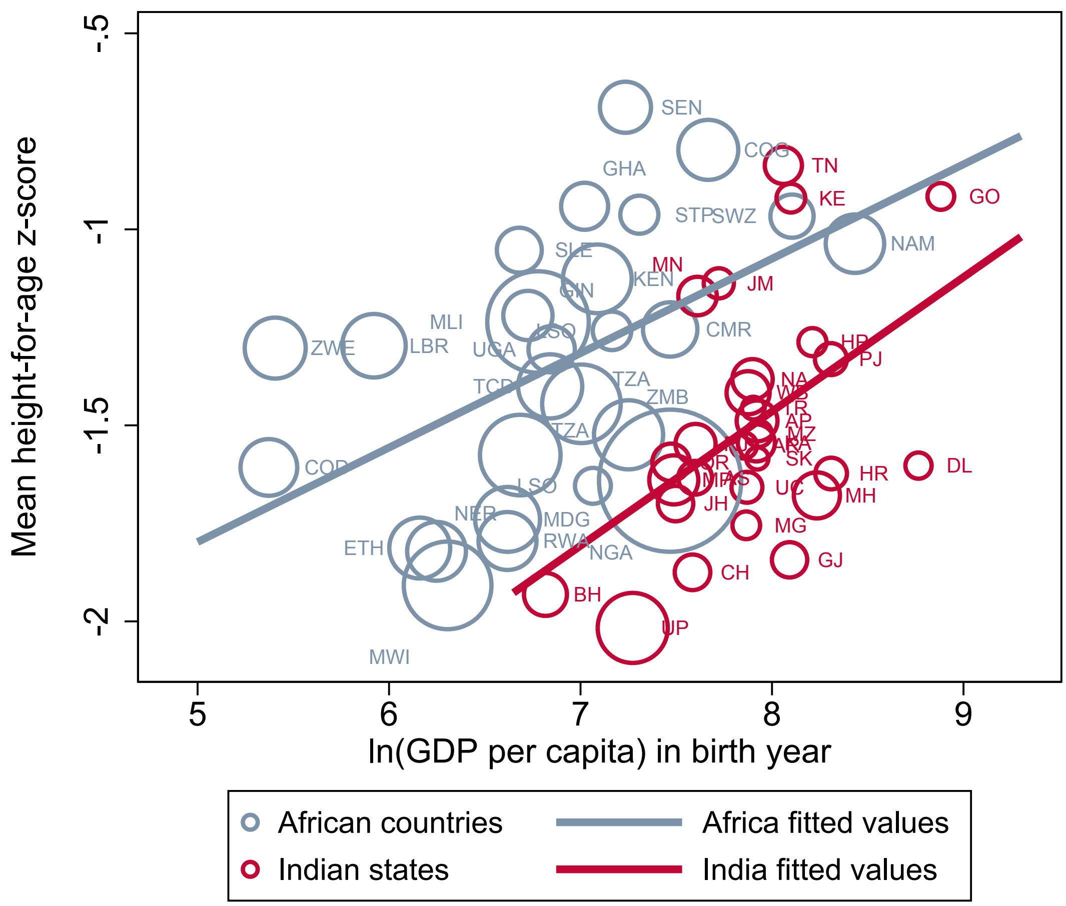
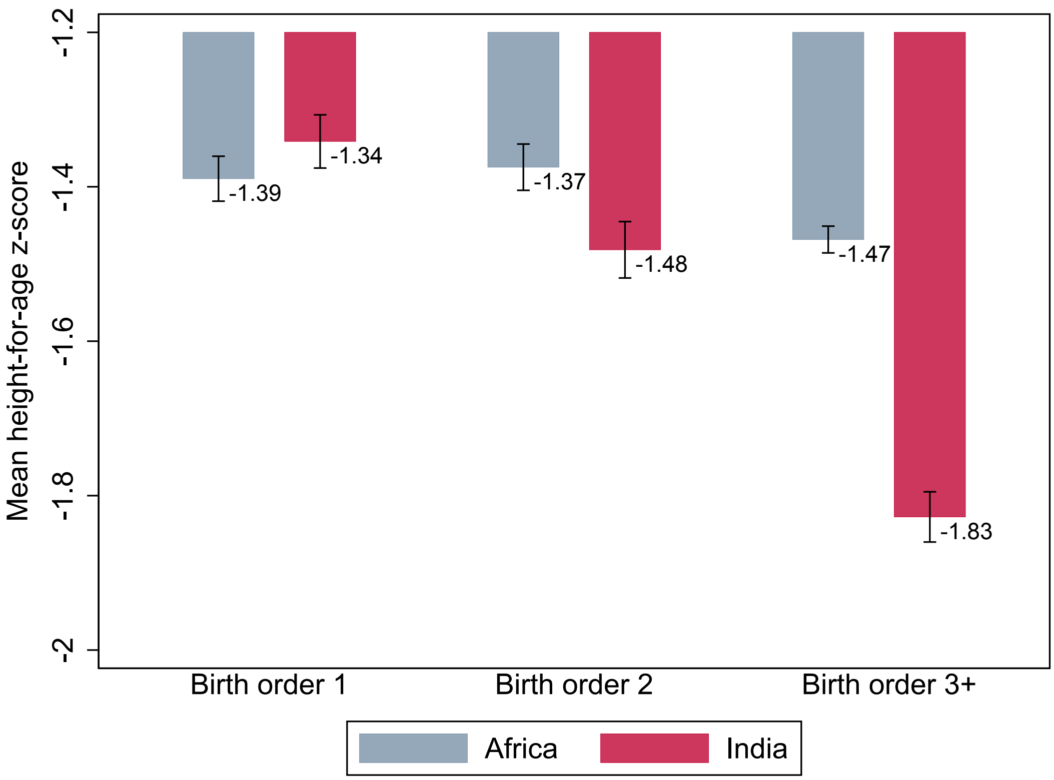
Figure 1: Child height versus national GDP



Notes: The light blue and dark red circles represent Sub-Saharan Africa countries and Indian states, respectively. The averages are calculated over all children less than 60 months old. The lines represent the best linear fit for each sample.

Figure 2: Child height in India and Africa, by child's birth order



Notes: The figure depicts the mean child height-for-age z-scores for Sub-Saharan Africa and India, by the birth order of the child. The mean is calculated over all children less than 60 months old with anthropometric data.

Table 1: Summary statistics

	India subsample	Africa subsample		India subsample	Africa subsample
Mother's age at birth (years)	24.767	26.954	Child's age (months)	30.051	28.062
	[5.239]	[6.857]		[16.872]	[17.026]
Mother's total children born	2.745	3.876	Child is a girl	0.465	0.494
	[1.829]	[2.543]		[0.499]	[0.500]
Preceding birth interval (months)	36.333	38.962	Child's birth order	2.625	3.742
	[21.431]	[22.247]		[1.808]	[2.477]
Total prenatal visits	4.031	3.828	Child's HFA z-score	-1.575	-1.435
	[3.483]	[3.095]		[2.114]	[2.466]
Mother took iron supplements	0.687	0.617	Child is stunted	0.414	0.390
	[0.464]	[0.486]		[0.493]	[0.488]
Mother's total tetanus shots	1.867	1.406	Child's WFA z-score	-1.546	-0.869
	[0.941]	[1.202]		[1.494]	[1.805]
Delivery at health facility	0.449	0.469	Child's hemoglobin level (g/dl)	10.271	10.145
	[0.497]	[0.499]		[1.568]	[1.680]
Postnatal check within 2 months	0.090	0.293	Child is deceased	0.050	0.072
	[0.287]	[0.455]		[0.217]	[0.259]
Mother is literate	0.584	0.492	Child taking iron pills	0.059	0.117
	[0.493]	[0.500]		[0.235]	[0.321]
DHS wealth index	-0.219	-0.145	Child's total vaccinations	6.593	6.187
	[0.949]	[0.928]		[2.809]	[3.149]
Rural	0.632	0.719	Diarrhea in last 2 weeks	0.095	0.157
	[0.482]	[0.449]		[0.293]	[0.364]
Mother wants more children	0.336	0.679	Open defecation	0.438	0.318
	[0.473]	[0.467]		[0.496]	[0.466]
Mother's height (meters)	1.519	1.583	% non-resident among children	0.023	0.098
	[0.058]	[0.069]		[0.039]	[0.086]
Mother's hemoglobin level (g/dl)	11.582	12.023	Land scarcity	5.035	2.629
	[1.731]	[1.829]		–	[1.137]
Mother's consumption index (non-pregnant)	1.924	2.246	Child sex ratio (boys/girls)	1.079	–
	[1.096]	[1.331]		[0.051]	–
Mother's consumption index (pregnant)	1.861	2.265	Main sample of children <60 months (N)	43,043	131,114
	[1.085]	[1.302]			
Log GDP per capita (in child's birth year)	7.735	6.891			
	[0.125]	[0.653]			

Notes: The means of the specified variables are calculated separately for the India and Africa subsamples. Standard deviations appear in brackets. The following variables are summarized at the mother level: total children born, mother is literate, wants more children, mother's height, hemoglobin level, and consumption index (non-pregnant and pregnant). Total prenatal visits, mother took iron supplements, total tetanus shots, postnatal check within 2 months are also, in effect, summarized at the mother level because they are only available for the most recent birth. Variables summarized at the child level include: mother's age at birth, preceding birth interval, delivery at health facility, DHS wealth index, rural, all child variables (first 10 variables in the second column), diarrhea in last 2 weeks, open defecation, % non-resident among children, land scarcity, child sex ratio, and log GDP.

Table 2: Birth order gradient in the India height gap

	HFA z-score (1)	HFA z-score (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	Stunted (6)
India	-0.110***	0.080***				
	[0.014]	[0.023]				
India × 2nd child		-0.168***	-0.144***	-0.158***	-0.263**	0.105***
		[0.030]	[0.030]	[0.030]	[0.110]	[0.027]
India × 3rd+ child		-0.401***	-0.211***	-0.231***	-0.414**	0.141***
		[0.029]	[0.029]	[0.036]	[0.193]	[0.046]
2nd child		0.038**	0.067***	0.021	-0.208***	0.045***
		[0.019]	[0.019]	[0.019]	[0.066]	[0.014]
3rd+ child		-0.063***	0.057***	-0.106***	-0.465***	0.093***
		[0.017]	[0.017]	[0.021]	[0.106]	[0.023]
Africa mean of outcome	-1.435	-1.435	-1.435	-1.435	-1.435	0.390
HH covariates × India	No	No	Yes	Yes	No	No
Child's age × India	No	No	No	Yes	Yes	Yes
Mother's age at birth × India	No	No	No	Yes	No	No
Mother FEs	No	No	No	No	Yes	Yes
Observations	174,157	174,157	174,157	174,157	174,157	174,157

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. *HFA z-score* is the child's height-for-age z-score, and *Stunted* is defined as having an HFA z-score ≤ -2. *2nd child* is an indicator for children whose birth order is 2. *3rd+ child* is an indicator for children whose birth order is 3 or higher. Child age dummies are included in all columns, and survey month controls are included in columns 1-4. Survey month controls are linear, quadratic and cubic terms for a continuous variable representing the month and year of the survey. In columns 3-4, the main effect *India* is included in the regression but is not shown. In columns 5-6, the main effect *India* is absorbed mother fixed effects. *Household covariates* in columns 3-4 include DHS wealth index, mother's literacy, rural, dummies for missing values of literacy, and *Household covariates* × *India*. In column 4, a linear variable for mother's age at birth and *Mother's age at birth* × *India* are included in the regression. See Data Appendix for further details.

Table 3: Child health inputs

	Prenatal inputs				*Postnatal inputs*						
	Total prenatal visits	Mother took iron supple-ments	Mother's total tetanus shots	Delivery at health facility	Postnatal check within 2 months	Child taking iron pills	Child's total vac-cinations	Pooled inputs	WFA z-score	Child's Hb level	Deceased
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
India × 2nd child	-0.448***	-0.012	0.028	-0.035***	-0.010	-0.002	-0.073*	-0.005	-0.133***	-0.103***	0.006*
	[0.056]	[0.008]	[0.017]	[0.006]	[0.013]	[0.005]	[0.042]	[0.004]	[0.023]	[0.029]	[0.003]
India × 3rd+ child	-1.140***	-0.095***	0.009	-0.107***	0.012	0.003	-0.342***	-0.050***	-0.157***	-0.146***	0.011***
	[0.059]	[0.009]	[0.019]	[0.008]	[0.013]	[0.006]	[0.055]	[0.004]	[0.026]	[0.033]	[0.004]
2nd child	-0.123***	-0.005	-0.095***	-0.077***	0.020**	-0.004	-0.064**	-0.033***	0.035**	-0.024	-0.019***
	[0.031]	[0.005]	[0.012]	[0.004]	[0.010]	[0.004]	[0.028]	[0.002]	[0.015]	[0.021]	[0.002]
3rd+ child	-0.536***	-0.014***	-0.204***	-0.143***	-0.019**	-0.022***	-0.378***	-0.079***	-0.066***	-0.101***	-0.018***
	[0.032]	[0.005]	[0.013]	[0.004]	[0.010]	[0.005]	[0.032]	[0.003]	[0.016]	[0.023]	[0.002]
Africa mean of outcome	3.828	0.617	1.406	0.469	0.293	0.112	6.187	0.627	-0.869	10.145	0.072
India mean of outcome	4.031	0.687	1.867	0.449	0.090	0.055	6.593	0.754	-1.546	10.271	0.050
Household & age controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120,570	122,977	122,530	173,772	39,248	95,986	127,544	802,627	174,157	91,505	199,665

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey month controls, child age dummies, household covariates, mother's age at birth, and household covariates, child's age, and mother's age interacted with *India*. The main effect *India* is included in all regressions but is not shown. Total prenatal visits, mother took iron supplements, mother's total tetanus shots, and postnatal check within 2 months are only available for the youngest living child in the family; postnatal check within 2 months is collected in only 13 African surveys. Delivery at health facility, child taking iron pills, and total vaccinations are available for all births in the past 5 years; child taking iron pills is collected in only 10 African surveys; total vaccinations uses children ages 13-59 months, as the recommended age for some is up to 1 year. In column 8, dummies for 4 prenatal and 3 postnatal inputs are pooled together to create the outcome. The dummies are: 1) total prenatal visits >4; 2) mother took iron supplements; 3) mother's total tetanus shots >1; 4) child was delivered at a health facility; 5) child is taking iron pills; 6) total vaccinations >7; 7) child had postnatal check within 2 months of birth. In column 11, the sample is restricted to children ages 13-59 months, as infant mortality is censored for children less than 1 year old. See Data Appendix for further details.

Table 4: Child gender and the birth order gradient in height

	Wants more children (1)	Wants more children (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)	HFA z-score (7)	HFA z-score (8)
India	-0.153***		-0.020	-0.024		0.151***		
	[0.013]		[0.018]	[0.018]		[0.032]		
India × Girl	-0.163***	-0.112***	-0.182***	-0.164***	-0.128*	-0.146***	0.039	-0.151
	[0.019]	[0.033]	[0.023]	[0.023]	[0.071]	[0.044]	[0.133]	[0.262]
India × No elder brother	-0.032***	0.014						
	[0.010]	[0.010]						
India × Girl × No elder brother	0.238***	0.227***						
	[0.016]	[0.015]						
India × 2nd child	-0.415***	-0.433***				-0.131***	-0.132***	-0.277*
	[0.012]	[0.012]				[0.044]	[0.044]	[0.160]
India × 3rd+ child	-0.315***	-0.460***				-0.373***	-0.217***	-0.430**
	[0.012]	[0.013]				[0.040]	[0.050]	[0.218]
India × Girl × 2nd child						-0.077	-0.054	0.038
						[0.063]	[0.062]	[0.229]
India × Girl × 3rd+ child						-0.057	-0.024	0.036
						[0.056]	[0.069]	[0.207]
Africa mean of outcome	0.679	0.679	-1.435	-1.435	-1.435	-1.435	-1.435	-1.435
p-value: India × No elder brother + India × Girl × No elder brother=0	0.000	0.000						
Sample	Mothers	Mothers	Children	Children	Children	Children	Children	Children
Household & age controls	No	Yes	No	Yes	No	No	Yes	No
Mother FEs			No	No	Yes	No	No	Yes
Observations	119,056	119,056	174,157	174,157	174,157	174,157	174,157	174,157

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Child age dummies are included in all regressions, and all columns control for survey month except for columns 5 and 8, which have mother fixed effects. Columns 2, 4, and 7 additionally include household covariates and mother's age. Columns 2 and 7 also have household covariates, child's age, and mother's age interacted with *Girl*, *India*, and *Girl* × *India*. The main effect *India* is included in columns 2 and 7 but is not shown. The sample in columns 1-2 is mothers, and the child and sibling gender variables are in reference to the youngest child in the household (in the case that the youngest child is a twin or a triplet, the latest born is used). In columns 3-5, the main effect *Girl* is included in the regression but is not shown. In columns 6-8, coefficients for *Girl*, *2nd child* and *3rd+ child* birth order dummies, and the birth order dummies × *Girl* are included in the regression but are not shown.

Table 5: Heterogeneity within India by son preference

Outcome:	HFA z-score			Pooled inputs			Deceased		
Gender preference proxy:	*Muslim*	*Kerala*	*Below-median child sex ratio*	*Muslim*	*Kerala*	*Below-median child sex ratio*	*Muslim*	*Kerala*	*Below-median child sex ratio*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Gender pref proxy × 2nd child	0.147**	0.223*	0.062	0.007	0.042***	0.011**	-0.014*	-0.004	-0.009
	[0.067]	[0.132]	[0.046]	[0.008]	[0.009]	[0.005]	[0.008]	[0.007]	[0.006]
Gender pref proxy × 3rd+ child	0.203**	0.249	0.001	0.032***	0.081***	-0.001	-0.012	0.008	-0.013*
	[0.081]	[0.206]	[0.057]	[0.009]	[0.014]	[0.007]	[0.009]	[0.014]	[0.007]
2nd child	-0.153***	-0.138***	-0.164***	-0.030***	-0.030***	-0.034***	-0.010***	-0.013***	-0.008*
	[0.027]	[0.023]	[0.033]	[0.003]	[0.003]	[0.004]	[0.003]	[0.003]	[0.004]
3rd+ child	-0.363***	-0.325***	-0.304***	-0.117***	-0.117***	-0.113***	-0.004	-0.007**	-0.001
	[0.033]	[0.029]	[0.041]	[0.004]	[0.003]	[0.005]	[0.004]	[0.003]	[0.005]
Comparison group mean of outcome	-1.558	-1.589	-1.631	0.431	0.416	0.430	0.050	0.050	0.051
p-value: Gender pref proxy × 2nd child + 2nd child=0	0.934	0.514	0.002	0.001	0.182	0.000	0.001	0.019	0.000
p-value: Gender pref proxy × 3rd+ child + 3rd+ child=0	0.031	0.710	0.000	0.000	0.010	0.000	0.050	0.950	0.004
Sample	Hindus & Muslims	India	India	Hindus & Muslims	India	India	Hindus & Muslims	India	India
Household & age controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	36,657	43,043	43,043	214,400	250,702	250,702	34,903	40,766	40,766

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. The sample is restricted to India and control variables included in all columns are survey month controls, child age dummies, household covariates, mother's age, and household covariates, child's age, and mother's age interacted with *Gender pref proxy*. The main effect for *Gender pref proxy* is included in all regressions but is not shown. *Child sex ratio* is defined as the number of boys aged 0-6 years over the number of girls aged 0-6 years in the respondent's state-by-rural cell. See Data Appendix for further details.

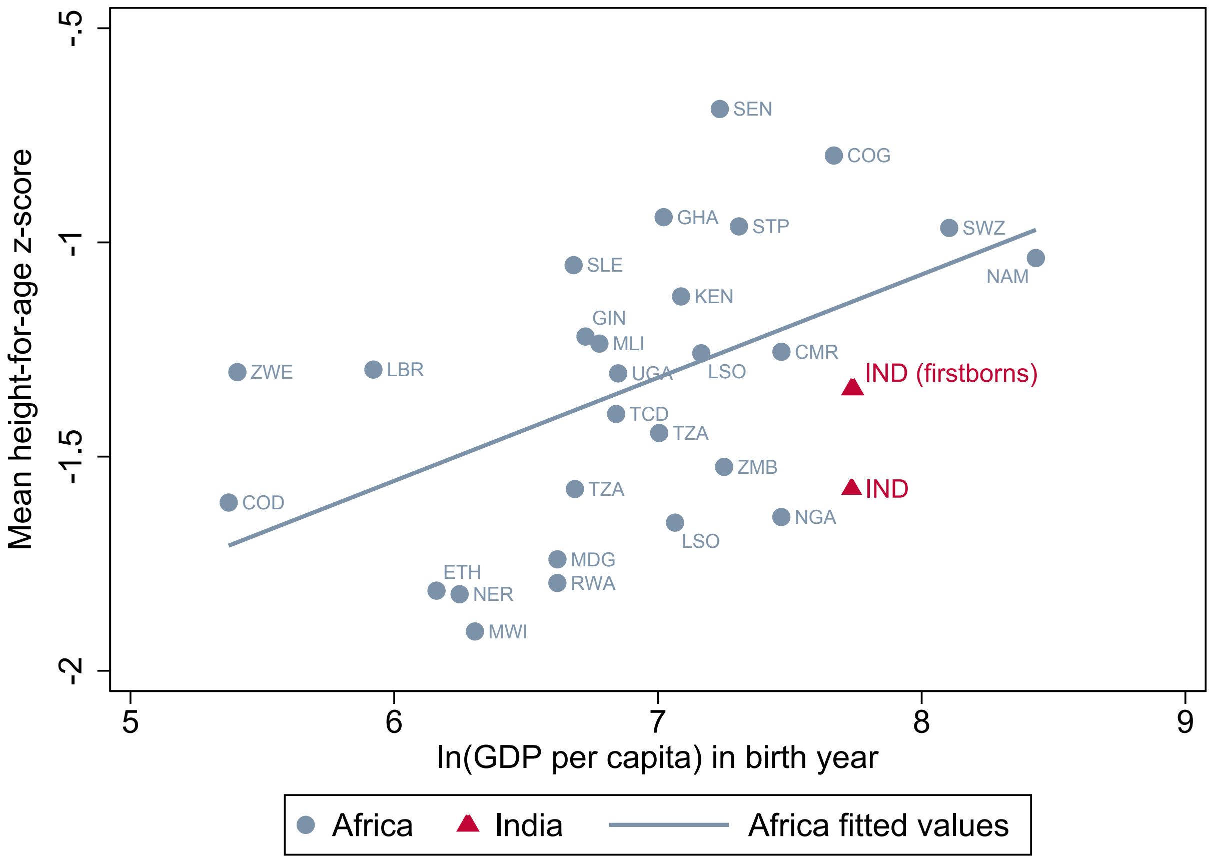
Table 6: Heterogeneity by the gender of older siblings

	Pooled inputs (1)	Pooled inputs (2)	HFA z-score (3)	HFA z-score (4)
India	-0.120***		0.028	
	[0.009]		[0.056]	
India × 2nd child	-0.025***	-0.016**	-0.074	-0.106**
	[0.008]	[0.008]	[0.049]	[0.049]
India × 3rd+ child	-0.091***	-0.043***	-0.281***	-0.179***
	[0.009]	[0.009]	[0.055]	[0.060]
India × No elder brother	-0.010	-0.009	0.123***	0.060
	[0.008]	[0.007]	[0.045]	[0.044]
India × Prenatal input	0.215***	0.163***		
	[0.011]	[0.020]		
India × Prenatal input × No elder brother	0.019**	0.015*		
	[0.009]	[0.009]		
India × Girl			0.017	0.166
			[0.078]	[0.151]
India × Girl × No elder brother			-0.163**	-0.115*
			[0.064]	[0.064]
Africa mean of outcome	0.447	0.447	-1.435	-1.435
p-value: India × No elder brother + India × Girl × No elder brother=0			0.412	0.247
p-value: India + India × 2nd child + India × No elder brother=0			0.048	
p-value: India + India × 3rd+ child + India × No elder brother=0			0.004	
Sample	Girls	Girls	Children	Children
Household & age controls	No	Yes	No	Yes
Observations	392,180	392,180	174,157	174,157

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey month controls and child age dummies. Even columns control for mother's age, household covariates, and household covariates, child's age, and mother's age interacted with *India*. Column 2 additionally includes household covariates, child's age, and mother's age interacted with *Prenatal input* and *Prenatal input* × *India*. Column 4 also includes household covariates, child's age, and mother's age interacted with *Girl* and *India* × *Girl*. The main effect *India* is included in even columns but is not shown. All other main effects (*2nd child*, *3rd+ child*, *Girl*, *No elder brother*, *Prenatal input*, and interactions) in addition to *India* × *Prenatal input* × *2nd child* and *India* × *Prenatal input* × *3rd+ child* are included but not shown. The sample in columns 1-2 is girls aged 1-59 months, and the sample in columns 3-4 is the main sample of children aged 1-59 months. See Data Appendix for further details.

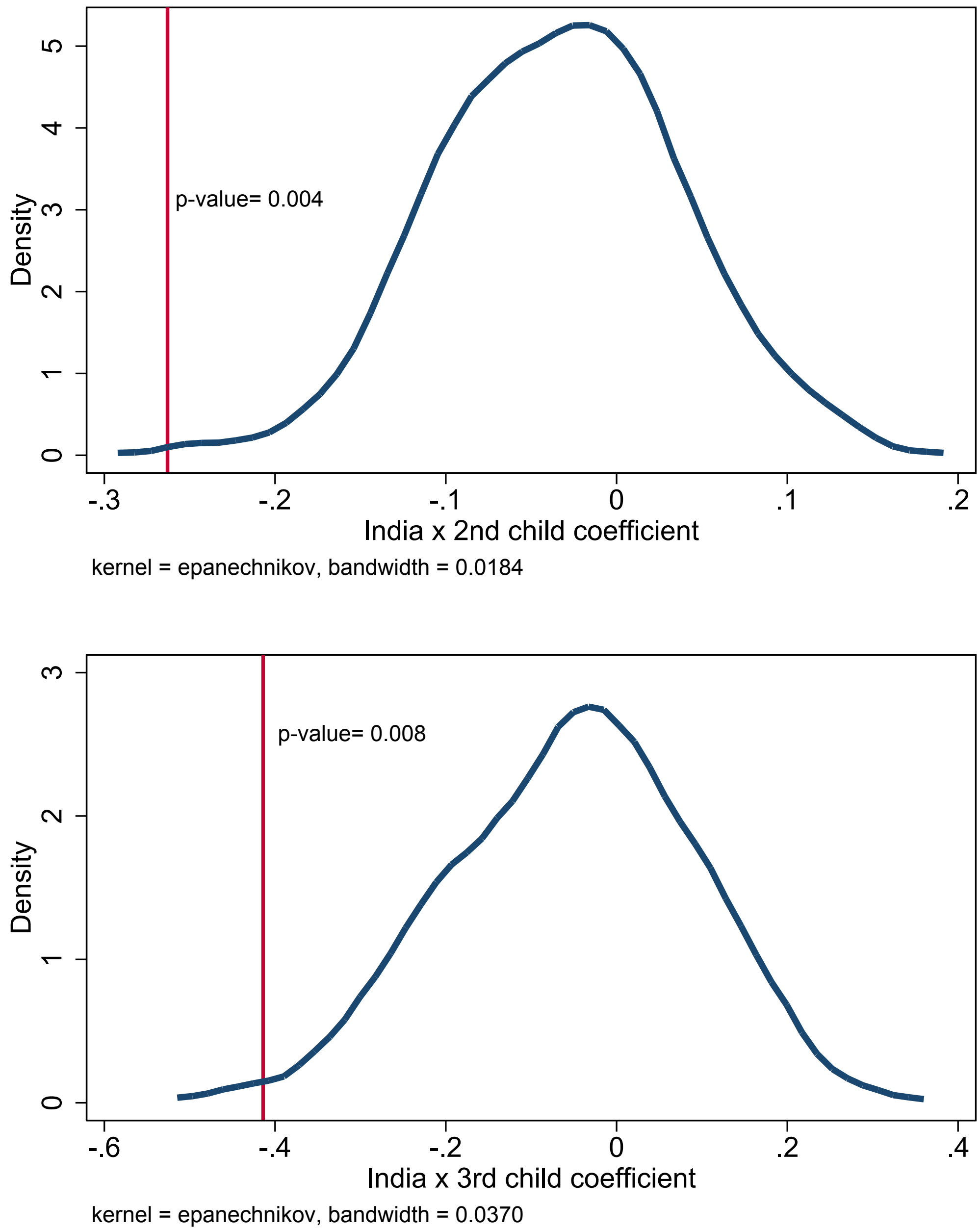
FOR ONLINE PUBLICATION

Appendix Figure 1: Height of Indian children relative to Africa



Notes: Firstborns comprise children under 60 months born at birth order 1. The gap between the Africa fitted line and India is -0.436. The gap between the Africa fitted line and India (firstborns) is -0.203.

Appendix Figure 2: Placebo test: Birth order gradient for India and “fake” India’s



Notes: From among the 25 unique African countries and 29 Indian states represented in our sample, 29 countries/states are randomly chosen to comprise a placebo “India”. The figure plots the distribution of *India* × *2nd child* coefficients over 500 iterations of the mother fixed effect specification (analogous to Table 2, column 5). The red line at -0.263 marks the real *India* × *2nd child* coefficient. The red line at -0.414 marks the real *India* × *3rd child* coefficient.

Appendix Table 1: Birth order gradient in the India height gap: Robustness checks

	Height in cm (1)	HFA z-score (2)	HFA z-score (3)
India × 2nd child	-1.283***	-0.259**	-0.315***
	[0.341]	[0.122]	[0.111]
India × 3rd+ child	-1.840***	-0.364*	-0.507**
	[0.596]	[0.219]	[0.200]
2nd child	-0.840***	-0.245***	-0.230***
	[0.202]	[0.078]	[0.065]
3rd+ child	-1.833***	-0.552***	-0.486***
	[0.322]	[0.131]	[0.107]
Africa mean of outcome	81.006	-1.422	-1.435
Mother FEs	Yes	Yes	Yes
Child's age × India	Yes	Yes	Yes
Sample	All	Children with same father	Birth order among living siblings
Observations	174,157	112,784	174,157

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are child age dummies and *Child's age × India*. In column 2, the sample is restricted to children whose mothers (likely) had children with only one partner. In column 3, birth order is redefined as the birth order among currently living siblings. See Data Appendix for further details.

Appendix Table 2: Robustness checks related to total fertility

	HFA z-score (1)	HFA z-score (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)
India × 2nd child	-0.112**	-0.197**	-0.217**	-0.104	-0.244*	-0.269*
	[0.052]	[0.093]	[0.091]	[0.100]	[0.143]	[0.156]
India × 3rd+ child		-0.059		-0.289*	-0.375	-0.453*
		[0.109]		[0.156]	[0.264]	[0.267]
2nd child	-0.060	-0.193***	-0.206***	-0.227***	-0.386***	-0.211*
	[0.037]	[0.059]	[0.071]	[0.062]	[0.089]	[0.125]
3rd+ child		-0.328***		-0.347***	-0.830***	-0.443**
		[0.070]		[0.108]	[0.157]	[0.205]
Africa mean of outcome	-1.392	-1.442	-1.403	-1.413	-1.402	-1.187
Sample:						
Total children<5	Any	Any	2+ children	2+ children	Any	Any
Total fertility	2 children	3 children	2 children	3 children	Any	Any
Other restrictions	None	None	None	None	Birth order ≤4	Below-median fertility
Household & age controls	Yes	Yes	Yes	Yes	No	No
Mother FEs	No	No	No	No	Yes	Yes
Observations	38,274	30,521	21,488	18,559	125,991	82,441

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included in all columns include child age dummies and survey month controls, except for columns 5-6, in which survey month is absorbed by mother fixed effects. In column 5, the sample is restricted to children of birth order 4 or less. In column 6, the sample is restricted to children from African countries with below median fertility, plus India.

Appendix Table 3: Placebo test: Birth order gradients for countries and regions in Africa

Country	*Country* × 2nd child	*Country* × 3rd+ child	Country	*Country* × 2nd child	*Country* × 3rd+ child
India	**-0.263****	**-0.414****	Eastern Africa	0.098	0.132
	[0.110]	**[0.193]**		[0.136]	[0.217]
Central Africa	0.016	0.043	Ethiopia	-0.371	-0.853
	[0.170]	[0.265]		[0.381]	[0.636]
Cameroon	-0.029	-0.025	Kenya	-0.080	-0.120
	[0.341]	[0.541]		[0.287]	[0.460]
Chad	0.063	0.059	Madagascar	0.172	-0.099
	[0.310]	[0.472]		[0.313]	[0.472]
Congo (Brazzaville)	0.215	0.469	Tanzania	0.277*	0.632**
	[0.374]	[0.591]		[0.155]	[0.246]
Democratic Republic of Congo	-0.329	-0.712	Uganda	0.020	-0.034
	[0.405]	[0.646]		[0.373]	[0.634]
Rwanda	0.337	0.644	Western Africa	-0.112	-0.281
	[0.341]	[0.514]		[0.141]	[0.222]
Sao Tome and Principe	-0.092	0.029	Ghana	0.022	-0.586
	[0.783]	[1.116]		[0.507]	[0.873]
Southern Africa	0.084	0.307	Guinea	0.216	0.742
	[0.158]	[0.267]		[0.523]	[0.797]
Lesotho	-0.283	-0.644	Liberia	0.160	0.113
	[0.491]	[0.943]		[0.375]	[0.604]
Malawi	0.340	0.466	Mali	-0.025	-0.022
	[0.257]	[0.419]		[0.236]	[0.366]
Namibia	-0.211	0.188	Niger	-0.047	0.001
	[0.430]	[0.780]		[0.347]	[0.594]
Swaziland	0.154	0.568	Nigeria	-0.194	-0.446
	[0.421]	[0.678]		[0.209]	[0.325]
Zambia	-0.066	0.322	Senegal	0.085	0.029
	[0.288]	[0.471]		[0.369]	[0.579]
Zimbabwe	0.143	0.279	Sierra Leone	-0.017	0.284
	[0.409]	[0.726]		[0.695]	[0.959]

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Controls include child age dummies, *Country* × *age* and mother fixed effects. Lesotho IV and V are pooled, and Tanzania IV and V are pooled. Each pair of coefficients represents one regression, with the specified country as the main effect *Country*. The comparison sample is restricted to Africa.

Appendix Table 4: Other comparison groups: Countries with similar GDP to India, and Europe, Central & West Asia

Comparison sample:	*Countries with similar GDP to India*				*Europe, Central & West Asia*			
	HFA z-score (1)	HFA z-score (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)	HFA z-score (7)	HFA z-score (8)
India	-0.003				-0.884***			
	[0.023]				[0.028]			
India × 2nd child	-0.115***	-0.107***	-0.265**		-0.055*	-0.034	-0.259**	
	[0.030]	[0.030]	[0.111]		[0.033]	[0.033]	[0.121]	
India × 3rd+ child	-0.311***	-0.152***	-0.463**		-0.305***	-0.120***	-0.627***	
	[0.028]	[0.035]	[0.196]		[0.032]	[0.039]	[0.224]	
2nd child	-0.016	-0.031	-0.203***	-0.111	-0.078***	-0.105***	-0.231***	-0.226***
	[0.019]	[0.019]	[0.067]	[0.100]	[0.023]	[0.024]	[0.080]	[0.077]
3rd+ child	-0.154***	-0.186***	-0.414***	-0.187	-0.162***	-0.216***	-0.296**	-0.290**
	[0.016]	[0.021]	[0.110]	[0.170]	[0.022]	[0.027]	[0.150]	[0.146]
Africa × 2nd child				-0.099				0.016
				[0.119]				[0.102]
Africa × 3rd+ child				-0.282				-0.182
				[0.200]				[0.180]
Comparison group mean of outcome	-1.390	-1.390	-1.390	-1.461	-0.595	-0.595	-0.595	-0.595
HH covariates & interactions	No	Yes	No	No	No	Yes	No	No
Child's age × India	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Mother's age & interactions	No	Yes	No	No	No	Yes	No	No
Mother FEs	No	No	Yes	Yes	No	No	Yes	Yes
Observations	172,065	172,065	172,065	178,282	85,553	85,553	85,553	173,624

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Child age dummies are included in all regressions, and all columns include survey month controls, except for columns 3, 4, 7 and 8, which have mother fixed effects. The main effect *India* is included but not shown in columns 2 and 6. In columns 1-4, the omitted category includes DHS's (2004-2010) of countries with height data that had a log GDP per capita within in a 50% upper and lower bound of India's 2005-6 log GDP per capita in its survey year. Columns 1-3 include 23 comparison surveys and column 4 excludes African countries, leaving a comparison sample of 8 surveys. In columns 5-8, the omitted category includes 16 DHS's (1995-2012) of European, Central and West Asian countries with height data available. In column 6, we use mother completed grade 4 or higher as a control instead of mother's literacy due to the large amount if missing data for mother's literacy in the the Europe, Central & West Asia sample. Completion of grade 4 or higher is recoded as 0 if mother's literacy is available in the data and she is illiterate.

Appendix Table 5: Heterogeneity by older siblings' gender: Robustness to sex-selection

Sample:	*Illiterate*		*Literate*		*Rural*		*Urban*		*Excludes Indian PSUs with >5% ultrasound use*	
	HFA z-score (1)	HFA z-score (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)	HFA z-score (7)	HFA z-score (8)	HFA z-score (9)	HFA z-score (10)
India	-0.236***		0.038		0.012		-0.120		-0.416***	
	[0.090]		[0.072]		[0.069]		[0.096]		[0.101]	
India × 2nd child	-0.005	-0.027	-0.083	-0.139**	0.009	-0.012	-0.209***	-0.248***	0.066	0.041
	[0.082]	[0.082]	[0.062]	[0.062]	[0.062]	[0.062]	[0.081]	[0.082]	[0.093]	[0.093]
India × 3rd+ child	-0.076	-0.059	-0.228***	-0.223***	-0.200***	-0.096	-0.425***	-0.284***	0.018	0.041
	[0.088]	[0.094]	[0.072]	[0.079]	[0.068]	[0.074]	[0.095]	[0.105]	[0.099]	[0.108]
India × Girl	0.036	0.240	-0.008	0.139	0.019	-0.003	-0.002	0.412	0.113	0.102
	[0.124]	[0.226]	[0.100]	[0.198]	[0.096]	[0.183]	[0.134]	[0.255]	[0.140]	[0.281]
India × No elder brother	0.070	0.039	0.136**	0.092	0.130**	0.057	0.113	0.059	0.040	0.025
	[0.068]	[0.069]	[0.059]	[0.058]	[0.055]	[0.054]	[0.079]	[0.078]	[0.081]	[0.081]
India × Girl × No elder brother	-0.152	-0.142	-0.155*	-0.111	-0.157**	-0.102	-0.155	-0.146	-0.260**	-0.244**
	[0.097]	[0.098]	[0.086]	[0.085]	[0.078]	[0.077]	[0.114]	[0.113]	[0.113]	[0.112]
Africa mean of outcome	-1.602	-1.602	-1.250	-1.250	-1.582	-1.582	-1.057	-1.057	-1.435	-1.435
p-value: India × No elder brother + India × Girl × No elder brother=0	0.254	0.154	0.775	0.764	0.632	0.424	0.625	0.299	0.008	0.007
p-value: India + India × 2nd child + India × No elder brother=0	0.007		0.068		0.002		0.001		0.000	
p-value: India + India × 3rd+ child + India × No elder brother=0	0.000		0.382		0.290		0.000		0.000	
Household & age controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	86,752	86,752	86,113	86,113	121,474	121,474	52,683	52,683	141,736	141,736

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey month controls and child age dummies. All columns include birth order dummies and birth order dummies interacted with *Girl* and *India × Girl*. Even columns additionally control for mother's age at birth, household covariates, and household covariates, child's age, and mother's age interacted with *India*, *Girl*, and *India × Girl*. Columns 2 and 4 omit literacy covariates and columns 6 and 8 omit rural covariates. The main effect *India* is included in even columns but is not shown. All other main effects (birth order dummies, *Girl*, *No elder brother*, and interactions) are included but not reported. The sample for columns 9-10 includes Indian children living in PSUs with a mean ultrasound usage of <5% and Africa, where ultrasound data are not available.

Appendix Table 6: Birth order gradient in the India height gap using NFHS-1 and NFHS-2

	HFA z-score (1)	HFA z-score (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	Stunted (6)
India	-0.690***	-0.558***				
	[0.019]	[0.028]				
India × 2nd child		-0.060*	-0.048	-0.071**	-0.172	0.053
		[0.034]	[0.033]	[0.034]	[0.194]	[0.040]
India × 3rd+ child		-0.287***	-0.178***	-0.235***	-0.203	0.059
		[0.030]	[0.030]	[0.037]	[0.339]	[0.069]
2nd child		0.044**	0.071***	0.028	-0.166	0.038*
		[0.022]	[0.022]	[0.022]	[0.111]	[0.023]
3rd+ child		-0.044**	0.073***	-0.079***	-0.396**	0.084**
		[0.019]	[0.019]	[0.024]	[0.179]	[0.037]
Africa mean of outcome	-1.351	-1.351	-1.351	-1.351	-1.351	0.384
Sample	≤ 48 mths	≤ 48 mths	≤ 48 mths	≤ 48 mths	≤ 48 mths	≤ 48 mths
HH covariates × India	No	No	Yes	Yes	No	No
Child's age × India	No	No	No	Yes	Yes	Yes
Mother's age at birth × India	No	No	No	Yes	No	No
Mother FEs	No	No	No	No	Yes	Yes
Observations	165,806	165,806	165,806	165,806	165,806	165,806

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Sample for India uses NFHS-1 and NFHS-2 rather than NFHS-3; NFHS-1 only has data for children age 4 years and younger, and NFHS-2 only has data for children age 3 years and younger. *HFA z-score* is the child's height-for-age z-score, and *Stunted* is defined as having an HFA z-score ≤ -2. *2nd child* is an indicator for children whose birth order is 2. *3rd+ child* is an indicator for children whose birth order is 3 or higher. Child age dummies are included in all columns, and survey month controls are included in columns 1-4. Survey month controls are linear, quadratic and cubic terms for a continuous variable representing the month and year of the survey. In columns 3-4, the main effect *India* is included in the regression but is not shown. In columns 5-6, the main effect *India* is absorbed by mother fixed effects. *Household covariates* in columns 3-4 include DHS wealth index, mother's literacy, rural, dummies for missing values of literacy, and *household covariates* × *India*. In column 4, a linear variable for mother's age at birth and *mother's age at birth* × *India* are included in the regression. See Data Appendix for further details.

Appendix Table 7: Heterogeneity by older siblings' gender using NFHS-1 and NFHS-2

	Pooled inputs (1)	Pooled inputs (2)	HFA z-score (3)	HFA z-score (4)
India	-0.165***		-0.677***	
	[0.014]		[0.062]	
India × 2nd child	-0.015	-0.013	0.096*	0.065
	[0.013]	[0.012]	[0.055]	[0.055]
India × 3rd+ child	-0.093***	-0.063***	-0.137**	-0.119*
	[0.014]	[0.014]	[0.060]	[0.065]
India × No elder brother	-0.025**	-0.018	0.166***	0.131***
	[0.012]	[0.011]	[0.049]	[0.048]
India × Prenatal input	0.171***	0.223***		
	[0.014]	[0.025]		
India × Prenatal input × No elder brother	0.038***	0.035***		
	[0.012]	[0.012]		
India × Girl			0.101	0.214
			[0.084]	[0.154]
India × Girl × No elder brother			-0.195***	-0.159**
			[0.069]	[0.068]
Africa mean of outcome	0.489	0.489	-1.351	-1.351
p-value: India × No elder brother + India × Girl × No elder brother=0			0.568	0.560
p-value: India + India × 2nd child + India × No elder brother=0			0.000	
p-value: India + India × 3rd+ child + India × No elder brother=0			0.000	
Sample	Girls	Girls	Children	Children
Household & age controls	No	Yes	No	Yes
Observations	351,504	351,504	165,806	165,806

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Sample for India uses NFHS-1 and NFHS-2 rather than NFHS-3; NFHS-1 only has data for children age 4 years and younger, and NFHS-2 only has data for children age 3 years and younger. Control variables included are survey month controls and child age dummies. Even columns control for mother's age, household covariates, and household covariates, child's age, and mother's age interacted with *India*. Column 2 additionally includes household covariates, child's age, and mother's age interacted with *Prenatal input* and *Prenatal input* × *India*. Column 4 also includes household covariates, child's age, and mother's age interacted with *Girl* and *India* × *Girl*. The main effect *India* is included in even columns but is not shown. All other main effects (*2nd child*, *3rd+ child*, *Girl*, *No elder brother*, *Prenatal input*, and interactions) in addition to *India* × *Prenatal input* × *2nd child* and *India* × *Prenatal input* × *3rd+ child* are included but not shown. The sample in columns 1-2 is girls aged 1-59 months, and the sample in columns 3-4 is the main sample of children aged 1-59 months. See Data Appendix for further details. Due to data availability, pooled inputs include 5 of the 7 inputs used in NFHS-3 and total vaccinations is based on 8 of the 9 vaccines used in NFHS-3.

Appendix Table 8: Alternative explanations for the Indian birth order gradient

	HFA z-score	Diarrhea in last 2 weeks	HFA z-score	HFA z-score	HFA z-score
	(1)	(2)	(3)	(4)	(5)
India × 2nd child	-0.144***	0.002	-0.172***	-0.134***	-0.178***
	[0.033]	[0.005]	[0.031]	[0.034]	[0.055]
India × 3rd+ child	-0.197***	0.011**	-0.237***	-0.206***	-0.220***
	[0.039]	[0.005]	[0.037]	[0.040]	[0.061]
2nd child	-0.221	-0.001	0.007	-0.012	0.000
	[0.391]	[0.003]	[0.022]	[0.029]	[0.046]
3rd+ child	-0.579	0.010***	-0.118***	-0.143***	-0.090*
	[0.439]	[0.003]	[0.024]	[0.032]	[0.050]
2nd child × Mother's height	0.151				
	[0.247]				
3rd+ child × Mother's height	0.293				
	[0.277]				
2nd child × Open defecation			0.049		
			[0.034]		
3rd+ child × Open defecation			0.032		
			[0.037]		
2nd child × % non-resident among children				0.342	
				[0.209]	
3rd+ child × % non-resident among children				0.445*	
				[0.229]	
2nd child × Land scarcity					0.008
					[0.017]
3rd+ child × Land scarcity					-0.005
					[0.019]
Africa mean of outcome	-1.435	0.157	-1.435	-1.435	-1.435
Household & age controls	Yes	Yes	Yes	Yes	Yes
Observations	172,630	173,570	168,840	174,157	174,157

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey month controls, child age dummies, mother's age at birth, household covariates, and household covariates, child's age, and mother's age at birth interacted with *India*. The main effect *India* is included in all columns but not shown. Column 1 additionally controls for household covariates, child's age, and mother's age at birth interacted with *Mother's height*. Column 3 additionally controls for household covariates, child's age, and mother's age at birth interacted with *Open defecation*. *Open defecation* is a dummy variable that equals 1 if the mother reports that the household has no toilet facility. Column 4 also controls for household covariates, child's age, and mother's age at birth interacted with *% non-resident among children*. Column 5 additionally controls for household covariates, child's age, and mother's age at birth interacted with *Land scarcity*. *Land scarcity* is defined as the log of the respondent's country's total population in 1961 divided by its land area in square km in 1961. See Data Appendix for further details.

Appendix Table 9: Adult food consumption and hemoglobin

Sample:	*African & Indian mothers*		*Indian parents*	
	Food consumption index	Hemoglobin level	Food consumption index	Hemoglobin level
	(1)	(2)	(3)	(4)
India × Has 1 child		-0.618***		
		[0.199]		
India × Has 2+ children	-0.140*	-0.952***		
	[0.081]	[0.238]		
India × Has 1 child × Not pregnant		0.263		
		[0.208]		
India × Has 2+ children × Not pregnant	0.093	0.509**		
	[0.085]	[0.248]		
Mother × Has 1 child			-0.047	-0.448
			[0.166]	[0.348]
Mother × Has 2+ children			-0.236	-0.775*
			[0.196]	[0.420]
Mother × Has 1 child × Not pregnant			0.049	-0.165
			[0.175]	[0.366]
Mother × Has 2+ children × Not pregnant			0.224	0.017
			[0.205]	[0.439]
Africa mean of outcome	2.248	11.988		
p-value: India × Has 2+ children × Not preg	0.069	0.000		
p-value: India × Has 1 child × Not preg		0.000		
p-value: Mother × Has 1 child × Not preg			0.978	0.000
p-value: Mother × Has 2+ children × Not preg			0.841	0.000
Household & age controls	Yes	Yes	Yes	Yes
Observations	59,928	148,408	40,076	34,240

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. In columns 1-2, control variables included are survey month controls, household covariates, mother's age at birth, and household covariates and mother's age at birth interacted with *India*, *Not pregnant*, and *India* × *Not pregnant*. In column 1, the sample includes mothers who have given birth to at least 1 child in the last 3 years; data to construct the mother's food consumption index in a comparable way to India is available in 10 African surveys. In column 2, the sample includes mothers who have given birth in the last 5 years or have never given birth; data on mother's hemoglobin level is available in 21 African surveys. In column 3-4, the control variables included are household covariates, mother's age at birth, and household covariates and mother's age at birth interacted with *India*, *Mother*, and *India* × *Mother*. The sample includes Indian women who have given birth to at least 1 child in the past 5 years or have never given birth and their husbands, if both answered consumption questions. Men whose wives are pregnant are also coded as pregnant, and the omitted category is men whose wives have never given birth. See Data Appendix for further details.

Data Appendix

DHS surveys used

The data sets included from Sub-Saharan Africa are Democratic Republic of the Congo 2007 (V), Republic of the Congo (Brazzaville) 2005 (V), Cameroon 2004 (IV), Chad 2004 (IV), Ethiopia 2005 (V), Ghana 2008 (V), Guinea 2005 (V), Kenya 2008-9 (V), Liberia 2007 (V), Lesotho 2004 (IV), Lesotho 2009 (VI), Madagascar 2003-4 (IV), Mali 2006 (V), Malawi 2004 (IV), Niger 2006 (V), Nigeria 2008 (V), Namibia 2006-7 (V), Rwanda 2005 (V), Sierra Leone 2008 (V), Senegal 2005 (IV), Sao Tome 2008 (V), Swaziland 2006-7 (V), Tanzania 2004-5 (IV), Tanzania 2010 (VI), Uganda 2006 (V), Zambia 2007 (V), and Zimbabwe 2005-6 (V). The DHS questionnaire version (IV, V, or VI) is given in parentheses. The data set for India is India 2005-6 (NFHS-3).

Height-for-age z-score

For comparing height across children of different gender and age, we create normalized variables using the World Heath Organization (WHO) method (WHO Multicentre Growth Reference Study Group, 2006b). The WHO provides the distribution of height separately for boys and girls, by age in months from a reference population of children from Brazil, Ghana, India, Norway, Oman and the United States. Because child height has a skewed distribution, the WHO recommends a restricted application of the LMS method using a Box-Cox normal distribution. The formula used is as follows:

$$\text{z-score} = \frac{(\text{observed value}/M)^{L-1}}{L \times S}$$

The WHO provides the values of M, L and S for each reference population by gender and age. M is the reference median value for estimating the population mean, L is the power used to transform the data to remove skewness, and S is the coefficient of variation. We construct the z-score using the height and age information in the data rather than using the truncated z-score variables included in the DHS data sets.

Birth order

Birth order is defined as birth order among children ever born to one's mother. Multiple births, such as twins, are assigned the same birth order. For a child born subsequent to a multiple birth, birth order is incremented by the size of the multiple birth, e.g., the next child born after firstborn twins is birth order 3.

Child's age

For all children whose anthropometric data are recorded, the DHS also provides measurement date. Our child age variable is in months, and is constructed by calculating the number of days elapsed between child's birth and measurement date, and then converting this age into months. When we refer to a child as n months old, we mean the child is in its n^{th} month of life such that a child who is one week old is in its 1st month of life, hence 1 month old.

Prenatal variables

Total prenatal visits is collected for the most recent birth in the past 5 years. Hence, our sample is restricted to youngest living child from each family for this variable. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of the total number of prenatal visits during the pregnancy. It is 0 if the mother never went for a prenatal visit, and the maximum number of visits is top-coded at 20.

Mother took iron supplements is collected for the most recent birth in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of whether she took iron supplements during the pregnancy of her youngest living child.

Mother's total tetanus shots is collected for the most recent birth in the past 5 years. The exception is the Democratic Republic of the Congo (2007), which collected it for all births in the past 5 years; we restrict the sample to the most recent birth for consistency. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of the number of tetanus toxoid injections given during the pregnancy to avoid convulsions after birth. The DHS recorded having more than 7 injections as 7.

Delivery at health facility is collected for all births in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is calculated based on the mother's self-report of where child was delivered. Delivery at a home is defined as a delivery at any home, including the respondent's home, her parents' home, traditional birth attendant's home or some other home. Any delivery that did not occur at a home is considered a delivery at health facility.

Postnatal variables

Postnatal check within 2 months is collected for the most recent birth in the past 5 years. It is available in 13 African DHS's (Ghana 2008, Kenya 2008-9, Liberia 2007, Lesotho 2009, Nigeria 2008, Namibia 2006-7, Sierra Leone 2008, Sao Tome 2008, Swaziland 2006-7, Tanzania 2010, Uganda 2006, Zambia 2007, and Zimbabwe 2005-6) as well as the NFHS. It is the mother's self-report of whether the child received a postnatal check within 2 months after it was born.

Child taking iron pills is collected for all births in the past 5 years. It is available in 10 African DHS's (Ghana 2008, Kenya 2008-9, Liberia 2007, Nigeria 2008, Namibia 2006-7, Sierra Leone 2008, Sao Tome 2008, Swaziland 2006-7, Tanzania 2010, and Uganda 2006) as well as the NFHS. It is the mother's self-report of whether the child is currently taking iron pills.

Child's total vaccinations is collected for all births in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of the total number of vaccinations the child has received to date from among those that the DHS collects data on: BCG, 3 doses of DPT, 4 doses of polio, and measles. Thus the value of child's total vaccinations is 9 if the child received all vaccines. The sample is restricted to children who should have completed their course of vaccinations, specifically those age 13-59 months, as the recommended age for the vaccinations is up to age 12 months.

Other child outcomes

Pooled inputs. We include regressions that pool all four prenatal inputs and three postnatal inputs, transforming continuous variables into dummy variables for being above the sample median. The dummy variables are: 1) total prenatal visits >4; 2) mother took iron supplements; 3) mother's total tetanus shots >1; 4) child was delivered at a health facility; 5) child is taking iron pills; 6) total vaccinations >7; 7) child had postnatal check within 2 months of birth.

Child's Hb level is the child's hemoglobin level in g/dl adjusted by altitude. It is defined for children 6 months or older and is not available for 6 surveys: Chad 2004, Kenya 2008-9, Liberia 2007, Namibia 2006-7, Nigeria 2008, and Zambia 2007.

Infant mortality is an indicator for whether the child is deceased is collected for all births in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of whether the child is deceased. The sample is restricted to children age 13-59 months because whether they died in infancy is censored for children under age 1 year.

Diarrhea in last 2 weeks is collected for all births in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of whether the child had diarrhea in the 2 weeks before the survey.

Maternal outcomes

Wants more children is created based on the question, "Would you like to have another child, or would you prefer not to have more children?" It is coded as 0.5 if the mother said she is undecided whether she wants to have more children and 0 if she wants no more children or has been sterilized. This variable is missing if the woman is infecund or indicated that she has never had sex.

Mother's food consumption index is constructed based on the DHS and NFHS variables on mother's food consumption. Mother's food consumption is available in 10 African DHS's (Ghana 2008, Liberia 2007, Nigeria 2008, Namibia 2006-7, Sierra Leone 2008, Sao Tome 2008, Swaziland 2006-7, Uganda 2006, Zambia 2007, and Zimbabwe 2005-6). These surveys asked detailed questions about food and liquid items consumed in the last 24 hours to mothers who have given birth in the last three years. Based on this, we create indicators for whether the mother consumed something from the following five food groups in the previous day: eggs/fish/meat, milk/dairy, fruits, pulses/beans, and leafy vegetables. For instance, for the eggs/fish/meat group, eggs, fish, meat are three separate questions, and we create an indicator for whether mothers consumed any of the three food items for those who answered all three questions. The consumption index is generated by adding the five indicators. The NFHS has related but different questions about mother's food consumption. The survey asked all women how frequently they consume a specified food item. Hence we code daily consumption as 1, weekly consumption as 1/7, and occasionally and never as 0 to make the variable comparable to the ones from the African surveys. We generate variables indicating consumption of the same 5 food groups, and sum them to generate the consumption index. When comparing Indian and African women, we restrict the sample to women who are living with a child younger than 36 months for consistency across surveys. The NFHS also asked the same set of consumption questions to fathers, so Indian father's consumption is coded the same way.

Mother's hemoglobin level is collected for all women in some DHS's and the NFHS, and is available for a smaller sample of women whose household is selected for hemoglobin testing in other DHS's. Overall, mother's hemoglobin level is available in 21 African DHS's and the NFHS. It is adjusted by altitude in all surveys except for Republic of the Congo (Brazzaville) 2005 (V), and measured in g/dl. We restrict the sample to women who have given birth in the last 5 years or never given birth.

Variables used in heterogeneity analyses

Child sex ratio is calculated as the number of boys aged 0-6 years old over the number of girls aged 0-6 years old in the respondent's state-by-region (either urban or rural) and comes from the 2001 Indian census. Higher values indicate greater gender imbalance favoring boys.

Mother's height is measured for mothers of children born in the 5 years preceding the survey. It is available in all 27 African DHS's and the NFHS. Mother's height is converted to meters and is coded as missing if the height is less than 1.25 meters.

Open defecation is available for all births in the past 5 years in the full sample of 27 African DHS's and the NFHS. It is the mother's self-report of whether the household has no toilet facility.

% non-resident among children is calculated as the percentage of children aged 10 years or lower who are living outside of the household, calculated at the level of primary sampling unit (PSU). Children's age and whether they are living in the household are available in the full sample of 27 African DHS's. Each mother's total number of living children 10 years old or younger are calculated, and summed at the PSU level. Then, the percentage of such children living outside of the household is calculated.

Land scarcity is the calculated as the log of each country's total population in 1961 over its land area in square km in 1961 and comes from the Food and Agriculture Organization of the United Nations (FAO).

Other variables

DHS wealth index is calculated by the DHS as a summary measure of the household's standard of living. It is based on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; sources of drinking water; and toilet facilities. Through principal component analysis, the DHS assigns a factor score to each of the assets, generating a standardized asset score specific to each survey. Within each full survey sample, the variable has a mean of 0 and standard deviation of 1. Because our sample comprises the subsample of households with children under age 5, the mean and standard deviation per survey are not identically 0 and 1.

Mother is literate is available for the full sample of 27 African DHS's and the NFHS. It is the mother's self-report of whether she can read in any language.

Preceding birth interval is the number of months between the mother's second or higher birth and the birth directly preceding it. It is calculated using the age of the mother's children and is top-coded at 120 months.

Sample definitions

The main sample includes children age 1-59 months who have anthropometric data. There is a high rate of missing data for children in their 60th month of life, and hence we limit the sample to children who are 59 months old or younger. In Appendix Table 2, column (6), *Below median fertility* indicates that children are either from India or from African countries with below median fertility. Fertility level is calculated as the mean number of children per mother for each African survey. Then the median value among the African surveys is used to determine which surveys have below median fertility values. *Children with the same father* is the sample restricted to households in which all children presumably have the same father. Such households meet the following conditions: the mother's total number of unions is 1, the firstborn child's age in years is smaller than or equal to the number of years since the parents' marriage, and the mother is currently married.

Countries with similar GDP to India include 23 DHS's administered between 2004-2010 from countries that have height data available and that had a log GDP per capita within a 50% upper and lower bound of India's 2005-6 log GDP per capita. These countries are: Benin 2006, Bolivia 2008, Burkina Faso 2010, Cambodia 2005, Cambodia 2010, Cameroon 2004, Chad 2004, Egypt 2005, Ghana 2008, Haiti 2005, Honduras 2005, Kenya 2008, Lesotho 2004, Lesotho 2009, Mali 2006, Moldova 2005, Nigeria 2008, Sao Tome and Principe 2008, Senegal 2005, Senegal 2010, Tanzania 2010, Timor-Leste 2009, Zambia 2007, Zimbabwe 2005, Zimbabwe 2010.

Europe, Central & West Asia includes 16 DHS's spanning 1995-2012 for European, Central and West Asian countries with height data available: Albania 2008-2009, Azerbaijan 2006, Armenia 2005 & 2010, Jordan 2012, 2007 & 2002, Moldova 2005, Turkey 2003 & 1998, Kazakhstan 1999 & 1995, Kyrgyz Republic 2012 & 1997, Tajikistan 2012, and Uzbekistan 1996. Because of the relative paucity of surveys in this region, we expand the time period to cover 1995 to 2012 rather than just 2004 to 2010.

NFHS-1 and NFHS-2 are the first two rounds of the National Family Health Survey; our main sample for India is the most recent round, NFHS-3. NFHS-1 (1992-3) collects height data for children up to age 4, while NFHS-2 (1998-9) does so for children up to age 3. Due to data availability, pooled inputs used in Appendix Table 7 include 5 of the 7 inputs used in NFHS-3, and total vaccinations is based on 8 of the 9 vaccines used in NFHS-3. Specifically, NFHS-1 and NFHS-2 do not have data on whether the child is taking iron pills, whether the child had a postnatal check within 2 months of birth, and whether the child received one of the four doses of the polio vaccine.

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Contact us
International Growth Centre,
London School of Economic and Political Science,
Houghton Street,
London WC2A 2AE

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