



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

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# Child Stunting

- Defined as having a height-for-age (HFA) that is  $2\sigma$  or more below the worldwide
- One in four children under age five, worldwide, is so short as to be classified as stunted (UNICEF 2014).
- A key marker of child malnutrition, casting 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



# About India and Africa

- Over 30% of the world's stunted children live in India and child stunting rate is over 40%
- India outperforms Africa on maternal mortality, life expectancy, food security, poverty incidence, and educational attainment (Gwatkin et al. 2007). Yet, India has the 5th 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.

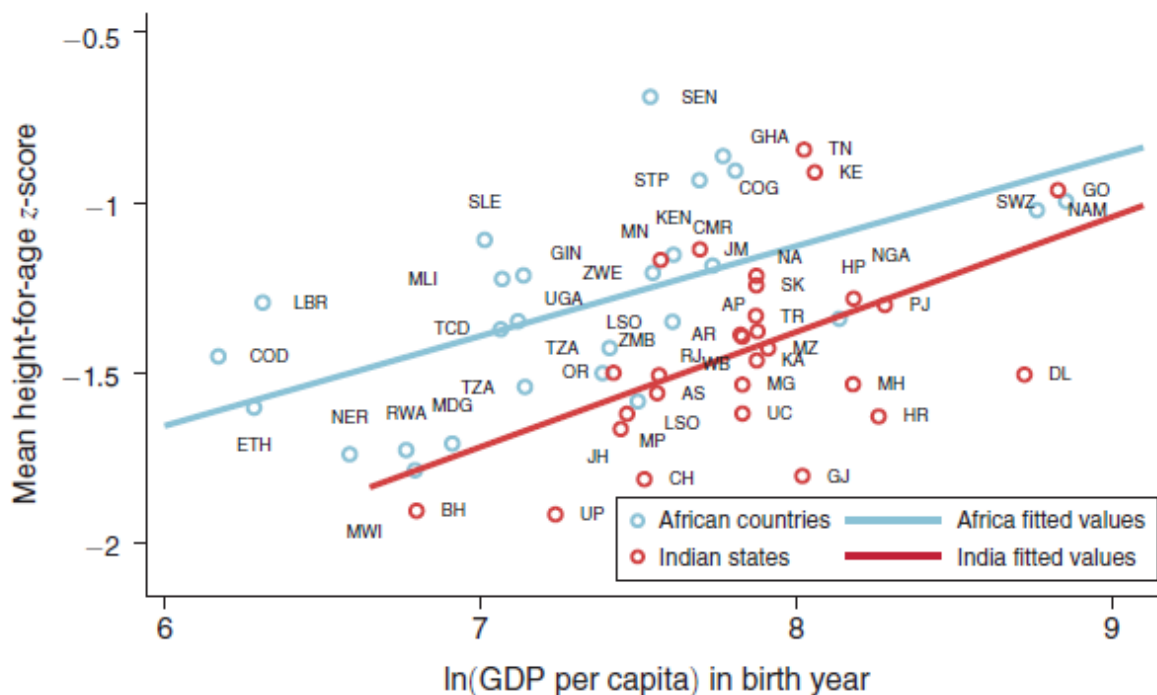


FIGURE 1. CHILD HEIGHT VERSUS NATIONAL GDP

*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).



# I. Background and Data Description

- **HFA z-score:** the established link between child stunting and adverse long-term outcomes, it is based on WHO universally applicable standard for 0-5 years old children

**z-score = 0** represents the reference population median

**z-score = -2 (cutoff)** indicates  $2\sigma$  below the reference population median



# I. Background and Data Description

- Data source for Indian children: 2005-2006 National Family Health Survey (NFHS-3)
- Data source for African children: Demographic and Health Surveys (DHS).
- The sample comprises the 168,108 children with anthropometric data



TABLE 1—SUMMARY STATISTICS

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



# I. Background and Data Description

- Within-India analysis uses two datasets

All three waves of NFHS (92-93, 98-99, 05-06), over 90,000 Indian children sample

Two waves of Indian Human Development Survey (IHDS), conducted in 2005 and 2012. Families that had no children between the two waves and therefore (almost surely) completed fertility





## II. Birth Order and Child Outcomes

### A. Child Height

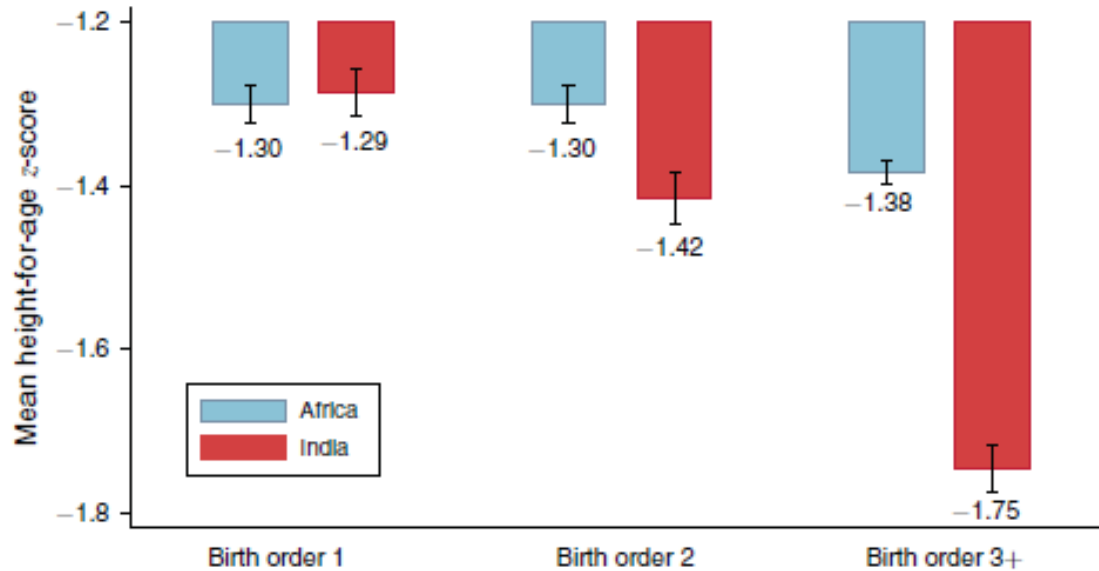


FIGURE 2. CHILD HEIGHT IN INDIA AND AFRICA, BY CHILD'S BIRTH ORDER

*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

The average India-Africa height gap, pooling all children

	(1)	HFA z-score				Stunted (6)	WFA z-score (7)	Hb level (8)	Deceased (9)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
India	-0.082 [0.011]	0.092 [0.018]							
India × 2nd child		-0.144 [0.025]	-0.161 [0.027]	-0.110 [0.063]	-0.243 [0.048]	0.051 [0.007]	-0.146 [0.020]	-0.094 [0.030]	0.003 [0.004]
India × 3rd+ child		-0.377 [0.024]	-0.227 [0.032]	-0.193 [0.092]	-0.436 [0.085]	0.064 [0.009]	-0.198 [0.024]	-0.159 [0.036]	0.002 [0.004]
2nd child		0.023 [0.015]	-0.011 [0.017]	-0.097 [0.053]	-0.167 [0.027]	0.009 [0.004]	0.009 [0.012]	-0.011 [0.022]	-0.014 [0.002]
3rd+ child		-0.066 [0.013]	-0.118 [0.019]	-0.169 [0.074]	-0.334 [0.044]	0.036 [0.005]	-0.063 [0.014]	-0.037 [0.025]	-0.011 [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



## II. Birth Order and Child Outcomes

### A. *Child Height*

- Next, disaggregate the height disadvantage by birth order. The outcome variable remains HFA for child  $i$  born to mother  $m$  in country  $c$ .

$$HFA_{imc} = \alpha_1 I_c + \alpha_2 I_c \times 2ndChild_{imc} + \alpha_3 I_c \times 3rd + Child_{imc} + \beta_1 2ndChild_{imc} + \beta_2 3rd + Child_{imc} + \gamma X_{imc} + \epsilon_{imc}$$

$I_c$ : indicator for Indian children

$\alpha_1$ : India gap for first-born children (omitted birth order category)

$\alpha_2$  and  $\alpha_3$ : how the gap differs for second-born children and third-and-higher birth order children

$X_{imc}$ : a vector of controls that always includes child age dummy variables (in months) to account for nonlinear patterns of  $z$ -scores and age.

TABLE 2—INDIA'S DIFFERENTIAL BIRTH ORDER GRADIENT IN CHILD HEIGHT AND RELATED OUTCOMES

	HFA					Stunted	WFA z-score	Hb level	Deceased
	(1)	(2)	z-score						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
India	-0.082 [0.011]	0.092 [0.018]							
India × 2nd child		-0.144 [0.025]	0.161 [0.027]						
India × 3rd+ child		-0.377 [0.024]	-0.227 [0.032]						
2nd child		0.023 [0.015]	-0.011 [0.017]	0.053 [0.027]		0.004 [0.012]	0.012 [0.022]	0.022 [0.002]	0.002
3rd+ child		-0.066 [0.013]	-0.118 [0.019]	-0.169 [0.074]	-0.334 [0.044]	0.036 [0.005]	-0.063 [0.014]	-0.037 [0.025]	-0.011 [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

The Indian height disadvantage opens up at birth order 2: the interaction of India and being second-born is highly significant.



- *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.

However, a large fraction of households in DHS sample have not completed childbearing. Hence, the regressions cannot control for total family size in general, raising an omitted variable bias concern.



TABLE 2—INDIA'S DIFFERENTIAL BIRTH ORDER GRADIENT IN CHILD HEIGHT AND RELATED OUTCOMES

	HFA					Stunted	WFA	Hb	Deceased
	z-score								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
India	-0.082 [0.011]	0.092 [0.018]							
India × 2nd child		-0.144 [0.025]	-0.161 [0.027]	-0.110 [0.063]	-0.243 [0.048]	0.051 [0.007]	-0.146 [0.020]	-0.094 [0.030]	0.003 [0.004]
India × 3rd+ child		-0.377 [0.024]	-0.227 [0.032]	-0.193 [0.092]	-0.436 [0.085]	0.064 [0.009]	-0.198 [0.024]	-0.159 [0.036]	0.002 [0.004]
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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						Yes	Yes	Yes	Yes
Mother's literacy × India						Yes	Yes	Yes	Yes
Mother's age at birth × India						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								o	No
Observations								838	199,514

Include a set of covariates to address endogeneity

In rural area it is a village, in urban area it is a neighborhood. Highly correlated to fertility outcomes

TABLE 2—INDIA'S DIFFERENTIAL BIRTH ORDER GRADIENT IN CHILD HEIGHT AND RELATED OUTCOMES

	HFA					Stunted	WFA z-score	Hb level	Deceased
	(1)	(2)	(3) z-score	(4)	(5)				
India	-0.082 [0.011]	0.092 [0.018]							
India × 2nd child		-0.144 [0.025]	-0.161 [0.027]	-0.111 [0.006]					003 004]
India × 3rd+ child		-0.377 [0.024]	-0.227 [0.032]	-0.191 [0.009]					002 004]
2nd child		0.023 [0.015]	-0.011 [0.017]	-0.091 [0.005]					014 002]
3rd+ child		-0.066 [0.013]	-0.118 [0.019]	-0.161 [0.007]					011 003]
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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
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The addition of these control variables reduces the magnitude but not significance of the  $lc \times 3rd+ Child$  coefficient, and does not appreciably change the  $lc \times 2nd Child$  coefficient.

TABLE 2—INDIA'S DIFFERENTIAL BIRTH ORDER GRADIENT IN CHILD HEIGHT AND RELATED OUTCOMES

	HFA					Stunted (6)	WFA z-score (7)	Hb level (8)	Deceased (9)
	(1)	(2)	z-score		(5)				
India	-0.082 [0.011]	0.092 [0.018]							
India	Results on the birth order gradient		-0.161 [0.027]	-0.110 [0.063]	-0.243 [0.048]	0.051 [0.007]	-0.146 [0.020]	-0.094 [0.030]	0.003 [0.004]
India	hold, although they are less		-0.227 [0.032]	-0.193 [0.092]	-0.436 [0.085]	0.064 [0.009]	-0.198 [0.024]	-0.159 [0.036]	0.002 [0.004]
2nd child			-0.011 [0.015]	-0.097 [0.017]	-0.167 [0.027]	0.009 [0.004]	0.009 [0.012]	-0.011 [0.022]	-0.014 [0.002]
3rd+ child			-0.066 [0.013]	-0.118 [0.019]	-0.334 [0.044]	0.036 [0.005]	-0.063 [0.014]	-0.037 [0.025]	-0.011 [0.003]
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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
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			193 092]	-0.436 [0.085]	0.064 [0.007]	0.108 [0.020]	0.150 [0.030]	0.002 [0.004]	
			097 053]	-0.167 [0.027]					
			169 074]	-0.334 [0.044]					
			351	-1.351					
Child's age dummies × India	No	No	Yes	Yes	Yes	Yes	Yes	Yes	
Mother's literacy × India	No	No	Yes	Yes	No	Yes	Yes	Yes	
Mother's age at birth × India	No	No	Yes	Yes	No	Yes	Yes	Yes	
PSU fixed effects	No	No	Yes	Yes	No	Yes	Yes	Yes	
Mother fixed effects	No	No	No	No	Yes	No	No	No	
Completed fertility sample	No	No	No	Yes	No	No	No	No	
Observations									

Include mother fixed effects, fully control for family size differences by only using within-family comparisons for identification. 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.

The key finding is that the birth order gradient in child height is twice as large in India as in Africa

An important robustness check includes fixed effects for eventual total family size, which does not vary with family.



Online Appendix Table 4: Birth order gradients compared to other regions

<i>Comparison sample:</i>	<i>Countries with similar GDP to India</i>			<i>Europe, Central &amp; West Asia</i>			<i>Bangladesh &amp; Pakistan</i>		
	HFA	HFA	HFA	HFA	HFA	HFA	HFA	HFA	HFA
	<i>z-score</i>	<i>z-score</i>	<i>z-score</i>	<i>z-score</i>	<i>z-score</i>	<i>z-score</i>	<i>z-score</i>	<i>z-score</i>	<i>z-score</i>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
India	-0.034			-0.785			0.221		
							[0.020]		
India × 2nd child							-0.111	-0.057	-0.182
							[0.028]	[0.030]	[0.062]
India × 3rd+ child							-0.192	-0.059	-0.297
							[0.028]	[0.038]	[0.114]
2nd child							-0.011	-0.116	-0.229
							[0.019]	[0.021]	[0.048]
3rd+ child	-0.159	-0.155	-0.251	-0.147	-0.193	-0.306	-0.251	-0.287	-0.468
	[0.013]	[0.019]	[0.044]	[0.019]	[0.026]	[0.064]	[0.019]	[0.027]	[0.088]
Comparison group mean of outcome	-1.303	-1.303	-1.303	-0.560	-0.560	-0.560	-1.610	-1.610	-1.610
Age & other controls	No	Yes	No	No	Yes	No	No	Yes	No
Mother FEs	No	No	Yes	No	No	Yes	No	No	Yes
Observations	166,709	166,281	81,742	83,998	83,461	39,463	75,535	75,435	30,357

Compare India to its two South Asian neighbors. The hypothesis is 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)

# II. Birth Order and Child Outcomes

## B. Other Health Outcomes

TABLE 2—INDIA'S DIFFERENTIAL BIRTH ORDER GRADIENT IN CHILD HEIGHT AND RELATED OUTCOMES

	HFA					Stunted	WFA	Hb	Deceased
	z-score								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
India	-0.082 [0.011]	0.092 [0.018]							
India × 2nd child		-0.144 [0.025]	-0.161 [0.027]	-0.110 [0.063]	-0.243 [0.048]	0.051 [0.007]	-0.146 [0.020]	-0.094 [0.030]	0.003 [0.004]
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					0.51	0.375	-0.877	10.150	0.071
					Yes	Yes	Yes	Yes	Yes
					Yes	Yes	Yes	Yes	Yes
					Yes	Yes	Yes	Yes	Yes
					Yes	Yes	Yes	Yes	Yes
					No	No	No	No	No
					No	No	No	No	No
					167,737	167,737	88,838	199,514	

Steep Indian birth order gradient holds for stunting: relative to Africa, the disadvantage for Indian second-borns is 5 percentage points, and for third-borns, 6 percentage points (statistically significant at the 1% level). Columns 7 and 8 show a differentially steep birth order gradient in weight-for-age and hemoglobin in India.



### III. Culture and Height Deficit

- 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 4/5 of India's population is Hindu.



# III. Culture and Height Deficit

## A. *Within-India Evidence*

- 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



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 [0.039]	0.008 [0.001]	1.040 [0.001]	0.078 [0.039]	0.039 [0.039]	0.374 [0.039]	-0.027 [0.039]	0.034 [0.039]	0.212 [0.360]
Low son pref proxy × 3rd+ child	0.108 [0.045]	0.008 [0.001]	1.040 [0.001]	0.078 [0.039]	0.039 [0.039]	0.374 [0.039]	-0.027 [0.039]	0.034 [0.039]	-0.279 [0.568]
2nd child	-0.185 [0.017]	-0.008 [0.001]	1.040 [0.001]	0.078 [0.039]	0.039 [0.039]	0.374 [0.039]	-0.027 [0.039]	0.034 [0.039]	-0.573 [0.123]
3rd+ child	-0.422 [0.020]	-0.008 [0.001]	1.040 [0.001]	0.078 [0.039]	0.039 [0.039]	0.374 [0.039]	-0.027 [0.039]	0.034 [0.039]	-0.413 [0.193]
Low son pref group mean of outcome	-1.388	-1.008	1.040	0.078	0.039	0.374	-0.027	0.034	-1.227
High son pref group mean of outcome	-1.710	-1.008	1.040	0.078	0.039	0.374	-0.027	0.034	-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

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 average child height: average child height in matrilineal states exceeds that in the rest of India.



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 [0.039]	0.008 [0.029]	1.040 [0.515]	0.078 [0.030]	0.039 [0.023]	0.374 [0.236]	0.007 [0.039]	0.034 [0.023]	0.310 [0.210]
Low son pref proxy × 3rd+ child	0.108 [0.045]	0.069 [0.033]	1.793 [1.043]	0.081 [0.036]	0.044 [0.027]	1.065 [0.372]	0.007 [0.039]	0.034 [0.023]	0.310 [0.210]
2nd child	-0.185 [0.017]	-0.154 [0.013]	-0.578 [0.116]	-0.207 [0.020]	-0.173 [0.015]	-0.650 [0.140]	0.007 [0.039]	0.034 [0.023]	0.310 [0.210]
3rd+ child	-0.422 [0.020]	-0.350 [0.015]	-0.472 [0.183]	-0.437 [0.024]	-0.363 [0.019]	-0.738 [0.218]	0.007 [0.039]	0.034 [0.023]	0.310 [0.210]
Low son pref group mean of outcome	-1.388	-1.198	-1.407	-1.561	-1.491	-1.485	0.007	0.034	0.310
High son pref group mean of outcome	-1.710	-1.648	-1.557	-1.721	-1.622	-1.584	0.007	0.034	0.310
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

Low-sex-ratio regions have a shallower birth order gradient and 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.



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 [0.039]	0.008 [0.029]	1.0 [0.000]				-0.027 [0.047]	0.034 [0.035]	0.212 [0.360]
Low son pref proxy × 3rd+ child	0.108 [0.045]	0.069 [0.033]	1.0 [1.000]				0.184 [0.055]	0.156 [0.041]	-0.279 [0.568]
2nd child	-0.185 [0.017]	-0.154 [0.013]	-0.0 [0.000]				-0.159 [0.017]	-0.153 [0.013]	-0.573 [0.123]
3rd+ child	-0.422 [0.020]	-0.350 [0.015]	-0.0 [0.000]				-0.412 [0.021]	-0.354 [0.016]	-0.413 [0.193]
Low son pref group mean of outcome	-1.388	-1.198	-1.0				-1.732	-1.602	-1.227
High son pref group mean of outcome	-1.710	-1.648	-1.0				-1.691	-1.628	-1.575
Sample	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
Observations	95,125	95,125	3,600				82,084	82,084	3,405

Relative to Hindus, Muslim Indians have a much more muted birth order gradient in HFA and WFA for birth order three and higher. 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





# III. Culture and Height Deficit

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

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

- Among boys: The eldest son, by definition, has the lowest birth order among sons in the family and will be favored over his siblings.
- Among girls: <1> A later-born girl is more likely to have an elder brother and be in competition with him for resources. <2> Consider a family with a desired fertility of two children and which wants at least one son. If the first-born is a daughter and their second child is also a girl...



### III. Culture and Height Deficit

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

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

- Expanded form of equation (1), where the key additional regressors are the triple interaction between India, birth order, and being a girl.
- Interested in  $\delta_2$  and  $\delta_3$ , which test whether India's steep birth order gradient is stronger among girls or boys.



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 [0.026]				-0.011 [0.014]			
India × Girl	-0.111 [0.036]				-0.143 [0.020]	-0.147 [0.019]	-0.098 [0.032]	-0.116 [0.014]
India × 2nd child	-0.107 [0.036]	-0.152 [0.040]	-0.228 [0.069]	-0.122 [0.030]				
India × 3rd+ child	-0.352 [0.033]	-0.221 [0.047]	-0.414 [0.097]	-0.175 [0.035]				
India × 2nd child × Girl	-0.076 [0.053]	-0.045 [0.057]	-0.024 [0.101]	-0.047 [0.043]				
India × 3rd+ child × Girl	-0.051 [0.047]	-0.048 [0.067]	-0.030 [0.092]	-0.064 [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



# III. Culture and Height Deficit

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

- While the birth order gradient does not differ by gender, there are two reasons to expect a level difference by gender in India.
  1. If eldest sons receive more resources than all other children, then sons on average will fare better than daughters.
  2. The gender composition of children influences fertility behavior: in India, the birth of a girl in a family with only daughters increases mothers' desire for additional children. Thus, daughters in India are more likely to belong to larger than planned families that lack adequate resources for their children. These two effects, together, yield a second prediction.



# III. Culture and Height Deficit

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

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

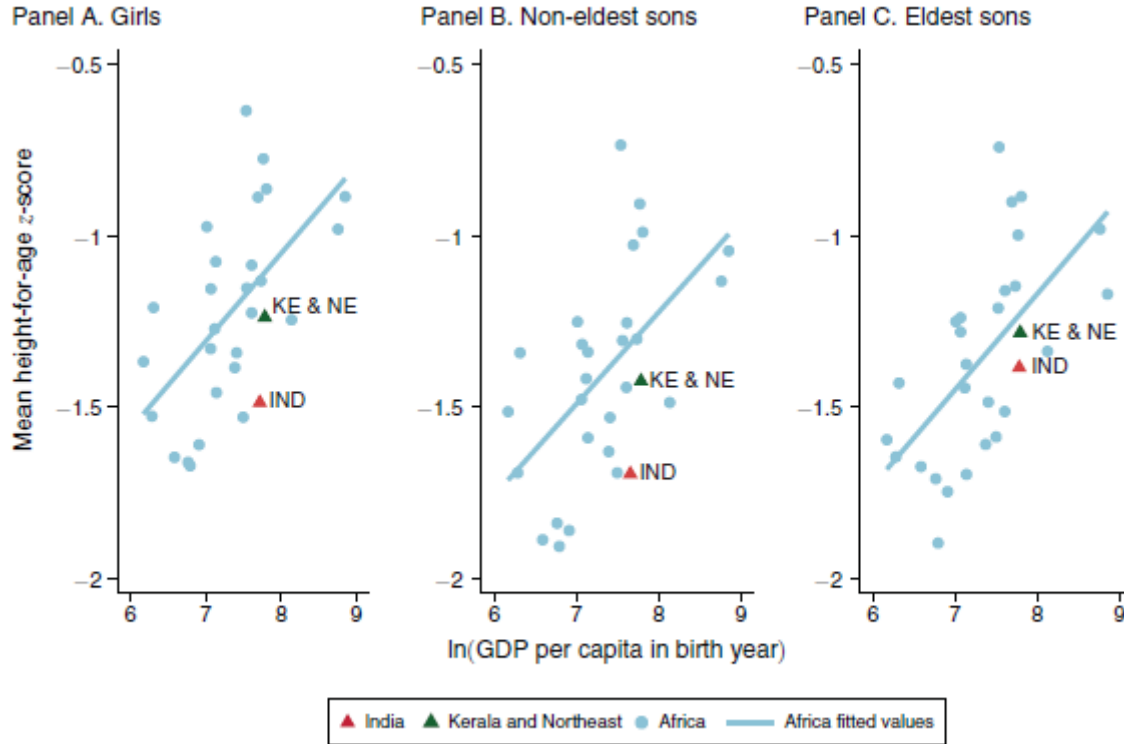
TABLE 5—CHILD GENDER AND THE BIRTH ORDER GRADIENT IN HEIGHT

	HFA z-score			WFA z-score (4)	HFA z-score			WFA z-score (8)
	(1)	(2)	(3)		(5)	(6)	(7)	
India	0.148				-0.011			
India × Girl					[0.014]			
India × 2nd child					-0.143	-0.147	-0.098	-0.116
India × 3rd+ child					[0.020]	[0.019]	[0.032]	[0.014]
India × 2nd child × Girl								
India × 3rd+ child × Girl								
Africa mean of outcome					-1.351	-1.351	-1.351	-1.351
Age and other controls					No	Yes	No	Yes
Mother fixed effects					No	No	Yes	No
Observations	168,108	165,596	83,228	165,596	168,108	167,737	83,228	167,737

Overall, only Indian girls show a child height disadvantage relative to Africa and this gender deficit remains significant when we include additional covariates and also when we estimate a regression with mother fixed effects



- *Eldest vs General Son Preference* — 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.



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

FIGURE 3. HEIGHT OF INDIAN CHILDREN RELATIVE TO AFRICA



# III. Culture and Height Deficit

## *C. Alternative Explanations*

- **Maternal Health:** Indian mothers are, on average, six centimeters shorter than African mothers. They examine whether maternal health endowment has differential effects on child height by birth order.



Online Appendix Table 10: Alternative explanations for the Indian birth order gradient

	HFA z-score (1)	Diarrhea in last 2 weeks (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)
India × 2nd child	-0.156 [0.031]	-0.001 [0.005]	-0.165 [0.028]	-0.142 [0.030]	-0.154 [0.029]	-0.153 [0.046]
India × 3rd+ child	-0.185 [0.038]				-0.212 [0.035]	-0.211 [0.054]
2nd child	0.244 [0.357]				-0.061 [0.027]	-0.003 [0.041]
3rd+ child	-0.404 [0.426]				-0.199 [0.033]	-0.100 [0.047]
2nd child × Mother's height	-0.161 [0.226]					
3rd+ child × Mother's height	0.183 [0.269]					
2nd child × Open defecation						
3rd+ child × Open defecation						
2nd child × Percent non-resident among children						
3rd+ child × Percent non-resident among children						
2nd child × Nr. of adult females in hh						
3rd+ child × Nr. of adult females in hh						
2nd child × Land scarcity					0.022 [0.012]	
3rd+ child × Land scarcity					0.044 [0.015]	
						-0.003 [0.015]
						-0.007 [0.017]
Africa mean of outcome	-1.351	0.156	-1.351	-1.351	-1.351	-1.351
Age & other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	166,292	167,737	162,503	167,737	167,737	167,737

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



# III. Culture and Height Deficit

## *C. Alternative Explanations*

- **Disease Environment:** Even absent changes in a household's sanitation infrastructure, later-born children may have a worse disease environment because older siblings expose them to pathogens or because they receive lower-quality care.

Online Appendix Table 10: Alternative explanations for the Indian birth order gradient

	HFA z-score (1)	Diarrhea in last 2 weeks (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)
India × 2nd child	-0.156 [0.031]	-0.001 [0.005]	-0.165 [0.028]	-0.142 [0.030]	-0.154 [0.029]	-0.153 [0.046]
India × 3rd+ child	-0.185 [0.038]	0.012 [0.006]	-0.217 [0.035]			
2nd child	0.244 [0.357]	-0.001 [0.003]	-0.024 [0.019]			
3rd+ child	-0.404 [0.426]	0.001 [0.004]	-0.138 [0.023]			
2nd child × Mother's height	-0.161 [0.226]					
3rd+ child × Mother's height	0.183 [0.269]					
2nd child × Open defecation			0.035 [0.030]			
3rd+ child × Open defecation			0.055 [0.035]			
2nd child × Percent non-resident among children						
3rd+ child × Percent non-resident among children						
2nd child × Nr. of adult females in hh						
3rd+ child × Nr. of adult females in hh						
2nd child × Land scarcity						
3rd+ child × Land scarcity						-0.007 [0.017]
Africa mean of outcome	-1.351	0.156	-1.351	-1.351	-1.351	-1.351
Age & other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	166,292	167,737	162,503	167,737	167,737	167,737

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.



# III. Culture and Height Deficit

## *C. Alternative Explanations*

- **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.

Online Appendix Table 10: Alternative explanations for the Indian birth order gradient

	HFA z-score (1)	Diarrhea in last 2 weeks (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)
India × 2nd child	-0.156 [0.031]	-0.001 [0.005]	-0.165 [0.028]	-0.142 [0.030]	-0.154 [0.029]	-0.153 [0.046]
India × 3rd+ child	-0.185 [0.038]	0.012 [0.006]	-0.217 [0.035]	-0.215 [0.036]	-0.212 [0.035]	-0.211 [0.054]
2nd child	0.244 [0.357]	-0.001 [0.003]	-0.024 [0.019]	-0.036 [0.025]	-0.061 [0.027]	-0.003 [0.041]
3rd+ child	-0.404 [0.426]	0.001 [0.004]	-0.138 [0.023]	-0.133 [0.028]	-0.199 [0.033]	-0.100 [0.047]
2nd child × Mother's height	-0.161 [0.226]					
3rd+ child × Mother's height	0.183 [0.269]					
2nd child × Open defecation			0.035 [0.000]			
3rd+ child × Open defecation						
2nd child × Percent non-resident among children				0.251 [0.178]		
3rd+ child × Percent non-resident among children				0.176 [0.204]		
2nd child × Nr. of adult females in hh					0.022 [0.012]	
3rd+ child × Nr. of adult females in hh					0.044 [0.015]	
2nd child × Land scarcity						-0.003 [0.015]
3rd+ child × Land scarcity						-0.007 [0.017]
Africa mean of outcome	-1.351	0.156	-1.351	-1.351	-1.351	-1.351
Age & other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	166,292	167,737	162,503	167,737	167,737	167,737

While both proxies are higher in Africa, the India-Africa birth order gradient is robust to inclusion of either proxy



# III. Culture and Height Deficit

## *C. Alternative Explanations*

- **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.

Online Appendix Table 10: Alternative explanations for the Indian birth order gradient

	HFA z-score (1)	Diarrhea in last 2 weeks (2)	HFA z-score (3)	HFA z-score (4)	HFA z-score (5)	HFA z-score (6)
India × 2nd child	-0.156 [0.031]	-0.001 [0.005]	-0.165 [0.028]	-0.142 [0.030]	-0.154 [0.029]	-0.153 [0.046]
India × 3rd+ child	-0.185 [0.038]	0.012 [0.006]	-0.217 [0.035]	-0.215 [0.036]	-0.212 [0.035]	-0.211 [0.054]
2nd child	0.244 [0.357]	-0.001 [0.003]	-0.024 [0.019]	-0.036 [0.025]	-0.061 [0.027]	-0.003 [0.041]
3rd+ child	-0.404 [0.426]	0.001 [0.004]	-0.138 [0.004]	-0.133	-0.199	-0.100 [0.047]
2nd child × Mother's height	-0.161 [0.226]					
3rd+ child × Mother's height	0.183 [0.269]					
2nd child × Open defecation			0			
3rd+ child × Open defecation			0			
2nd child × Percent non-resident among children			0			
3rd+ child × Percent non-resident among children						
2nd child × Nr. of adult females in hh						
3rd+ child × Nr. of adult females in hh						
2nd child × Land scarcity						-0.003 [0.015]
3rd+ child × Land scarcity						-0.007 [0.017]
Africa mean of outcome	-1.351	0.156	-1.351	-1.351	-1.351	-1.351
Age & other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	166,292	167,737	162,503	167,737	167,737	167,737

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.



# III. Culture and Height Deficit

## *C. Alternative Explanations*

- In sum, limited evidence support these alternative explanations that can cause a large differential birth order gradient in height in India compared to Africa
- 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.





## 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.



## IV. Conclusion

- They examine a specific mechanism that could drive India's steep birth order gradient in child height: eldest son preference. They compare subgroups within India and show that subgroups with lower son preference exhibit a shallower birth order gradient. Then they 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.



***THANK YOU***