Gender Bias in Breastfeeding and Missing Girls in Africa: The Role of Fertility Choice*

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Abstract

This paper investigates whether there is gender bias in the duration that children are breastfed in Africa. Given evidence that breastfeeding is negatively related to future fertility, we further investigate whether any part of the gender bias is due to son preference in fertility choice. We use identical methodology to Jayachandran and Kuziemko (2010), and compare our results on Africa to their findings on India. We present separate results for North and Sub-Saharan Africa to account for differing regional levels of gender discrimination, and use a sample of over 100,000 children from 32 waves of DHS surveys across 17 countries. We find that boys are breastfed for 0.657 months longer than girls in North African countries, which is nearly twice male advantage of 0.391 months found for India. For Sub-Saharan African countries, the male breastfeeding advantage is much smaller at 0.059 months. We also find evidence analogous to Jayachandran and Kuziemko (2010) linking son-biased fertility choice to breastfeeding duration, with children being breastfed longer as birth order increases, as mothers approach or exceed their ideal total fertility, and if mothers already have a male child. Having older male siblings reduces the male advantage in breastfeeding in North Africa, but not in Sub-Saharan Africa. We estimate that annually approximately 43,000-45,000 girls in Sub-Saharan Africa are missing due to gender discrimination in breastfeeding.

JEL classification: I14, J16, O15, O55

Keywords: Breastfeeding, gender bias, son preference, Africa

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1 Introduction

Contrary to previously held wisdom, recent research has shown that the "missing women" phenomenon is prevalent in Sub-Saharan Africa (Anderson and Ray, 2010; Klasen, 1996). Anderson and Ray (2010) estimates that excess female mortality in the region is approximately 1.33-1.51 million women per year. This figure is greater than the authors' estimate of the annual number of excess female deaths in India and China combined, which is startling as the latter countries were long considered to be jointly responsible for the significant majority of the world's missing women. 184,000-192,000 of the annual excess female deaths in Sub-Saharan Africa are calculated to lie in the age-group of 0-4 year old children. This constitutes at least 12% of the total annual figure, and points to potential gender discrimination taking place in health investments during early childhood. In this paper we investigate to what extent gender discrimination is taking place in breastfeeding of children on the African continent. We also specifically try to isolate how much of any existing gender bias in breastfeeding is due to son preference in fertility preferences using an identical methodology to Jayachandran and Kuziemko (2010) and compare our findings to their's on India. We carry out the analysis using a large sample of over 100,000 children from 32 waves of Demographic and Health Survey (DHS) data from Burkina Faso, Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Egypt, Ethiopia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Morocco, Namibia, Nigeria, Swaziland, Tanzania, Zambia, and Zimbabwe. We present results separately for the North African countries of Egypt and Morocco, and the remaining countries in Sub-Saharan Africa to account for differing levels of gender bias between the two regions.

To the best of our knowledge, this is the first paper that presents estimates of gender bias in breastfeeding duration for a large sample of children across several African countries, and also the first paper to attempt to identify whether son-biased fertility preferences play a role in creating the gender difference. The consensus in the previous literature has been that Sub-Saharan Africa despite widespread poverty has little or no gender discrimination against girls in child health outcomes, and with evidence even pointing to some pro-female bias in mortality, stunting, and wasting incidence (Svedberg, 1990). Our results are the first to identify prevailing gender bias against girls in breastfeeding in the region, and also to link the discrimination to desired fertility outcomes. This is also the first paper to present comparisons of prevailing gender differences in breastfeeding in North and Sub-Saharan Africa with those in India. Finally, we present estimates of the annual excess female mortality among children aged 0-4 years in Sub-Saharan Africa that can be attributed to gender discrimination in breastfeeding during childhood that are new to the literature.

Our results have important policy implications regarding access to contraception as described in Jayachandran and Kuziemko (2010). Access to more forms of contraception could reduce breastfeeding if women adopt alternative forms of birth control and reduce their reliance on the contraceptive properties of breastfeeding. On the other hand breastfeeding could increase as a result of the greater control on the timing and and frequency of conception afford by modern contraception. There are also important implications for child health, as breastfeeding provides immunity against infectious diseases and is a healthier alternative to potentially unsafe food and water. Hence the mechanical negative relationship between number of offspring and duration of breastfeeding has potentially significant health consequences, and son preference therefore is an important factor to consider in this context as it influences the desired number of children women wish to conceive.

Separating the effect of son preference in fertility choice on gender discrimination in breastfeeding from potential alternative causes of bias, such as a simple desire to invest more in sons' health or greater relative ease of breastfeeding boys, is not straightforward. Therefore as in Jayachandran and Kuziemko (2010), we present a specific empirical pattern of results with respect to ideal fertility and sibling sex composition that albeit do not rule out alternative hypotheses, but are such that any other hypothesis would also have to explain. Our results are similar to those in Jayachandran and Kuziemko (2010) and also point to a link between desired fertility, offspring sex composition, and duration of breastfeeding. We find that there is gender discrimination in the duration of breastfeeding, with boys being breastfed 0.657 months longer on average in North Africa. This is nearly twice the male advantage of 0.391 months found in India. For Sub-Saharan African children, the male advantage is smaller at 0.059 months.

Breastfeeding duration increases in both samples with birth order, indicating a declining desire to conceive with increasing number of offspring. Breastfeeding duration increases sharply when women have conceived their reported ideal number of children, and also increases with the fraction of older siblings that are male, indicating that women do adjust the length of time they breastfeed their children to accommodate their fertility preferences and desire for male children in both North and Sub-Saharan Africa. The gain in breastfeeding from having an older male sibling reduces the male breastfeeding advantage in North Africa, but not in Sub-Saharan Africa. Overall, gender discrimination against girls in breastfeeding and the effect of son preference in fertility on this gender difference appears to be significantly stronger in North Africa than in Sub-Saharan Africa and in India. Using the results from a WHO study on the impact of breastfeeding on child mortality in developing countries, we estimate that 43,000-45,000 women are missing annually in Sub-Saharan Africa due to gender discrimination in breastfeeding.

The rest of the paper is organised as follows. Section 2 discusses the roots of differing levels of gender bias between North and Sub-Saharan Africa, and the links between breastfeeding duration and reduced fertility. Section 3 describes the data and methodology used in the analysis. Section 4 presents the results from our estimations and accompanying robustness checks. Section 5 concludes.

2 Background

The evidence linking breastfeeding to reduced future fertility is described in Jayachandran and Kuziemko (2010). According to the medical literature, breastfeeding reduces fertility by interrupting the release of the Gonadotropin-releasing hormone that is necessary to begin ovulation. Breastfeeding also may increase the level of the hormone prolactin that is an ovulation inhibitor (Blackburn, 2007). Calories are diverted away from the mother while breastfeeding, and in developing countries this may very well lead to malnutrition that prevents ovulation. The caloric requirements of breastfeeding also ostensibly play a role in children being weaned earlier in developing countries if their mothers become pregnant.

There is a wealth of evidence in the medical and social science literatures documenting the presence of son preference in human capital investments and fertility choice in North African countries (Obermeyer, 1996; El-Gilany and Shady, 2007; Klasen, 2002). This is largely because women in this region have less autonomy than men in household decision-making, have fewer rights over owning and inheriting property, and have low participation rates in the labour force (World Bank, 2004). In Sub-Saharan Africa on the other hand, son preference in fertility appears to be much less prevalent. The main reasons put forward for the lower levels of gender discrimination are that women in this region play a crucial role in agricultural production, and therefore historically exercised considerable autonomy over their own incomes, and had rights to cultivate their own land. Women also traditionally were valued further as they could bear sons, which brought honour and financial security to their husbands (Tambiah et. al., 1989). However there is still evidence of discrimination against girls in human capital investments, potentially caused to some extent by the deterioration of women's property rights with increased formalisation of land ownership which has also led to reduced decision-making autonomy (Boserup, 1985; Klasen, 1990).

3 Data and Methodology

To carry out our analysis we use data from 32 waves of DHS surveys across 17 African countries. The survey is carried out via interviews with women aged 15-49 years, and collects detailed information on each woman's fertility history, education, marital history, as well as child health and mortality outcomes, household wealth indicators, and information on family members. Specifically for our purposes, the survey records the number of months a child is breastfed for the last six children born to each woman interviewed.

As in Jayachandran and Kuziemko (2010) we make sampling restrictions to facilitate the empirical analysis. We only include children born within a mother's first eight offspring, which retains 95% of the original sample of children and prevents our results from being skewed by unusually large family size. We also only carry out our estimations for children who are living, as breastfeeding duration for deceased children is truncated in a fashion unrelated to maternal preferences. Additionally, exclude children of multiple births as children as they could bias our estimates with respect to birth order. Our North African sample from Egypt and Morocco consists of 43,471 children born to 32,305 women. The Sub-Saharan Africa sample consists of 144,454 children born to 108,292 women.

Table 1 presents descriptive statistics of of women and children. On average children are breastfed for 14.2 months in North Africa, and 15.64 months in Sub-Saharan Africa. The sex ratio is marginally biased in favour of boys in both samples. Mothers on average have 3.41-3.50 births, and 36.2-38.7% have completed primary schooling.

3.1 Empirical Strategy

We start by investigating the presence of gender bias in months of breastfeeding, as well as the variation in breastfeeding duration by birth order. To do this we use the following specification,

$$Breastfeed_i = \alpha + \gamma\, Female_i + \sum_{k=2}^{8} \beta_k \cdot \mathbb{1}(Birth\,Order_i = k) + \delta\, X_i + \theta_i + \epsilon_i \quad (1)$$

where the dependent variable $Breastfeed_i$ is the number of months child i is breastfed. $Female_i$ is a dummy variable taking the value one when child i is a girl, and zero otherwise. The coefficient γ captures any gender difference in breastfeeding that may be present. The beta coefficients capture the birth order effects, which are entered as dummy variables with the oldest child acting as the reference category. X_i is the standard vector of controls as implemented in Jayachandran and Kuziemko (2010), which includes linear and quadratic terms of mother's age, dummy variables for mother's educational attainment, linear and quadratic controls for child birth year, and a dummy variable for whether the mother resides in a rural area. These regressors control for potential confounders of the effect of child birth order, such as mother's decreased attachment to labour force with age and increasing trends in breastfeeding over time. θ_i is a vector of age-in-months fixed effects that corrects for the fact that recently-born children will appear to have fewer months of breastfeeding due to right-censoring. ϵ_i is an idiosyncratic error term. We also child birth order with the female child indicator to identify whether the gender difference in breastfeeding duration changes along different stages of the fertility cycle.

We then explore how breastfeeding changes as women near or exceed their ideal reported number of offspring. The specification implemented for this is as follows,

$$\begin{aligned} Breastfeed_i = \alpha + \gamma\, Female_i + \tau_1\, \Delta Ideal_i + \tau_2\, \mathbb{1}(\Delta Ideal_i \geq 0) \\ + \tau_3\, \mathbb{1}(\Delta Ideal_i \geq 0)^*\, \Delta Ideal_i + \delta\, X_i + \theta_i + \epsilon_i \end{aligned} \quad (2)$$

where $\Delta Ideal_i$ measures the distance from the mother's reported ideal number of children, which is defined as $(Birth\,Order_i - Ideal)$, where Ideal is the mother's reported ideal number of children. τ_1 captures the effect on breastfeeding duration as the woman approaches her ideal fertility level, and τ_2 will identify any discrete change in breastfeeding once a woman reaches or exceeds this fertility level. τ_3 captures the effect of distance from the ideal number of children once a woman has exceeded her ideal fertility level. The remaining regressors are the same as in (1).

There are some potential issues with the $\Delta Ideal_i$ variable, which are also discussed in Jayachandran and Kuziemko (2010). First, a woman's report of her ideal number of children potentially depends on the number of sons she conceives, or expects to conceive, under son-biased fertility preferences. Secondly, women may progressively update their ideal number of offspring to equal their actual number of children if they exceed their initial total desired fertility. This does not seem to be a problem in our data, as 38,255 women exceed their reported ideal total fertility by an average of 2.53 additional children.

Finally, we examine whether breastfeeding duration changes as the sex composition of older siblings changes. The specification we use for this is the following,

$$\begin{aligned} Breastfeed_i \;=\; & \alpha + \gamma\, Female_i + \chi_1\, Male\, Fraction_i \\ & + \chi_2\, Older\ Siblings_i + \delta\, X_i + \theta_i + \epsilon_i \end{aligned} \tag{3}$$

where $Male\,Fraction_i$ is the fraction of older living siblings of child i that are male, and we additionally condition on the number of older living siblings with the regressor $Older\ Siblings_i$. χ_1 will capture any impact of son preference on breastfeeding separately from that of total fertility identified in χ_2, as a higher fraction of males among total offspring is likely to increase subsequent birth intervals and therefore also potentially increase breastfeeding duration under son-biased fertility preferences. We also investigate whether the presence of just one son among the older siblings is enough to alter breastfeeding duration by replacing the regressor $Male\,Fraction_i$ with $\mathbb{1}(Male\,Fraction_i > 0)$. The remaining regressors are the same as in (1) and (2), except we also include the number of older siblings of child i who have died.

While we have data on breastfeeding duration for all children born to mothers in the five years preceding the survey, we do not estimate the above specifications with mother fixed effects. This is because women with more children born in these five years would also have conceived these children with shorter birth intervals, and therefore would have also breastfed them for shorter periods. This would create a sample selection problem, as selecting siblings born in a small time period potentially means that the older sibling was weaned early. Hence we would obtain a mechanical positive relationship between increasing birth order and breastfeeding duration, which would also bias our results with respect to ideal fertility. Mother fixed effects also do not allow us to exploit the much greater variation in male fraction of offspring between mothers.

We estimate all the specifications using ordinary least squares. We include administrative area fixed effects, and cluster the standard errors at the administrative area level.[1] Given that breastfeeding duration is right-censored due to younger children still being nursed, we also estimate the specifications using a Cox proportional hazard duration model and present these results alongside the OLS estimates for the purpose of comparison. The failure event in the Cox model is defined as a child being weaned.

4 Results

The gender-specific effects of birth order on breastfeeding duration in North and Sub-Saharan Africa estimated from (1) without additional covariates are presented in Figures 1 and 2 respectively. Breastfeeding duration increases at a diminishing rate with birth order in both regions. In North Africa it appears that the male advantage in breastfeeding is approximately 0.6 months at the first birth and increases weakly over additional births. In contrast there is a much smaller male advantage of approximately 0.1 months in breastfeeding in Sub-Saharan Africa that does not change with birth order. Both these results differ from those for India in Jayachandran and Kuziemko (2010), which finds an inverted-u pattern in the male breastfeeding advantage that peaks in the middling birth orders where mothers' desire for additional children is most gender sensitive.

The analogous estimates for North Africa after including the standard regressors are shown in Table 2. In column (1) we find that the male advantage in breastfeeding is 0.657 months on average and highly significant. This is nearly twice the male advantage of 0.391 found in the corresponding estimates for India in column (5). The linear and quadratic controls for birth order in column (1) also capture the increase in breastfeeding duration

[1]Administrative areas used are departments for Burkina Faso and Cameroon, governorates for Egypt, communes for Morocco, sub-prefectures for Cote d'Ivoire, level 3 divisions for the Democratic Republic of Congo, divisions for Kenya, local authorities for Nigeria, constituencies for Namibia, level 2 divisions for Malawi, and districts for the remaining countries.

with each birth that diminishes at higher birth order values. The same significant increase in breastfeeding duration with birth order is seen in the results for India in column (5). In column (2) we interact birth order with the female child indicator, and find a weakly increasing effect of birth order on the male breastfeeding advantage. The effect however does not have a diminishing pattern with increasing birth order, as including the interaction term of the female child dummy with the quadratic birth order control makes all the interactions insignificant. This is in contrast to the evidence for India in column (6), which shows an increasing male advantage in breastfeeding which peaks at middling birth order and then declines as discussed previously. The Cox proportional hazard results in column (4) show that girls are 2.7% more likely to be weaned than boys, but show that breastfeeding duration declines with birth order unlike in the OLS results. This is most likely because other omitted variables are biasing these coefficients, or causing the proportional hazard assumption to be violated. Cox regressions with a fuller set of controls yield more robust results, and are discussed at a later stage when calculating the impact of gender discrimination in breastfeeding on missing women in Sub-Saharan Africa.

The results on the impact of birth order on breastfeeding in Sub-Saharan Africa are reported in Table 3. In column (1) we find a male advantage in breastfeeding duration of 0.059 months on average, which is much smaller than the 0.391 month male advantage found in India in column (5), and more than ten times smaller than the estimate of 0.657 in North Africa. We also find in column (1) the same increase in breastfeeding with birth order that we did for North Africa, and as reported for India in column (5). However there are no changes in the male breastfeeding advantage in birth order in columns (2) and (3), with the interaction terms of the female child dummy with linear and quadratic birth order terms yielding insignificant estimates. This is not surprising given the evidence already seen in Figure 2, and the fact that the male advantage in breastfeeding is small to begin with. In fact the Cox regression results in column (4) show no significant gender bias in probability of weaning. They also again yield the opposite result to the OLS estimates on the effect of birth order on breastfeeding duration, but this is rectified with a fuller set of controls as mentioned previously.

We now turn to the estimates from (2) on the impact of ideal fertility. The results for North Africa are in Table 4. In column (1) we find that breastfeeding duration increases by 0.170 months with each additional child that brings the mother closer to her ideal reported number of offspring. Once she has reached this fertility level there is a sharp additional increase in breastfeeding of 0.447 months; an effect which remains positive and significant even after allowing the impact of distance from ideal total fertility to vary after the mother has exceeded her ideal fertility level. An analogous set of results is found for India in Jayachandran and Kuziemko (2010) in column (4), with breastfeeding duration increasing by 0.320 months with each child that brings the mother closer to her ideal total fertility, and then increasing discretely by 0.399 months once she has reached that number of offspring. However upon interacting the ideal fertility variables with the female child dummy, we find no gender differences in the response of breastfeeding duration as women approach or attain their ideal total fertility. This is very different from the results for India in column (5), which show that women breastfeed girls 0.590 months less if even they are at the birth order that equals or exceeds their ideal number of offspring. This reflects a high degree of sensitivity to child gender when deciding to conceive towards the end of the fertility cycle in India, which does not seem to be present in North Africa. The Cox results in column (3) show differing estimates from those in column (1), but this is most likely due to the effect of omitted variables such as birth order.

The estimates on ideal fertility for Sub-Saharan Africa are shown in Table 5. In column (1) we find as in North Africa and in column (4) for India that breastfeeding duration increases by 0.049 months with each child that brings the mother closer to her ideal fertility level, and then increases sharply by an additional 0.202 months once this fertility level is reached. In column (2) we find that girls are breastfed less if they are born after the mother has exceeded her desired number of offspring, with the gender difference increasing by 0.103 months with each birth after the ideal fertility level. This is a qualitatively different result from what we see for India in column (5), as the gender discrimination appears *after* women have reached ideal fertility rather than with the marginal child at the mother's desired fertility limit. The Cox regression results again show conflicting estimates compared to the OLS results, most likely due to omitted variables bias as discussed earlier.

We now discuss the results from specification (3) on the impact of sibling sex composition on breastfeeding. The estimates for North Africa are in Table 6. In column (1), we find breastfeeding increases by 0.528 months when the child has an older male sibling. While this is indicative of son preference in fertility choice, it could also simply reflect a maternal desire for gender diversity among her offspring. Hence in column (2) we replace the older male sibling indicator with the male fraction of older siblings to examine whether breastfeeding increases continuously with rising share of brothers among older siblings. We indeed find that an incremental increase in the fraction of brothers among older offspring increases breastfeeding, with a maximum increase of 0.557 months when all older siblings are male. It is worth noting that these estimates in columns (1) and (2) reflect the same qualitative impacts of sibling sex composition as those found for India in columns (3) and (4), and are also approximately twice as large. Given this evidence of son preference, we investigate whether the gains in breastfeeding from having an older male sibling are gender-neutral by interacting the one older male sibling indicator with the female child dummy in column (5). The estimates reveal that girls receive 0.223 more months of breastfeeding than boys due to having an older brother, eliminating 33.94% of the 0.657 month male breastfeeding advantage estimated in column (1). Similarly interacting the male fraction of older siblings with the female child dummy in column (6) shows that girls are breastfed increasingly longer than boys as the male fraction of older siblings increases, with a maximum relative female gain of 0.485 months when all older siblings are male. This is 73.82% of the male breastfeeding advantage in column (1). This evidence is suggestive of a maternal willingness to breastfeed for longer and more equitably between sons and daughters when she has already conceived sons. To investigate at which point in their fertility cycle this closing of the gender gap takes place, we include three-way interactions of the female child dummy, the older male sibling indicator, and the ideal fertility variables in column (7). The estimates show that even after already having an older son, women only breastfeed girls and boys more equally when they have reached or exceeded their ideal total fertility.

The analogous results on sibling sex composition for Sub-Saharan Africa are presented in Table 7. Columns (1) and (2) show that having one older male sibling or an increased fraction of male older siblings increases breastfeeding by 0.124 months and a maximum of 0.123 months respectively. These figures are less than half of the corresponding estimates for India in columns (3) and (4). Upon including the interaction terms of the older male sibling indicator with the female child indicator in column (5), we find that the gains in breastfeeding from having an older brother are equal between boys and girls unlike in North Africa. Including the interaction term of the male fraction of older siblings with the female child dummy in column (6) yields the same qualitative result. Including the three-way interactions of older male sibling indicator, female child dummy, and ideal fertility variables in column (7) reveals no differential breastfeeding gains by gender from an older brother along different points in the maternal fertility cycle.

4.1 Robustness Check

So far the results indicate that son preference in fertility plays a part in determining gender discrimination levels in breastfeeding duration in North and Sub-Saharan Africa. However we cannot rule out with certainty that our results are not driven by standard bias in favour of sons in health investments that manifests in a pattern highly correlated with our birth order, ideal fertility, and sibling sex composition variables. We therefore implement the same estimations with vaccinations as the dependent variable to provide additional evidence supporting the role of fertility preferences. As vaccinations are not a fertility-related health investment, we should not find the same pattern of results with respect to our regressors of interest as we do for BCG and measles vaccines, and three rounds each of the polio and DPT vaccines. The results of these estimations are in Table 8, where results for North and Sub-Saharan Africa are presented in columns (1)-(3) and (4)-(6) respectively. In column (1) we find that there is a significant bias against girls in vaccination levels in North Africa, as we also find for breastfeeding. However vaccinations received decline with birth order, in contrast to breastfeeding which increases with birth order. This is evidence in favour of the role of fertility choice in breastfeeding decisions, and also against the "learning by doing" hypothesis that could also explain our results on breastfeeding with respect to birth order. In column (2) we find that attaining or exceeding the mother's reported ideal total fertility has no impact on vaccinations. Finally in column (3) we find no impact of having an older male sibling on vaccinations in North Africa. In Sub-Saharan Africa, column (4) again shows that vaccinations decline with birth order instead of increasing as with breastfeeding duration. Column (5) shows no impact of reaching or exceeding ideal fertility level. Finally in column (6) we find that vaccinations decline when the child has an older brother, in contrast to breastfeeding duration which increases. These results collectively point to son-biased fertility choice playing an important role in our results on breastfeeding and gender bias.

4.2 Gender Bias in Breastfeeding and Missing Girls

In our earlier Cox proportional hazard estimations our results did not match the OLS results as there were problems with omitted variable bias. We therefore re-estimate the Cox specifications with a much fuller set of controls, and use the results to investigate how many of the missing girls in Sub-Saharan Africa can be attributed to gender bias in breastfeeding duration. We also use samples inclusive of children of multiple births as we are less concerned with accurately identifying birth order effects at this stage, and instead wish to accurately gauge the child age intervals at which the gender bias in breastfeeding manifests. The "survival function" for breastfeeding duration in North and Sub-Saharan Africa from the new Cox regressions are shown in Figures 1 and 2 respectively. The addition of household wealth indicators, mother's age at first birth, mother's height, sibling sex composition and birth order controls, and several other regressors greatly improve the Cox estimates of gender bias in breastfeeding duration and provide us with the necessary information to construct our missing girls estimate.

Figure 2 shows that the female disadvantage in breastfeeding occurs during the ages of 12-36 months. Research linking breastfeeding duration to child mortality in Sub-Saharan Africa is very limited, so we rely on a WHO study based on developing countries including The Gambia, Ghana, and Senegal showing that children are twice as likely to die in this age interval if they are not breastfed (WHO, 2000). Calculating the distance between the gender-specific breastfeeding survival functions in Figure 2 reveals that girls are 11.77% less likely to be breastfed than boys while aged 12-36 months. This leads to an estimate of 23.54% (11.77% * 2) excess mortality for girls in this age group. Given that Anderson and Ray (2010) estimates the number of missing girls in Sub-Saharan Africa in the age group of 0-4 years to be 184,000-192,000 per year, gender discrimination in breastfeeding would account for approximately 43,000-45,000 of these missing girls based on our estimates.

5 Conclusion

Our results show that there is significant gender bias against girls in breastfeeding duration in North Africa. On average girls are breastfed for 0.657 months less than boys, which is nearly twice the male breastfeeding advantage of 0.391 months estimated for India in Jayachandran and Kuziemko (2010). In contrast, the average male breastfeeding advantage in Sub-Saharan Africa is much smaller at 0.059 months. In both North and Sub-Saharan Africa we find that breastfeeding increases with birth order, suggesting a reduced desire to conceive additional children as mothers have more offspring. We additionally find in both regions that breastfeeding duration increases as the male fraction of older siblings increases, revealing the presence of son preference in fertility choice. Women breastfeed their children more as they approach their ideal total fertility, and breastfeeding duration increases sharply once they reach their ideal fertility level in both regions. The presence of an older male sibling greatly reduces the gender gap in breastfeeding in North Africa, especially once mothers have reached their ideal total fertility. This indicates an increased willingness on the part of mothers to stop having children and breastfeed boys and girls more equally if they already have an older son. In Sub-Saharan Africa on the other hand, the gender gap in breastfeeding is not affected by sibling sex composition. Rather, girls are breastfed less than boys if they are born after the mother has exceeded her total fertility. This potentially reflects a desire to invest relatively more in sons' health when resources are scarce due to family size exceeding the mothers' desired fertility level. This pattern of results provides much evidence linking son-biased fertility preferences to gender bias in breastfeeding, and is unlikely to be replicated by alternative hypotheses. Overall, a comparison of estimates between both African regions and India indicates that gender bias against girls in breastfeeding and son preference in fertility choice is much stronger in North Africa than in India. In Sub-Saharan Africa on the other hand, gender bias and son preference is significantly weaker than in India.

The findings we present have important implications for policy, as outline in Jayachandran and Kuziemko (2010). As access to modern contraception increases in Africa, the impact of this increased access on breastfeeding duration is ambiguous. Breastfeeding could decline if women stop relying on its contraceptive properties and substitute towards other forms of birth control. Or breastfeeding could increase if women are better able to control the timing and number of their conceptions with modern contraceptives. This has particular relevance in Sub-Saharan Africa where evidence shows that the percentage of women using condoms for pregnancy prevention has increased significantly in at least thirteen countries between 1993 and 2001, with the median proportion increasing from 5.3% to 18.8% (Cleland and Ali, 2006). Given this evidence it appears government efforts to increase contraception use are working, and therefore accompanying policies to ensure breastfeeding does not decline are also required. This is especially important in the African context as breastfeeding provides immunity to disease in early life and is a much healthier alternative to unclean food and water in unsanitary environments. For example in a study of 10,947 infants in Ghana, neonatal mortality rates were four times higher for infants who were given milk-based fluids or solids alongside breast milk compared to those who were exclusively breastfed (Edmond et. al., 2006). With such high mortality differentials attributable just to exclusive breastfeeding, policy attempting to increase contraceptive availability must be coupled with breastfeeding information campaigns to avoid unintended declines in nursing.

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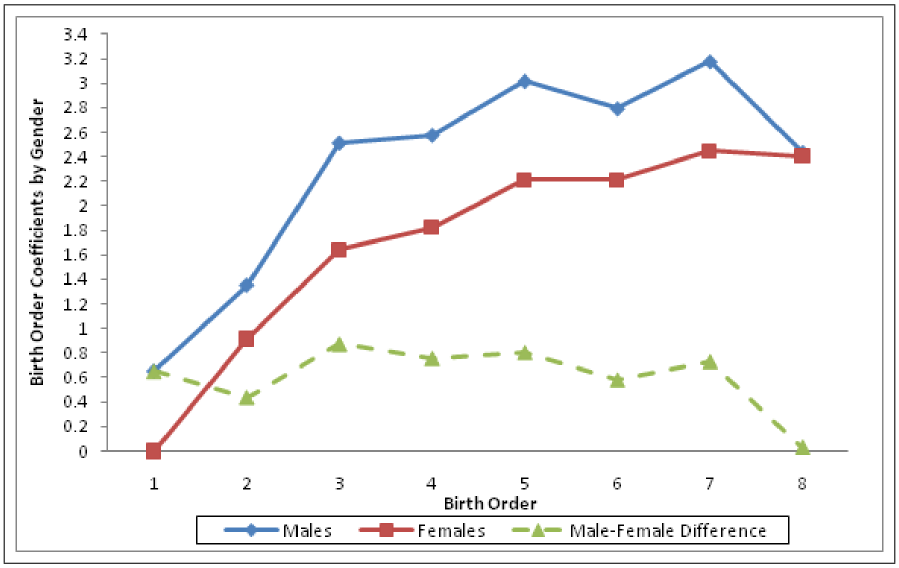
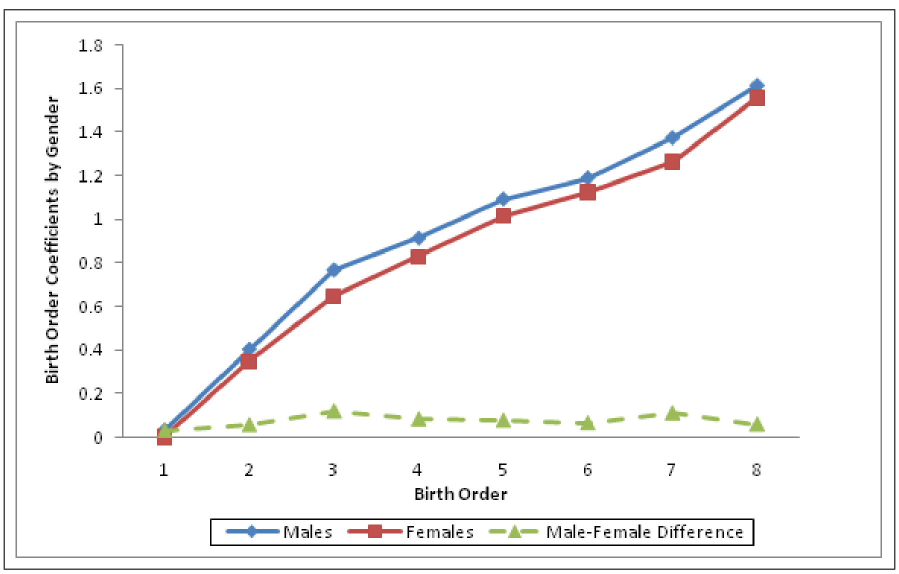
Figure 1: Months of Breastfeeding by Gender and Birth Order - North Africa



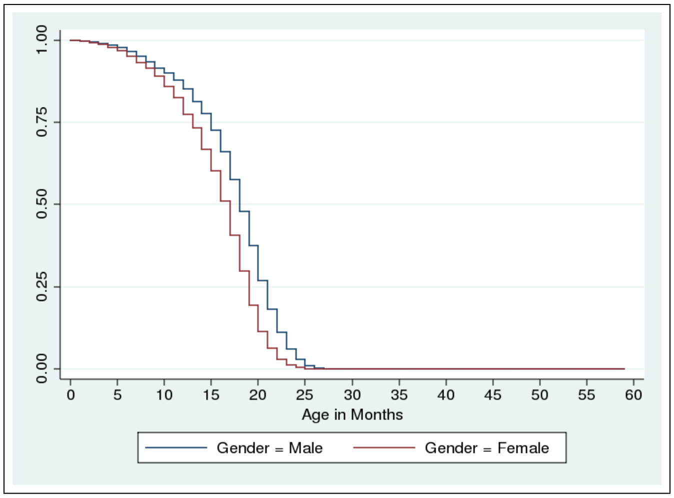
Notes: The solid lines show gender-specific coefficients from a regression of months of breastfeeding on birth order dummies. The regression also contains age-in-months fixed effects as controls. The dashed line shows the difference between the male and female-specific coefficients.

Figure 2: Months of Breastfeeding by Gender and Birth Order - Sub-Saharan Africa



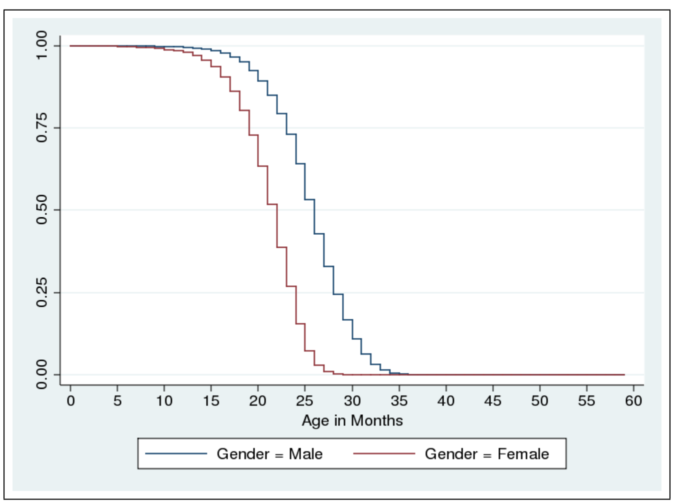
Notes: The solid lines show gender-specific coefficients from a regression of months of breastfeeding on birth order dummies. The regression also contains age-in-months fixed effects as controls. The dashed line shows the difference between the male and female-specific coefficients.

Figure 3: Breastfeeding Duration Probability - North Africa



Notes: The figure shows the breastfeeding survival function by child gender from a Cox proportional hazard regression with mother's current age, mother's age at first birth, mother's height, mother's educational attainment, number of older living siblings, The fraction of older living siblings that are male, the number of older siblings that have died, birth order dummies, indicators of household wealth and whether the child is of multiple births, and country and birth year fixed effects as controls.

Figure 4: Breastfeeding Duration Probability - Sub-Saharan Africa



Notes: The figure shows the breastfeeding survival function by child gender from a Cox proportional hazard regression with mother's current age, mother's age at first birth, mother's height, mother's educational attainment, number of older living siblings, The fraction of older living siblings that are male, the number of older siblings that have died, birth order dummies, indicators of household wealth and whether the child is of multiple births, and country and birth year fixed effects as controls.

Table 1: Summary Statistics of Mothers and Children

	North Africa				*Sub-Saharan Africa*			
Mother Characteristics	Mean	S.D	Min.	Max	Mean	S.D	Min.	Max
Current Age in Years	28.92	6.24	15	49	27.95	6.76	15	49
Years in Current Residence	21.29	11.56	0	49	15.75	11.98	0	49
Total Births	3.07	1.89	1	11	3.48	2.15	1	11
Age at First Birth	21.01	4.07	10	45	19.03	3.53	8	45
Height (cm)	158.04	5.67	125	198.7	158.46	6.64	120.2	199.8
Completed Primary School	0.471	-	0	1	0.361	-	0	1
Owns Television	0.836	-	0	1	0.180	-	0	1
Owns Radio	0.778	-	0	1	0.605	-	0	1
Earth or Sand Floor	0.253	-	0	1	0.477	-	0	1
Poorest Two Quintiles	0.429	-	0	1	0.413	-	0	1
Child Characteristics	Mean	S.D	Min.	Max	Mean	S.D	Min.	Max
Months of Breastfeeding	14.20	8.11	0	80	15.64	8.54	0	59
Age in Months	143.37	92.21	0	445	27.37	17.16	0	59
Birth Order	2.93	1.86	1	8	3.33	2.05	1	8
Female	0.486	-	0	1	0.497	-	0	1

Notes: Statistics are for samples used in estimations.

Table 2: Breastfeeding by Birth Order and Gender - North Africa

	Months of Breastfeeding					
	OLS			Cox	India	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.657***	-0.555***	-0.583***	0.027***	-0.391***	0.066
	(0.0559)	(0.083)	(0.127)	(0.010)	(0.037)	(0.131)
Birth Order	0.708***	0.725***	0.717***	0.190***	0.210***	-
	(0.062)	(0.059)	(0.080)	(0.009)	(0.018)	
$Birth\,Order^{2}$	-0.048***	-0.048***	-0.047***	-0.010***	-	-
	(0.006)	(0.006)	(0.008)	(0.001)		
$Female^{*}\,Birth\,Order$	-	-0.033*	-0.015	-	-	-0.311***
		(0.018)	(0.080)			(0.092)
$Female^{*}\,Birth\,Order^{2}$	-	-	-0.002	-	-	0.038***
			(0.009)			(0.013)
Observations	46,951	46,951	46,951	45,582	110,183	110,183
Admin. Area FE	Yes	Yes	Yes	No	No	No
Admin. Areas	360	360	360	-	-	-
R-Squared	0.459	0.459	0.459	-	0.527	0.527

Notes: Robust standard errors clustered by administrative area are in parentheses. Additional regressors include linear and quadratic terms of mother's current age, dummy variables for mother's educational attainment, linear and quadratic terms of the child's birth year, a dummy variable for whether the mother lives in a rural area, and child age-in-months fixed effects. The Cox regression results are reported in column (4). Columns (5) and (6) report OLS results for India from Jayachandran and Kuziemko (2010), where the coefficients for birth order controls in column (6) are not reported. *** Significant at 1% ; ** Significant at 5% ; * Significant at 10%.

Table 3: Breastfeeding by Birth Order and Gender - Sub-Saharan Africa

	Months of Breastfeeding					
	OLS			Cox	India	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.059**	-0.028	-0.009	0.001	-0.391***	0.066
	(0.029)	(0.054)	(0.093)	(0.007)	(0.037)	(0.131)
Birth Order	0.449***	0.454***	0.461***	0.219***	0.210***	-
	(0.037)	(0.038)	(0.046)	(0.009)	(0.018)	
$Birth\,Order^{2}$	-0.037***	-0.037***	-0.038***	-0.013***	-	-
	(0.004)	(0.004)	(0.005)	(0.001)		
$Female^{*}\,Birth\,Order$	-	-0.009	-0.023	-	-	-0.311***
		(0.014)	(0.055)			(0.092)
$Female^{*}\,Birth\,Order^{2}$	-	-	0.002	-	-	0.038***
			(0.007)			(0.013)
Observations	142,940	142,940	142,940	141,320	110,183	110,183
Admin. Area FE	Yes	Yes	Yes	No	No	No
Admin. Areas	2,485	2,485	2,485	-	-	-
R-Squared	0.571	0.571	0.571	-	0.527	0.527

Notes: Robust standard errors clustered by administrative area are in parentheses. Additional regressors include linear and quadratic terms of mother's current age, dummy variables for mother's educational attainment, linear and quadratic terms of the child's birth year, a dummy variable for whether the mother lives in a rural area, and child age-in-months fixed effects. The Cox regression results are reported in column (4). Columns (5) and (6) report OLS results for India from Jayachandran and Kuziemko (2010), where the coefficients for birth order controls in column (6) are not reported. *** Significant at 1% ; ** Significant at 5% ; * Significant at 10%.

Table 4: Breastfeeding by Ideal Fertility - North Africa

	Months of Breastfeeding				
	OLS		Cox	India	
	(1)	(2)	(3)	(4)	(5)
$Female$	-0.645***	-0.816***	0.024**	-0.374***	-0.019
	(0.051)	(0.159)	(0.010)	(0.039)	(0.130)
$\Delta Ideal$	0.170***	0.217***	0.020**	0.320***	-
	(0.049)	(0.055)	(0.008)	(0.044)	
$\mathbb{1}(\Delta Ideal \geq 0)$	0.447***	0.320***	0.199***	0.399***	-
	(0.090)	(0.104)	(0.016)	(0.074)	
$\mathbb{1}(\Delta Ideal \geq 0) * \Delta Ideal$	-0.214***	-0.239***	0.030***	-0.215***	-
	(0.059)	(0.056)	(0.009)	(0.052)	
$Female * \Delta Ideal$	-	-0.089	-	-	-0.102
		(0.090)			(0.082)
$Female * \mathbb{1}(\Delta Ideal \geq 0)$	-	0.255	-	-	-0.590***
		(0.196)			(0.013)
$Female * \mathbb{1}(\Delta Ideal \geq 0) * \Delta Ideal$	-	0.0429	-	-	0.113
		(0.088)			(0.096)
Observations	40,775	40,775	39,638	104,456	104,456
Admin. Area FE	Yes	Yes	No	No	No
Admin. Areas	360	360	-	-	-
R-Squared	0.447	0.447	-	0.524	0.524

Notes: Robust standard errors clustered by administrative area are in parentheses. Additional regressors include linear and quadratic terms of mother's current age, dummy variables for mother's educational attainment, linear and quadratic terms of the child's birth year, a dummy variable for whether the mother lives in a rural area, and child age-in-months fixed effects. The Cox regression results are reported in column (3). Columns (4) and (5) report OLS results for India from Jayachandran and Kuziemko (2010), where the coefficients for ideal fertility controls in column (5) are not reported. *** Significant at 1% ; ** Significant at 5% ; * Significant at 10%.

Table 5: Breastfeeding by Ideal Fertility - Sub-Saharan Africa

	Months of Breastfeeding				
	OLS		Cox	India	
	(1)	(2)	(3)	(4)	(5)
$Female$	-0.050	0.007	0.001	-0.374***	-0.019
	(0.031)	(0.058)	(0.007)	(0.039)	(0.130)
$\Delta Ideal$	0.049***	0.042***	0.025***	0.320***	-
	(0.010)	(0.013)	(0.003)	(0.044)	
$\mathbb{1}(\Delta Ideal \geq 0)$	0.202***	0.203***	0.113***	0.399***	-
	(0.050)	(0.071)	(0.014)	(0.074)	
$\mathbb{1}(\Delta Ideal \geq 0) * \Delta Ideal$	-0.083***	-0.031	-0.022***	-0.215***	-
	(0.026)	(0.035)	(0.006)	(0.052)	
$Female * \Delta Ideal$	-	0.012	-	-	-0.102
		(0.015)			(0.082)
$Female * \mathbb{1}(\Delta Ideal \geq 0)$	-	0.000	-	-	-0.590***
		(0.101)			(0.013)
$Female * \mathbb{1}(\Delta Ideal \geq 0) * \Delta Ideal$	-	-0.103**	-	-	0.113
		(0.048)			(0.096)
Observations	130,733	130,733	129,277	104,456	104,456
Admin. Area FE	Yes	Yes	No	No	No
Admin. Areas	2,485	2,485	-	-	-
R-Squared	0.568	0.568	-	0.524	0.524

Notes: Robust standard errors clustered by administrative area are in parentheses. Additional regressors include linear and quadratic terms of mother's current age, dummy variables for mother's educational attainment, linear and quadratic terms of the child's birth year, a dummy variable for whether the mother lives in a rural area, and child age-in-months fixed effects. The Cox regression results are reported in column (3). Columns (4) and (5) report OLS results for India from Jayachandran and Kuziemko (2010), where the coefficients for ideal fertility controls in column (5) are not reported. *** Significant at 1% ; ** Significant at 5% ; * Significant at 10%.

Table 6: Breastfeeding by Sibling Sex Composition - North Africa

	Months of Breastfeeding						
	OLS		India		OLS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Female$	-0.657*** (0.055)	-0.656*** (0.056)	-0.244*** (0.049)	-0.262*** (0.055)	-0.773*** (0.079)	-0.828*** (0.078)	-0.739*** (0.058)
$\mathbb{1}(Male\,Fraction > 0)$	0.528*** (0.076)	-	0.280*** (0.062)	-	0.420*** (0.075)	-	0.482*** (0.155)
$Male\,Fraction$	-	0.557*** (0.090)	-	0.231*** (0.075)	-	0.321*** (0.089)	-
$Female * \mathbb{1}(Male\,Fraction > 0)$	-	-	-	-	0.223** (0.098)	-	-
$Female * Male\,Fraction$	-	-	-	-	-	0.485*** (0.145)	-
$Female * \mathbb{1}(Male\,Fraction > 0) * \Delta Ideal$	-	-	-	-	-	-	-0.066 (0.045)
$Female * \mathbb{1}(Male\,Fraction > 0) * \mathbb{1}(\Delta Ideal \geq 0)$	-	-	-	-	-	-	0.273** (0.111)
Observations	46,951	46,951	110,183	110,183	46,951	46,951	40,775
Admin. Area FE	Yes	Yes	No	No	Yes	Yes	Yes
Admin. Areas	360	360	-	-	360	360	360
R-Squared	0.459	0.459	0.527	0.527	0.459	0.459	0.450

Notes: Robust standard errors clustered by administrative area are in parentheses. Additional regressors include the number of older living siblings, the number of older siblings that have died, linear and quadratic terms of mother's current age, dummy variables for mother's educational attainment, linear and quadratic terms of the child's birth year, a dummy variable for whether the mother lives in a rural area, and child age-in-months fixed effects. Columns (3) and (4) report OLS results for India from Jayachandran and Kuziemko (2010). Column (7) also includes two-way interactions of the older male sibling dummy and the ideal fertility variables, and the un-interacted ideal fertility variables. *** Significant at 1% ; ** Significant at 5% ; * Significant at 10%.

Table 7: Breastfeeding by Sibling Sex Composition - Sub-Saharan Africa

	Months of Breastfeeding						
	OLS		India		OLS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Female$	-0.059**	-0.059**	-0.244***	-0.262***	-0.077*	-0.068*	-0.074*
	(0.029)	(0.029)	(0.049)	(0.055)	(0.041)	(0.039)	(0.038)
$\mathbb{1}(Male\,Fraction > 0)$	0.124***	-	0.280***	-	0.107**	-	0.103
	(0.039)		(0.062)		(0.047)		(0.066)
$Male\,Fraction$	-	0.123***	-	0.231***	-	0.111**	-
		(0.041)		(0.075)		(0.053)	
$Female * \mathbb{1}(Male\,Fraction > 0)$	-	-	-	-	0.034	-	-
					(0.055)		
$Female * Male\,Fraction$	-	-	-	-	-	0.024	-
						(0.071)	
$Female * \mathbb{1}(Male\,Fraction > 0) * \Delta Ideal$	-	-	-	-	-	-	-0.023
							(0.015)
$Female * \mathbb{1}(Male\,Fraction > 0) * \mathbb{1}(\Delta Ideal \geq 0)$	-	-	-	-	-	-	0.027
							(0.083)
Observations	142,940	142,940	110,183	110,183	142,940	142,940	130,733
Admin. Area FE	Yes	Yes	No	No	Yes	Yes	Yes
Admin. Areas	2,485	2,485	-	-	2,485	2,485	2,485
R-Squared	0.571	0.571	0.527	0.527	0.571	0.571	0.568

Notes: Robust standard errors clustered by administrative area are in parentheses. Additional regressors include the number of older living siblings, the number of older siblings that have died, linear and quadratic terms of mother's current age, dummy variables for mother's educational attainment, linear and quadratic terms of the child's birth year, a dummy variable for whether the mother lives in a rural area, and child age-in-months fixed effects. Columns (3) and (4) report OLS results for India from Jayachandran and Kuziemko (2010). Column (7) also includes two-way interactions of the older male sibling dummy and the ideal fertility variables, and the un-interacted Ideal fertility variables. *** Significant at 1% ; ** Significant at 5% ; * Significant at 10%.

Table 8: Vaccinations by Gender, Birth Order, and Ideal Fertility

	Number of Vaccinations					
	North Africa			Sub-Saharan Africa		
	(1)	(2)	(3)	(4)	(5)	(6)
$Female$	-0.062***	-0.050***	-0.062***	-0.012	-0.012	-0.012
	(0.020)	(0.018)	(0.020)	(0.012)	(0.013)	(0.012)
$Birth\,Order$	-0.023*	-	-	-0.089***	-	-
	(0.013)			(0.016)		
$Birth\,Order^{\,2}$	-0.002	-	-	0.005***	-	-
	(0.001)			(0.002)		
$\mathbb{1}(\Delta Ideal\ \geq\ 0)$	-	-0.011	-	-	-0.026	-
		(0.022)			(0.018)	
$\mathbb{1}(Male\,Fraction\ >\ 0)$	-	-	-0.018	-	-	-0.044**
			(0.015)			(0.018)
Observations	46,951	40,775	46,951	142,940	130,733	142,940
Admin. Area FE	Yes	Yes	Yes	Yes	Yes	Yes
Admin. Areas	360	360	360	2,486	2,486	2,485
R-Squared	0.666	0.683	0.666	0.243	0.249	0.243

Notes: Robust standard errors clustered by administrative area are in parentheses. Additional regressors include linear and quadratic terms of mother's current age, dummy variables for mother's educational attainment, linear and quadratic terms of the child's birth year, a dummy variable for whether the mother lives in a rural area, and child age-in-months fixed effects. Columns (3) and (6) also include linear and quadratic birth order controls. *** Significant at 1% ; ** Significant at 5% ; * Significant at 10%.