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

By Seema Jayachandran and Rohini Pande*

Child stunting in India exceeds that in poorer regions like sub-Saharan Africa. Data on over 168,000 children show that, relative to Africa, India's height disadvantage increases sharply with birth order. We posit that India's steep birth order gradient is due to favoritism toward eldest sons, which affects parents' fertility decisions and resource allocation across children. We show that, within India, the gradient is steeper for high-son-preference regions and religions. The gradient also varies with sibling gender as predicted. A back-of-the-envelope calculation suggests that India's steeper birth order gradient can explain over one-half of the India-Africa gap in average child height. (*JEL* I12, J13, O15, Z12, Z13)

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 lower cognitive ability, and earn less as adults.[1]

India, where over 30 percent of the world's stunted children live, stands out in particular (UNICEF 2013). Its child stunting rate is over 40 percent, an outlier even among poor countries (IIPS 2010).[2] Figure 1 graphs average child height-for-age for sub-Saharan African (hereafter, African) countries and Indian states against income.

* Jayachandran: Department of Economics, Northwestern University, 2211 Campus Drive, Evanston, IL 60208 (email: seema@northwestern.edu); Pande: Harvard Kennedy School, Harvard University, Mailbox 46, 79 JFK Street, Cambridge, MA 02138 (email: rohini_pande@harvard.edu). We thank Patrick Agte, Alejandro Favela, Lydia Kim, Suanna Oh, and Alexander Persaud for excellent research assistance. We are grateful to Abhijit Banerjee, Jere Behrman, Diane Coffey, Angus Deaton, Rebecca Dizon-Ross, Jean Drèze, Erica Field, Dominic Leggett, Nachiket Mor, Debraj Ray, Dean Spears, Tomasz Strzalecki, Alessandro Tarozzi, several seminar participants, and three anonymous referees for helpful comments. We thank the International Growth Centre, National Science Foundation (Jayachandran) and Harvard's Women and Public Policy Program (Pande) for funding. The authors declare that they have no relevant or material financial interests that relate to the research described in this paper.

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[1] Stunting is defined as having a height-for-age that is two standard deviations or more below the worldwide reference population median for one's gender and age in months. Child height is predictive of adult height (Healy et al. 1956) and taller adults have greater cognitive skills (Glewwe and Miguel 2008; Guven and Lee 2015), fewer functional impairments (Barker and Osmond 1986; Barker et al. 1993; Gould 1989), and higher earnings (Strauss and Thomas 1998; Case and Paxson 2008; Hoddinott et al. 2013).

[2] Unlike in western countries where economic growth was accompanied by rapid height increases (Floud et al. 2011), recent economic growth has only modestly increased average height in developing countries (Deaton 2007). Between 1992 and 2005, India's annual economic growth exceeded 6 percent, yet stunting declined by just 0.6 percentage points (1.3 percent) per year (Tarozzi 2012).

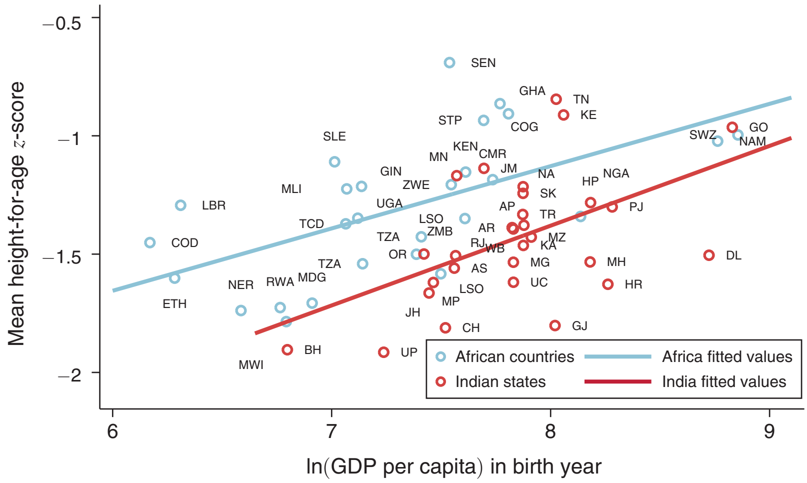

Figure 1. Child Height versus National GDP

Notes: The light and dark circles represent sub-Saharan African 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. National GDP data are based on the Penn World Table 9.0 (Feenstra, Inklaar, and Timmer 2015).

Both regions exhibit a positive correlation between income and child height, but the curve for India is lower; at a given level of income, Indian children are shorter. Given that India performs better than African countries on most health and development indicators, this contrast is striking and is the focus of this paper.[3]

Using survey data on over 168,000 children from India and 25 African countries, we demonstrate a steeper height drop-off for later-born children in India. India's relative 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 distribution. The steeper drop-off with birth order in India than Africa also holds for weight-for-age, child hemoglobin and, importantly, for an array of prenatal and postnatal health inputs.

We use several approaches to ensure that differential household selection into high fertility is not generating the observed steeper birth order gradient in India. First, the same patterns hold when we control for maternal and neighborhood characteristics that are correlated with total fertility and child outcomes. Second, the results are robust to estimating the patterns using only between-sibling variation in child height (i.e., holding family size and other family characteristics fixed). Finally, we consider two different samples where mothers have likely completed fertility, and in both cases the birth order patterns are robust to flexibly controlling for total fertility in parallel to birth order.

[3] India outperforms African countries on maternal mortality, life expectancy, food security, poverty incidence, and educational attainment (Gwatkin et al. 2007). Yet, India has the fifth highest stunting rate among 81 low-income and low-middle-income countries with comparable child height data (UNICEF 2013), despite being in the middle of the group (rank 43) for GDP per capita.

Turning to the underlying mechanism at work, we propose that eldest son preference in India—encompassing both a desire to have at least one son and for the son to be healthy—influences parents' fertility decisions and how they allocate resources across children, leading to the steep birth order gradient in height. Eldest son preference can be traced to the patrilocal and patrilineal Hindu kinship system: aging parents typically live with, and bequeath property to, their eldest son (Dyson and Moore 1983; Gupta 1987). Further, Hindu religious texts emphasize post-death rituals which can only be conducted by a male heir (Arnold, Choe, and Roy 1998). (Henceforth, "son preference" is shorthand for eldest son preference.)[4]

The data support several specific predictions of this hypothesis. First, within India, the birth order gradient is shallower among children living in Indian states that practice matrilineality (Kerala and the eight Northeast states) and those with a less male-skewed sex ratio.[5] We also observe a shallower birth order gradient within India among Muslim children; relative to Hinduism, Islam places less emphasis on having a son. Finally, consistent with the Hindu-Muslim difference in eldest son preference, we show that the birth order gradient in India exceeds that in the neighboring countries of Bangladesh and Pakistan.[6]

Second, the son-preference mechanism predicts that the drop-off in height across successive children will depend on their older siblings' gender composition. Among boys, we posit that eldest sons receive more health and nutrition inputs than their brothers. Consistent with the fact that sons born at high birth order are less likely to be the family's first son, we observe a birth order gradient among boys. We also exploit variation in when the family's first son is born, and show that a son born at birth order 2 is taller in India than Africa if and only if his older sibling is a girl: i.e., he is the family's eldest son.

Among girls, older siblings' gender composition affects resources in two ways, both of which disfavor later-born daughters. First, there is the "sibling rivalry effect": a girl born at later birth order has (by definition) more older siblings. It follows that she is also more likely to have an elder brother, and likely to fare poorly when competing with him for family resources (Garg and Morduch 1998; Pande 2003).

The second mechanism is fertility-stopping behavior, which instead confers a disadvantage to a later-born daughter who lacks brothers. When a daughter is born into a family with only girls, her parents are likely to continue 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 and fewer resources are expended on her. Both mechanisms generate a birth order gradient among girls, and the net effect of having an older brother on the resources allocated to a girl is ambiguous. Empirically, we find that the net effect is positive, pointing to the importance of the fertility-stopping mechanism.

[4] India also exhibits a general preference toward all sons. In Section III, we discuss the role of eldest son preference versus general son preference in explaining the patterns we find.

[5] In Kerala and the Northeast states, some but not all population groups follow matrilineal practices.

[6] Using country comparison groups other than Africa also helps address the concern that it may be Africa that is special, not India. In addition to the within-South-Asia comparison, we also compare Indian children to those in countries with similar GDP and those in countries with genetically similar population groups. In all cases, India exhibits the steepest birth order gradient.

These two mechanisms affecting girls provide a third testable prediction among daughters with no elder brother. While a lack of sibling rivalry will increase both prenatal and postnatal investments in these daughters relative to those with an elder brother, the fertility-stopping effect reduces the postnatal investment they receive because, after their birth, parents realize they need to try again for a son. We show that, relative to Africa and to prenatal inputs, girls in India receive fewer postnatal resources if their family does not yet have a son. Theories for the steep Indian birth order gradient other than son preference seem unlikely to explain the several patterns we find in the data.

The birth order differences in health inputs and height directly demonstrate stark inequality across Indian children. This inequality is also informative about the average Indian deficit in child height. At a most basic level, the decomposition by birth order and gender is informative about the genetic potential of Indian children: unless genotypes vary systematically by birth order, all Indian children have the genetic potential to be at least as tall as the observed average height of first-borns. The absence of a height deficit for Indian first-borns, thus, suggests that genetics cannot explain most of India's height deficit compared to Africa.

More directly, we argue that parents' unequal allocation of resources across children affects average height in India. Mirroring the India-Africa patterns, our within-India analyses show that there is higher average child height *and* a shallower birth order gradient for Indian regions with less son preference. For these subgroups, we observe a more equal allocation of resources, but not more inputs to children on average. Consistent with height production functions in the literature, these patterns suggest that height exhibits diminishing returns to inputs (Steckel 1995).[7] With diminishing returns to inputs, unequal investment across children will depress average child height.

To quantify the link between birth order gradient differences across India and Africa and the average child height deficit in India, we conduct two back-of-the-envelope calculations. The first asks how much of the gap is explained by the birth order gradient, and the second how much is explained specifically by eldest son preference generating a birth order gradient. As a starting point, we demonstrate a negative correlation between the birth order gradient and level of height across African countries. For the first exercise, we multiply this estimated correlation by the India-Africa gap in the birth order gradient. When we compare the resulting estimate to the observed India-Africa height gap (adjusted for GDP per capita), we find that the birth order gradient explains over one-half of the Indian height puzzle.

Next, we use the low eldest son preference states of Kerala and the Northeast as a proxy for India without eldest son preference and conduct a similar calculation. We find that the birth order gradient rooted in eldest son preference explains one-third of the India-Africa height gap. While not rigorously establishing the link between the gradient and level, these two accounting exercises are suggestive that eldest son preference and, relatedly, the birth order gradient have quantitatively important implications for average height in India.

[7] We also use Indian Human Development Survey data to directly demonstrate that child height exhibits diminishing returns to household income and expenditures in India.

Our paper complements, and adds to, the literature on the environmental determinants of child height. Spears (2013), for instance, focuses on open defecation as a cause of the Indian height disadvantage.[8] We also contribute to the literature on 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 the first paper to examine how cultural norms of son preference influence birth order effects and, more generally, is one of the few papers in economics to study why birth order effects arise.[9] 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 I describes the data and presents descriptive statistics for the sample. Section II presents evidence on the birth order gradient in the Indian height disadvantage, and Section III presents evidence on eldest son preference as the root cause and also tests alternative explanations for the within-family patterns. Section IV concludes.

I. Background and Data Description

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 the one we follow, is to create the child's height-for-age (HFA) z-score based on the World Health Organization (WHO) universally applicable growth standard for children aged zero to five years.[10] 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 two standard deviations below that reference-population median, which is the cutoff for being considered stunted. Our primary outcome of interest is the HFA z-score because it is the child health measure that has been most often linked to later-life outcomes and is viewed as the best cumulative measure of

[8] Much of the recent evidence weighs against genetic explanations in explaining India's height deficit (Coffey et al. 2013). For instance, work examining the height of Indian children whose parents migrate to rich countries finds significant narrowing in the gap between Indian-born children and worldwide norms (Tarozzi 2008; Proos 2009).

[9] Price (2008) studies parental care-giving time as a reason for birth order effects. Birth order gradients have been documented for outcomes as varied as IQ, schooling, height, and personality (Behrman and Taubman 1986; Sulloway 1996; Black, Devereux, and Salvanes 2005, 2011; Belmont, Stein, and Susser 1975; Horton 1988).

[10] The WHO standard describes 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 Multicentre Growth Reference Study Group 2006a). The WHO constructs the height distribution using a sample of children from six affluent populations across five continents (Brazil, Ghana, India, Norway, Oman, and the United States) with no known health or environmental constraints to growth and who received recommended nutrition and health inputs (WHO Multicentre Growth Reference Study Group 2006b).

child malnutrition. As a robustness check we also consider weight for age (WFA) z-scores (which are similarly defined) as an outcome variable.

The 2005–2006 National Family Health Survey (NFHS-3) is our data source for Indian children; it employs the same sampling methodology and survey instrument as the internationally used Demographic and Health Surveys (DHS). 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 (from now on, African countries) where DHS Surveys collected child anthropometric data and occurred between 2004 and 2010 (to ensure a comparable time period to NFHS-3). Two African countries (Tanzania and Lesotho) were surveyed twice in this time period, and we include both survey rounds. The DHS sample in our main analysis refers to the 27 Demographic and Health Surveys for African countries plus India's NFHS-3 survey. Our robustness checks use DHS surveys from other regions.

The DHS interviews women aged 15 to 49 years, and measures height for their children aged 5 and under. Our sample comprises the 168,108 children with anthropometric data.[11] Table 1 provides summary statistics, and the online Data Appendix provides other survey details. The average Indian child is slightly older than the average African child (30.2 months versus 28.3 months). A comparison of HFA z-scores shows that Indian children are shorter than African children (-1.51 and -1.35, respectively). We define child birth order based on all children, currently alive or deceased, ever born to a mother. As African women have more children (3.9) than their Indian counterparts (2.7), the mean birth order in Africa (3.7) exceeds that in India (2.6). Lower total fertility in India implies that despite similar mothers' age at first birth, average maternal age at birth for children in our sample is lower in India (25 years) than Africa (27 years). The average spacing between births is reasonably high and similar in India (36 months) and Africa (39 months). We also define a subsample with likely completed fertility comprising the 49,880 mothers who state that they do not want more children or are sterilized or infertile.

In addition, we 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 they had a medical checkup within the first two months of life, whether they received 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. Table 1 also summarizes our control variables. Reflecting differences in the number of countries covered and total sample size, Africa has close to 3 times as many primary sampling units as India (10,366 and 3,822, respectively), while

[11] Following WHO guidelines on handling outlier values, we exclude observations with a HFA z-score > 6 or < -6 (> 5 or < -6 for WFA) as these are likely to be erroneous.

Table 1—Summary Statistics

	India subsample	Africa subsample		India subsample	Africa subsample
Mother's age at birth (years)	24.75	26.96	Child's age (months)	30.20	28.27
	[5.23]	[6.86]		[16.90]	[17.06]
Mother's total children born	2.74	3.88	Child is a girl	0.48	0.50
	[1.82]	[2.54]		[0.50]	[0.50]
Mother's desired fertility	2.47	4.62	Child's birth order	2.62	3.74
	[0.96]	[1.47]		[1.80]	[2.48]
Mother wants more children	0.34	0.67	Child's HFA *z*-score	−1.51	−1.35
	[0.47]	[0.46]		[1.81]	[1.94]
Mother completed her fertility	0.67	0.33	Child is stunted	0.40	0.38
	[0.47]	[0.47]		[0.49]	[0.48]
Mother is literate	0.58	0.50	Child's WFA *z*-score	−1.53	−0.88
	[0.49]	[0.50]		[1.33]	[1.42]
Mother's height (meters)	1.52	1.58	Child's hemoglobin level (g/dl)	10.28	10.15
	[0.06]	[0.07]		[1.57]	[1.68]
Mother took iron supplements	0.69	0.62	Child is deceased	0.05	0.07
	[0.46]	[0.48]		[0.22]	[0.26]
Mother's total tetanus shots	1.87	1.41	Child taking iron pills	0.06	0.11
	[0.94]	[1.20]		[0.23]	[0.32]
Total prenatal visits	4.04	3.85	Child's total vaccinations	6.61	6.24
	[3.48]	[3.07]		[2.80]	[3.12]
Delivery at health facility	0.45	0.47	Birth spacing (months)	36.16	38.69
	[0.50]	[0.50]		[20.32]	[20.63]
Postnatal check within two months	0.09	0.30	Diarrhea in last two weeks	0.09	0.16
	[0.29]	[0.46]		[0.29]	[0.36]
Average pooled inputs	0.33	0.38	Open defecation	0.46	0.32
	[0.28]	[0.30]		[0.50]	[0.47]
Percent nonresident among children	0.02	0.10	Land scarcity	5.03	2.56
	[0.04]	[0.08]		–	[1.17]
Number of adult females in household	1.85	1.60	Number of PSUs	3,822	10,366
	[1.09]	[1.06]			
log GDP per capita (in child's birth year)	7.78	7.36	Main sample of children	42,069	126,039
	[0.10]	[0.65]			

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's desired fertility, wants more children, mother completed her fertility, mother is literate, and mother's height. Total prenatal visits, mother took iron supplements, total tetanus shots, postnatal check within two 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, birth spacing (the birth interval between a child and his or her older sibling), delivery at health facility, average pooled inputs, all child variables (first ten variables in the second column), diarrhea in last two weeks, open defecation, percent nonresident among children, number of adult females in the household, and log GDP per capita in child's birth year. Land scarcity is summarized at the country level.

maternal literacy is higher in India. The online Data Appendix provides further details on variables entering the analysis.

Our within-India analysis uses two datasets. First, we pool all three waves of NFHS (conducted in 1992–1993, 1998–1999, and 2005–2006), which gives us a sample of over 90,000 Indian children. Second, we use the Indian Human Development Survey (IHDS), a two-wave survey conducted in 2005 and 2012. The IHDS panel structure and seven-year gap between waves allow us to focus on families that had no children between the two waves and therefore (almost surely) completed fertility. While the sample size among families with completed fertility is relatively small

(3,615 children under age 5 with height data in wave 1), the IHDS analysis allows us to show that our results are robust to controlling for family size. Online Appendix Table 1 provides summary statistics for these two datasets.

II. Birth Order and Child Outcomes

We start by documenting the key fact that underlies our analysis: the steeper birth order gradient in child height in India relative to Africa. We then discuss endogeneity concerns, and provide relevant robustness checks. We conclude this section by documenting similar gradients in parental inputs that likely influence height and in other child health outcomes.

A. *Child Height*

Basic Finding.—Figure 2 plots the average child height-for-age (HFA) *z*-scores for India and Africa, separately by birth order. 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 height gap, pooling all children. Indian children are, on average, 0.08 standard deviations shorter than African children, a difference that is significant at the 1 percent level. As shown in column 1, online Appendix Table 2, this average deficit remains significant and increases to -0.16 standard deviations if one controls for PPP-adjusted GDP per capita in the child's birth year; India is richer than the African comparison group, on average.

We next disaggregate the height disadvantage by birth order. The outcome variable remains HFA for child *i* born to mother *m* in country *c*. We estimate

$$(1) \qquad HFA_{imc} = \alpha_1 I_c + \alpha_2 I_c \times \text{2nd}\, Child_{imc} + \alpha_3 I_c \times \text{3rd+}\, Child_{imc} + \beta_1 \text{2nd}\, Child_{imc} + \beta_2 \text{3rd+}\, Child_{imc} + \gamma X_{imc} + \epsilon_{imc},$$

where I_c is an indicator for Indian children; α_1 is the India gap for first-born 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 child age dummy variables (in months) to account for nonlinear patterns of *z*-scores and age. We also expand the set of controls to check the robustness of our results, as described below. Throughout, standard errors are clustered at the mother level.

Column 2 of Table 2 shows that the Indian height disadvantage opens up at birth order 2: the interaction of India and being second-born is -0.14 and highly significant. The Indian disadvantage remains significant and increases, with third and higher births having a height *z*-score gap of -0.28 compared to African children (sum of main effect and interaction term).[12]

[12] In Section IIIF, we conduct an accounting exercise that quantifies how much this gradient contributes to the average height deficit in India compared to Africa.

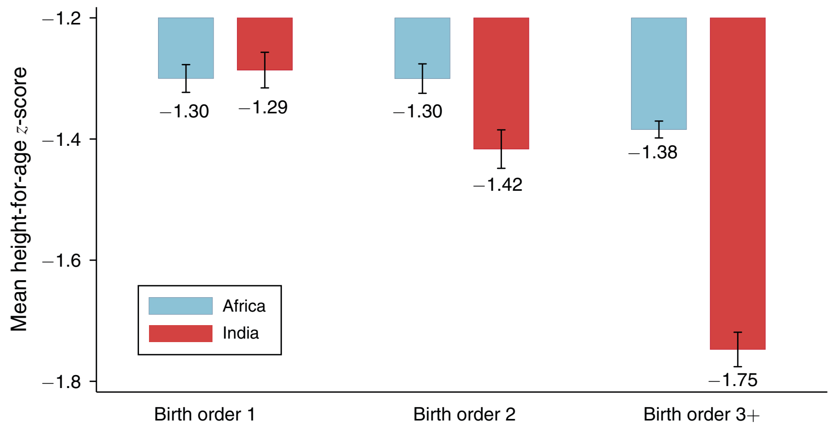

Figure 2. Child Height in India and Africa, by Child's Birth Order

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.

Table 2—India's Differential Birth Order Gradient in Child Height and Related Outcomes

	HFA z-score					Stunted	WFA z-score	Hb level	Deceased
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
India	−0.082	0.092							
	[0.011]	[0.018]							
India × 2nd child		−0.144	−0.161	−0.110	−0.243	0.051	−0.146	−0.094	0.003
		[0.025]	[0.027]	[0.063]	[0.048]	[0.007]	[0.020]	[0.030]	[0.004]
India × 3rd+ child		−0.377	−0.227	−0.193	−0.436	0.064	−0.198	−0.159	0.002
		[0.024]	[0.032]	[0.092]	[0.085]	[0.009]	[0.024]	[0.036]	[0.004]
2nd child		0.023	−0.011	−0.097	−0.167	0.009	0.009	−0.011	−0.014
		[0.015]	[0.017]	[0.053]	[0.027]	[0.004]	[0.012]	[0.022]	[0.002]
3rd+ child		−0.066	−0.118	−0.169	−0.334	0.036	−0.063	−0.037	−0.011
		[0.013]	[0.019]	[0.074]	[0.044]	[0.005]	[0.014]	[0.025]	[0.003]
Africa mean of outcome	−1.351	−1.351	−1.351	−1.351	−1.351	0.375	−0.877	10.150	0.071
Child's age dummies × India	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mother's literacy × India	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Mother's age at birth × India	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes
PSU fixed effects	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Mother fixed effects	No	No	No	No	Yes	No	No	No	No
Completed fertility sample	No	No	No	Yes	No	No	No	No	No
Observations	168,108	168,108	167,737	66,566	83,228	167,737	167,737	88,838	199,514

Notes: Standard errors are clustered by mother and appear in brackets. HFA z-score is the child's height-for-age z-score, Stunted is defined as having an HFA z-score ≤ -2, WFA z-score is the child's weight-for-age z-score, and Hb level is the child's hemoglobin level; 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. In columns 3–4 and 6–9, the main effect India is absorbed by PSU fixed effects. In column 5, the main effect India is absorbed by mother fixed effects. Columns 3–4 and 6–9 include PSU fixed effects, a linear and a quadratic variable for mother's age at birth, mother's literacy, and mother's literacy, maternal age, and child age dummies interacted with India. In columns 3 and 5–9, the sample is restricted to PSUs with at least two children aged 1–59 months. In column 4, the sample is restricted to children whose mothers report that they do not want to have more children, are sterilized, or are infecund. Column 4 includes total fertility dummies, top-coded at 6 children, and total fertility dummies interacted with India. In column 8, Hb level is defined for children 6 months or older and is not available for six surveys. In column 9, the sample consists of ever-born children aged 13–59 months. See the online Data Appendix for further details.

Endogeneity Concerns.—The ideal data for examining differences in the birth order gradient across India and Africa would use households that had completed fertility and would have height data for all children. This would allow us to control for total family size in parallel to birth order and ensure that the estimates are not confounding the effects of birth order and family size (Black, Devereux, and Salvanes 2005). In this case, birth order would be orthogonal to family characteristics (so adding mother fixed effects might improve precision but would not change the birth order coefficients).

However, the nature of DHS sampling implies that a large fraction of households in our sample have not completed childbearing. The best proxy for intended family size is a survey question on the mother's desired fertility, but it is not asked prior to childbearing, rendering it potentially endogenous to a woman's fertility outcomes. Moreover, actual and desired fertility often differ in countries where access to contraception is limited. Hence, our regressions cannot control for total family size in general, raising an omitted variable bias concern; the birth order variable in between-household comparisons could be proxying for high-fertility families. Higher birth order children are more likely to come from larger families, and family size could be correlated with child height; family size could affect child height via its effect on the available resources per child, plus larger families tend to be poorer.

One response is to include family fixed effects; eventual total family size is held fixed when making comparisons across siblings, despite our not directly observing it. The one caveat is that DHS surveys only provide height data for children age five and younger, raising the possibility of endogenous selection into the relevant sample; for example, the sample in regressions with family fixed effects will typically have shorter birth spacing than the full sample and birth spacing could differ across India and Africa.

Given this, we address endogeneity concerns in multiple ways. First, and as we describe immediately below, we conduct a set of robustness checks using the DHS data. Second, in Section III we conduct a parallel within-India analysis for children of women who have completed fertility using the IHDS data. Finally, we consider comparison groups of countries other than Africa; if the nature of differential selection is specific to the India-Africa comparison then we should not observe a steeper birth order gradient when we use alternative comparison groups.

Our first approach to address endogeneity is to include a rich set of covariates in parallel to birth order: primary sampling unit (PSU) fixed effects, maternal literacy, maternal age, and child age. In rural areas a PSU is a village, and in urban areas it is a neighborhood. PSU fixed effects control for many dimensions of economic and health status, as well as unobserved environmental conditions. For instance, fertility outcomes are highly correlated within PSUs. We also control for maternal literacy, which again is highly correlated with observed fertility.[13] Our other two controls relate to maternal and child age. Within families, birth order is correlated with maternal age. The public health literature identifies a nonlinear relationship

[13] For the completed fertility sample, in India (Africa) the average standard deviation of fertility within a PSU is 1.27 (2.01) while the standard deviation across all of India (Africa) is 1.88 (2.76). Pooling regions, literate women with completed fertility have 1.7 fewer children than illiterate women. In India (Africa), literate women with completed fertility have 1.6 (1.9) fewer children than illiterate women.

between maternal age and child health (specifically, early and late pregnancies are associated with worse outcomes: see Fall et al. 2015). To ensure that birth order effects do not proxy for maternal age, we include a quadratic in maternal age in the controls.[14] Finally, child age is correlated with birth order within families; among siblings, the higher birth order child will, by definition, be younger. We therefore use child age dummies as covariates. Importantly, for each of these covariates, we include the interaction with the India dummy. Column 3 of Table 2 shows that the addition of these control variables reduces the magnitude but not significance of the $I_c \times$ 3rd+ *Child* coefficient, and does not appreciably change the $I_c \times$ 2nd *Child* coefficient. This specification will be our main specification in later analyses.

Next, we classify women who stated they do not want any more children or who have been sterilized as likely to have completed fertility. We then reproduce column 3 for children belonging to this subsample of households where the mother has likely completed fertility (our sample size is roughly 40 percent of the original sample). We use the observed number of children for these households as their total family size, and in our regression include controls for family size dummies interacted with India. Column 4 shows that our results on the birth order gradient hold, although they are less precisely estimated. Finally, similar in spirit to controlling for actual family size is to control for desired family size. Keeping in mind the caveats mentioned earlier, column 1 of online Appendix Table 2 shows that our results are robust to controlling for desired fertility.

In column 5 of Table 2 we report regressions that include mother fixed effects. By only using within-family comparisons for identification, we fully control for family size differences. Birth order and child's age are strongly correlated within a family, so we continue to control for $I_c \times$ *ChildAge*. Requiring there to be at least 2 children from a family in the sample reduces the sample size to 83,228 children. The effective sample size is even smaller: the birth order coefficients are identified off of 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 3rd+ *Child* category). The Indian birth order gradient remains statistically significant, and the results are similar though somewhat larger in magnitude to those in columns 2 and 3. Consistent with findings in many settings that low-parity children have better outcomes, we observe a negative birth order gradient in Africa (the coefficients on 2nd *Child* and 3rd+ *Child* are negative and significant). The key finding is that the birth order gradient in child height is twice as large in India as in Africa.

The mother fixed effects specification is an important robustness check that de facto includes fixed effects for eventual total family size, which does not vary within family. The drawback is that the birth order gradient is identified off less than one-half of the sample. A specific concern is that siblings with shorter than average birth spacing identify the mother fixed effects estimates and, therefore, selection based on birth spacing might differ between India and Africa. Reassuringly, average birth spacing in this subsample is reasonably high and similar across India and Africa (26 months versus 29 months). Moreover, because the mother fixed effects

[14] We de facto control for mother's current age, as it is the sum of child age and mother's age at birth.

specification includes child age (in months) dummies, we are de facto controlling for birth spacing between the siblings in the sample. As a further robustness check, we also control directly for a child's birth spacing from his or her older sibling interacted with India. In the specification with household controls (online Appendix Table 3, column 2), the birth order gradient is very similar to our main results. With mother fixed effects (column 3), India's birth order gradient remains statistically significantly steeper for children of birth order 3 and higher; the coefficient for the birth order 2 interaction becomes smaller but remains marginally significant.[15]

Next, we use alternative geographic comparison groups to check whether what we interpret as an abnormally steep birth order gradient in India is actually an abnormally shallow gradient in Africa. In online Appendix Table 4, columns 1–3 we define the comparison group for India economically: the comparison group comprises 25 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 2005–2006 GDP per capita. India exhibits a significantly stronger birth order gradient than this alternative comparison group.

In columns 4–6 we define the comparison group in terms of 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 significantly stronger birth order gradient in India than in the comparison group.[16]

Finally, we compare India to its two South Asian neighbors. The puzzle of stunting is often framed as the "South Asian enigma," but our hypothesis that son preference is the root cause predicts that the birth order gradient should be steeper in India than Bangladesh and Pakistan (which are majority Muslim countries; Islam has less eldest son preference than Hinduism). Columns 7–9 show that the birth order gradient is indeed steeper in India. (In Section III, we will show that a steeper birth order gradient among Hindus than Muslims also holds within India.)[17]

[15] Online Appendix Table 3 reports further robustness checks. In columns 4 and 5 we find similar estimates when we restrict the sample to children who are birth order 4 or lower. Our estimates are also robust to considering a more endogenous definition of birth order, namely birth order among currently living children (columns 6 and 7). In Jayachandran and Pande (2015) we show that the results are robust to excluding African countries with fertility that is above the median of our full African sample. Further, to check that polygamy (which is more common in Africa than India) is not biasing estimates, we show that the results are similar when the sample is restricted to mothers who have only had children with one partner.

[16] One difference is the absence of a first-born advantage in India, which is unsurprising given that this comparison group is significantly richer than the African comparison group.

[17] Jayachandran and Pande (2015) report a placebo test for whether India's birth order gradient is an outlier among countries. We compare each country in our sample to the rest of the sample and find that India is the only country with a significantly steeper birth order gradient than the rest of the sample. This is the case even when, to account for India's larger sample size, we aggregate African countries to regions. A second placebo test uses the 25 African countries and 29 Indian states in the sample, randomly selects 29 countries or states to comprise a placebo *India*, and estimates the differential *Indian* birth order gradient, repeating the exercise 500 times. The actual $India \times 2nd\,Child$ and $India \times 3rd{+}\,Child$ coefficients are in the bottom 1 percent of the distribution of estimates, i.e., have a p-value < 0.01.

B. *Other Health Outcomes*

We focus on the continuous HFA z-score but of specific policy relevance is the stunting rate (a measure of overall child malnutrition): the incidence of children with a HFA z-score ≤ -2. Column 6 of Table 2 shows that the steep Indian birth order gradient holds for stunting: relative to their African counterparts, the disadvantage for Indian second-borns is 5 percentage points, and for third-borns, 6 percentage points (statistically significant at the 1 percent level). Thus, the high birth order penalty for stunting is two to three times as large in India as in Africa. A similar pattern holds when height in centimeters is the outcome (online Appendix Table 3, columns 8 and 9).

If the birth order gradient in height reflects unequal resource allocation across children then we would also predict a birth order gradient in other health outcomes. To examine this possible mechanism, we start by considering other health outcomes that are likely also affected by parents' resource allocation. Table 2, columns 7 and 8 show a differentially steep birth order gradient in weight-for-age and hemoglobin in India. Column 9 examines infant mortality. This is a negative health outcome, so we would predict positive India-birth order interaction terms. The point estimates are indeed positive, though statistically insignificant. Examining infant mortality also serves a different purpose: it addresses the concern that mortality selection might underlie India's strong birth order gradient. For mortality selection to explain the height patterns, we would need India to have a negative differential birth order gradient in infant mortality; weak later-born children survive at a high rate, generating a negative birth order gradient in survivors' height. However, we observe the opposite pattern.

C. *Health Inputs*

Next, in Table 3 we examine birth order gradients in prenatal and postnatal child investments. The prenatal input information is based on retrospective information about inputs in utero and at childbirth; the prenatal outcomes (and some of the postnatal outcomes) are only available for the youngest child in the family. We estimate equations of the form of equation (1), and the set of covariates includes PSU fixed effects and controls for maternal literacy, mother's and child's age, and their interactions with the India dummy.

In columns 1 to 4 we examine whether the steeper gradient holds for each prenatal input. 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 significantly 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 receive fewer inputs than their African counterparts.[18]

[18] As the main effect for India is absorbed by PSU fixed effects, the tables do not report the gap among first-borns. The comparison of absolute levels is based on a specification without PSU fixed effects.

TABLE 3—CHILD HEALTH INPUTS

	Prenatal inputs				Postnatal inputs			
	Total prenatal visits (1)	Mother took iron supplements (2)	Mother's total tetanus shots (3)	Delivery at health facility (4)	Postnatal check within two months (5)	Child taking iron pills (6)	Child's total vaccinations (7)	Average pooled inputs (8)
India × 2nd child	−0.525	−0.031	−0.019	−0.040	−0.009	−0.008	−0.203	−0.011
	[0.052]	[0.008]	[0.018]	[0.006]	[0.013]	[0.005]	[0.039]	[0.003]
India × 3rd+ child	−1.012	−0.071	−0.036	−0.092	0.014	−0.010	−0.462	−0.033
	[0.060]	[0.009]	[0.021]	[0.008]	[0.014]	[0.006]	[0.051]	[0.004]
2nd child	−0.181	−0.014	−0.112	−0.088	0.005	−0.004	−0.098	−0.044
	[0.029]	[0.005]	[0.013]	[0.004]	[0.010]	[0.004]	[0.025]	[0.002]
3rd+ child	−0.431	−0.031	−0.206	−0.133	−0.022	−0.013	−0.207	−0.071
	[0.033]	[0.005]	[0.014]	[0.004]	[0.011]	[0.005]	[0.030]	[0.003]
Africa mean of outcome	3.846	0.622	1.415	0.472	0.302	0.113	6.245	0.380
India mean of outcome	4.041	0.689	1.872	0.450	0.090	0.055	6.607	0.334
Age and other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	115,343	117,686	117,199	167,377	35,888	91,936	122,898	167,724

Notes: Standard errors are clustered by mother and appear in brackets. Control variables included are child age dummies, mother's literacy, maternal age, PSU fixed effects, and child age dummies, mother's literacy, and maternal age interacted with India. The main effect India is absorbed by PSU fixed effects. 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 five years; child taking iron pills is collected in only ten African surveys; total vaccinations uses children ages 13–59 months, as the recommended age for some is up to 1 year. In column 8, the average across four prenatal and three postnatal inputs is used to create the outcome. The dummies are (i) total prenatal visits > 3; (ii) mother took iron supplements; (iii) mother's total tetanus shots > 2; (iv) child was delivered at a health facility; (v) child is taking iron pills; (vi) total vaccinations > 8; (vii) child had postnatal check within two months of birth. See the online Data Appendix for further details.

Columns 5 to 7 analyze three postnatal investments. The prevalence of postnatal checkups is much lower in India than Africa (reflecting an Indian social norm of maternal home confinement for 40 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 and statistically significant India birth order gradient.[19] In column 8 we summarize our findings and show that the steeper birth order gradient holds for a composite input measure: the average pooled inputs received by a child. This measure is the average value of seven indicator variables. For the three input variables that are originally multivalued (total prenatal visits, total tetanus shots, and total vaccines), we construct dummy variables that equal 1 if the original measure exceeds the sample median. In sum, to the extent that child health inputs affect child height, this birth order gradient in inputs is consistent with a behavioral basis for the height birth order gradient.

[19] 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).

III. Culture and Height Deficits

The Indian birth order gradient in child height is steeper than that in Africa and several alternative comparison groups including India's neighboring countries of Bangladesh and Pakistan. An important difference between India and comparator countries lies in the religious make-up of the population: roughly four-fifths of India's population is Hindu.

In this section, we provide two types of evidence that eldest son preference—which follows from the tenets of Hinduism—is an important mechanism underlying the steep child height gradient in India. First, we use regional and religious variation within India to show that the birth gradient in height is shallower when son preference is lower. Second, we show that the Indian birth order gradient varies with the gender composition of siblings in a manner consistent with eldest son preference.

A. *Within-India Evidence*

We identify multiple subgroups within India that are marked by lower than average son preference and examine whether, relative to the rest of India, these subgroups have a less negative birth order gradient.

To do so, we use two different datasets. First, we use the pooled sample of all three NFHS waves, conducted in 1992–1993, 1998–1999, and 2005–2006. By pooling the three waves, we gain statistical power. Second, we use a completed-fertility sample from the Indian Human Development Survey (IHDS), a panel with two waves collected seven years apart. To construct our IHDS sample, we use the second wave to identify mothers who had completed fertility by the first wave: nonpregnant women who did not give birth after the first wave.[20] Among children born to these mothers, we examine height-for-age of children who were under age five in wave 1.

To examine whether the birth order gradient is muted in regions and among social groups that exhibit lower son preference, we estimate a model analogous to equation (1) with one difference: the indicator for India is replaced by an indicator for the low-son-preference subgroup. In regressions using the IHDS sample, we also control for family size dummies in parallel to birth order, i.e., include fixed effects for family size interacted with the son-preference proxy.

We begin by comparing matrilineal Indian states—Kerala and the eight Northeastern states—with the rest of India. Matrilineality—which is associated with kinship practices that favor boys less and do not prioritize eldest sons—is more common in these states (Oommen 1999; Chakrabarti and Chaudhuri 2007; Gneezy, Leonard, and List 2009). Column 1 of Table 4 shows that the birth order gradient in height is significantly more muted in matrilineal states. A comparison of subsample means provides suggestive evidence that differences in the gradient influence

[20]The approach of using a long gap of no childbearing to identify completed fertility complements is arguably superior to using mothers' stated desire to not have more children to measure completed fertility in DHS surveys, which we employed in Table 2, column 4. Mothers who completed their fertility have, on average, 3.11 children in IHDS as compared to 3.22 among mothers in the NFHS-3 sample who we identified as likely having completed fertility. With our IHDS analysis, we can enlarge the sample slightly by also including women who gave birth after wave 1, but just not in the five years preceding wave 2; we find similar and somewhat more precisely estimated effects.

Table 4—Cultural Norms and Child Height: Within-India Evidence

Low son preference proxy	Kerala and Northeast			Below-median child sex ratio			Muslims		
	HFA *z*-score (1)	WFA *z*-score (2)	HFA *z*-score (3)	HFA *z*-score (4)	WFA *z*-score (5)	HFA *z*-score (6)	HFA *z*-score (7)	WFA *z*-score (8)	HFA *z*-score (9)
Low son pref proxy × 2nd child	0.078	0.008	1.040	0.078	0.039	0.374	−0.027	0.034	0.212
	[0.039]	[0.029]	[0.515]	[0.030]	[0.023]	[0.236]	[0.047]	[0.035]	[0.360]
Low son pref proxy × 3rd+ child	0.108	0.069	1.793	0.081	0.044	1.065	0.184	0.156	−0.279
	[0.045]	[0.033]	[1.043]	[0.036]	[0.027]	[0.372]	[0.055]	[0.041]	[0.568]
2nd child	−0.185	−0.154	−0.578	−0.207	−0.173	−0.650	−0.159	−0.153	−0.573
	[0.017]	[0.013]	[0.116]	[0.020]	[0.015]	[0.140]	[0.017]	[0.013]	[0.123]
3rd+ child	−0.422	−0.350	−0.472	−0.437	−0.363	−0.738	−0.412	-0.354	−0.413
	[0.020]	[0.015]	[0.183]	[0.024]	[0.019]	[0.218]	[0.021]	[0.016]	[0.193]
Low son pref group mean of outcome	−1.388	−1.198	−1.407	−1.561	−1.491	−1.485	−1.732	−1.602	−1.227
High son pref group mean of outcome	−1.710	−1.648	−1.557	−1.721	−1.622	−1.584	−1.691	−1.628	−1.575
Sample	NFHS 1-3	NFHS 1-3	IHDS 1	NFHS 1-3	NFHS 1-3	IHDS 1	NFHS 1-3	NFHS 1-3	IHDS 1
Age and other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95,125	95,125	3,615	95,125	95,125	3,615	82,084	82,084	3,405

Notes: Standard errors are clustered by mother and appear in brackets. In columns 1–2, 4–5, and 7–8, the sample uses NFHS 1-3. NFHS-1 only has data for children aged four years and younger, and NFHS-2 only has data for children aged 3 years and younger. In columns 3, 6, and 9, the sample uses IHDS 1 and consists of children aged 1–59 months in IHDS 1 whose mothers (likely) had completed their fertility, i.e., their mothers did not give birth between IHDS 1 and IHDS 2. All columns include child age dummies, maternal age, mother's literacy, and child age dummies, maternal age, and mother's literacy interacted with Low son pref proxy. Columns 1–2, 4–5, and 7–8 include survey and PSU fixed effects, and survey and PSU fixed effects interacted with Low son pref proxy. Columns 3, 6, and 9 include total fertility dummies, top-coded at 6 children, and total fertility dummies interacted with Low son pref proxy. In columns 1–2 and 4–5, the main effect Low son pref proxy is absorbed by PSU fixed effects. In columns 3 and 6–9, the main effect low son pref proxy is included but not shown. Kerala and Northeast include Arunachal Pradesh, Assam, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. 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. In columns 7–9, the sample is restricted to Muslims and Hindus. See the online Data Appendix for further details.

average child height: average child height in matrilineal states exceeds that in the rest of India. Column 2 shows that the same pattern holds for weight-for-age. In column 3 we estimate this relationship using the IHDS sample. We observe the same pattern—a significantly shallower birth order gradient for child height in matrilineal states.[21]

Next 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 NFHS). The sex ratio, as defined, is increasing in the proportion male. In columns 4 to 6 we find that, as predicted, low-sex-ratio regions have a shallower birth order gradient. We continue to see a negative correlation between the steepness of birth order gradient and average child height: the subsample means show that average child height is higher in low-sex-ratio regions.

Finally, we examine differences by religion: compared to Hinduism, Islam places less emphasis on needing a son for religious ceremonies, and Islamic inheritance rules disfavor women less. Son preference, in turn, is weaker among Muslims; for

[21] Online Appendix Table 5 reports similar specifications examining weight-for-age using IHDS data and prenatal and postnatal inputs using NFHS data.

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). Using our NFHS data we find that, relative to Hindus, Muslim Indians have a much more muted birth order gradient in HFA and WFA for birth order three and higher (columns 7 and 8). However, we do not observe a differential Hindu-Muslim height gradient using IHDS data (column 9). It could be that our covariates do not fully control for unobserved socioeconomic characteristics by religion; this may also be the reason why subsample averages show that Muslim children have relatively lower HFA and WFA z-scores. Consistent with Muslim families being, on average, poorer, online Appendix Table 5 shows that child inputs are lower among Muslim families. Importantly, these resources are more equally distributed across birth order among Muslims.

B. *Favoritism toward Eldest Sons and Birth Order Gradients*

We now use the DHS sample to test a series of predictions that follow if the child height gradient stems from parents' eldest son preference.

PREDICTION 1: *Relative to African counterparts, both boys and girls in India will exhibit a steeper birth order gradient.*

Among boys this is straightforward: the eldest son, by definition, has the lowest birth order among sons in the family and will be favored over his siblings. Importantly, this gradient should be absent if, instead, parents exhibit general son preference, i.e., they favor sons over daughters but not the eldest son particularly.

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

Second, parents' desire for a son affects their fertility decisions. Consider a family with a desired fertility of two children and which wants at least one son. Ex ante the preferences are compatible because the likelihood of any child being male is (very close to) 50 percent. If the first-born is a daughter, then parents realize that they may need to exceed desired fertility to ensure a son. They will decide expenditures on this daughter given their available resources and an expected family size of three. If their second child is also a girl, then parents certainly need to exceed their desired fertility of two in order to have a son. Consequently, and assuming fixed family resources, the second daughter will receive fewer early-life resources than her older sister because the expected family size has increased from three to four.[22]

It is theoretically ambiguous whether the male or female gradient in India should be steeper. Eldest son preference directly drives unequal allocation of resources across brothers and, thus, might have a particularly strong effect on allocation and outcomes across boys. In contrast, the birth order gradient for girls is *not* generated

[22] In our data, the majority of Indian mothers report an ideal family size of two children. Families strongly want at least one son and thereafter prefer having a roughly balanced gender composition (Jayachandran 2017). Myopia among parents such that they only update their fertility plans when it is certain that they need to exceed their desired fertility will 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.

by parents having discriminatory preferences across daughters per se. It is also possible that inequality among girls is larger if having more children than originally planned has important consequences for resources allocated to each child. We turn to the data and estimate the gender-specific gradients:

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

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, which test whether India's steep birth order gradient is stronger among girls or boys.

Column 1 of Table 5 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 first-born height advantage is absent for Indian girls (relative to their African counterparts). Specifically, the main effect for India implies that, on average, first-born Indian sons are 0.15 z-score points taller than their African counterparts.

The coefficients remain fairly similar when we include additional covariates (column 2) and mother fixed effects (column 3). Finally, in column 4 we show that the same pattern holds when we consider weight-for-age as the outcome variable.

While the birth order gradient does not differ by gender, there are two reasons to expect a level difference by gender in India. First, if eldest sons receive more resources than all other children, then sons on average will fare better than daughters. Second, the gender composition of children influences fertility behavior: in India, relative to Africa, the birth of a girl in a family with only daughters increases mothers' desire for additional children (Jayachandran and Pande 2015). Thus, relative to sons, daughters in India are more likely to belong to larger than planned families that lack adequate resources for their children (Clark 2000; Jensen 2003). These two effects, together, yield a second prediction.

PREDICTION 2: *The India-Africa height gap will be more pronounced among girls.*

Table 5, column 5 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 -0.14. Thus, overall, only Indian girls show a child height disadvantage relative to Africa and this gender deficit remains significant when we include additional covariates (column 6), and also when we estimate a regression with mother fixed effects (column 7). Column 8 shows that Indian girls are relatively disadvantaged in terms of weight-for-age as well.

Table 5—Child Gender and the Birth Order Gradient in Height

	HFA z-score			WFA z-score	HFA z-score			WFA z-score
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
India	0.148				−0.011			
	[0.026]				[0.014]			
India × Girl	−0.111				−0.143	−0.147	−0.098	−0.116
	[0.036]				[0.020]	[0.019]	[0.032]	[0.014]
India × 2nd child	−0.107	−0.152	−0.228	−0.122				
	[0.036]	[0.040]	[0.069]	[0.030]				
India × 3rd+ child	−0.352	−0.221	−0.414	−0.175				
	[0.033]	[0.047]	[0.097]	[0.035]				
India × 2nd child × Girl	−0.076	−0.045	−0.024	−0.047				
	[0.053]	[0.057]	[0.101]	[0.043]				
India × 3rd+ child × Girl	−0.051	−0.048	−0.030	−0.064				
	[0.047]	[0.067]	[0.092]	[0.049]				
Africa mean of outcome	−1.575	−1.575	−1.575	−1.575	−1.351	−1.351	−1.351	−1.351
Age and other controls	No	Yes	No	Yes	No	Yes	No	Yes
Mother fixed effects	No	No	Yes	No	No	No	Yes	No
Observations	168,108	165,596	83,228	165,596	168,108	167,737	83,228	167,737

Notes: Standard errors are clustered by mother and appear in brackets. Child age dummies are included in all regressions. Columns 2, 4, 6, and 8 additionally include mother's literacy, maternal age, and PSU fixed effects. In columns 2 and 4, child age dummies, maternal age, and mother's literacy are interacted with Girl, India, and India × Girl and PSU fixed effects are interacted with Girl. In columns 3 and 7, the main effect India is absorbed by mother fixed effects. In columns 2 and 4, the main effects India and India × Girl are absorbed by PSU fixed effects and their interactions with Girl. In columns 6 and 8, the main effect of India is absorbed by PSU fixed effects. The main effect of Girl is included in all regressions but not shown. In columns 1–3, coefficients for 2nd child and 3rd+ child, 2nd child × Girl, and 3rd+ child × Girl are included in the regression but not shown. See the online Data Appendix for further details.

Eldest versus General Son Preference.—An overall gender gap in child height would also be observed if parents favor all sons and not just their eldest sons. This raises the question of whether India's birth order gradient and height gap are driven by eldest son preference or general son preference. As we elaborate on below, while both types of son preference are present—Indian parents favor all sons over daughters and also favor the eldest son over other sons—eldest son preference appears to be what causes the birth order gradient.

As evidence that India exhibits general son preference, when we compare boys and girls with an older brother, the boys enjoy a relative height advantage over the girls in India. In other words, even non-eldest sons are favored over girls. However, general son preference cannot by itself explain two patterns we see in the data. First, general son preference does not predict a birth order gradient among boys (Prediction 1). Second, the within-India evidence using matrilineal states indicates that the birth order gradient is linked to eldest son preference. We showed earlier that matrilineal states have a shallower gradient and a higher level of height than the rest of India. If what differentiates these states from the rest of India is weaker eldest son preference, then both girls and non-eldest sons should do better in these states. If, instead, matrilineal states differ in their general son preference, then we should see a smaller girl disadvantage in these states but no obvious gains among non-eldest boys in these states. Figure 3 plots average child height in all-India and

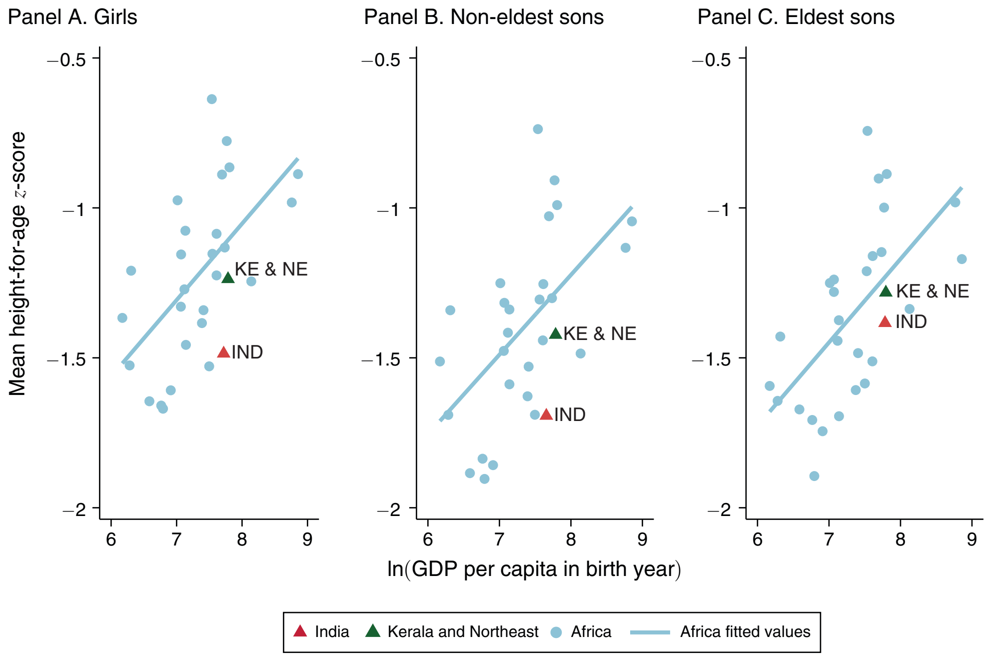

FIGURE 3. HEIGHT OF INDIAN CHILDREN RELATIVE TO AFRICA

Notes: The difference between the gap between the Africa fitted line and Kerala and Northeast and the gap between the Africa fitted line and India is 0.231 for girls, 0.235 for non-eldest sons, and 0.098 for eldest sons. GDP data are based on the Penn World Table 9.0 (Feenstra, Inklaar, and Timmer 2015).

the matrilineal states in comparison to the Africa sample and shows that both girls and non-eldest sons fare much better in matrilineal states than the rest of India, while eldest sons enjoy a much smaller gain.[23] In other words, what distinguishes the matrilineal states, where we see a shallow gradient, from the rest of India is how not just girls but also non-eldest sons are treated.

C. *Implications of Son-Biased Fertility-Stopping Behavior*

We now further drill down on the implications of son-biased fertility-stopping behavior for resource allocation across siblings. The birth of a daughter with no older brothers causes her parents to exceed their intended fertility to try again for a son, reducing resources spent on her. Our first test seeks to provide evidence on the "try again" mechanism, separate from the sibling rivalry mechanism that posits that having a brother worsens outcomes for a girl because she has to compete with him for resources (Garg and Morduch 1998).

At the prenatal stage, both mechanisms benefit daughters without an older brother: there is no sibling rivalry and parents will invest in her while she is in utero

[23] Less eldest son preference might also imply that eldest sons do worse in matrilineal states than the rest of India given a household budget constraint. The fact that they do slightly better likely derives from higher overall spending on children in matrilineal societies (Lowes 2017). Also, while girls' and non-eldest boys' disadvantage relative to Africa is smaller in matrilineal states than in the rest of India, it still exists (online Appendix Table 6). We return to this fact while doing the accounting exercises in Section IIIF.

anticipating that, with 50 percent chance, they are investing in their eldest son.[24] Post-birth, the negative effects of son-biased fertility-stopping behavior materialize as parents reoptimize fertility and expenditure decisions. Thus, at the postnatal stage, not having an older brother disadvantages girls through the fertility continuation mechanism.

PREDICTION 3: *Relative to African counterparts, later parity girls with no older brothers in India face larger disadvantages in postnatal than prenatal investments.*

Table 6 reports results from regressions estimated at the input-level for the sample of girls. We consider the set of inputs reported in Table 3 and distinguish between prenatal and postnatal inputs. In columns 1 and 2 we see a positive and significant coefficient on $I_c \times PrenatalInputs \times NoElderBro$. This tells us that parents allocate more prenatal inputs during a pregnancy when they do not have any sons. Strikingly, this pattern is exactly reversed for postnatal inputs, and we observe a negative and significant coefficient on $I_c \times NoElderBro$.

Given this evidence, we examine how height deficits vary with the gender of elder siblings. If the fertility-stopping mechanism dominates the sibling rivalry mechanism, then Indian daughters with only sisters as elder siblings should do relatively worse than their African counterparts, and vice versa.

Among boys, eldest sons in India should do well, but those born at 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 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 older sisters and exceeded its desired fertility. Prediction 4 summarizes.

PREDICTION 4: *Relative to African counterparts, outcomes for Indian children will vary with sibling composition and birth order as follows:*

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

(*ii*) *High birth order eldest sons fare worse than eldest sons born at lower birth order.*

To test (i), we estimate a model based on equation (2), but adding in interactions with *NoElderBro*. 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 first-born. In Table 6, column 3 we observe a positive coefficient

[24] 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.

Table 6—Heterogeneity by the Gender of Older Siblings

	Pooled inputs (1)	Pooled inputs (2)	HFA z-score (3)	HFA z-score (4)	WFA z-score (5)	WFA z-score (6)
India × Prenatal input	0.047					
	[0.004]					
India × Prenatal input × No elder brother	0.057	0.034				
	[0.006]	[0.007]				
India × Girl			−0.021		0.008	
			[0.066]		[0.050]	
India × Girl × No elder brother			−0.091	−0.103	−0.088	−0.110
			[0.055]	[0.058]	[0.041]	[0.042]
India × No elder brother	−0.036	−0.025	0.060	0.024	0.059	0.081
	[0.007]	[0.006]	[0.038]	[0.040]	[0.029]	[0.029]
India	−0.022		0.088		−0.488	
	[0.007]		[0.047]		[0.036]	
India × 2nd child	−0.028	−0.034	−0.080	−0.142	−0.098	−0.084
	[0.007]	[0.005]	[0.041]	[0.044]	[0.031]	[0.033]
India × 3rd+ child	−0.120	−0.060	−0.311	−0.208	−0.239	−0.119
	[0.007]	[0.007]	[0.046]	[0.056]	[0.035]	[0.042]
India × Girl × 2nd child			−0.118	−0.093	−0.086	−0.099
			[0.059]	[0.064]	[0.045]	[0.047]
India × Girl × 3rd+ child			−0.122	−0.122	−0.139	−0.143
			[0.065]	[0.080]	[0.049]	[0.058]
Africa mean of outcome	0.385	0.385	−1.351	−1.351	−0.877	−0.877
p-value: India + India × No elder brother = 0			0.000		0.000	
p-value: India × No elder brother + India × Girl × No elder brother = 0			0.448	0.070	0.343	0.355
p-value: India + India × 2nd child + India × No elder brother = 0			0.037		0.000	
p-value: India + India × 3rd+ child + India × No elder brother = 0			0.000		0.000	
Sample	Girls	Girls	Children	Children	Children	Children
Age and other controls	No	Yes	No	Yes	No	Yes
Observations	379,055	377,922	168,108	165,596	168,108	165,596

Notes: Standard errors are clustered by mother and appear in brackets. Control variables include child age dummies. Even columns control for maternal age, mother's literacy, PSU fixed effects, and child age dummies, maternal age, and mother's literacy interacted with India. Column 2 additionally includes child age dummies, maternal age, and mother's literacy interacted with Prenatal input and India × Prenatal input and PSU fixed effects interacted with Prenatal input. Columns 4 and 6 includes child age dummies, maternal age, and mother's literacy interacted with Girl and India × Girl, and PSU fixed effects interacted with Girl. In column 2, the main effects India and India × Prenatal input are absorbed by PSU fixed effects and their interactions with Prenatal input. In columns 4 and 6, the main effects India and India × Girl are absorbed by PSU fixed effects and their interactions with Girl. In columns 1–2, all other main effects (2nd child, 3rd+ child, No elder brother, Prenatal input, Prenatal input × No elder brother) are included but not shown. In columns 3–6, all other main effects (2nd child, 3rd+ child, Girl, 2nd child × Girl, 3rd+ child × Girl, No elder brother, Girl × No elder brother) are included but not shown. The sample in columns 1–2 is girls aged 1–59 months, and the sample in columns 3–6 is the main sample of children aged 1–59 months. See the online Data Appendix for further details.

on $I_c \times NoElderBro$ (p-value of 0.12). Adding in the main effect, relative to his African counterpart, an Indian eldest son enjoys a significant 0.15 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 lacking an elder brother is negative in India relative to Africa ($I_c \times NoElderBro + I_c \times Girl \times NoElderBro$), but insignificant. In column 4, this finding of lower height for girls in India who only have sisters as elder siblings is marginally significant (p-value of 0.07). Thus, the son-biased fertility mechanism appears to slightly dominate, such that not having an older brother on net disadvantages girls.

Column 3 also allows us to examine whether eldest sons born at later parity are advantaged as long as they are born within their family's desired family size. $I_c + I_c \times 2\text{nd}\,Child + I_c \times NoElderBro$, which gives the relative Indian advantage for an eldest son at birth order 2, is positive and significant (p-value of 0.04). Meanwhile, an eldest son born at birth order 3 does worse in India than Africa, which is consistent with Prediction 4(ii), assuming that families want two children (the modal preference in India). Columns 5 and 6 show similar patterns using weight-for-age as the outcome.

In unreported results, we observe a birth order gradient between a 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 to eldest son preference being an important determinant of resource allocation across siblings and fertility stopping behaviors—and consequently child height—in India. In Section IIIF, we provide an accounting exercise that quantifies the fraction of the India-Africa height gap that can be explained by the eldest son preference mechanism.

D. *Sex Selection as a Potential Confounder*

The incidence of sex-selective abortions is higher in India than Africa, raising concerns about selection into high fertility in India. Wealthier households in India are more likely to use sex-selection techniques, as measured both by use of ultrasound and incidence of skewed sex ratios. If poor families who do not have a son within their desired family size try again for a son, while wealthy families use sex-selection, then, first, this could cause poor families to be overrepresented at high birth order in India (relative to Africa). Second, if wealthy households who have girls at low birth order are particularly likely to engage in sex-selection, then girls at birth order 2 or 3 may belong to relatively poor households in India, so treating gender as an exogenous variable is problematic. This could create selection bias when we include interactions with the child's or siblings' gender.

On the first concern, 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 socioeconomic variables in India, and importantly to the inclusion of family size fixed effects interacted with India.

To address the concern that endogenous child gender in India may bias our estimates, we replicate our main results with the first NFHS survey. This survey was conducted in 1992–1993, which was prior to significant sex-selection by Indian families (Jha et al. 2011). To create the comparison sample of African countries, we consider the 18 African countries with DHS surveys between 1991 and 1997. First, online Appendix Table 7 shows that the differential birth order gradient in height and weight between India and Africa also holds for this sample, and the magnitudes are comparable to our main results. Next, online Appendix Table 8 replicates the results that use the child's or his or her siblings' gender. Columns 1 and 4 show an overall height and weight deficit for girls. We also continue to find a significantly steeper birth order gradient in India than Africa for both genders (columns 2 and 5). Columns 3 and 6 find some evidence that eldest sons are the most advantaged in India and having an older brother is a net positive for girls; the point estimate is similar to the result in NFHS-3 but is statistically insignificant.[25]

A different worry is whether the fertility-continuation behavior that we posit is a contributor to the birth order gradient was made obsolete by sex-selective abortion by the time of NFHS-3. To allay this concern, we show that the "try again" approach was still prevalent at the time of NFHS-3. Even when sex-selective abortion is available, it is financially, physically, and psychologically costly, and many families continue to use son-biased fertility-stopping rules. Online Appendix Table 9 shows this by examining, first, whether families have gone beyond their desired fertility and, second, whether they want more children even if they are already at or beyond their desired fertility. In India, families are more likely to go beyond their desired fertility or want to go beyond their desired fertility if they do not yet have a son. The prevalence of fertility continuation is, as expected, somewhat diminished in NFHS-3 compared to NFHS-1, but importantly, it is still very pronounced in NFHS-3. For example, not having a son yet is associated with a 19-percentage-point increase in the desire to go beyond one's desired family size to have another child in India.

E. *Alternative Explanations*

We conclude this section by examining a set of alternative explanations for India's steep birth order gradient in height. Online Appendix Table 10 reports the results.

Health Conditions

Maternal Health: Indian mothers are, on average, six centimeters shorter than African mothers. To examine whether maternal health endowment has differential effects on child height by birth order, column 1 presents our basic birth order regression adding in interactions between mother's height and birth order.[26] The test is whether including mother's height "knock outs" the stronger birth order gradient in India, and it does not: the coefficients on *Mother'sHeight* × *BirthOrder* dummies are small and insignificant, and the steep Indian birth order gradient remains.[27]

Disease Environment: Spears (2013) highlights India's high rate of open defecation as a contributor to child stunting. Even absent changes in a household's sanitation infrastructure, later-born children may have a worse disease environment because

[25] The very limited data on postnatal health inputs in NHFS-1 makes it infeasible to estimate regressions that use pooled inputs.

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

[27] In Jayachandran and Pande (2015), we examined India-Africa differences in how, holding constant number of children born, maternal nutritional inputs and outcomes vary with a woman's pregnancy status: relative to African mothers, Indian women show a greater drop-off in food consumption and hemoglobin levels across successive pregnancies. These India-Africa differences are absent among nonpregnant mothers. This suggest that differences in

older siblings expose them to pathogens or because they receive lower-quality care. Column 2 shows that there is no appreciable birth order gradient for diarrhea in India. Column 3 directly shows that controlling for the rate of open defecation does not diminish the magnitude of the India-Africa birth order gradient in child height.

Other Cultural Norms

Communal Child-Rearing: The presence of older siblings will typically reduce the time parents can devote to later-born infants. This constraint may be less strict in Africa, which has a strong norm of relatives and neighbors helping raise children (Goody 1982), allowing greater investments in later-born children. To test this hypothesis, we consider two PSU-level "communal child-rearing" proxies: the proportion of women's children aged ten years and younger who are nonresident in their household and the number of adult females in the household. While both proxies are higher in Africa, the India-Africa birth order gradient is robust to inclusion of either proxy (columns 4 and 5).

Land Scarcity: In Africa, where land is more abundant, parents might value a larger number of children as farm help, and this could imply that early- and later-born children are more equally valued. This, in turn, could have engendered an African norm of valuing higher birth order children more. In column 6 we include the 1961 ratio of population to land area as a proxy for historical land scarcity. By this metric, while land is indeed more scarce in India than Africa, it 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 large differential birth order gradient in height in India compared to Africa. 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.

F. *Impact on Average Height*

The inequality across children in health inputs and outcomes that we document is important per se if we value equity. But does it also affect the average height gap across India and Africa, which is an important motivation for our paper?

Our within-India comparisons provide suggestive evidence. There is higher average height and a shallower birth order gradient for Indian subgroups with less son preference such as Kerala and the Northeast. A second piece of supportive evidence comes from the literature documenting diminishing returns to inputs for adult height (Steckel 1995). While our data do not allow for a rigorous estimation of a similar height production function for child height, using the IHDS data we find that child

preferences, not a steeper decline in Indian household resources over the life cycle relative to African counterparts, underlies observed birth order patterns.

height exhibits diminishing returns to household income and expenditures in India (online Appendix Table 11). We use the IHDS because, unlike NFHS, it provides measures of family resources that have a cardinal interpretation (income, expenditures). The ideal data, which we lack, are child-level expenditures.

The facts above suggest a link, but leave open the question of how much of the level deficit is explained by the gradient. To this end, we conduct two back-of-the-envelope calculations to estimate: (i) how much of the India-Africa height gap is explained by the birth order gradient; and (ii) how much is explained specifically by eldest son preference generating a birth order gradient.

The first step is to estimate the correlation between the birth order gradient and level of height across countries in our African subsample. Up until now, our regressions have quantified the birth order gradient via the coefficients on birth order 2 and on birth order 3 and higher (relative to birth order 1). For our accounting exercise we need to collapse this information into a single country-specific summary measure, and we do this in two ways. Our first gradient proxy is defined as the average height gap between first- and second-borns and between first- and third-borns and higher, weighted by the observed distribution of birth order in that country. To obtain our second proxy we estimate, separately for each country, a regression of height on a linear birth order variable, top-coded at birth order 3, and then use the regression coefficient as the gradient proxy. The first approach has the advantage that it does not impose linearity (i.e., that the drop-off in height from birth order 1 to 2 is the same as the drop-off from birth order 2 to 3+), while the second approach uses a measure derived from regression analysis, paralleling the analyses presented earlier in the paper.

Online Appendix Table 2 shows the correlation between the HFA z-score and each gradient proxy. We use only the African sample so that this calculation is not "assuming the answer" by comparing India (with its steeper gradient and lower average height) to Africa. The regression controls for child age dummies and real GDP per capita in the child's birth year. Column 2 uses the first gradient proxy, and we observe a strong positive correlation between the level of height and the gradient proxy.[28] For (i)—quantifying the role of the birth order gradient—we multiply the coefficient of 0.400 from column 2 by the India-Africa gap in the birth order gradient. Assuming that Indian children showed the same relationship between average child height and the birth order gradient as African children, this product provides an estimate of how much India's steeper-than-usual birth order gradient depresses its average height compared to Africa. We can then compare this explained amount (-0.106 z-score points) to the overall India-Africa height gap (adjusted for GDP per capita) in column 1 of -0.162 z-score points. This exercise suggests that the birth order gradient accounts for 65 percent of the Indian height puzzle. When we repeat the exercise using the second gradient proxy, we again find a significant correlation between the HFA z-score and the gradient proxy (column 3), and the birth order gradient accounts for 84 percent of the Indian height deficit.

[28] Online Appendix Figure 1 shows the scatter plot of average height and the gradient proxy. Panel A and panel B correspond to the gradient proxies in columns 2 and 3, respectively. India is roughly on the regression line, but slightly below, consistent with the birth order gradient explaining much but not all of India's height deficit in our accounting exercise.

For (ii), we use the matrilineal states of Kerala and the Northeast as a proxy for India without eldest son preference and conduct a similar calculation. Using the first gradient proxy, Kerala and the Northeast have an average gradient that is 0.129 z-score points smaller in magnitude than the rest of India. This gradient difference multiplied by the gradient-level correlation accounts for a −0.052 z-score level deficit. Thus, the birth order gradient rooted in eldest son preference explains 32 percent of the India-Africa height gap (or 43 percent using the second gradient proxy). The fact that one-half (32 percent/65 percent with the first gradient proxy and 43 percent/84 percent with the second) rather than all of the birth order gradient effect is explained by eldest son preference in this exercise could be due to Kerala and the Northeast having some eldest son preference compared to Africa even though they have low eldest son preference compared to the rest of India,[29] or to other mechanisms such as those discussed in the previous subsection also contributing to India's steep gradient.

These accounting exercises by no means establish a causal link between the gradient and level, but they are suggestive that eldest son preference and the birth order gradient have quantitatively important implications for average height in India.

IV. Conclusion

This paper compares child height-for-age in India and Africa in order to shed light on India's puzzlingly high rate of stunting. Several facts point to intrafamily allocation decisions as a key factor. First, India's height disadvantage emerges with second-born children and increases with birth order. Second, investments in successive pregnancies and higher birth order children decline faster in India than Africa.

We examine a specific mechanism that could drive India's steep birth order gradient in child height: eldest son preference. We compare subgroups within India and show that subgroups with lower son preference exhibit a shallower birth order gradient. We then derive a set of predictions linking the extent of unequal resource allocation within a family to the gender composition of siblings and find that these predictions are supported in the data. We take this as evidence that son-biased fertility stopping rules are an important factor linking eldest son preference and the observed birth order gradient in child height. Finally, an accounting exercise suggests that roughly two-thirds of India's child height deficit (relative to Africa) can be explained by India's steeper birth order gradient. One-half of this can be attributed to eldest son preference in India.

One might expect that unequal allocation in the household will matter less as India develops. With greater financial resources, families could provide all children with enough food and health care to achieve their height potential. The time trend in India can shed some light on this: between the earlier and recent NFHS waves of data, the stunting rate in India indeed fell, but it remains very high. Malnutrition could eventually be an obsolete problem, but India still appears decades away from this achievement. Moreover, the inequality across birth order has persisted over time. Parents' son preference and unequal investment in children do not seem to

[29] Online Appendix Table 6 shows that in India's matrilineal states, girls have a height deficit relative to Africa and there is a steeper birth order gradient than in Africa.

be diminishing. Even cross-sectionally, richer families in India show a steeper birth order gradient than poorer ones.[30]

Thus, even once the problem of chronic malnutrition is solved, other important human capital investments might remain unequally allocated within families. This matters, first, because if the investments have diminishing returns, unequal investment will depress India's total human capital and economic growth. Second, intrafamily inequality might widen societal inequality which, in turn, could limit the economic opportunities available to many people, exacerbate societal discord, or have other attendant ills.[31] Third, and perhaps most important, most societies value equality per se (Sen 1992). For all these reasons, policies to counteract the intrafamily allocation decisions that parents are making, such as poverty-alleviation programs targeted toward specific children, could be very valuable. The need for such policies might be especially strong in India, given the level and persistence of its intrafamily inequality.

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[30]The analysis behind this finding is reported in Jayachandran and Pande (2015), where we examine cross-sectional heterogeneity by wealth within India to infer the likely effect of economic development (given the caveat that the wealthy may also differ on unobserved characteristics that predict son preference such as caste). We also find that at each birth order, children in wealthier households (defined as those in the top two quintiles of the wealth index) are taller than those in less wealthy families, and that even among the wealthy, stunting is prevalent (the rate is 21 percent).

[31]The effects of intrafamily inequality may be distinct from those of general inequality. For instance, it might translate into differences in bargaining power enjoyed by siblings once they form independent households (Chiappori and Meghir 2015).

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