Why Are Indian Children Shorter Than African Children?*

Seema Jayachandran
Northwestern University

Rohini Pande
Harvard University

July 27, 2013

Abstract

Height-for-age among children is lower in India than in Sub-Saharan Africa. This presents a puzzle since India is richer than the average African country and fares better on most other development indicators including infant mortality. Using data from African and Indian Demographic and Health Surveys, we document three facts. First, among firstborns, Indians are actually taller than Africans; the Indian height disadvantage appears with the second child and increases with birth order. Second, investments in successive pregnancies and higher birth order children decline faster in India than Africa. Third, the India-Africa birth order gradient in child height appears to vary with sibling gender. These three facts suggest that parental preferences regarding higher birth order children, driven in part by cultural norms of eldest son preference, underlie much of India's child stunting.

---

*We thank Suanna Oh and Alexander Persaud for excellent research assistance, and Jere Behrman, Angus Deaton, Jean Drèze, Erica Field, Dominic Leggett, Nachiket Mor, Debraj Ray, Alessandro Tarozzi and several seminar and conference participants for comments. Contact information: Jayachandran: seema@northwestern.edu; Pande: rohini.pande@harvard.edu.

1 Introduction

Despite India's strong growth performance in recent years, a striking proportion of Indian children continue to fall short of their height potential. Over 40 percent of Indian children age five years and younger are classified as stunted (IIPS, 2010), and Figure 1 shows that Indian (and more broadly South Asian) children are shorter than those born in other low-income regions such as Sub-Saharan Africa. The India-Africa child height disparity stands in sharp contrast to India's relatively better performance on most other health and socioeconomic indicators ranging from infant and maternal mortality and life expectancy to food security, poverty incidence and educational attainment (Gwatkin et al., 2007), and suggests potential limits on the future prosperity on young Indians.[1]

The biological literature on the determinants of child height identifies two distinct potential explanations for the India-Africa gap: genetic and environmental.[2] In this paper, we use 27 Sub-Saharan African and one Indian Demographic and Health Survey (DHS) conducted since 2004 to demonstrate the importance of parental preferences within the class of environmental explanations. We find a much greater height drop-off for later-born children in India than in Africa: Height-for-age is actually *higher* in India than in Africa for firstborn children. The Indian height disadvantage materializes for second-born children and increases for third and higher order births, at which point Indian children have a mean height-for-age lower than that of African children by 0.35 standard deviations of the worldwide distribution. We see the same pattern – a much steeper birth order gradient in child height in India than in Africa – when the estimation is limited to between-sibling variation. Thus, birth order is not just proxying for family background differences between smaller and larger families.

This birth order pattern suggests that the prevalence of malnutrition in India is not an artefact of using child height to measure malnutrition rates (Panagariya, 2013). Genotypes do not vary with birth order, so a simple genetic predisposition to be short likely would not generate the very significant birth order effects we find. In addition, the birth order

---

[1] The Indian Prime Minister Manmohan Singh has called the problem "a national shame," stating that, "We cannot hope for a healthy future for our country with a large number of malnourished children," (Sinha, 2012). In the academic literature, early-life malnutrition, with stunting as a marker, has been associated with impaired immunocompetence (Falkner and Tanner, 1989), poor cognitive skills and education attainment (Glewwe and Miguel, 2007) and overall functional impairment (Barker and Osmond, 1986; Barker et al., 1993) and has been linked to detrimental effects on long-term economic status (Strauss and Thomas, 1998; Case and Paxson, 2008).

[2] Adult height is largely determined in the first few years of life (Tanner et al., 1956).

pattern does not appear to reflect differential infant survival or initial maternal health. For differential mortality selection to explain the birth order effect, we would need India's infant survival to be especially high for later-born children since this is where the Indian height disadvantage is largest. But in fact the opposite pattern is seen: the infant survival rate in India is particularly high at low birth order. Regarding initial maternal health, it is possible that Indian women are unhealthier than African women at the start of childbearing and, therefore, predisposed to having smaller babies.[3] This environmental explanation posits that the die is cast during the mother's childhood and adolescence. However, the impact of mother's height, a summary measure of a woman's health inputs before adulthood, on child height does not vary much with birth order. Thus, it appears that the birth order gradient in child height reflects contemporaneous choices by households rather than the past environment the mother faced before entering her childbearing years.

The within-family patterns in child height also cast doubt on simply access to services as the explanation, since access typically does not vary substantially with the child's birth order, and instead point to take-up of services. In the remainder of the paper we provide evidence that variation in stunting within households reflects parental preferences and their decisions concerning when services and household resources are utilized. We explore two classes of explanations for the strong birth order gradient in India: household resource constraints and cultural norms that influence preferences toward children of different birth order. The evidence points against resource constraints and in favor of parental preferences as the underlying explanation. In particular, eldest son preference seems to help explain Indian families' relatively higher investment in earlier-born children.

Regarding household resources as a potential explanation, if families are liquidity constrained, then even with identical preferences over birth order in India and Africa, the child height patterns could emerge if the time profile of income declines more steeply (or increases less steeply) for families in India. Indian families might simply not have the financial resources to spend on later-born children. A related hypothesis is that there are smaller economies of scale in care-giving in India, so African families effectively have more resources to spend on later born children. Two pieces of evidence militate against these explanations. First, we analyze food consumption patterns across Indian and African mothers and find a

---

[3] This maternal health channel is an important contributor to the "gradual catch-up" hypothesis (Deaton and Drèze, 2009), according to which it takes time for a historically malnourished population to meet their genetic potential, even when their nutrition improves.

relatively greater decline in food consumption among Indian mothers as family size increases. However, this decline is concentrated among pregnant women, suggesting an explicit decline in investments in pregnant women rather than a generalized decrease in financial resources (or even treatment of women). Second, comparing the food consumption of Indian women and their husbands, we find that the pattern of food consumption declining as the family size increases is concentrated only among pregnant women and not their husbands. Thus, it appears that Indian households disinvest relatively more in women across successive pregnancies. The fact that the disinvestment is accentuated during pregnancy is suggestive of an explicit preference over child health, but it could be the case that child health is an unintended consequence. Women's food consumption, body mass index, and hemoglobin levels decline more with successive pregnancies in India; these effects would be detrimental to fetal and child health, whether or not the family is aware of this implication.

However, further evidence points to a more conscious preference over children's health. Several arguably time-intensive prenatal health inputs such as prenatal checkups, maternal iron supplementation, and childbirth at a health facility exhibit a stronger drop-off with birth order in India than Africa. Moreover, *postnatal* inputs such as child vaccinations and postnatal checkups, which are not indirect inputs to child health made via maternal health, also sharply decline with birth order in India. In addition, later in life, we see a steep birth order drop-off in parents' investment in their children's education in India, which is also consistent with Indians having a relatively weaker preference for higher birth order children.

We next ask whether the stronger preference for earlier born children in India may, at least partially, reflect a cultural norm of eldest son preference. A large literature documents how higher economic returns associated with sons combined with the kinship rules of Hinduism (Dyson and Moore, 1983) and the Hindu requirement that only a male heir can light the funeral pyre (Arnold et al., 1998) implies that son preference is strongest for the firstborn son (Gupta, 1987).

Indeed, we find suggestive evidence that the birth order gradient in height depends on the sex of older siblings. The small stature of later-born boys in India is larger if they have an older brother; once the family has its eldest son, it seems to disinvest in subsequent children. Moreover, this "advantage" of having only older sisters is not seen for girls, presumably because in these cases the family expects to have another child to try for a son, so holds back on spending on the current daughter. Thus, eldest son preference appears to generate a birth order gradient in child health in India through high investments in utero for the potential eldest son in the family (which disfavors later-born girls and boys), through fertility stopping rules (which disfavor later-born girls), and potentially through exhaustion of resources on the eldest son (which disfavors later-born girls and boys).

This paper makes several contributions. First, we add to the literature on the causes of India's high rate of child malnutrition. One approach has been to ask whether the rate is really as high as Indians' short stature would suggest, testing for the potential role of genetics by examining whether wealthy and well fed Indian children are short by international standards. The findings are mixed (Bhandari et al., 2002; Tarozzi, 2008; Panagariya, 2013). Another approach is to examine the height of Indian children who migrate to rich countries, with most authors finding that the gap between the Indian-born children and worldwide norms narrows but does not close (Tarozzi, 2008; Proos, 2009). We take a different approach of examining within-family patterns. Our results give support to the environment side of the the genes-versus-environment debate, and therefore are complementary to papers such as Spears (2013), which points to open defecation as an environmental explanation for India's high rate of stunting.[4] However, we offer a quite different type of environmental explanation: parental choices regarding resource allocation across children. Our work is related to Mishra, Roy, and Retherford (2004) who also examine intrahousehold patterns, using earlier rounds of the Indian DHS to show that stunting in India varies with the gender composition of siblings. Also related is Coffey, Spears, and Khera (2013) who compare first cousins living in the same Indian joint household and show that children born to the younger brother in the household do worse, potentially due to the mother facing greater discrimination.

Second, we add to the growing literature on the ramifications – including unintended ones – of son preference in India (Sen, 1990; Clark, 2000; Jensen, 2003; Jayachandran and Kuziemko, 2011). In this case, son preference causes inequality in health inputs and outcomes even among sisters. Third, we contribute to a much broader literature on inequality in parental allocations among children (Rosenzweig and Schultz, 1982; Behrman, 1988; Garg and Morduch, 1998). Finally, we add to a literature on the effects of birth order, which

---

[4] Spears (2013) shows that the high rate of open defecation in India helps explain the high rate of child stunting. There are reasons to think this channel could contribute to the birth order gradient, for example if older siblings expose younger siblings to disease or if the childcare of higher birth order children is less vigilant. However, empirically, open defecation has smaller effects or no differential effects on height for higher birth order children.

has documented gradients in outcomes as varied as IQ, schooling, height, and personality (Behrman and Taubman, 1986; Sulloway, 1996; Black, Devereux, and Salvanes, 2007; Savage, Derraik, Miles, et al., 2013). Our contribution to this literature is to document the strong birth order effects in India and to demonstrate how birth order effects account for the entire height gap between Indian and African children.

The remainder of the paper is organized as follows. Section 2 describes the data and presents descriptive statistics for the sample. Section 3 presents evidence on the birth order gradient in the Indian height disadvantage, and Section 4 examines potential explanations for this gradient. Section 5 concludes.

2 Data and descriptive statistics

Our analysis uses data from Indian and African household surveys which we describe below. We then use these data to provide a simple descriptive analysis of the India-Africa height gap.

2.1 Demographic and Health Surveys

The data used for analysis come from Demographic and Health Surveys (DHS) for Sub-Saharan African countries plus India's National Family Health Survey (NFHS), which uses the Demographic and Health Survey questionnaire (throughout we refer to this set of surveys as the DHS). For India, we focus on the most recent round from 2005-6 (NFHS-3). As a comparison group, we use all 27 Sub-Saharan African surveys (which represent 25 countries) that collected child anthropometric data and were conducted between 2004 and 2010 (to ensure a comparable time period to NFHS-3).

The surveys sample and interview mothers who are 15 to 49 years old at the time of survey. Child height and weight are collected for respondents' children who were under five years of age at the time of the interview.[5] Our sample comprises the 174,157 children with non-missing anthropometric data. Appendix Table 1 provides summary statistics for the Indian and African samples. The average age of the children in the sample is 30.1 months in India and 28.1 months in Africa. The mother's average age at birth is 24.8 years in India and 27.0 years in Africa. African women have had more children (3.9) than their Indian

---

[5] The DHS nominally collects anthropometric data for children less than 60 months old, but many children who are in their 60th month of life are missing anthropometric data. Hence we limit the sample to children who are 59 months old or younger, or have not completed 59 months of life.

counterparts (2.7).

A key variable of interest is birth order. The DHS records the date of birth for all children ever born, and we define birth order based on all children ever born, currently alive or deceased.

To make height comparisons across children of different age and gender, we combine anthropometric data on the child's height with information on the date of measurement and the child's date of birth to create the child's height-for-age z-score based on World Health Organization (WHO) guidelines. For each combination of gender and age in months, the WHO provides the distribution of these measures for a reference population of children from Brazil, Ghana, India, Norway, Oman and the United States. A z-score of 0 is the median of the reference population. A z-score of -1 indicates that the child is 1 standard deviation below the reference-population median for his or her gender and age. A height-for-age z-score of -2 is the cutoff for being considered stunted. The average height-for-age z-score in India and Africa are -1.58 and -1.44, respectively. We similarly use the child's weight to calculate weight-for-age and weight-for-height z-scores. The average weight-for-age z-score in India and Africa are -1.55 and -0.87.

The DHS also collects anthropometric data for the mother, including her height, weight, and hemoglobin levels. We also use data collected on health-related behaviors during pregnancy including the number of prenatal care visits a mother had during the pregnancy and whether she took an iron supplementation during the pregnancy, as well as her food consumption patterns, namely how often she ate particular kinds of foods such as fruits or meat or eggs. In general, India performs better on the prenatal inputs and worse on the measures of pregnant women's health. For example, 68 percent of the time, pregnant women in India took iron supplements, compared to 62 percent in Africa, while the average BMI of pregnant women is 21.1 in India and 23.0 in Africa.

We examine data on health inputs and outcomes for young children including incidence of exclusive breastfeeding, whether the child had diarrhea in the past two weeks, whether he or she received a postnatal checkup within the first two months, whether he or she was given iron supplementation, and the total number of vaccinations.[6] Vaccination rates are higher on average in India, while child iron supplementation is more common in Africa. The

---

[6] We restrict attention to vaccinations for which the DHS collects data (BCG, three doses of DPT, four doses of polio, and measles); this analysis is restricted to children age one year and older who should have completed their course of vaccinations.

incidence of child diarrhea, as reported by the mother, is considerably higher in Africa than India. We also consider domestic violence as an outcome, specifically whether the woman has been the victim of any physical violence by the husband.[7] The rate is 28 percent in India and 26 percent in Africa. Appendix Table 2 shows the correlation between child height and these several variables.

Some of these variables, such as anemia or food consumption or domestic violence, are measured at the mother level while others are child-level variables. In addition, some of the child-level variables are asked retrospectively of all children age three years and younger or five years and younger, while most are asked only of the most recent birth. For this reason, as well as due to missing values, the sample analyzing these outcomes is often smaller than the full sample analyzing height, and we will not be able to estimate mother fixed effects models with most of these variables.

We also examine infant mortality and children's schooling as outcomes. For infant mortality, the sample includes all alive or deceased children, excluding those whose date of birth is less than one year before the survey date; the outcome of whether the child died before age one is not fully determined until he or she reaches (or could have reached) age one year. The infant mortality sample consists of children age 13 to 59 months comprises 199,696 children. The rate is 5 percent in India and 7 percent in Africa. For children's years of education, we use a sample of children age 7 to 17.[8] Average years of schooling is 4.5 years in India and 2.4 years in Africa.

2.2 Covariate analysis

To set the stage for our analysis, we describe how some of the most commonly discussed determinants of the Indian height disadvantage influence the India-Africa child height-for-age (HFA) gap. We estimate for child i born to mother m in country c a regression of the form

$$HFA_{imc} = \alpha I_c + \beta Y_{mc} + \gamma C_{imc} + \delta G_{imc} + \phi X_{mc} + \epsilon_{imc}. \quad (1)$$

---

[7] Ackerson and Subramanian (2008) use Indian NFHS data to show a correlation between spousal violence and child malnutrition. They posit two channels – first, that spousal violence is often accompanied by withholding food consumption from the mother and second, violence increases maternal stress.

[8] Age 7 is the typical school-entry age, and we exclude children over age 17 years since those living at home will be a non-random sample.

The regression includes dummy variables for the survey year Y_{mc}, the child's age in months C_{imc}, and the child's gender G_{imc}, to adjust for any sampling differences between India and Africa. In all cases, standard errors are clustered at the mother level. The coefficient α on the India dummy I_c is an estimate of the India-Africa gap. Column (1) of Appendix Table 3 reports this gap when no other covariates are included: The gap is -0.14, measured in standard deviations of the worldwide distribution, and significant at the 1 percent level.[9]

We control for several factors that have been proposed as explanations for Indian malnutrition and examine whether these covariates "knock out" the India coefficient. The remaining columns of Appendix Table 3 report these regressions where we include different household-level covariates (X_{mc}). While we do not intend to make causal claims from these correlations, this exercise suggests little prima facie support for most posited explanations.

We first examine how the India-Africa gap changes after controlling for various environmental factors. Columns (2) to (7) of Appendix Table 3 considers three widely discussed categories of environmental factors: household economic characteristics, access to clean water and sanitation, and female empowerment. Our measures of household-level economic measures are a household asset index and a dummy for rural. Columns (2) and (3) show that in both cases, India is more developed than Africa, and controlling for these makes the India coefficient larger in magnitude. These patterns echo what was seen in Figure 1 that overall economic development as measured by GDP is not the explanation; GDP is higher in India than the African countries in the sample.

Turning to access to water and sanitation, controlling for piped water makes the India gap larger (column 4). In contrast, open defecation is more common in India than in Africa and is negatively correlated with child height, so controlling for it reduces the India gap by one third (column 5). Of the environmental factors studied, open defecation seems like the most likely to contribute to the India-Africa height gap, consistent with the findings of Spears (2013). Nonetheless, over two thirds of the gap remains unexplained after adjusting for open defecation rates.

Many papers document a greater willingness by mothers, relative to fathers, to devote resources towards children (Thomas, 1990). However, on observed measures of empowerment such as female literacy and women's decision-making, women in India fare better than those in Africa, so controlling for them makes the India gap larger. To summarize, for most

---

[9] The raw India-Africa gap is also -0.14 and significant at the 1 percent level with no covariates included.

environmental factors proposed as explanations for the India height gap, India does better than Africa on observable measures. Furthermore, the correlation between these factors and HFA is generally too small to explain the India height gap. Thus pursuing standard environmental explanations for the gap arguably heightens the puzzle of stunting in India more than it solves it.

We next turn to examining if this simple accounting approach provides more support for a genetic explanation. Columns (8) and (9) control for parental height, which should capture the genetic component of child height. The patterns are quite striking. Mother's height is a strong predictor of child height, and controlling for it reverses the India-Africa gap in child height. However, just as strikingly, controlling for father's height only reduces the gap by 20 percent.[10] This pattern indicates that maternal height should not be interpreted as measuring purely genetics; the asymmetry with father's height suggests that low maternal height is also measuring non-genetic factors, such as maternal health or possibly empowerment. We take this as a first indication that gender discrimination – and potentially its expression across generations – may influence the child height gap. Father's height is presumably also partly measuring environmental factors, but if taken at face value as measuring genetics, then column (9) suggests that genetics leave 80 percent of the India-Africa height gap unexplained.

To recap, the basic correlations do not uncover a smoking gun explanation for the India height disadvantage, either environmental or genetic. We next turn to our main empirical analysis, which takes a different approach to establishing the role of environmental factors: We examine whether the height gap varies within households, specifically by birth order.

3 India-Africa child height gap: The birth-order effect

Figure 2 presents our key finding graphically by comparing the raw mean of child height-for-age z-scores in India and Africa, separately by birth order. Among firstborn children, HFA is higher in India than Africa. An Indian deficit emerges at birth order 2 and widens for birth order 3 and higher.

Table 1 reports regressions that demonstrate the robustness of this result and rule out

---

[10] Father's height is available for a smaller sample of African surveys. The results for mother's height are nearly identical to those reported in column (8) if we restrict the subsample with father's height used in column (9). The coefficient on mother's height is 5.9 compared to 5.1 in the larger sample.

several selection-based explanations. We estimate the following equation:

$$\begin{aligned} HFA_{icm} &= \alpha_1 I_c + \alpha_2 I_c \times 2ndChild_{imc} + \alpha_3 I_c \times 3rd{+}Child_{imc} \\ &\quad + \beta_1 2ndChild_{imc} + \beta_2 3rd{+}Child_{imc} + \beta Y_c + \gamma C_{imc} + \delta X_{imc} + \epsilon_{imc} \end{aligned} \qquad (2)$$

α_1 is the India gap for firstborn children (omitted category) and α_2 and α_3 capture how the gap differs for second-born children and third-and-higher birth order children. The regression adjusts for any sampling differences in child age or survey year. Standard errors are clustered by mother. As suggested by Figure 2, column (1) shows a very strong birth order gradient in the India-Africa gap. For the omitted birth order category, firstborns, Indian children are significantly taller than African children. The India height disadvantage opens up at birth order 2: The interaction of India and secondborn is -0.17 and highly significant. The Indian disadvantage then grows larger, with third and higher births having an HFA z-score gap of -0.35 compared to African children.

Columns (2) and (3) examine the birth order gradient separately for boys and girls. A stronger birth order gradient in India than Africa is seen for both genders. The point estimates suggest a larger birth order gradient for girls than boys, though in the jointly estimated model, neither the triple interaction of India, female, and birth order 2 nor the corresponding triple interaction for birth order 3 and above is statistically significant. Consistent with son preference in India, the India height advantage over Africa for firstborns is driven by boys.[11]

Turning to omitted variables, a first concern is that higher birth order children are born when their mothers are older, so the birth order gradient might actually reflect an India-Africa gap in the effect of maternal age on child height. In column (4) we show that the findings are robust to inclusion of $MotherAge \times India$ dummies, where mother's age is measured in five-year bins. Next, we include $ChildAge \times India$ interactions. Given that the DHS samples women at different points in their childbearing years, there should be

---

[11] Overall, girls do relatively worse in India than Africa but boys do not (See Table 7, Column (1)). In Africa, the average z-score for boys is lower than that for girls. One explanation is that male fetal and infant health are more vulnerable to disease and resource deprivation, consistent with the higher male infant mortality rate found in most countries. In other words, absent gender discrimination, one might expect better anthropometric outcomes among females than males in developing countries. Without using another poor region as a comparison group, mean HFA z-scores in India are higher for girls than boys, as shown by Mishra, Roy, and Retherford (2004) and Tarozzi and Mahajan (2007), for example.

no systematic correlation between the child's age and birth order, but some women have multiple children in the sample, and among siblings the higher birth order child will, by definition, be younger. Thus, the patterns seen could reflect age effects rather than birth order effects. As seen in column the coefficients on $I_c \times 2ndChild$ and $I_c \times 3rd{+}Child$ are essentially unchanged when controlling for child age in months interacted with $India$.

A stronger robustness check is to only use within-family variation for identification. Households where a second- or third-born child is observed in the data will on average have a larger family size than households where a firstborn child is observed, and households with higher fertility differ along several dimensions. Thus, the birth order variable in between-family comparisons could be proxying for high-fertility families. Column (6) includes mother fixed effects along with child age dummies interacted with India. The Indian birth order gradient remains similar in magnitude to column (1) and statistically significant. The birth order gradient is twice as large in India as in Africa, and large enough to account for the overall India-Africa height gap.[12] In column (7) we show that the patterns seen for the continuous HFA z-score are robust to using stunting (HFA z-score ≤ -2) as the outcome.

Child height is the outcome most often used in the genes-versus-environment discussions, and is the most common anthropometric marker of malnutrition because it is a stock rather than flow measure, but child weight is also lower in India than in Africa. In Appendix Table 4, we report the results for weight-for-age (WFA) and weight-for-height (WFH). There is also an Indian birth order gradient for WFA and WFH, though the latter becomes statistically insignificant with mother fixed effects. For the weight outcomes, the higher birth order children do not account for all of the India-Africa gap; Indian firstborns have significantly lower weight than African firstborns.[13]

---

[12] The birth order gradient in Africa, as measured by the coefficients on $2ndChild$ and $3rd{+}Child$ is negative and significant in column (6), which is reassuring since a pattern of better outcomes for low-parity children is well-established in the literature (Black, Devereux, and Salvanes, 2007).

[13] Weight is typically thought of as a flow measure of nutrition, with deficits later manifesting themselves in height. It is thus a puzzle why the India/Africa WFA and WFH gaps are larger than the HFA gap. Others have noted the puzzling features related to weight as measured in the 2005-6 NFHS, for example the fact that child weight did not improve from the 1999 NFHS round in contrast to height, which did (Deaton and Drèze, 2009; Tarozzi, 2012).

4 Why are later born children shorter in India?

The fact that firstborn children in India are no shorter than firstborn children in Africa—and in fact are *taller*—casts doubt on the genetic-based explanation for Indian stunting, since no obvious genetic theory suggests that genes express themselves differently on first births; any purely genetic (as opposed to epigenetic) difference would likely materialize in children of all birth orders. We next turn to considering several possible explanations for why there is a strong birth order gradient in height in India.

4.1 Mortality selection

The Indian height gap could be an artefact of measurement if it is generated by mortality selection, wherein relatively weaker (and shorter) children survive in India as compared to Africa. For mortality selection to explain the birth order patterns we find, India's infant survival would need to be especially high for later-born children since this is where the Indian height disadvantage is largest. In Table 2 we show that the infant survival rate in India is if anything relatively lower at high birth order. Thus, mortality selection is unlikely to explain the birth order patterns we find.

4.2 Mother's predetermined health

Another potential explanation is that women's predetermined health is worse in India than in Africa and with successive childbirths, women's health deteriorates more rapidly to the detriment of infant health. This mechanism is related to the gradual catch-up hypothesis of Deaton and Drèze (2009), who propose that it could take generations to close the height gap in India if a mother's malnutrition and poor health as a child in turn affect her children's size. We test whether mothers' childhood malnutrition and poor health, as proxied by their height, has differential effects by birth order.

Columns (3) and (4) of Table 2 present interactions between the mother's height and birth order. The prediction is not that there is a differential effect of height by birth order in India, but rather that there is an effect of height by birth order, which can explain why there is a stronger birth order gradient in India. (Women are on average six centimeters shorter in India than in Africa.)

As seen in column (3), there is a strong effect of mother's height on the child's height. This is consistent with genetics indeed playing a role in height, though it could also partly reflect women's health endowment affecting their children's height. The key coefficients are the interactions of mother's height and the birth order dummies. The signs of the coefficients are negative, suggesting that for women who are shorter/less healthy (e.g., women in India), there is a less negative birth order gradient in child height. In other words, these coefficients have the opposite sign of what one would expect if poor maternal health explains the negative birth order gradient in child height in India. The patterns are similar with mother fixed effects (and restricting the sample to mothers who are at least 21 years old and who have likely reached their full adult height, as seen in unreported results).

To recap, the birth order variation in the India-Africa gap is at odds with a genetic-based explanation and does not appear to reflect either mortality selection among children or long-term differences in maternal health across India and Africa. In addition, and consistent with the correlational evidence presented in Appendix Table 3, the birth order pattern casts doubt on *access* to services (such as health care or sanitation) as the main explanation, since access usually does not vary a lot with the child's birth order. We now turn to examining how contemporaneous inputs across successive pregnancies and children vary between India and Africa, and use this evidence to rule out and rule in different hypotheses for why there is a sharp birth order gradient in child height in India. In particular, we examine two classes of explanations: budget constraints and parental preferences.

4.3 Resource constraints

Later-born children are born later in their parents' lives, on average, and the resources available to spend on them could differ depending on the time profile of income in the household. If families could save and borrow freely, then the timing of income should not affect the available resources for each child, but families in both India and Africa likely have limited ability to smooth consumption intertemporally. Thus, if Indian families have relatively less income than African parents at the time later born children are born, then this could lead to fewer resources to spend on these children and worse outcomes for them. A related idea is that even if income profiles do not differ between regions, there could be greater economies of scale in Africa, which, in effect, allow parents to invest relatively more in later born children.

To test this budget constraint hypothesis, we examine recall data on food consumption, which was collected for mothers who have given birth in the last three years. We create indicator variables for whether the mother reports consuming specific food items. The data are fairly crude, asking whether the mother consumed a type of food in the recall window, but they give an indication of dietary diversity and the nutritional inputs for women. Almost everyone has consumed starchy foods, so we focus on the categories with variation (and which are important sources of protein and vitamins), namely fruit, dairy, and meat/fish/eggs. Our sample is African and Indian mothers, and we allow effects to vary depending on whether the woman is currently pregnant. (Note that as the questions were only asked of women who had given birth, we cannot examine women who have no children or are pregnant with their first child).

Table 3 columns (1) to (3) show that for dairy and fruit consumption, among pregnant women (the omitted category) we see a sharper birth order gradient among Indians (i.e, a greater drop-off in food consumption across successive pregnancies). The positive triple interaction coefficients of India, higher birth order, and not being pregnant indicate that this differential birth order gradient in India is muted among non-pregnant mothers. The fact that the decline in consumption is concentrated among pregnant Indian women weighs against different time profiles of income which likely would lead to similar patterns for both pregnant and non-pregnant women. These patterns are also inconsistent with generalized mistreatment of women in India growing larger over time, which again would likely not predict that the effects are concentrated among pregnant mothers. In columns (4) to (6) we consider as outcomes the mother's BMI, absence of anemia and absence of physical violence (we define outcomes so that a higher value is a better outcome). For all three outcomes, we observe a differential India-Africa gradient among women as they have more children. And as with food consumption, this gradient differs depending on whether the woman is pregnant. Specifically, across successive pregnancies the drop off for Indian mothers exceeds that for African mothers but the gradient is smaller or non-existent for non-pregnant women. (Also, note that the consumption level of Indian women is typically higher than African women across all pregnancies; it is just that the gradient is sharper for Indians).

The evidence in Table 3 casts doubt on financial resources of Indian households dropping off faster over the lifecycle than for African households as the explanation for the birth order patterns. A complementary way of examining whether pregnant Indian mothers do particularly badly is to consider the sample of Indian couples where we observe both the husband's and wife's food consumption.[14] A number of papers have shown that women receive fewer household resources, such as food and health care, than men (Dandekar, 1975; Agarwal, 1986; Sudo, Sekiyama, Watanabe, et al., 2004). We observe that the consumption declines as family size increases are concentrated among women and do not extend to their husbands. Again, the gap between women's and men's consumption widens in particular during pregnancies.

Another scarce resource is time. When parents have less time for child care with successive births, older siblings or other lower quality caregivers might step in.[15] It is possible that this could have worse consequences for child health in India. For example, there is evidence that the worse disease environment and specifically the high rate of open defecation in India contribute to the prevalence of child stunting (Spears, 2013). However, it does not appear that the explanation for the birth order gradient is greater exposure to this disease environment, via the channel of worse child care or another mechanism such as older siblings worsening the disease environment for their younger siblings. Empirically, open defecation has, if anything, smaller consequences for height for higher birth order children, as seen in Appendix Table 5.

4.4 Parental preferences

The evidence above suggests that parental preferences toward children are what is driving the birth order gradient in child height in India. We now examine birth order patterns in prenatal and postnatal health inputs, which corroborates this interpretation.

Columns (1) to (5) of Table 5 examine retrospective information about health inputs in utero and childbirth conditions. Note that the sample for these outcomes is typically smaller than for our height analysis since most questions are asked only for the youngest child in the family (which also precludes mother fixed effects specifications). In general, Indian women are more likely to obtain prenatal care during pregnancy, take iron supplements and receive tetanus shots during the pregnancy and are less likely to deliver at home. They are also less likely to report vision problems during pregnancy. However, for each of these outcomes we observe a sharper decline with birth order in India relative to Africa. For instance,

---

[14] The module on men's consumption is unfortunately fielded in very few of the African surveys.

[15] Barcellos, Carvalho, and Lleras-Muney (forthcoming) find that the childcare time provided to a child under age two years in India is over twice as large if there are no other children in the household under age six years. Adsera and Lin (2013) show that the gap in housework done by girls and boys is increasing in parents' son preference.

column (1) shows that while prenatal care is more common in India with firstborns, the gap closes with subsequent birth order and third born children get less prenatal care in India than Africa. We find a similar pattern for whether the mother took iron supplements while pregnant (column 2) and whether the delivery was outside of a health facility (column 5), with firstborns doing better in India than Africa, then a significant India birth order gradient beginning with secondborns, with third born and higher children getting less care than their counterparts in Africa.

In principle, the households could have preferences over the well-being of pregnant women, and child health could be an unintended consequence of this pattern: women's food consumption and body mass index decline with successive pregnancies and this would affect fetal health and breastfed children's health. Similarly prenatal care and delivery in a health facility could be driven by preferences toward mothers rather than children. Besides being an arguably less plausible type of preference, we next show that there is also a strong Indian birth order gradient in postnatal investments such as vaccinations, where maternal health is not the conduit for providing health inputs to the child.[16]

Columns (6) to (10) of Table 5 present the results for postnatal health inputs. Columns (6) and (7) consider outcomes related to child feeding practices – whether the child was exclusively breastfed for the first five months and whether he or she receives the minimum acceptable diet, as defined by the WHO. Although breastfeeding is nearly universal in India, exclusive breastfeeding for the first six months is not the norm in either India or Africa. It is, however, slightly higher in India and increases more with birth order in India than Africa (column 6). This trend could reflect differential fertility rates across Africa and India since subsequent fertility reduces breastfeeding (Jayachandran and Kuziemko, 2011), rather than faster improvements in child-feeding practices across births in India. Consistent with this interpretation, in column (7) we see the opposite pattern for minimum acceptable diet. The likelihood that the child receives the minimum acceptable diet declines more sharply with birth order in India.

Next, we consider postnatal health inputs that are linked to receiving professional health care. While Indian mothers are less likely to seek postnatal health care within two months of child birth (column 8), their children are more likely to take iron pills and get vacci-

---

[16] Consistent with postnatal investments contributing to the birth order gradient, while the overall HFA gap gets smaller over the 0 to 5 year age range, the birth order effects appear to get larger with age (Appendix Table 4, columns (3) and (4)).

nated. However, for both postnatal checkups and vaccinations we see, relative to Africa, a significant decline with birth order (the effect is similar but statistically insignificant for iron supplementation).

In Table 6 we consider child morbidity measures and educational investments. Alongside the deterioration in investments with birth order, the incidence of anemia rises more sharply with birth order in India (column (1)). In terms of other measures of morbidity – child had diarrhea or a fever or cough in the last two weeks – Indian children do better than their African counterparts and there is little evidence of a birth order effect, though there is a small relative increase in diarrhea incidence among thirdborn and later children in India.

We also examine a non-health outcome, namely schooling, as further evidence that there seems to be a broad-based preference for earlier born children in India. Here we examine a different sample of children, those age 7 to 17 at the time of the survey. The regression specification controls for child age in years rather than months but is otherwise the same. The education patterns (column (4)) mirror the height and health input results. Firstborns do better in India than Africa, but there is also a stronger drop off with birth order in India compared to Africa.

4.5 Do differential investments reflect son preference?

We next examine whether the differential investments in mothers and their children reflect, in part, cultural norms of gender discrimination, especially son preference.

A norm of strong son preference in India, with particular favoritism toward the family's eldest son, is partly rooted in religion, but probably largely derives from son preference combined with standard diminishing returns. To examine the role of son preference in explaining the birth order patterns in India, we examine whether the birth order gradient in child height varies with the gender of older siblings. To start, as seen in Table 7, column (1), India's strong son preference is apparent in child height: The coefficient of $India \times Girl$ is large and negative. The India-Africa gap is -0.05 among boys but over four times as large at -0.23 among girls.

Column (2) focuses on the subsample of secondborn children and examines whether their outcomes depend on the gender of their older sibling. The estimates are imprecise, but the positive coefficient for $India \times FirstbornIsAGirl$ is consistent with worse outcomes for secondborn boys in India if they have an older brother, that is, when the family has its eldest son and is presumably pouring resources into this favored child. Meanwhile, for girls, the benefit of having no older brothers is smaller in magnitude (triple interaction term). This is consistent with fertility stopping rules that are driven by son preference. If a child is a girl and her older siblings are girls, then the parents presumably revise their target family size and are more likely to want to have another child to try for a son, and thus conserve their resources by spending relatively little on their most recently born daughter. (Appendix Table 6 shows the well-known fact that having only daughters is a positive predictor of continued fertility in India.) Thus, in nuanced ways, Indian parents' favoritism toward eldest sons appears to generate inter-sibling variation in child height based on the sex composition of older siblings and to lead to generally worse outcomes for later-born children.

5 Conclusion

This paper compares child height-for-age in India and Sub-Saharan Africa to shed light on the puzzlingly high rate of stunting in India. We present three facts that support "environment" as the explanation in the genes-versus-environment debate and, more specifically, point to parents' intra-family allocation decisions as the underlying factor driving malnutrition in India. First, among firstborns, Indians are actually taller than Africans; the height disadvantage appears with the second child and increases with birth order. The particularly strong birth order gradient in height in India is robust to including family fixed effects, which helps rule out most selection concerns. Second, investments in successive pregnancies and higher birth order children decline faster in India than Africa. The fact that the decline is concentrated among pregnant women and children, and non-pregnant women and men are less affected, suggests that a preference over children rather than a gradient in financial resources or increasing mistreatment of women drives the height patterns. Third, the India-Africa birth order gradient in child height appears to be somewhat larger for boys if the family has a son already; Indian parents seem to disinvest in their subsequent children once their eldest son is born. Meanwhile, for Indian girls, secondborns are relatively disadvantaged by having no elder brothers, presumably because the family conserves resources in anticipation of having another child to try for a son. These three facts suggest that parental preferences regarding higher birth order children, driven in part by eldest son preference, underlie much of India's child stunting.

References

Ackerson, L. K., and S. V. Subramanian (2008): "Domestic Violence and Chronic Malnutrition among Women and Children in India," American Journal of Epidemiology, 167(10), 1188–1196.

Adsera, A., and T. Lin (2013): "Parental Son Preference and Children's Housework: The Indian Case," Population Research and Policy Review, forthcoming.

Agarwal, B. (1986): "Women, Poverty and Agricultural Growth in India," Journal of Peasant Studies, 13(4), 165–220.

Arnold, F., et al. (1998): "Son Preference, the Family-building Process and Child Mortality in India," Population Studies, 52, 301–315.

Barcellos, S. H., L. Carvalho, and A. Lleras-Muney (forthcoming): "Child Gender and Parental Investments in India: Are Boys and Girls Treated Differently?," American Economic Journal: Applied Economics.

Barker, D. J. P., et al. (1993): "Fetal Nutrition and Cardiovascular Disease in Adult Life," The Lancet, 341(8850), 938–941.

Barker, D. J. P., and C. Osmond (1986): "Infant Mortality, Childhood Nutrition, and Ischaemic Heart Disease in England and Wales," The Lancet, 327(8489), 1077–1081.

Behrman, J. R. (1988): "Nutrition, Health, Birth Order and Seasonality: Intrahousehold Allocation among Children in Rural India," Journal of Development Economics, 28(1), 43–62.

Behrman, J. R., and P. Taubman (1986): "Birth Order, Schooling, and Earnings," Journal of Labor Economics, 4(3).

Bhandari, N., et al. (2002): "Growth Performance of Affluent Indian Children Is Similar to That in Developed Countries," Bulletin of the World Health Organization, 80(3), 189–195.

Black, S., P. Devereux, and K. Salvanes (2007): "Older and Wiser? Birth Order and IQ of Young Men," National Bureau of Economic Research Working Paper No. 13237.

Case, A., and C. Paxson (2008): "Stature and Status: Height, Ability, and Labor Market Outcomes," Journal of Political Economy, 116(3), 499–532.

Clark, S. (2000): "Son Preference and Sex Composition of Children: Evidence from India," Demography, 37(1), 95–108.

Coffey, D., D. Spears, and R. Khera (2013): "Women's Status and Children's Height in India: Evidence from Joint Rural Households," Working paper.

Dandekar, K. (1975): "Why Has the Proportion of Women in India's Population Been Declining," Economic and Political Weekly, pp. 1663–1667.

Deaton, A., and J. Drèze (2009): "Food and Nutrition in India: Facts and Interpretations," Economic & Political Weekly, 46(7), 42–65.

Dyson, T., and M. Moore (1983): "On Kinship Structure, Female Autonomy, and Demographic Behavior in India," Population and Development Review, 9(1), 35–60.

Falkner, F., and J. Tanner (1989): "The Low-Birth-Weight Infant," in Human Growth: A Comprehensive Treatise, ed. by F. Falkner, and J. Tanner, vol. 1, pp. 391–413. Plenum, New York.

Garg, A., and J. Morduch (1998): "Sibling Rivalry and the Gender Gap: Evidence from Child Health Outcomes in Ghana," Journal of Population Economics, 11(4), 471–493.

Glewwe, P., and E. A. Miguel (2007): "The Impact of Child Health and Nutrition on Education in Less Developed Countries," in Handbook of Development Economics, ed. by T. P. Schultz, and J. Strauss, vol. 4, pp. 3561–3606. Elsevier, Amsterdam.

Gupta, M. D. (1987): "Selective Discrimination Against Female Children in Rural Punjab, India," Population and Development Review, 13(1), 77–100.

Gwatkin, D., et al. (2007): "Socio-Economic Differences in Health, Nutrition and Population Within Developing Countries: An Overview," Health, Nutrition and Population Network Informal Paper Series, World Bank.

IIPS (2010): District Level Household and Facility Survey (DLHS-3), 2007-08. International Institute for Population Sciences, Mumbai.

Jayachandran, S., and I. Kuziemko (2011): "Why Do Mothers Breastfeed Girls Less Than Boys: Evidence and Implications for Child Health in India," Quarterly Journal of Economics, 126(3), 1485–1538.

Jensen, R. (2003): "Equal Treatment, Unequal Outcomes? Generating Sex Inequality Through Fertility Behavior," Mimeo, Harvard University.

Mishra, V., T. K. Roy, and R. D. Retherford (2004): "Sex Differentials in Childhood Feeding, Health Care and Nutritional Status," Population and Development Review, 30(2), 269–295.

Panagariya, A. (2013): "Does India Really Suffer from Worse Child Malnutrition Than Sub-Saharan Africa?," Economic and Political Weekly, 48(18).

Proos, L. A. (2009): "Growth and Development of Indian Children Adopted in Sweden," Indian Journal of Medical Research, 130, 646–650.

Rosenzweig, M. R., and T. P. Schultz (1982): "Market Opportunities, Genetic Endowments, and Intrafamily Resource Distribution: Child Survival in Rural India," The American Economic Review, 72(4), 803–815.

Savage, T., J. G. B. Derraik, H. L. Miles, et al. (2013): "Birth Order Progressively Affects Childhood Height," Clinical Endocrinology.

SEN, A. (1990): "More Than 100 Million Women Are Missing," New York Review of Books, 37(20).

SINHA, K. (2012): "Malnourishment a National Shame: Manmohan Singh," The Times of India.

SPEARS, D. (2013): "How Much International Variation in Child Height Can Sanitation Explain?," Mimeo, Princeton University.

STRAUSS, J., AND D. THOMAS (1998): "Health, Nutrition, and Economic Development," Journal of Economic Literature, 36(2), 766–817.

SUDO, N., M. SEKIYAMA, C. WATANABE, ET AL. (2004): "Gender Differences in Food and Energy Intake Among Adult Villagers in Northwestern Bangladesh: A Food Frequency Questionnaire Survey," International Journal of Food Sciences and Nutrition, 55(6), 499–509.

SULLOWAY, F. J. (1996): Born To Rebel. Pantheon, New York.

TANNER, J., M. HEALY, R. LOCKHART, J. MACKENZIE, AND R. WHITEHOUSE (1956): "Aberdeen Growth Study: I. The Prediction of Adult Body Measurements from Measurements Taken Each Year from Birth to 5 Years," Archives of Disease in Childhood, 31(159), 372.

TAROZZI, A. (2008): "Growth Reference Charts and the Nutritional Status of Indian Children," Economics and Human Biology, 6(3), 455–468.

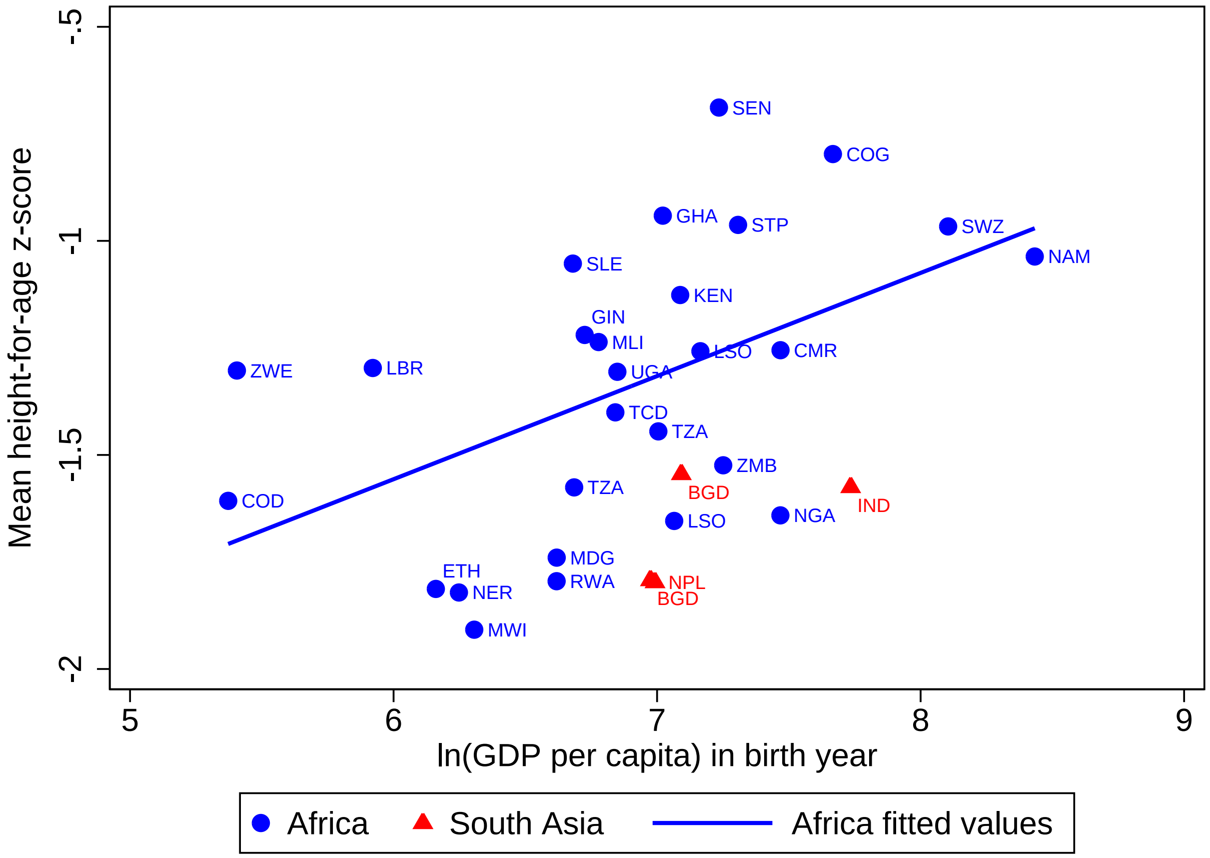
——— (2012): "Some Facts about Boy versus Girl Health Indicators in India: 19922005," CESifo Economic Studies, 58(2), 296–321.

TAROZZI, A., AND A. MAHAJAN (2007): "Child Nutrition in India in the Nineties," Economic Development and Cultural Change, 55(3), 441–486.

THOMAS, D. (1990): "Intra-household Resource Allocation: An Inferential Approach," Journal of Human Resources, 25(4), 635–664.

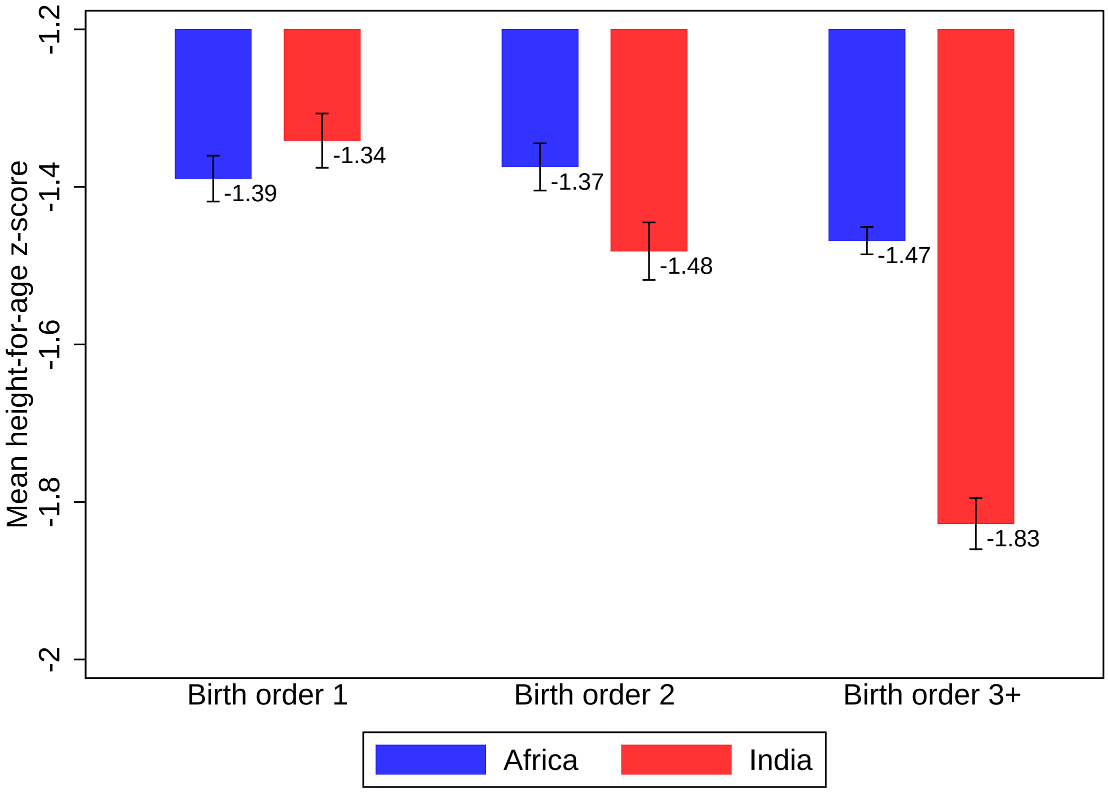
WHO MULTICENTRE GROWTH REFERENCE STUDY GROUP (2006): WHO Child Growth Standards: Methods and Development. World Health Organization, Geneva, (available at `http://www.who.int/childgrowth/standards/technical_report/en/index.html`).

Figure 1: Child height versus national GDP



The blue dots and red triangles indicate survey-specific means for Sub-Saharan Africa and South Asia surveys, respectively. The mean is calculated over all children less than 60 months old with anthropometric data. The blue line is the best linear fit for Sub-Saharan Africa.

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



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

Table 1: Birth order gradient in the India height gap

Dependent var.:	HFA z-score						Stunted
Sample:	All (1)	Boys (2)	Girls (3)	All (4)	All (5)	All (6)	All (7)
India	0.054**	0.097***	0.012				
	[0.026]	[0.037]	[0.036]				
India*2nd child	-0.171***	-0.133***	-0.212***	-0.184***	-0.174***	-0.270***	0.106***
	[0.030]	[0.044]	[0.043]	[0.031]	[0.030]	[0.079]	[0.019]
India*3rd+ child	-0.409***	-0.384***	-0.436***	-0.395***	-0.412***	-0.426***	0.143***
	[0.029]	[0.040]	[0.040]	[0.035]	[0.029]	[0.137]	[0.033]
2nd child	0.041**	0.053*	0.028	-0.089***	0.041**	-0.205***	0.045***
	[0.019]	[0.029]	[0.027]	[0.021]	[0.019]	[0.047]	[0.010]
3rd+ child	-0.056***	-0.049**	-0.062***	-0.369***	-0.055***	-0.461***	0.093***
	[0.017]	[0.024]	[0.022]	[0.023]	[0.017]	[0.075]	[0.016]
Africa mean of dep. var.	-1.435	-1.548	-1.319	-1.435	-1.435	-1.448	0.396
Mother fixed effects	No	No	No	No	No	Yes	Yes
Child age*India fixed effects	No	No	No	No	Yes	Yes	Yes
Mother's age at birth*India fixed effects	No	No	No	Yes	No	No	No
Observations	174,157	88,471	85,686	174,157	174,157	88,263	88,263

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. *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. Control variables included are survey year and child age dummies. In Columns 4-7, the main effect of *India* is absorbed by a full set of *Mother's age×India* or *Child's age×India* or mother fixed effects. In Columns 6-7, for the specifications with mother fixed effects, the sample is restricted to children who have at least one sibling in the sample. See Data Appendix for further details.

Table 2: Birth order gradient in infant mortality and in the effect of maternal height on child height

	Deceased (1)	Deceased (2)	HFA z-score (3)	HFA z-score (4)
Mother's height			5.465***	
			[0.180]	
2nd child*Mother's height			-0.026	-0.266
			[0.245]	[0.496]
3rd+ child*Mother's height			-0.621***	-0.725
			[0.217]	[0.707]
India	-0.038***		0.477***	
	[0.003]		[0.028]	
India*2nd child	0.005	0.015	-0.155***	-0.282***
	[0.003]	[0.014]	[0.033]	[0.084]
India*3rd+ child	0.013***	0.010	-0.374***	-0.470***
	[0.003]	[0.024]	[0.031]	[0.144]
2nd child	-0.018***	-0.059***	0.071	0.211
	[0.002]	[0.007]	[0.388]	[0.785]
3rd+ child	-0.013***	-0.103***	0.895***	0.678
	[0.002]	[0.012]	[0.344]	[1.120]
Africa mean of dep. var.	0.072	0.102	-1.435	-1.448
Mother fixed effects	No	Yes	No	Yes
Child age*India fixed effects	No	Yes	No	Yes
Observations	199,666	91,099	172,630	87,568

Notes: Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. In Columns 1-2, the sample comprises children, alive or deceased, who are or would have been age 13 to 59 months at the time of the survey, regardless of whether anthropometric data are available. In Columns 3-4, the sample comprises children age 1-59 months with anthropometric data. Standard errors are clustered by mother and appear in brackets. Control variables included are survey year and child age dummies. See Data Appendix for further details.

Table 3: Health inputs and outcomes for women

	Consumes fruit (1)	Consumes milk/dairy (2)	Consumes eggs/fish/ meat (3)	BMI (4)	Not anemic (5)	No physical violence (6)
India	-0.095***	0.195***	-0.235***	-1.824***	0.069***	-0.049***
	[0.022]	[0.023]	[0.020]	[0.106]	[0.011]	[0.017]
India*Has 1 child				-0.278*	-0.073***	-0.020
				[0.160]	[0.017]	[0.024]
India*Has 2+ children	-0.070***	-0.135***	-0.002	-0.685***	-0.171***	-0.109***
	[0.026]	[0.028]	[0.024]	[0.142]	[0.015]	[0.021]
India*Has 1 child*Not pregnant				0.508***	0.073***	0.059**
				[0.169]	[0.018]	[0.027]
India*Has 2+ children*Not pregnant	0.020	0.089***	0.009	0.064	0.147***	0.063***
	[0.027]	[0.029]	[0.025]	[0.147]	[0.015]	[0.023]
India*Not pregnant	-0.003	-0.050**	0.043**	0.042	-0.096***	-0.019
	[0.022]	[0.024]	[0.021]	[0.107]	[0.011]	[0.019]
Has 1 child				-0.034	0.032***	-0.101***
				[0.093]	[0.012]	[0.016]
Has 2+ children	-0.054***	-0.012	-0.042**	0.093	0.033***	-0.153***
	[0.018]	[0.020]	[0.017]	[0.072]	[0.009]	[0.012]
Has 1 child*Not pregnant				0.475***	-0.043***	0.073***
				[0.099]	[0.013]	[0.018]
Has 2+ children*Not pregnant	0.020	-0.031	-0.018	0.964***	-0.042***	0.067***
	[0.019]	[0.021]	[0.018]	[0.075]	[0.010]	[0.014]
Not pregnant	-0.005	0.037**	0.011	-1.520***	0.220***	-0.056***
	[0.017]	[0.018]	[0.016]	[0.063]	[0.008]	[0.013]
Africa mean of dep. var.	0.407	0.299	0.633	22.266	0.873	0.727
India*Has 1 child*Not preg				0.000	0.905	0.002
India*Has 2+ children*Not preg	0.000	0.000	0.407	0.000	0.000	0.000
Observations	60,697	60,521	60,604	227,872	148,561	92,119

Notes: Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. In Columns 1-3, the sample comprises women who have given birth to at least one child in the past 5 years, which is the inclusion criterion for being asked questions about food consumption; the omitted category is women who have given birth once. In columns 4-6, the sample is composed to all women for whom anthropometric data are available; the omitted category is women who have never given birth. Physical violence (column 6) is collected in only 14 African surveys. For all columns, there is one observation per mother in the regressions. Robust standard errors appear in brackets. Control variables included are survey year dummies. See Data Appendix for further details.

Table 4: Food consumption of women in India compared to their husbands

	Consumes fruit (1)	Consumes milk/dairy (2)	Consumes eggs/fish/meat (3)
Mother	0.088***	0.001	-0.001
	[0.016]	[0.017]	[0.012]
Mother*Has 1 child	-0.044*	-0.021	-0.012
	[0.025]	[0.026]	[0.018]
Mother*Has 2+ children	-0.079***	-0.098***	-0.033**
	[0.020]	[0.025]	[0.016]
Mother*Has 1 child*Not pregnant	0.031	0.025	0.024
	[0.027]	[0.029]	[0.020]
Mother*Has 2+ children*Not pregnant	0.048**	0.085***	0.035*
	[0.022]	[0.027]	[0.018]
Mother*Not pregnant	-0.067***	-0.044**	-0.021
	[0.019]	[0.020]	[0.014]
Has 1 child	-0.027	-0.023	-0.012
	[0.019]	[0.024]	[0.016]
Has 2+ children	-0.156***	-0.165***	-0.055***
	[0.016]	[0.022]	[0.015]
Has 1 child*Not pregnant	0.054**	0.035	0.028
	[0.022]	[0.027]	[0.018]
Has 2+ children*Not pregnant	0.104***	0.108***	0.033**
	[0.018]	[0.024]	[0.016]
Not pregnant	-0.046***	-0.034*	-0.003
	[0.015]	[0.018]	[0.012]
Mother*Has 1 child*Not preg	0.292	0.764	0.157
Mother*Has 2+ children*Not preg	0.001	0.250	0.785
Observations	40,177	40,190	40,159

Notes: Standard errors are clustered by household and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. The sample includes Indian women who have given birth to at least 1 child in the past 5 years and their husbands, if both spouses answered consumption questions. The omitted category is men whose wives have never given birth. See Data Appendix for further details.

Table 5: Child health inputs

	Total prenatal visits (1)	Mother took iron supplements (2)	Total tetanus shots (3)	No vision problem (4)	Delivery at health facility (5)	Exclus. breastfed for 6 mos. (6)	Min. acceptable diet (7)	Postnatal check within 2 mos. (8)	Child taking iron pills (9)	Total vaccinations (10)
India	1.871***	0.113***	0.510***	0.097***	0.046***	0.054***	0.026**	-0.104***	0.016***	0.793***
	[0.050]	[0.007]	[0.015]	[0.005]	[0.006]	[0.017]	[0.012]	[0.015]	[0.005]	[0.043]
India*2nd child	-0.497***	-0.021***	0.005	-0.007	-0.035***	0.036*	-0.005	-0.017	-0.002	-0.230***
	[0.063]	[0.008]	[0.017]	[0.005]	[0.007]	[0.021]	[0.010]	[0.013]	[0.005]	[0.043]
India*3rd+ child	-2.007***	-0.173***	-0.133***	-0.022***	-0.180***	0.051***	-0.023***	-0.035***	-0.002	-1.158***
	[0.054]	[0.007]	[0.016]	[0.005]	[0.007]	[0.019]	[0.008]	[0.011]	[0.005]	[0.046]
2nd child	-0.165***	-0.016***	-0.133***	-0.007*	-0.090***	-0.008	-0.002	0.024**	-0.006	-0.075***
	[0.034]	[0.005]	[0.013]	[0.004]	[0.004]	[0.011]	[0.007]	[0.010]	[0.004]	[0.029]
3rd+ child	-0.729***	-0.056***	-0.343***	-0.039***	-0.199***	-0.001	-0.019***	0.002	-0.031***	-0.446***
	[0.027]	[0.004]	[0.010]	[0.003]	[0.004]	[0.009]	[0.005]	[0.008]	[0.004]	[0.026]
Africa mean of dep. var.	3.828	0.617	1.406	0.854	0.469	0.313	0.130	0.297	0.112	6.187
Observations	120,570	122,977	122,530	120,119	173,772	19,936	37,710	39,248	95,986	127,544

Notes: Standard errors are clustered by household and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year and child age dummies. In Column 1-5, the sample includes children age 1-59 months; whether the mother took iron pills is collected in 10 African surveys. Data on postnatal outcomes are available for a subset of children in the sample: In Column 6, the sample comprises the youngest child from each family, age 1-6 months. In Column 7, the sample comprises the youngest child from each family, age 7-24 months; data to construct minimum acceptable diet in a comparable way to India is available in 17 African surveys. In Column 8, the sample comprises the youngest child from each family, age 1-59 months; postnatal check within 2 months is collected in 13 African surveys. In Columns 9-10, the sample includes children age 1-59 months. See Data Appendix for further details.

Table 6: Child morbidity and school enrollment

	Not anemic (1)	No diarrhea in last 2 weeks (2)	No fever or cough in last 2 weeks (3)	Years of education (4)
India	0.149***	0.062***	0.089***	1.650***
	[0.008]	[0.004]	[0.006]	[0.018]
India*2nd child	-0.020**	-0.001	0.001	-0.014
	[0.009]	[0.005]	[0.006]	[0.018]
India*3rd+ child	-0.053***	-0.008*	0.009	-0.261***
	[0.008]	[0.004]	[0.006]	[0.020]
2nd child	-0.005	0.003	0.016***	-0.030***
	[0.006]	[0.003]	[0.004]	[0.011]
3rd+ child	-0.022***	-0.003	0.011***	-0.240***
	[0.005]	[0.003]	[0.003]	[0.011]
Africa mean of dep. var.	0.567	0.843	0.664	1.999
Observations	91,661	173,570	173,316	265,352

Notes: Standard errors are clustered by household and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year and child age dummies (measured in months in columns 1-3 and years in column 4). In columns 1-3, the sample comprises children age 1-59 months. In column 4, the sample comprises children age 7 to 17 years at the time of the survey. See Data Appendix for further details.

Table 7: Birth order gradient in child height, by gender of older siblings

	HFA z-score (1)	HFA z-score (2)
India	-0.047**	-0.085
	[0.022]	[0.056]
Girl	0.230***	0.205***
	[0.013]	[0.040]
India*Girl	-0.183***	-0.160**
	[0.023]	[0.062]
Firstborn is a girl		0.021
		[0.042]
India*Firstborn is a girl		0.078
		[0.063]
India*Girl*Firstborn is a girl		-0.126
		[0.090]
Girl*Firstborn is a girl		0.032
		[0.057]
Sample	All children	2nd born children
Africa mean of dep. var.	-1.435	-1.375
Observations	174,157	36,842

Notes: Standard errors are clustered by household and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year and child age dummies. The sample includes all children age 1-59 months in Column 1 and all second-born children age 1-59 months in Column 2. See Data Appendix for further details.

Appendix Table 1: Summary statistics

	India subsample	Africa subsample		India subsample	Africa subsample
Child's age (months)	30.051 [16.872]	28.062 [17.026]	No vision problem	0.892 [0.31]	0.854 [0.353]
Mother's age at birth (years)	24.767 [5.239]	26.954 [6.857]	Delivery at health facility	0.449 [0.497]	0.469 [0.499]
Girl	0.479 [0.5]	0.496 [0.5]	Exclusively breastfed for 6 mos.	0.4 [0.49]	0.313 [0.464]
Mother's total children born	2.745 [1.829]	3.876 [2.543]	Minimum acceptable diet	0.095 [0.294]	0.13 [0.336]
HFA z-score	-1.575 [2.114]	-1.435 [2.466]	Postnatal check within 2 mos.	0.092 [0.289]	0.297 [0.457]
WFA z-score	-1.546 [1.494]	-0.869 [1.805]	Child taking iron pills	0.055 [0.228]	0.112 [0.315]
WFH z-score	-0.95 [1.998]	-0.057 [2.695]	Child's total vaccinations	6.593 [2.809]	6.187 [3.149]
Mother's BMI	21.138 [3.125]	23.133 [3.622]	Child not anemic	0.613 [0.487]	0.567 [0.495]
Mother's height	1.519 [0.058]	1.583 [0.069]	No diarrhea in last 2 weeks	0.905 [0.293]	0.843 [0.364]
Mother not anemic	0.687 [0.464]	0.702 [0.457]	No fever or cough in last 2 weeks	0.772 [0.42]	0.664 [0.472]
Mother consumes fruit	0.177 [0.337]	0.4 [0.49]	No physical violence	0.719 [0.45]	0.741 [0.438]
Mother consumes milk/dairy	0.373 [0.463]	0.282 [0.45]	Child stunted	0.414 [0.493]	0.39 [0.488]
Mother consumes egg/fish/meat	0.128 [0.27]	0.642 [0.479]	Child deceased	0.05 [0.217]	0.072 [0.259]
Total prenatal visits	4.031 [3.483]	3.828 [3.095]	Child's years of schooling	3.613 [2.556]	1.999 [2.097]
Took iron supplements	0.687 [0.464]	0.617 [0.486]	ln(GDP/cap, birth year)	7.735 [0.125]	6.891 [0.653]
Total tetanus shots	1.867 [0.941]	1.406 [1.202]			

Notes: Mean of the specified variables are calculated separately for the Indian subsample and the African subsample. Standard deviations appear in brackets.

Appendix Table 2: Correlation between child height-for-age and prenatal and postnatal inputs

Dependent var. = HFA z-score			
Sample:	All (1)	India (2)	Africa (3)
Total prenatal visits	0.035***	0.041***	0.033***
	[0.003]	[0.004]	[0.003]
Took iron supplements	0.064***	-0.051*	0.098***
	[0.015]	[0.028]	[0.018]
Total tetanus shots	0.001	0.024*	-0.006
	[0.006]	[0.014]	[0.007]
No vision problem	0.007	-0.029	0.019
	[0.019]	[0.037]	[0.022]
Delivery at health facility	0.258***	0.278***	0.254***
	[0.013]	[0.029]	[0.015]
Exclusively breastfed for 6 mos.	-0.387***	-0.372***	-0.382***
	[0.044]	[0.084]	[0.052]
Minimum acceptable diet	0.068*	0.181***	0.052
	[0.041]	[0.068]	[0.050]
Postnatal check within 2 mos.	0.097***	-0.005	0.139***
	[0.029]	[0.056]	[0.035]
Child taking iron pills	0.109***	0.014	0.142***
	[0.029]	[0.043]	[0.037]
Child's total vaccinations	0.041***	0.036***	0.042***
	[0.002]	[0.004]	[0.003]
Child not anemic	0.352***	0.519***	0.254***
	[0.013]	[0.021]	[0.017]
No diarrhea in last 2 weeks	0.170***	0.092***	0.192***
	[0.016]	[0.033]	[0.018]
No fever or cough in last 2 weeks	-0.034***	-0.005	-0.039***
	[0.012]	[0.022]	[0.014]
Consumes eggs/fish/meat	0.144***	0.139***	0.135***
	[0.024]	[0.034]	[0.031]
Consumes milk/dairy	0.064***	0.193***	-0.051
	[0.020]	[0.022]	[0.033]
Consumes fruit	0.108***	0.200***	0.048
	[0.023]	[0.033]	[0.030]
Mother's BMI	0.040***	0.039***	0.039***
	[0.002]	[0.003]	[0.002]
Mother not anemic	0.040**	0.107***	-0.035
	[0.018]	[0.027]	[0.026]
No physical violence	0.071***	0.104***	0.034
	[0.017]	[0.024]	[0.023]
Mean of dep. var.	-1.469	-1.575	-1.435
Observations	174,157	43,043	131,114

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year and child age dummies.

Appendix Table 3: Can covariates account for the India height gap?

Dependent var. = HFA z-score									
Explanatory var. :	None	Economic characteristics		Environmental features		Mother characteristics		Parents' height	
	(1)	Household wealth index (2)	Rural house-hold (3)	Open defeca-tion (4)	Access to piped water (5)	Mother is literate (6)	Empower-ment index (7)	Mother's height (8)	Father's height (9)
India	-0.135***	-0.363***	-0.189***	-0.085***	-0.203***	-0.282***	-0.208***	0.312***	-0.107**
	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.020]	[0.020]	[0.044]
Explanatory var.		0.127***	-0.512***	-0.358***	0.425***	0.449***	0.266***	5.138***	4.329***
		[0.002]	[0.012]	[0.012]	[0.012]	[0.012]	[0.017]	[0.093]	[0.224]
Explanatory var. :									
Africa mean		4.299	0.719	0.322	0.260	0.477	0.492	1.583	1.693
India mean		6.346	0.632	0.456	0.413	0.563	0.611	1.519	1.642
Observations	174,157	174,157	174,157	168,840	168,688	172,865	139,248	172,630	23,047

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year, child age, and child gender dummies. Columns 2-9 include the explanatory variable specified in the column heading. Father's height is collected in India and 4 African surveys.

Appendix Table 4: Birth order gradient in child weight + height outcomes by child age

Dependent var.:	WFA z-score		WFH z-score		HFA z-score			
Sample:	All	All	All	All	Age 1-6 mos.	Age 7-59 mos.	Age 1-6 mos.	Age 7-59 mos.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
India	-0.313***		-0.493***		-0.392***	-0.106***	-0.200**	0.079***
	[0.019]		[0.027]		[0.067]	[0.019]	[0.101]	[0.026]
India*2nd child	-0.146***	-0.213***	-0.045	-0.071			-0.099	-0.175***
	[0.022]	[0.058]	[0.033]	[0.083]			[0.129]	[0.030]
India*3rd+ child	-0.329***	-0.305***	-0.113***	-0.095			-0.310***	-0.410***
	[0.021]	[0.095]	[0.031]	[0.141]			[0.113]	[0.029]
2nd child	0.027*	0.013	-0.024	0.195***			0.172**	0.021
	[0.015]	[0.035]	[0.024]	[0.054]			[0.074]	[0.020]
3rd+ child	-0.098***	-0.058	-0.111***	0.331***			0.239***	-0.098***
	[0.013]	[0.054]	[0.021]	[0.085]			[0.060]	[0.017]
Africa mean of dep. var.	-0.869	-0.911	-0.057	-0.101	0.590	-1.713	0.590	-1.713
Observations	174,157	88,263	174,157	88,263	20,023	154,134	20,023	154,134

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year and child age dummies.

Appendix Table 5: Effect of open defecation on child height, by birth order

	HFA z-score (1)	HFA z-score (2)
Open defecation	-0.441***	
	[0.024]	
2nd child*Open defecation	0.060*	-0.032
	[0.033]	[0.068]
3rd+ child*Open defecation	0.154***	-0.078
	[0.029]	[0.098]
India	0.100***	
	[0.027]	
India*2nd child	-0.175***	-0.255***
	[0.031]	[0.081]
India*3rd+ child	-0.384***	-0.389***
	[0.030]	[0.140]
2nd child	0.028	-0.184***
	[0.021]	[0.051]
3rd+ child	-0.088***	-0.427***
	[0.019]	[0.081]
Africa mean of dep. var.	-1.435	-1.448
Mother fixed effects	No	Yes
Child age*India fixed effects	No	Yes
Observations	168,840	86,172

Notes: Standard errors are clustered by mother and appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year and child age in months dummies. Open defecation is a dummy variable that equals 1 if the mother reports that the household has no toilet facility.

Appendix Table 6: Fertility stopping patterns in India compared to Africa

	Has 2+ children (1)	Has 3+ children (2)
India	-0.103***	-0.232***
	[0.004]	[0.007]
Firstborn is a girl	-0.003	
	[0.003]	
India*Firstborn is a girl	0.037***	
	[0.005]	
First and second borns are girls		0.000
		[0.004]
First and second borns include a boy and a girl		-0.003
		[0.004]
India*First and second borns are girls		0.136***
		[0.009]
India*First and second borns include a boy and a girl		0.019**
		[0.008]
Africa mean of dep. var.	0.810	0.771
Sample	All	Mother has 2+ children
Observations	128,129	101,119

Notes: Robust standard errors appear in brackets. Asterisks denote significance: * $p < .10$, ** $p < .05$, *** $p < .01$. Control variables included are survey year and child age in months dummies.

Data Appendix

DHS surveys used

The data sets included from Sub-Saharan Africa are Democratic Republic of the Congo 2007 (V), Republic of the Congo (Brazzaville) 2005 (V), Cameroon 2004 (IV), Chad 2004 (IV), Ethiopia 2005 (V), Ghana 2008 (V), Guinea 2005 (V), Kenya 2008-9 (V), Liberia 2007 (V), Lesotho 2004 (IV), Lesotho 2009 (VI), Madagascar 2003-4 (IV), Mali 2006 (V), Malawi 2004 (IV), Niger 2006 (V), Nigeria 2008 (V), Namibia 2006-7 (V), Rwanda 2005 (V), Sierra Leone 2008 (V), Senegal 2005 (IV), Sao Tome 2008 (V), Swaziland 2006-7 (V), Tanzania 2004-5 (IV), Tanzania 2010 (VI), Uganda 2006 (V), Zambia 2007 (V), and Zimbabwe 2005-6 (V). The DHS questionnaire version (IV, V, or VI) is given in parentheses. The data set included from India is India 2005-6 (NFHS-3). For the analysis on child's educational attainment, 2 additional surveys are included, Benin 2006 (V) and Madagascar 2008-9 (V).

Height-for-age, weight-for-age, and weight-for-height z-scores

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

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

The WHO provides the values of M, L and S for each reference population by gender and age. M is the reference median value for estimating the population mean, L is the power used to transform the data to remove skewness, and S is the coefficient of variation.

Child age

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

Birth order

Children of multiple births, such as twins or triplets, are assigned the same birth order. For a child born subsequent to a multiple birth, birth order is incremented by the size of the multiple birth. For example, the next child born after firstborn twins is birth order 3. We construct birth order based on children ever born, not on only surviving children.

Maternal outcomes

Mother consumes fruit, milk/dairly, egg/fish/meat is constructed based on the DHS and NFHS variables on mother's food consumption. Mother's food consumption is available in 10 African DHS's (Ghana 2008, Liberia 2007, Nigeria 2008, Namibia 2006-7, Sierra Leone 2008, Sao Tome 2008, Swaziland 2006-7, Uganda 2006, Zambia 2007, and Zimbabwe 2005-6). These surveys asked detailed questions about the food and liquid items consumed in the last 24 hours to mothers who have given birth in the last 3 years. Based on this, we created an indicator for whether mother consumed the specified food item in the previous day. For instance, eggs, fish, meat were 3 separate questions, so we created an indicator for whether mothers consumed any one of the 3 food groups for those who answered all three questions. NFHS-3 had related but different questions about mother's food consumption. They asked all women living with a child younger than 36 months about how frequently they consume the specified food group.

Hence we coded daily consumption as 1, weekly consumption as 1/7, and occasionally and never as 0 to make the variable comparable to the one from the African DHS's. We then restrict the sample to women who are living with a child younger than 36 months to ensure that the sample inclusion criterion is consistent across surveys. NFHS-3 also asked the same set of consumption related questions to fathers in the Men's Questionnaire, and father's consumption is coded the same way.

Mother's BMI is collected for all women in some DHS's and NFHS, and collected for a smaller sample of women whose household was selected for the men's survey in the other DHS's. Hence, BMI information is available in 26 African DHS's and the NFHS. Chad 2004 is excluded because it only collects BMI information from women who had a birth in the last 3 years. Mother's BMI is the women's weight in kilograms divided by her height in meters squared. We restrict the sample to women who have given birth in the last 5 years or never given birth.

Mother's anemia is collected for all women in some DHS's and NFHS, and collected for a smaller sample of women whose household was selected for hemoglobin testing in other DHS's. Many DHS's collected anemia for smaller subsamples or did not collect anemia information at all, although they collected BMI of all women. Hence, anemia information is available in 21 African DHS's and the NFHS. It is the measure of whether the women has severe or moderate anemia according to the DHS standards. Levels below 7.0 g/dl are regarded as severe anemia and levels between 7.1g/dl and 9.9g/dl are regarded as moderate anemia. We restrict the sample to women who have given birth in the last 5 years or never given birth.

Any physical violence is collected for all married women who are selected for the domestic violence module. It is available in 14 African DHS's (Democratic Republic of the Congo 2007, Cameroon 2004, Ghana 2008, Kenya 2008-9, Liberia 2007, Mali 2006, Malawi 2004, Nigeria 2008, Rwanda 2005, Sao Tome 2008, Tanzania 2010, Uganda 2006, Zambia 2007, and Zimbabwe 2005-6) and the NFHS. It is the mother's self-report of whether she experienced any physical violence from the current spouse.

Prenatal variables

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

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

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

Any vision problem is constructed from 2 variables related to vision problems, collected for the most recent birth in the past 5 years. It is available in 26 African DHS's and the NFHS, but not available in Liberia 2007. Mothers reported whether they experienced difficulty with daylight vision (a sign of pre-eclampsia), and also whether they experienced night blindness (a sign of vitamin A deficiency) during their most recent pregnancy. Any vision problem is constructed for mothers that answered both questions, and it equals 1 if they experienced either of the problems.

Delivery at home is collected for all births in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of whether the child was delivered at her home, her parents' home, traditional birth attendant's home or some other home, in other words, not in a health facility.

Postnatal variables

Exclusively breastfed is constructed based on the mother's recall of liquid and food items given to the child in the 24 hours before the survey, and her self-report of whether the child is currently being breastfed. Both pieces of information are available for all births in the last 5 years in the full sample of 27 African DHS's and the NFHS. Since WHO recommends exclusive breastfeeding for children age 1-6 months, we restrict the sample to children age 1-6 months, which gives us the sample of youngest child in family. The variable takes the value 1 if the child is currently being breastfed and was not given any liquid or food other than breast milk.

Minimum acceptable diet is constructed based on the mother's recall of liquid and food items given to the child in the 24 hours before the survey, the frequency of feeding, and whether the child is currently being breastfed. For children age 7-24 months, WHO defines 'minimum dietary diversity' as having at least 4 of following 7 food groups: grains, roots and tubers; legumes and nuts; dairy products; flesh foods (meat, fish, poultry and liver/organ meats); eggs; vitamin-A rich fruits and vegetables; other fruits and vegetables. However, DHS questionnaires often group egg and meat together and do not differentiate vitamin A rich fruits/vegetables and regular fruits/vegetables. Hence, we modified the definition of minimum dietary diversity as having at least 4 of the following 5 food groups: grains, roots and tubers; legumes and nuts; dairy products; flesh foods (meat, fish, poultry and liver/organ meats) or eggs; fruits and vegetables. WHO defines minimum meal frequency as 2 times for breastfed infants 6-8 months old, 3 times for breastfed children 9-23 months old, and 4 times for non-breastfed children 6-23 months old. Minimum acceptable diet is meeting the minimum dietary diversity and the minimum meal frequency during the previous day. In addition, non-breastfed children should also receive a milk feeding, which we modify from WHO's recommendation of 2 milk feedings due to the lack of milk feeding frequency data. 17 African DHS's and the NFHS contain all necessary variables to determine whether the child has minimum acceptable diet. Since individual DHS's and NFHS differ in the criteria for collecting the necessary information, we restrict the sample to meet the most exclusive criteria, namely the youngest child in the family. The sample age is also restricted to age 7-24 months to meet the WHO's guideline.

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

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

Child's total vaccinations is collected for all births in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of the total number of vaccinations the child has received to date. The vaccines counted include BCG, 3 doses of DPT, 4 doses of polio, and measles, so child's total vaccinations is 9 if the child received all vaccines. The sample is restricted to children age 13-59 months since the recommended age for the vaccinations is up to age 12 months.

Child morbidity variables

Child anemic is collected for all births in the past 5 years. It is available in 21 African DHS's and the NFHS. It is the measure of whether the child is moderately or severely anemic, determined by the child's blood sample collected. Levels below 7.0 g/dl are considered as severe anemia and levels between 7.1g/dl and 9.9g/dl are considered as moderate anemia.

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

Fever or cough in last 2 weeks is constructed from 2 questions on child's recent health. Mothers reported whether the child had fever in the 2 weeks before the survey, and also whether the child had cough in the last 2 weeks. The two variables are collected for all births in the past 5 years, and is available in the full sample of 27 African DHS's and the NFHS. So the variable, Fever or cough in last 2 weeks, takes the value 1 if the child had either fever or cough in the last 2 weeks.

Other variables

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

Father's height is measured for fathers of children in some surveys. However, the survey must also provide the line number of fathers in order for fathers' information to be correctly matched to children's information. 4 African DHS's (Lesotho 2009, Sao Tome 2008, Swaziland 2006-7, Uganda 2006) as well as the NFHS provide both pieces of information. Father's height is converted to meters and is coded as missing if the height is less than 1.25 meters.

Household wealth index is constructed based on basic household asset data and available for all births in the full sample of 27 African DHS's and the NFHS. It is calculated as the sum of the following 14 indicators of household assets: Non-surface source of drinking water (surface water includes rivers, spring, pond, etc.); flush toilet; electricity; radio, television; refrigerator; bicycle; motorcycle; car; telephone; non-natural floor material (natural materials include mud/clay/earth, sand, dung, etc.); non-natural roof material (natural materials include no roofs, leaves, mud, etc.); non-natural wall material (natural materials include no walls, cane/palm/trunks, grass/reeds, etc.); and non-natural cooking fuel (natural materials include dung, straw/shrubs/grass, etc.). If the information for some of the 14 items are missing for a household, the missing values are replaced with the African mean for African DHS's, and the Indian mean for the NFHS.

Rural household is available for all births in the past 5 years in the full sample of 27 African DHS's and the NFHS. It is a DHS recoded variable of whether the child is living in a rural area.

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

Access to piped water is available for all births in the past 5 years in the full sample of 27 African DHS's and the NFHS. It is the mother's self-report of whether the household has access to piped water.

Mother is literate is available for all births in the past 5 years in the full sample of 27 African DHS's and the NFHS. It is the mother's self-report of whether she can read in any language.

Empowerment index is constructed based on four variables about the woman's say in household decision-making in different domains: health, large purchases, daily purchases, and visiting family. It is available for all births in the full sample of 27 African DHS's and the NFHS. Two other decision-making variables are available in only some surveys and hence excluded: food preparation is excluded in India and how to spend husband's earnings is excluded in the majority of African DHS's. Binaries were created for each of the four key variables for whether or not the woman had a say, either alone or with someone else, in making that decision. The index is the sum of these binaries and then re-scaled to [0,1].

Infant mortality is an indicator for whether the child is deceased is collected for all births in the past 5 years. It is available in all 27 African DHS's and the NFHS. It is the mother's self-report of whether the child is deceased. The sample is restricted to children age 13-59, as infant mortality is only defined for children over 1 year of age.

Children's years of education uses DHS data on years of schooling of household members aged 7 to 14. This analysis includes 2 additional DHS data from Sub-Saharan Africa, which were previously excluded because they did not provide anthropometric data. Years of schooling data are obtained from the DHS Household Member Recode file, and birth order data are obtained the Birth Recode file. Only those children who can be linked across the two files (i.e., have non-missing values of their own and their mother's line number variable in both files) are included. Furthermore, if the reported age of the child in the two data sets differs by more than 3 years, we exclude the child from the analysis because either the age or line number variable is likely incorrect. Thus, the education sample includes children that can be matched across files whose age, gender, and years of education are not missing, who are aged 7-14 years, and who are from India or Sub-Saharan Africa. Age 6 or 7 is the standard school entry age in most of the countries in the sample. The DHS asks for each household member's highest education level attained, excluding preschool. Based on the highest level of schooling completed and the duration of each level of schooling by country, we compute the total years of schooling the child completed. If the difference between the child's age and his or her years of schooling is less than 4 years, implying he or she entered primary school before age 4, we top-code years of schooling at the child's age minus 4 because the reported value is likely erroneous.