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Abhishek Dureja, Plaksha University
Digvijay S. Negi, Ashoka University

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Birth Order Effects in Maternal Health-Seeking Behavior: Evidence from India

Abhishek Dureja* Digvijay S. Negi†

Abstract

Can maternal health-seeking behavior change with subsequent births? We find a 5 percentage point decline in the likelihood of a mother delivering her later born in an institutional facility compared to her first born. We also observe a 4 percentage point decline in medically supervised births for higher birth order children. These effects seem to be driven by changed risk perceptions associated with a complication free first child's delivery and increased financial constraints. Improvements in roads and banking infrastructure attenuate this negative birth order gradient. Results highlight the importance of birth order as an important determinant of maternal health-seeking behavior.

Keywords: Birth order, institutional delivery, prenatal investments, India

JEL Classification: **I12, I15, I18**

*Assistant Professor, Plaksha Univerisity, Sahibzada Ajit Singh Nagar, Punjab, 140306, India. Email: abhishek.dureja@plaksha.edu.in.

†Associate Professor, Department of Economics, Ashoka University, Sonepat, Haryana, 131029, India. Email: digvijay.negi@ashoka.edu.in.

1 Introduction

The choice of institutional healthcare during pregnancy reflects parental investment in children before or at the time of their birth. Evidence shows that institutional prenatal healthcare has an important role in childrens' health endowments at birth in turn influencing their future health and economic outcomes (Almond and Currie, 2011; Almond et al., 2018; Bharadwaj and Lakdawala, 2013; Black et al., 2007; Blencowe et al., 2010; Case et al., 2005; Currie and Vogl, 2013; Fox et al., 1994; Gortmaker, 1979; Gupta and Keyl, 1998; Jaakkola and Gissler, 2004). Institutional delivery in the presence of doctors ensures access to good intrapartum as well as emergency obstetric care and thus is associated with lower neonatal (maternal) deaths (Daysal et al., 2015; Godlonton and Okeke, 2016; Okeke and Chari, 2018) and plausibly better future health outcomes through higher parental health investments like breastfeeding or vaccination (Friedman et al., 2022; Hirani et al., 2022; Sievertsen and Wüst, 2017). More importantly, measures of prenatal health-seeking behavior also correlate with postnatal care-seeking (Alebel et al., 2017, 2018; Bharadwaj and Lakdawala, 2013; Biks et al., 2015; Bishaw Geremew et al., 2021; Moyer et al., 2013).

Institutional delivery and professional assistance during maternity, however, impose a financial burden on the household. The associated costs may either be direct or indirect for the family members (O'Donnell, 2007). The direct costs include the user fees associated with delivering in the institutional facility and availing healthcare services (Banke-Thomas et al., 2021; Mori et al., 2020; Odhiambo et al., 2019). In developing countries, even the nearest health facility may be located very far from the village implying high travel costs for seeking healthcare (Kruk et al., 2008; Kumar et al., 2014). The opportunity cost associated with the forgone labor market opportunities for the mother and the person accompanying the expecting mother may also impose significant indirect costs of availing formal healthcare services (Dureja and Negi, 2022; Grimes et al., 2011; Kowalewski et al., 2002). These factors constrain limited household finances and can restrict general healthcare utilization (Cohen and Dupas, 2010; Hangoma et al., 2018; McGuire et al., 2021; Renard, 2022).

In this paper, we evaluate whether maternal health-seeking behavior changes with a mother's subsequent births. We use delivery in a medical health facility and the presence of a medically trained practitioner as measures of a mother's prenatal health-seeking behavior. In particular, we compare how the likelihood of delivery in an institutional facility varies with the birth order of the children born to the mother. We use data from the two most recent waves of the Demographic and Health Survey (DHS) (or the National Family Health Survey (NFHS) IV and V) of India, conducted in 2015-16 and 2019-21. The women's module of the survey records information on the place of delivery for each birth delivered by the surveyed woman five years prior to the date of the survey. It also records self-reported information on the type of personnel who assisted the mother at the time of delivery.

We construct a mother-level panel of child births for mothers who started child bearing in the survey reference period, i.e., five years before the survey and delivered at least two children in the last five years. Our final sample has 111,000 births from over 52,000 mothers. We focus on three related indicators of maternal health-seeking behavior during delivery: delivery in an institutional facility; skilled healthcare professional presence for delivery assistance; and non-healthcare professional presence for delivery assistance. We exploit the within-mother variation to examine the change in the likelihood of a second (or a third) child being born in an institutional facility (or in the presence of a formal healthcare professional) when compared with the first born child of the mother. We find, on average, a 5 percentage point decline in the likelihood of a mother delivering her second and third born in an institutional facility as compared to her first born. This maps to a 4 percentage point decline in medically supervised births for higher birth order children. Instead, these higher birth order children are more likely to be delivered in the presence of traditional birth attendants. We observe that first born children delivered in an institutional facility are more likely to be vaccinated than first borns who are not delivered in a medical facility. Moreover, we also find a negative birth order gradient in the likelihood of a child receiving a BCG or a Polio vaccine at birth. However, the birth order gradient in vaccination is absent for children delivered in a medical facility.

We explore three potential factors that may drive a negative birth order gradient in

the demand for institutional care. First, we test the dilution hypothesis which states that the available household resources may be lower for later born, at each comparable stage, when compared to the first born (Blake, 1981, 2022). However, the dilution of resources with the birth order may be absent in wealth-rich households relative to poorer households. We test and find weak evidence in support of the dilution hypothesis. The birth-order effects are also present for wealth-rich households suggesting that the dilution of household resources is not the only explanation for the observed effects.

Second, we test for the role of uncertainty in engendering behavioral shifts in maternal health-seeking behavior. A smooth and complication free first child's delivery experience may dampen the mother's perceived level of uncertainty (or risks) associated with pregnancy and delivery care, or alternatively can make her more informed about her health status, thus reducing the demand for medical care (Brenøe and Molitor, 2018; Dardanoni and Wagstaff, 1990). We test this by using the neonatal death of the first born as an adverse outcome before the mother's subsequent birth. We find the negative birth-order gradient to be completely absent for this subset of mothers. This is suggestive of the role of uncertainty in the observed birth-order gradient in maternal health-seeking behavior. We also examine if first born son preference is driving the gradient but do not find supporting evidence.

Finally, we examine whether the birth order effects are moderated by infrastructure improvements. We find that later born children are 6.8 percentage points less likely to be born in an institutional facility. However, this effect is 2 percentage points lower for those women whose later born children were born after the construction of a new rural road in their village. Further, the effect is additionally 1.2 percentage points lower for the later born if the village was unbanked when a woman's first child was born, but a new bank branch subsequently opened before the birth of the later born.

We contribute to the thin literature that explores and documents birth order effects in prenatal child health investment. Evidence from developed countries suggests that the demand for prenatal care – regarded as a measure of prenatal health investment – subsequently declines with birth order. In particular, mothers are less likely to take prenatal vitamins, receive prenatal

care, visit midwives or a medical practitioner, reduce alcohol consumption, and are more likely to seek delayed prenatal care for their later born children when compared to their first born child (Brenøe and Molitor, 2018; Buckles and Kolka, 2014; Lehmann et al., 2018; Pruckner et al., 2021).[1] Evidence in the context of developing countries is even more limited. Using the DHS for three African countries – Malawi, Uganda, and Zimbabwe – Makate (2016) finds that mothers are less likely to make prenatal health visits and utilize medical facilities for delivering their later born children. Similarly, Guliani et al. (2012) pools DHS across 32 low-income countries and finds that mothers are monotonically less likely to deliver children of higher birth orders in an institutional facility.[2]

We add to this literature by documenting a negative birth-order gradient in prenatal health investments for later born children in India. We compare outcomes between the first and later born children of the same mother who started childbearing in the reference period of the DHS. We find that second and third-born children are less likely to be born in an institutional facility in the presence of a skilled medical health practitioner. Further, we show that this makes the later born less likely to receive vaccines that are administered at the time of birth.

A recent set of papers document a differential birth-order gradient in health outcomes of children in India when compared to those in Africa (Coffey and Spears, 2021; Jayachandran and Pande, 2017; Spears et al., 2022). Coffey and Spears (2021) find significant neonatal mortality advantage at higher birth orders for children in India as compared to those in Africa. They find that Indian mothers are malnourished at the beginning of their child bearing careers but subsequently gain weight, thus generating a neonatal mortality advantage for later born children, irrespective of the mother's fertility (or the *sibsize*). Similarly, Spears et al. (2022) find a positive birth order gradient in the height-for-age for later born children in India but not for children in Africa. This literature also highlights the pitfalls of using survey data rather than

[1] Evidence relating to smoking, however, is less clear. Further, post-natal investments – as measured by the likelihood of breastfeeding, preventive medical screenings, and vaccination uptake – are also lower for later born when compared to their first born sibling (Buckles and Kolka, 2014; Lehmann et al., 2018; Pruckner et al., 2021).

[2] De Haan et al. (2014) presents evidence from Ecuador that later born siblings are breastfed for longer duration as compared to the first born.

complete birth history in generating spurious correlations (Black et al., 2005; Spears et al., 2019, 2022). We add to this literature documenting birth order gradients in previously unexplored maternal health-seeking behavior while paying special attention to the empirical challenges of using censored survey data for studying birth order effects. Our findings, however, suggest a negative birth order gradient in maternal health-seeking behavior and immunization which can generate a neonatal mortality disadvantage for later born. Even though the empirical evidence suggests that neo-natal mortality in India declines with subsequent births, our findings suggest that this can possibly be constrained by a decline in mothers' health-seeking behavior with subsequent pregnancies.

Finally, we also connect with the literature studying the role of improved infrastructure in healthcare utilization. It is well established that demand side factors constrain healthcare utilization, especially in the context of developing countries (O'Donnell, 2007). In particular, monetary factors including household income, direct cost of the service as well as the indirect costs of seeking care, like travel costs and the opportunity cost of time, restrict utilization of healthcare facilities during pregnancy. In such a scenario, improvements in the supply side support infrastructure, like better road connectivity, may improve healthcare utilization by lowering travel costs and reducing distance to nearest health facility (Kumar et al., 2014; Masters et al., 2013; McGuire et al., 2021; Tegegne et al., 2018). Similarly, the availability of financial institutions or access to saving mechanisms can increase preventive health investments and enhance the ability to meet expenses during health emergencies by relaxing binding credit or liquidity constraints (Augsburg et al., 2023; Dupas and Robinson, 2013; Egami and Matsumoto, 2020; Meredith et al., 2013; Tarozzi et al., 2014). Dupas and Robinson (2013) provide evidence from rural Kenya that providing a *safe-box* to save money can increase preventive health investments. In particular, in the context of maternal health behavior, evidence from India suggests that women participating in microcredit programs and having a bank account are more likely to make antenatal care visits and deliver in formal healthcare facilities (Dehingia et al., 2019; Singh et al., 2019). Cramer (2021) documents the general equilibrium effects of bank presence on health investments and health outcomes in India. Using a regression discontinuity design, Cramer (2021) finds that bank presence reduces the likelihood of suffering from a non-

chronic illness and lowers the number of illness (or missed work) days. Further, Cramer (2021) finds an increase in household healthcare demand, as measured by the likelihood of delivering in a health facility and seeking vaccination. While better infrastructure is shown to improve health-seeking behavior and health outcomes, we test whether expansion or improvements in road or bank infrastructure between subsequent deliveries of a mother can moderate the observed birth order gradient in maternal health-seeking behavior.

2 Data and Empirical Framework

2.1 Data

We combine the two most recent rounds of the Demographic and Health Survey (DHS) of India– the fourth and the fifth wave of the National Family Health Survey (NFHS-IV and NFHS-V)– conducted in 2015-16 and 2019-21. NFHS is a nationally representative survey of women in reproductive ages of 15-49 years. The "Pregnancy, Delivery, Postnatal Care and Children's Nutrition" section of the women's questionnaire collects information on the place of delivery of each child born to the surveyed woman five years prior to the date of the survey. In particular, it enquires whether the child was delivered at home or in a public or private health facility.[3]

It also records self-reported information on the type of personnel who assisted the woman at the time of delivery. More specifically, it records whether assistance from health or non-health personnel was sought during delivery. Health personnel include doctors, nurses, Auxiliary Nursing Midwifes (ANM), Accredited Social Health Activist (ASHA), or any other health professional. Non-health personnel include traditional birth attendants, friends, or relatives. The place of institutional delivery and type of personnel assisting during delivery reflects

[3]Home further includes whether the child was born in her own home, parent's home, or any other home. Public health facilities are sub-categorized into Government/Municipal hospitals, Government dispensaries, community or public health centers, health sub-centers, or rural hospitals. Private health facilities include private hospitals, maternity homes/clinics, or any other NGO/Trust hospitals or clinics provided by the private sector.

the mother's (or household's) demand for delivery care. The 'Kids Recode' module of the DHS provides this information. However, this information is recorded only for those children who were born within five years preceding the date of the survey. Since NFHS-IV was conducted in 2015-16, the reference recall period extends over 2010-2016. The reference period for NFHS-V is 2014-2021. We append this information for two rounds of the DHS. In the appended sample, we observe child births from 2010 to 2021. See Appendix Table A1 for details.

Our dataset is constructed as follows. We are interested in comparing the differences in mothers' demands for institutional delivery care of later born children to those of first borns. This renders the full sample of childbirths to be less useful in examining the birth order effects of maternal health-seeking behavior. The reason is that the information regarding the mother's demand for delivery care is available only for those births that were delivered five years before the date of the survey. Therefore we retain only those mothers who started childbearing in the reference period, i.e. five years before the survey.

Further, we also remove all mothers who delivered more than three children in the reference period as these are likely to be high fertility mothers with very low birth spacing. The total fertility rate per woman in India has constantly been declining and has reduced from 3.4 children per women in 1992-93 to 2.7 children per woman in 2004-05 and subsequently to 2.2 children per woman in 2015-16 and 2 children per woman in 2019-21 (IIPS and ICF, 2017, 2021). Following Black et al. (2005), we also remove all mothers who gave birth to twins (or more children). We further restrict our data to those women whose places of residence did not change after they started childbearing. We do this in two steps. First, we dropped all the mothers who reported being 'visitors' during the survey while enquiring about the number of years they have been residing in their current place of residence. Second, we remove all those mothers for whom the number of years lived in the current place of residence is lower than the number of years before her eldest child was born. By doing this, we remove all those mothers who didn't start childbearing in their current place of residence, thereby restricting the differential impact of the nearest health facility distance as a confounding factor in choice

of institutional delivery (Kumar et al., 2014; McGuire et al., 2021).[4] After doing this, we have 1,59,855 first-time mothers with 2,18,127 childbirths, wherein 1,06,895 mothers delivered exactly one child (first born); 47,648 mothers delivered exactly two children (first and second born); and 5,312 mothers delivered exactly three children (first, second, and third-born) in the reference period. See Appendix Table A1 for details. Given that we would be doing a within mother comparison, our primary estimation sample does not consider mothers with just one birth during the survey reference period hence has 111,000 births from over 52,853 mothers.

2.1.1 Rural Road Expansion

The Government of India launched the Pradhan Mantri Gram Sadak Yojana (PMGSY) or the Prime Minister Village Road Construction Program on 25th December 2000 to connect previously unconnected rural habitations (villages) to the nearest market center by constructing a network of paved all-weather roads. While the program aimed at providing feeder roads to unconnected villages, the program also provided for upgrading existing roads (Aggarwal, 2021; Asher and Novosad, 2020). As per the policy, the eligibility criteria were based on the village's population thus making it less susceptible to endogeneity concerns (Aggarwal, 2021). In particular, the policy provided for prioritizing constructing roads in unconnected villages with populations of at least 1000 followed by connecting villages with populations above 500 and 250, respectively.[5] The program implementation, however, varied across states depending upon the population distribution of unconnected villages. Nonetheless, previous empirical studies examining the impact of the PMGSY provide evidence that the program implementation broadly followed the policy provided population based threshold criteria (Adukia et al., 2020; Asher and Novosad, 2020; Shamdasani, 2021).

The administrative data relating to the PMGSY implementation is provided online by the Ministry of Rural Development via the Online Management, Monitoring and Accounting

[4]Notetheless, the access to health facilities over time may still improve due to opening up of new healthcare facilities or development of road infrastructure etc. We discuss this in more detail later.

[5]However, the population-based threshold was lower in hilly, desert, and tribal regions.

System (OMMAS). The Socioeconomic High resolution Rural Urban Geographic Dataset on India (SHRUG) provides ready access to this administrative data for over 5,70,000 uniquely identified villages till the year 2015 (Asher et al., 2021; Asher and Novosad, 2020). In particular, it provides information on the date of completion of each newly constructed or upgraded road under the PMGSY program. It additionally provides geographic coordinates of each of these uniquely identified villages. While it is not possible to directly match the DHS villages with villages in the SHRUG, we match each DHS cluster (village) with its nearest neighbor in the SHRUG dataset. The geographic location of DHS clusters is displaced up to 2 km in urban clusters and up to 5 km in rural clusters. To reduce the measurement error induced by this, we removed all the villages observed in the DHS sample that mapped to two or more nearest villages in the SHRUG dataset. This variation is useful for us to examine whether improvements in road connectivity can moderate the birth order effects in maternal health-seeking behavior.

2.1.2 Banking Expansion

To increase the presence of commercial banks in districts with inadequate banking facilities, the Reserve bank of India (RBI), on 8^{th} September 2005, liberalized its branch licensing policy. In particular, the RBI allowed banks to propose annual bank branch expansion plans in line with the medium term goals and strategy of each respective bank (Reserve Bank of India, 2005). Commercial banks were incentivized to expand in inadequately served districts where the population-to-branch ratio was higher than the national average (Cramer, 2021). In particular, the banks were granted licenses for new branches in high demand metropolitan and urban centers provided they also opened up new branches in rural and low demand underbanked regions (Garg and Gupta, 2023). This policy led to a significant bank branch expansion in the rural regions. More importantly, the growth of branches in rural regions outnumbered the growth in urban or semi-urban regions.

The Commercial Bank Directory of the RBI provides detailed information relating to all the bank branches, including identifiers for the state, district, and village (or, town) and the date of opening of each branch. Garg and Gupta (2020) compile and combine this information

with the Population Census 2011 and the village boundaries to consistently map and identify the villages where each branch is located. This information on bank branch locations till October 2019 is also made publicly available by Garg and Gupta (2020) and is linked with the SHRUG dataset by the Development Data Lab. As before, we map our DHS clusters with the clusters observed in the SHRUG dataset to identify villages that benefited from this banking expansion program.

2.2 Descriptive Statistics

Previous studies documenting birth order effects highlight the importance of separating the impact of birth order from that of sibsize (total count of children born to a mother) (Black et al., 2005; Blake, 1981). The reason is that, first, children at higher birth orders are born in families with higher sibsize, thereby generating a mechanical correlation between birth order and sibsize (Spears et al., 2019). Second, and more importantly, higher sibsize is negatively selective for child health outcomes in India due to high fertility mothers coming from poor socio-economic backgrounds (Coffey and Spears, 2021; Spears et al., 2022). The literature, therefore, suggests estimating birth order effects within a given sibsize or stratifying birth order effects by sibsize. We will follow this advice throughout the analysis.

Figure 1 (a) plots the proportion of total childbirths that took place in an institutional facility, including any public or private health facility from 2010-11 till 2020-21. It indicates a secular rise in the proportion of children delivered in health facilities from 82% in 2010-11 to 92% in 2020-21. Figure 1 (b) examines how the proportion of births in an institutional facility varies with the child's birth order stratified by the mother's fertility (total count of children born to a mother).

We observe that the likelihood of a second or third born child being delivered in an institutional facility is significantly lower in comparison to the first born, irrespective of the mother's fertility. Further, the second and third born appear equally likely to be born in a health facility. Figure 1 (c) suggests a decline in the likelihood of a mother receiving skilled

health personnel assistance – including doctors, nurses, ANMs, ASHAs, or any other – while delivering higher order births in comparison to her first birth. Rather, mothers are more likely to receive assistance from traditional birth attendants or friends and relatives for their higher order births (Figure 1 (d)). It is worthwhile to mention that many women report receiving assistance from healthcare personnel as well as non-healthcare personnel at the same time for any given birth. For instance, many women report receiving assistance from a doctor as well as a friend during delivery. Hence, the presence of health and non-healthcare personnel during delivery is not mutually exclusive.

Appendix Figure A1a and A1b provide information on the expansion of the PGMSY program in India. The program took off in 2001 and picked up quickly after 2007 and kept expanding till 2015. There is no increase in the proportion of villages benefitting beyond the year 2015, as the PMGSY data provided by SHRUG does not provide information beyond 2015. By 2015, more than 7% villages in India had received a new rural road under the PMGSY program. Similarly, 12% of Indian villages benefited under the program via the upgradation of existing roads. The staggered nature of road expansion across villages within a district provides quasi-random variation to examine if improvements in road connectivity can moderate the birth order effects in maternal health-seeking behavior. The figures additionally highlight that NFHS-IV, whose recall period extends from 2010 to 2016, is best suited to undertake this analysis as there is no information on program expansion after 2015.

Appendix Figure A1c plots the banking expansion or the availability of a bank branch for villages in India. In 2005, less than 3.5% of the villages had a bank branch. However, after the policy change, we observe a secular increase in the availability of bank branches. In 2019, close to 7.8% of villages had access to a bank branch. We exploit this variation to examine how infrastructure expansion programs can moderate the birth order effects in maternal health-seeking behavior.

2.3 Empirical Framework

Studies documenting birth order effects generally utilize family fixed effects (or mother fixed effects) to separate the effects of birth order from family size while accounting for household-specific time invariant unobservables. To identify the birth order effects in maternal health-seeking behavior, we also do a within mother comparison in the likelihood of a mother delivering her later born children in an institutional facility in comparison to her first born while accounting for covariates. Empirically, we use the following specification:[6]

$$y_{imntdr} = \sum_{b=1}^{3} \beta_{1b} \times [Birth\ Order = b]_{imntdr} + \lambda_{1m} + \theta_{1nt} + \nu_{1dt} + \gamma_{1rt} + Gender_{1i} + \epsilon_{1imntdr} \quad (1)$$

y_{imntdr} indicates whether child i, born to mother m in the cohort-month n of cohort-year t in district (cluster) d, observed in round r, was delivered in a health facility – including both public and private facilities. We also consider two additional outcome variables that indicate whether a trained health professional or untrained attendant was present at the time of delivery. $Birth\ Order$ denotes the birth order of child i. $Birth\ Order$ in our sample varies from 1 to 3. Coefficients β_{12} and β_{13} capture the difference in the likelihood of an institutional delivery for the second and third born child in comparison to the first born child of the mother, respectively.

λ_{1m} represents mother fixed effect. It controls for time invariant mother specific observables as well as unobservables that may affect fertility decisions and the demand for delivery care. In particular, it accounts for observables like the mother's education, completed fertility (sibsize) at the time of the survey, the sibling sex composition amongst children, and the mother's birth month year cohort. The unobservables include mother's latent health status, knowledge and health beliefs about pregnancy risks, perceived costs and benefits of

[6]To account for multiple fixed effects in our benchmark (and other) specification(s), we use the 'reghdfe' stata package which helps to absorb high dimensional fixed-effects in the estimation process (Correia, 2019).

delivery care, desired fertility level and preferences. Given the stratified sampling design of the DHS, mother fixed effects also control for time invariant household and community specific observables as well as unobservables, including time invariant supply side factors that influence household's access to care like the availability of or distance to the nearest health center or hospital.

θ_{1nt} represents the child's birth cohort month year fixed effect. It accounts for secular trends in institutional delivery rates (as observed in Figure 1 (a)) while controlling for other macroeconomic and price changes (or shocks) and federal policy interventions affecting maternal health-seeking behavior. Mother fixed effects combined with the child's birth cohort month year fixed effects account for the mother's age at each child's birth. They also control for birth spacing between children of a mother (Pruckner et al., 2021).

ν_{1dt} represents district cohort year fixed effect. It accounts for district specific shocks in the year in which the child was born. In particular, it controls for changes in the unemployment rate, price shocks, or any other district specific shocks like floods and droughts which may simultaneously influence household's health-seeking behavior and fertility decisions (Bhalotra, 2010; Dehejia and Lleras-Muney, 2004). Since the district is a local administrative decision making unit, ν_{1dt} also factors out district specific provisioning and trends in the availability of supply side healthcare infrastructure and any other district (or state) specific time varying policy interventions to promote delivery care. γ_{1rt} indicates the survey round year fixed effects. Survey round year fixed effects account for any systematic sampling differences across the two survey rounds. $Gender_{1i}$ indicates whether the child is a male. We cluster standard errors at the district level.

Our empirical strategy relies on mother fixed effects which means that the birth order effects are for a subsample of mothers who report delivering at least two children in the reference period. This may be a selected sample of mothers with shorter birth spacing (Spears et al., 2022). Shorter birth spacing may be negatively selective for investments in child health as well as child health outcomes and may drive the observed birth order effects (Dhingra and Pingali,

2021).[7] In other words, this negative birth order gradient may be unique to the subset of mothers with shorter birth spacing. Consider the following modification of Equation (1) which excludes mother fixed effects:

$$y_{imntdr} = \sum_{b=1}^{3} \beta_{2b} \times [Birth\ Order = b]_{imntdr} + \sum_{k=1}^{3} \alpha_{2k} \times [Sibsize = k]_{imntdr} + \theta_{2nt} + \nu_{2dt} + \gamma_{2rt} + Gender_{2i} + \omega_2^{'} X_{2imntdr} + \epsilon_{2imntdr} \tag{2}$$

Equation 2 replaces mother fixed effects in Equation 1 by $Sibsize$ and $X_{2imntdr}$. $Sibsize$ denotes the total number of siblings of the i^{th} child. We add sibsize as a covariate to control for any potential confounding of the birth order effects. $X_{2imntdr}$ denotes a vector of household and mother specific controls. It includes controls for the mother's literacy; linear, quadratic, and cubic of the cohort month year of mother's birth; household's wealth index, and a district-rural region interaction indicating whether the region is rural in that district.[8] After accounting for the sibsize, birth order is not expected to be correlated with household or mother level covariates, at least for the mothers who have completed their fertility (Coffey and Spears, 2021). Further, replacing mother fixed effects by sibsize, or vice-versa, in such a case should produce qualitatively as well as quantitatively similar results (Coffey and Spears, 2021).

[7]Birth spacing is the difference in the mother's age between her subsequent children. However, birth spacing is a child-pair phenomenon and cannot be directly included as a covariate in regressions. Econometrically, birth spacing is the difference between the birth cohort month-year of the mother and her subsequent children, each of which we separately control in our regressions. In our specification, mother fixed effects de-facto account for the mother's month-year cohort of birth. Further, the birth cohort-month-year fixed effect, θ_{nt}, captures the month and year of the child's birth.

[8]Mother's age at child's birth is simply the difference in cohort month year of the mother and the child's birth, hence is de-facto controlled.

3 Results

3.1 Benchmark Results

Table 1 Panel A, column (1) presents the differential impact of birth order on the mother's demand for institutional delivery care. The coefficients on the birth order variable capture the change in the likelihood of an institutional delivery associated with a mother's second and third birth in comparison to the mother's first birth. We find that, on average, the second and third-born children are 5.1 and 4.9 percentage points less likely to be born in an institutional facility. We disaggregate the institutional facilities into public hospitals, other public health facilities, and private hospitals. Public hospitals include any government or municipal hospitals, whereas deliveries in other public health facilities primarily include deliveries in a community or a public health centre.[9] In columns (2) - (4), we find that the birth order gradient in institutional delivery is primarily driven by a decline in the likelihood of the mother delievering in a public or a private hospital.

The decline in the likelihood of delivering in an institutional facility may lead to a reduction in medically supervised higher order births. Indeed, in Table 2 Panel A we observe that deliveries of later born children are 3.5 - 3.8 percentage points less likely to be assisted by skilled healthcare providers, especially doctors. This implies that later born children may be more likely to be born in the presence of informal healthcare providers, including traditional birth attendants or friends and relatives. In particular, we find that mothers are 4.1 percentage points more likely to receive assistance from informal healthcare personnel for higher order births (Table 3 Panel A).

While the average fertility rate in India was 2.2 children per woman in 2015-16 and 2 children per woman in 2019-21, it is nonetheless possible that many of the women in our sample may not have completed their fertility when they were surveyed and may subsequently go on to

[9] Additionally, a small proportion of births in government dispensaries, urban health centers, or health sub-centers are also classified under the other public health facilities category.

deliver more children in the future. This would then imply that we do not have the complete longitudinal data on a woman's fertility for capturing birth order effects (Coffey and Spears, 2021). We re-run the analysis on a subset of mothers who are likely to have completed their fertility at the time of the survey. We create a sub-sample of mothers who report that they do not desire more children in the future, or report being sterilized (either herself or her partner), or infecund. We call this the 'completed fertility sub-sample'. The results are presented in Panel B of Tables 1, 2, and 3. These results are qualitatively similar and comparable to the main results.

3.2 Birth Spacing and the Influence of Selected Sample

The literature suggests stratifying the sample by the mother's fertility to identify birth order effects. We re-run all the previous regressions for mothers who delivered exactly two children in the past five years. The results are presented in Appendix Table A3. We find that our results are comparable to the main results. Focusing on mothers with fertility of two children also helps to address the concern regarding selected sample of mothers with shorter birth spacing.

For mothers with a fertility of two, we create an indicator variable that classifies whether a mother has short birth spacing. The mothers are classified as short birth spacing mothers if the birth spacing between the first and the second child is less than 34 months.[10] We then compare if the birth order effects are different amongst mothers with shorter and longer birth spacing. We do this by adding an interaction term of the birth order variable and the short birth spacing dummy. The results are presented in columns (2), (4), and (6) of Table A4. We find no differential birth order effects amongst mothers who are classified as short birth spacing mothers and those who are not – reducing the concern of selection in identification being responsible for driving these negative birth order effects. Columns (4) and (6) rather suggest that the negative birth order gradient in maternal health-seeking behavior is relatively

[10] Another reason for using mothers with a sibsize of two is that birth spacing is a child-pair phenomenon and we classify a mother as short birth spaced by comparing the time interval between the first two births. If we consider mothers with a sibsize of three, then it is difficult to ascertain the time interval between which of the child pairs should be used to classify the mother as a short birth spacing mother.

lower for mothers with shorter birth spacing.

Previous results are still based on the selected sample of mothers who started childbearing in the survey reference period and had at least two births as they include mother fixed effects. We now present estimates for Equation (2) without mother fixed effects hence also considering mothers with just one birth during the reference period. The estimated results are presented in Table 4. We still find negative birth order effects in maternal health-seeking behavior in columns (1), (3), and (5). In columns (2), (4), and (6) we repeat the analysis for mothers with a sibsize of two and find similar results. Moreover, we observe negative selection in maternal health-seeking behavior based on the fertility of the mother. In particular, higher fertility mothers are less likely to go for an institutional delivery and seek medical supervision.

The birth order effects in Table 4 are still identified by utilizing childbirths from mothers who started childbearing only in the reference period. In these results, we are not utilizing the entire information in the 'Kids-Recode' module as provided by the DHS.[11] As discussed in Spears et al. (2019) and Spears et al. (2022), another plausible way of highlighting birth order effects is by comparing the outcomes of the last born child with that of the next-to-last-born child. This comparison allows us to use the entire sample of mothers in the 'Kids Recode' module. We do this flexibly by using both equations (1) and (2). In particular, we replace the birth order variable with a dummy variable indicating whether the child is the last born child, with the omitted category as the next-to-last-born. We estimate the difference in the likelihood of being born in a medical facility (in the presence of professional healthcare providers) between the last born and the next-to-last born. Further, we estimate the impacts with mother fixed effects (using Equation 1) as well as without mother fixed effects (using Equation 2).[12] The results are presented in Table A5. Results in odd numbered columns include mother fixed effects and results in even numbered columns are based on specification (2). We again

[11] Information on the universe of childbirths – all children born in the last five years prior to the survey irrespective of when the mother started childbearing– in the DHS is provided in Table A2.

[12] Since 90% of children observed in the kids-recode dataset come from a sibsize of four or less, we base our results on the subsample of children with a sibsize of four or less.

find a negative birth order gradient in maternal health-seeking behavior during pregnancy. The results indicate that the last birth of the mother is less likely to be delivered in a formal medical institution in the presence of professionally trained birth attendants than the next-to-the-last-born child. In particular, the last born is 1.8-2.5 percentage points less likely to be delivered in an institutional facility, and the mother is 1.2-1.6 percentage points less likely to have received assistance from health professionals for her last born child. This maps with an increase in the odds of being born in the presence of traditional healthcare providers for the last born child.

It is important to note that birth order effects in Table A5 are not directly comparable to our results in Tables 1 and 4. The reason is that Table 1 compares the difference in the outcomes of the second born (or third born) with that of the first born. Whereas the results in Table A5 compare the outcomes of the last born with that of the next-to-last-born. Nonetheless, these estimates alleviate concerns about the selected sample and indicate a negative birth order gradient in maternal health-seeking behavior during pregnancy.

4 Mechanisms

4.1 Binding Financial Constraints

The dilution hypothesis suggests that financial constraints may become more binding over successive births (Blake, 1981, 2022). This is because the propensity to invest resources in the first born is higher. If the family plans a second child, the dilution hypothesis suggests that the resources available for investing in the second child's health may be significantly lower as compared to what was available for the first child.[13] For wealthy households, however, these constraints may be less binding (or, absent altogether). This can generate a larger negative birth

[13]This is based on the assumption that the family's net real wealth remains unchanged over time. Further, the maternal health-seeking behavior may also be dampened due to significantly lower available time after the birth of the first born (Monfardini and See, 2016; Price, 2008). In terms of the opportunity cost of time, time constraints can also amplify financial constraints with subsequent births.

order effect in maternal health-seeking behavior for resource constrained households than for resource abundant households. We examine this in two ways. First, we use the wealth index, a continuous variable provided by the DHS, as a measure of household wealth and interact it with the child's birth order. Second, we create a dummy variable "Rich" which is coded as 1 if the DHS classifies the household to be in the richer or richest wealth quintile and 0 if the household is classified to be in the poorest, poorer, or middle wealth quintile. We interact this indicator variable with the child's birth order.

The results are presented in Table 5. In columns (1) and (3), we find that the interaction term is positive and statistically significant. This implies that the negative birth order effects in maternal health-seeking behavior monotonically decline with a household's wealth status. Further, the interaction terms in columns (5) and (7) are expectedly negative, though statistically insignificant. Nonetheless, the findings are indicative of attenuated birth order effects amongst mothers from wealthier households.

In columns (2) and (4), we find that the second born is 5.1 percentage points less likely to be born in an institutional facility and 3.7 percentage points less likely to have received assistance from a skilled medical practitioner during birth. However, these effects are 1 percentage point lower for second born children in asset-rich households. More importantly, the birth order effects for the second born children in wealthier households persist and are statistically different from zero.

While findings suggest that financial constraints do play a role in driving the birth order gradient, the negative birth order effects in maternal health-seeking behavior persist, though attenuated, for the richest set of mothers too. Thus financial constraints cannot fully explain the observed birth order gradient in maternal health-seeking behavior.

4.2 Uncertainty, Behavioral Shifts and Child-Sex Preference

The second mechanism relates to the role of uncertainty in maternal health-seeking behavior. Dardanoni and Wagstaff (1990) illustrate that if the uncertainty about an individual's ex-ante health status decreases (increases), this leads to a decrease (increase) in the demand for medical care.[14] Thus, if uncertainty around the perceived risks decreases after the first delivery, this may negatively affect the maternal health-seeking behavior, thereby explaining the observed negative birth order effects. Relatedly, Brenøe and Molitor (2018) find that mothers in Denmark make fewer prenatal visits to midwives and special practitioners for children born at higher orders in comparison to their first born child. They posit that the reduced prenatal visits for subsequent births may be an *efficeint response* to the useful knowledge and experience already gathered by the mother during her first delivery.

We test for this by exploiting the variation in outcomes experienced by mothers during their first delivery. In particular, we exploit whether the first born child of the mother died in the neonatal period. A sizable portion of infant deaths in the developing world are at the neo-natal stage and are avoidable conditional on the availability of good intrapartum care and emergency obstetric care (Jones et al., 2003; Million Death Study Collaborators, 2010). Thus, a neo-natal death can increase the uncertainty about a mother's health status and the perceived level of risks associated with pregnancy. This may positively affect maternal health-seeking behavior for subsequent deliveries. Therefore, the birth order effect should be lower or absent in mothers whose first child died in the neonatal period.

To test this, we construct an indicator variable if the mother's first child died in the neonatal period. We interact it with the birth order dummy to examine the difference in the birth order effects based on the past experience of mothers. The results are presented in Table 6. In column (1), we find that the birth order effect is completely absent for the second born child if the first born child died in the neonatal period. In particular, for mothers whose first born

[14] Further, if this decrease (increase) in uncertainty is accompanied by an increase (decrease) in the individual's expected health status, then this will also lead to a decline (an increase) in the demand for healthcare.

child survived the neonatal period, we observe a 6 and 6.5 percentage points reduction in the likelihood of availing institutional delivery for second and third born children. However, this effect is zero for mothers who did not have a smooth first delivery experience, that is, their first born died in the neonatal period. This also holds for mothers who delivered only two children in the reference period (column (2)). We also observe the absence of a birth order gradient in seeking health professional assistance for the subset of mothers with a bad previous delivery experience. These findings suggest that uncertainty may engender behavioral changes and play a key role in driving birth order effects in maternal health-seeking behavior.

Differential child sex preference may also drive the observed birth order effects. In the presence of son preference, if the child's sex is known before birth, parents (mothers) may make differentially higher prenatal health investments in sons (Bharadwaj and Lakdawala, 2013). In other words, male children may be more likely to be delivered in a medical facility than female children.[15] We test this by interacting birth order with the child's gender. We do not find any evidence in support of this as the interaction terms in columns (1) and (3) of Table 7 are statistically insignificant. Instead, a third born child is more likely to be delivered in the presence of informal healthcare personnel or a traditional birth attendant if the child is male (columns (5) and (7)).

We also test if the preference for a first born son may be driving our results. If there is a first born son preference, then the negative birth order effect must be stronger amongst mothers whose first born child is a son as compared to mothers with first born daughter. We test this by interacting birth order with a dummy indicating whether the first born child of the mother was a male. We find that the interaction terms in columns (2) and (4) are statistically insignificant (Table 7). However, we observe that mothers are more likely to receive assistance from traditional birth attendants for their second order birth. Nonetheless, the interaction coefficient is very small in comparison to the coefficient on the birth order dummy and insufficient to account for the magnitude of the birth order effects that we observe.

[15] We nonetheless control the gender of the child in all our specifications.

4.3 Infrastructure Improvements

To examine the moderating effect of improved road connectivity and bank branch expansion on the birth order gradient, we modify Equation (1). We add three dummies – indicating the availability of a bank branch and whether the village benefited from the PMGSY program via the construction of a new road or the upgradation of an existing road. To ascertain the moderating effect of these support infrastructure improvements, we additionally interact each dummy with the child's birth order. For ease of interpretation, we replace birth order with a *later born* dummy indicating whether the child is a second or a third born. In essence, we compare the first born with the later born children and examine how the birth order gradient changes if new infrastructure becomes available after the birth of the first child. These results are presented in Table 8.

In column (1) we find that the later born are 6.6 percentage points less likely to be born in a medical health facility. However, the construction of an all-weather paved road after the birth of the first child reduces this birth order gradient by 2 percentage points. This represents a 30% decline in the birth order gradient. On the other hand, we do not observe any impact of an upgraded but previously existing road on the birth order gradient. In column (2), we find that the presence of a bank branch also moderates the birth order gradient. More specifically, with the opening of a bank branch in previously unbaked villages, the negative birth order gradient is attenuated by 1.7 percentage points. In column (3), we add all three dummies and their respective interaction terms together and find that the interaction coefficients are unchanged. In column (5), we examine how these infrastructure improvements impact the likelihood of seeking assistance from a healthcare professional at the time of delivery. The birth order gradient is 1.9 percentage points lower amongst mothers in areas that benefitted from the opening of a bank branch. Our results remain unchanged if we restrict our sample to regions that are classified as rural by the NFHS (see columns (4) and (6)). The results indicate that improvements in infrastructure support may moderate and lower the negative birth order gradient in maternal health-seeking behavior. We also estimate specifications with birth order dummies and find similar results (see Appendix Table A6). As indicated earlier, we present results from NFHS-IV,

given that SHRUG does not provide PMGSY data beyond 2015. Nonetheless, we also present results from the combined sample in Appendix Table A7.

The moderating effect of infrastructure improvements on the birth order effects in maternal health-seeking behavior indicates that our results are unlikely to be driven by biomedical changes or complications that occur over the maternal life course.

5 Robustness Tests

5.1 Confounding Policy Changes

In January 2017, the government of India launched the Pradhan Mantri Matritva Vandana Yojana (PMMVY), a conditional cash transfer program for improving maternal and child health outcomes. Expectant mothers were eligible to receive total cash assistance of Rupees 5000, split over three installments, subject to meeting certain program conditions (Ministry of Women and Child Development, 2017). The first installment of Rupees 1000 was to be disbursed after the registration of the pregnancy at the approved public health facility. After six months of pregnancy, the expectant mother was entitled to receive Rupees 2000 conditional on completing at least one antenatal visit. The final installment of Rupees 3000 was provided to the lactating mother given two conditions were met. First, the birth of the child is registered. Second, the child should have received the first round of BCG, OPV, DPT, and Hepatitis-B vaccination. Additionally, the program also permitted eligible expectant mothers to seek cash assistance under a safe motherhood program known as the Janani Suraksha Yojana (JSY), ongoing since 2005. The JSY entitled eligible expectant mothers to seek cash assistance provided they delivered in a public or an accredited private health facility (Ministry of Health and Family Welfare, 2005). The average transfer to an eligible expectant mother under JSY was Rupees 1000. Combined with JSY, PMMVY entitled a conditional cash transfer of Rupees 6000 to expectant and lactating mothers.

Most importantly in the context of our findings, the PMMVY program provided this assistance only to the first born child of the mother. These cash incentives may have been instrumental in incentivizing mothers to seek care at the time of the first delivery, and the absence of incentives may have demotivated health-seeking during subsequent deliveries. Thus, our findings may be confounded by the launch of the PMMVY program.[16] We, however, observe a negative birth order gradient in maternal-seeking behavior even when we limit analysis to NFHS-4 (2015-16), conducted well before the announcement of the PMMVY program (see Tables 8 and A6).

5.2 Measurement Errors in Birth Order

The 'Kids-Recode' module of the NFHS only records information relating to health-seeking behavior for live births delivered in the reference period. The birth order variable in our sample may be mismeasured if there was any pregnancy that resulted in a miscarriage or a stillbirth. For instance, if before the first live birth the mother experienced a stillbirth then the actual birth order of the first live birth is two as opposed to one. We re-estimate our results by removing all mothers from our sample who have ever had a pregnancy that led to a miscarriage, stillbirth, or an abortion. This helps to reduce the concern of measurement error in the birth order. The results are comparable to our main findings and are presented in Table A8.

5.3 Physiological Changes

Medical literature suggests that children born at higher birth orders are less likely to suffer from maternal physiological constraints that affect the supply of nutrients to the fetus (Gluckman and Hanson, 2004; Khong et al., 2003). Empirical studies in the literature provide suggestive evidence that later born children are endowed with better health status at birth and are less likely to have low birth weight (Brenøe and Molitor, 2018; Pruckner et al., 2021). If this information is

[16]The conditional cash assistance to expectant mothers under JSY is not restricted to the first birth of the mothers.

known to the mother, then the negative birth order gradient may rather be a means to substitute better health endowment with lower health investment (Pruckner et al., 2021).[17] While this remains a possibility, our results, however, show that birth order effects attenuate with the availability of better support infrastructure. Further, our results also indicate the absence of birth order effects for mothers witnessing an infant death. Thus, it is unlikely that maternal information about lower physiological constraints leading to better health endowments for later born is driving our results.

5.4 Vaccination

Empirical evidence from developing countries suggests that antenatal and post-natal care are positively correlated. In particular, institutional delivery strongly predicts infant immunization (Moyer et al., 2013). Second, and more importantly in our context, this implies that a birth order gradient in institutional delivery can also generate a gradient in the child's vaccination status, at least for vaccinations that are administered at the time of the delivery. It is unlikely for mothers delivering at home (or, outside a formal health facility) to accompany the newborn child to a health facility for vaccination immediately after the child's birth.

The DHS data also records information about the vaccination status of each child born to the mother. We test for the possibility of a birth order gradient in child vaccination.[18] Table 9 tests for birth order gradient in vaccination for vaccines that are administered at the time of childbirth. The findings are twofold. First, first born children delivered in an institutional facility are more likely to be vaccinated than first borns who are not delivered in a medical facility. Second, there is evidence of a negative birth order gradient in the likelihood of a child

[17]Note, Pruckner et al. (2021) do not find evidence in support of such a substitution behavior for children in Austria.

[18]To ascertain a child's vaccination status for each vaccine, the DHS records information under these five mutually exclusive categories – "no", "vaccination date on card", "reported by mother", "vaccination marked on card", and "don't know". We consider a child as vaccinated if it is reported by the mother or the vaccination (date) is marked on the card.

receiving a BCG or a Polio vaccine at birth. However, this effect is absent for later born children delivered in a medical facility.[19]

We further test for the presence of birth order differential in the vaccinations that are administered, or due, within first 6 weeks (and 10 weeks) post the child's birth. We observe that the first born children delivered in a health facility are always more likely to be vaccinated than those not delivered in an institutional facility (Table A9). However, there is no evidence of birth order gradient in vaccines meant to be administered much later after the child's birth, irrespective of whether the later born are delivered in a medical facility or not.

Note that, in the context of India, institutional delivery may not necessarily translate into better outcomes for children due to the quality of institutional facilities. This is especially true of states like Bihar and Uttar Pradesh, where the quality of health infrastructure may be abysmally low (Coffey, 2019; Coffey and Spears, 2021). In these states, the link between facility birth and neonatal deaths remains broken (Coffey, 2019). However, the birth order gradient observed in vaccination implies that the birth order gradient in institutional delivery will still be relevant for immunization. Moreover, we also observe a birth order gradient after excluding the states of Uttar Pradesh and Bihar from the sample (see Table A10).

6 Conclusion

Utilization of formal healthcare during pregnancy represents a prenatal health investment that the parents make even before the child is born. Such health investments are not only likely to positively affect child health outcomes but also improve maternal health. However, there is a

[19]However, we note that this information is available only for a sub-sample of children in our sample. The information on vaccination is missing for 7% of observations in NFHS-4 and 40% in NFHS-5 sample. The reason is that information relating to vaccination is predominantly recorded for the last-born child of the mother in the NFHS-5 sample, limiting observations for a within-mother comparison. We run a bridge regression to test the negative birth order gradient in institutional delivery for the subset of mothers with non-missing vaccination information. We find a similar negative birth order effect amongst this subset of mothers.

possibility that parents may make differential health investments in children born at different birth orders. Such birth order gradients may arise due to differential parental (time and financial) constraints, child-rearing and behavioral practices, genetic endowments, and household environment. The choice of delivery in a formal medical institution in the presence of professionally qualified healthcare providers, as opposed to delivering at home in the presence of traditional caregivers or friends/relatives, may also change with subsequent births.

This paper pools data from two recent waves of the Demographic and Health Survey (DHS) of India conducted in the years 2015-16 and 2019-21 to examine the presence of birth order effects in maternal health-seeking behavior. Using mother fixed effects, we compare outcomes of the second and the third born child with the first born of a mother. We find evidence of a negative birth order gradient in maternal health-seeking behavior wherein the mothers are less likely to deliver their later born (second and third born) children, as compared to their first born child, in a medical institutional facility in the presence of medically trained healthcare providers including doctors and nurses. Mothers are more likely to deliver these later born children at home in the presence of traditional birth attendants and friends and relatives. We also test and provide empirical evidence that imporved infrastructure, as measured by the availability of roads and banking can moderate the negative birth order gradient in maternal health-seeking behavior.

Further, we find that financial constraints and post-natal behavioral changes may be responsible for driving such effects. In particular, with an increase in the family size after the birth of the first child, the financial resources are diluted for the later born when compared to the first born at comparable stages. Since delivering in a formal health facility involves high direct and indirect financial costs, the dilution of family financial resources may lead to a reduction in the likelihood of the later born being delivered in a formal medical institution. We find weak evidence in support of this. Financial constraints are unable to account for the magnitude of birth order effects documented in the paper.

Maternal knowledge about her health status and health practices involved during pregnancy may increase after the first pregnancy. This, combined with a complication free first

delivery experience may reduce uncertainty and thus negatively affect health-seeking behavior in the form of lowering the maternal demand for institutional delivery for subsequent births. On the other hand, poor first delivery experience like neonatal death of the first born, may increase a mother's uncertainty about her health status and increase the demand for medical care. We find empirical support suggesting such behavioral changes. The birth order gradient is driven by mothers whose first born child survived the neonate period. The negative birth order gradient is however absent in mothers whose first born child died in the neonatal period. A significant proportion of neonatal deaths in India and in other developing countries are avoidable if emergency obstetric care is available, as is the case in institutional delivery (Million Death Study Collaborators, 2010). Thus, there is suggestive evidence of behavioral changes, based on past experience, driving such negative birth order effects in demand for healthcare during pregnancy.

The birth order effects we document are distinct from the birth order effects generally studied in the literature. The birth order differences in maternal health-seeking behavior represent a parental decision that is necessarily taken before the child is born. Thus, any birth order difference in maternal demand for care-seeking during delivery is attributed to parental choice and differential investment in the child's short-term as well as longer-term health. A birth order gradient in health and labor market outcomes across siblings, however, reflects only a partial manifestation of differential parental investments (Monfardini and See, 2016). A child's own actions and choices combined with differential parental investments may jointly bring about such differences in labor market outcomes (Del Boca et al., 2017).

While it is believed that first time mothers are required to be educated and apprised about the benefits of formal medical care during pregnancy, the findings suggest that this may not necessarily translate into mothers seeking professional help in subsequent pregnancy and childbirth. The findings highlight some salient constraints, perceptional changes, and behavioral factors that may play an important role in seeking professional healthcare during childbirth.

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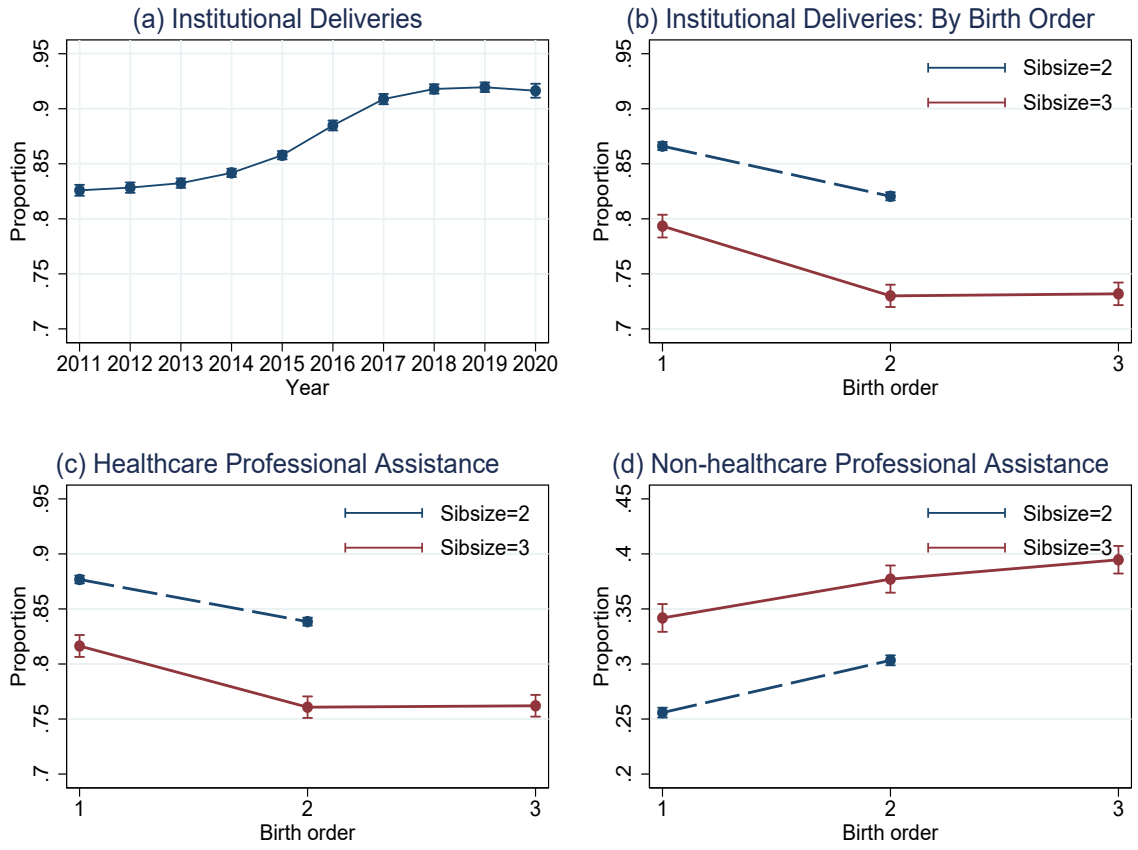
Figures

Figure 1: Maternal Health-Seeking Behavior



Note: Based on authors' estimates. Panel (a) plots the proportion of total births that occur in an institutional facility from 2010-11 till 2020-21. Panel (b) plots the proportion of total births that occur in an institutional facility by the birth order of the child. Panel (c) plots the proportion of total births that received healthcare professional assistance by the birth order of the child. Panel (d) plots the proportion of total births that received non-healthcare professional assistance by the birth order of the child. Graphs in panel (b), (c), and (d) are stratified by Sibsize. Sibsize indicates the total count of children born to a mother, the number of siblings or the fertility of the mother.

Tables

Table 1: Birth Order and Maternal Health Seeking Behavior

VARIABLES	Institutional delivery	Public		Private
		Hospital	Other facility	
	(1)	(2)	(3)	(4)
Panel A: Mother fixed effects subsample				
Birth order (#)				
2	-0.051***	-0.029***	0.006	-0.028***
	(0.005)	(0.005)	(0.005)	(0.005)
3	-0.049***	-0.038***	0.013	-0.024***
	(0.009)	(0.009)	(0.010)	(0.009)
Observations	111,000	111,000	111,000	111,000
R-squared	0.782	0.852	0.839	0.836
F stat	44.35	15.67	1.356	16.89
Mean of dependent variable	0.830	0.269	0.355	0.206
Panel B: Completed fertility subsample				
Birth order(#)				
2	-0.053***	-0.021***	0.006	-0.038***
	(0.006)	(0.006)	(0.007)	(0.006)
3	-0.053***	-0.027**	0.010	-0.036***
	(0.012)	(0.012)	(0.013)	(0.011)
Observations	67,724	67,724	67,724	67,724
R-squared	0.786	0.865	0.854	0.852
F stat	31.36	5.063	1.406	18.39
Mean of dependent variable	0.863	0.284	0.353	0.226

Note: The dependent variables in both Panel A and Panel B are whether the child was delivered in an institutional facility (column (1)), in a public hospital (column (2)), in other public health facilities (column (3)), or in a private hospital (column (4)), respectively. Public hospital category includes all government or municipal hospitals. Other public health facility category includes community health centres, public health centres, government dispensaries, urban health centres, or health subscentres. Private hospital category includes any private hospitals, maternity homes, clinics or any other private health facility. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Birth order indicates the birth rank of the child. Panel B is a subset of mothers in Panel A who have completed their fertility (those who report that they do not desire more children in the future, or report being sterilized (either herself or her partner) or infecund) at the time of the survey. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2: Birth Order and Formal Supervision Received

VARIABLES	(1) Health professional	(2) Doctor	(3) Nurse	(4) Others
Panel A: Mother fixed effects subsample				
Birth order (#)				
2	-0.038***	-0.033***	-0.010*	0.004**
	(0.005)	(0.005)	(0.006)	(0.002)
3	-0.035***	-0.025**	-0.014	0.008**
	(0.009)	(0.010)	(0.011)	(0.004)
Observations	111,000	111,000	111,000	111,000
R-squared	0.791	0.854	0.824	0.793
F stat	27.30	20.72	1.201	1.646
Mean of dependent variable	0.846	0.535	0.599	0.0255
Panel B: Completed fertility subsample				
Birth order (#)				
2	-0.037***	-0.031***	-0.009	0.002
	(0.006)	(0.007)	(0.007)	(0.003)
3	-0.041***	-0.024*	-0.018	0.007
	(0.012)	(0.013)	(0.015)	(0.005)
Observations	67,724	67,724	67,724	67,724
R-squared	0.798	0.863	0.840	0.801
F stat	17.78	11.01	0.521	0.954
Mean of dependent variable	0.874	0.569	0.608	0.0250

Note: The dependent variables in both Panel A and Panel B indicate the type of supervision received by the mother while delivering her child. Dependent variables indicate if the child was delivered under the supervision of any trained healthcare professional (column (1)), doctor (column (2)), nurse (including an auxiliary nursing midwife, or an accredited social health activist) (column (3)), or any other medically trained health professional (column (4)), respectively. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Birth order indicates the birth rank of the child. Panel B is a subset of mothers in Panel A who have completed their fertility (those who report that they do not desire more children in the future, or report being sterilized (either herself or her partner) or infecund) at the time of the survey. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Birth Order and Informal Supervision Received

VARIABLES	Non-health professional (1)	Traditional birth attendant (2)	Friend (3)	Others (4)
Panel A: Mother fixed effects subsample				
Birth order (#)				
2	0.041***	0.020***	0.031***	0.005***
	(0.005)	(0.004)	(0.004)	(0.002)
3	0.041***	0.013	0.037***	0.006**
	(0.010)	(0.009)	(0.008)	(0.003)
Observations	111,000	111,000	111,000	111,000
R-squared	0.835	0.808	0.845	0.795
F stat	27.85	13.62	22.68	3.625
Mean of dependent variable	0.293	0.136	0.190	0.0169
Panel B: Completed fertility subsample				
Birth order (#)				
2	0.035***	0.020***	0.023***	0.005**
	(0.007)	(0.005)	(0.006)	(0.002)
3	0.039***	0.022*	0.027**	0.005
	(0.014)	(0.011)	(0.011)	(0.004)
Observations	67,724	67,724	67,724	67,724
R-squared	0.847	0.819	0.853	0.806
F stat	11.35	6.292	6.962	2.570
Mean of dependent variable	0.269	0.121	0.177	0.0158

Note: The dependent variables in both Panel A and Panel B indicate the type of supervision received by the mother while delivering her child. Dependent variables indicate if the child was delivered under the supervision of any non-healthcare professional (column (1)), traditional birth attendant (column (2)), friend/relatives (column (3)), or any other non-health professional (column (4)), respectively. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Birth order indicates the birth rank of the child. Panel B is a subset of mothers in Panel A who have completed their fertility (those who report that they do not desire more children in the future, or report being sterilized (either herself or her partner) or infecund) at the time of the survey. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Maternal Health-Seeking Behavior and Birth Order Effects without Mother Fixed Effects

VARIABLES	Institutional delivery		Health professional		Non-health professional		Traditional birth attendant	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Birth Order (#)								
2	-0.039***	-0.040***	-0.031***	-0.034***	0.041***	0.045***	0.026***	0.029***
	(0.002)	(0.004)	(0.002)	(0.004)	(0.003)	(0.005)	(0.002)	(0.004)
3	-0.040***		-0.032***		0.047***		0.027***	
	(0.006)		(0.006)		(0.007)		(0.006)	
Sibsize(#)								
2	-0.024***		-0.019***		0.002		0.009***	
	(0.002)		(0.002)		(0.003)		(0.002)	
3	-0.065***		-0.053***		0.038***		0.040***	
	(0.006)		(0.005)		(0.007)		(0.006)	
Sibsize	<=3	2	<=3	2	<=3	2	<=3	2
Observations	218,075	95,167	218,075	95,167	218,075	95,167	218,075	95,167
R-squared	0.207	0.236	0.164	0.199	0.152	0.187	0.143	0.171
F stat	93.57	67.73	72.36	51.92	53.23	33.16	52.28	35.19
Mean of dependent variable	0.871	0.844	0.880	0.858	0.258	0.279	0.122	0.140

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(2)), whether the delivery was assisted by a healthcare professional (columns (3)-(4)), and whether the delivery was assisted by any non-healthcare professional (columns (5)-(6)), and whether the delivery was assisted by a traditional birth attendant (columns (7)-(8)), respectively. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Traditional birth attendant is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant. Birth order indicates the birth rank of the child. Each column represents regression results from a separate regression. Each regression specification includes cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, an indicator for the child's gender, and dummies for the sibship size. It also includes controls for the mother's literacy; linear, quadratic, and cubic of the cohort month-year of mother's birth; household's wealth index; and a district-rural region interaction indicator indicating whether the region is classified as a rural region in that district. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5: Maternal Health-Seeking Behavior and the Birth Order Effects: Role of Financial Constraints

VARIABLES	Institutional delivery		Health professional		Non-health professional		Traditional birth attendant	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Birth order (#)								
2	-0.049***	-0.051***	-0.037***	-0.039***	0.041***	0.042***	0.025***	0.025***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
3	-0.045***	-0.051***	-0.033***	-0.035***	0.040***	0.040***	0.017*	0.019**
	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)
Birth order (#) × Wealth index								
2 × wealth index	0.001***		0.001***		-0.000		-0.000	
	(0.000)		(0.000)		(0.000)		(0.000)	
3 × wealth index	0.002**		0.001		-0.001		-0.001	
	(0.001)		(0.001)		(0.001)		(0.001)	
Birth order (#) × Richest								
2 × Richest		0.011***		0.010***		-0.004		-0.001
		(0.004)		(0.004)		(0.005)		(0.004)
3 × Richest		0.047***		0.009		0.018		-0.002
		(0.017)		(0.018)		(0.021)		(0.019)
p-val : Birth order(#) + Birth order(#) × Richest = 0								
2		0.0000		0.0000		0.0000		0.0001
3		0.7924		0.1557		0.0086		0.3912
Observations	111,000	111,000	111,000	111,000	111,000	111,000	111,000	111,000
R-squared	0.782	0.782	0.791	0.791	0.835	0.835	0.808	0.808
F stat	28.33	27.54	17.91	17.04	17.06	16.80	9.929	9.673
Mean of dependent variable	0.830	0.830	0.846	0.846	0.293	0.293	0.151	0.151

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(2)), whether the delivery was assisted by a healthcare professional (columns (3)-(4)), whether the delivery was assisted by a non-healthcare professional (columns (5)-(6)), and whether the delivery was assisted by a traditional birth attendant (columns (7)-(8)), respectively. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Traditional birth attendant is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant. Birth order indicates the birth rank of the child. Rich is an indicator variable that is 1 if the household is classified as either richer or richest and is 0 if classified as either poorest, poorer, or middle by the DHS dataset. Wealth index is a continuous variable indicating wealth status of the household, and is provided by the DHS dataset. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 6: Maternal Health-Seeking Behavior and the Birth Order Effects: Behavioral Mechanisms

VARIABLES	Institutional delivery		Health professional		Non-health professional		Traditional birth attendant	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Birth order (#)								
2	-0.060***	-0.050***	-0.046***	-0.039***	0.045***	0.049***	0.029***	0.027***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
3	-0.065***		-0.045***		0.046***		0.024**	
	(0.010)		(0.010)		(0.010)		(0.009)	
Birth order (#) × Neonatal death of first born								
2 × Neonatal death of first born	0.063***	0.059***	0.051***	0.049***	-0.023***	-0.021**	-0.028***	-0.026***
	(0.010)	(0.011)	(0.008)	(0.009)	(0.009)	(0.011)	(0.008)	(0.009)
3 × Neonatal death of first born	0.058***		0.028		-0.012		-0.015	
	(0.021)		(0.019)		(0.019)		(0.015)	
p-val : Birth order(#) + Birth order(#) × Neonatal death of first born = 0								
2	0.7574	0.4424	0.5575	0.3051	0.0240	0.0159	0.8420	0.8904
3	0.7550		0.3552		0.0778		0.5670	
Observations	111,000	95,024	111,000	95,024	111,000	95,024	111,000	95,024
R-squared	0.782	0.802	0.791	0.810	0.835	0.849	0.808	0.823
F stat	34.97	33.06	25.97	25.59	18.19	23.87	11.52	10.92
Mean of dependent variable	0.830	0.844	0.846	0.858	0.293	0.279	0.151	0.140

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(2)), whether the delivery was assisted by a healthcare professional (columns (3)-(4)), whether the delivery was assisted by a non-healthcare professional (columns (5)-(6)), and whether the delivery was assisted by a traditional birth attendant (columns (7)-(8)), respectively. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Traditional birth attendant is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant. Birth order indicates the birth rank of the child. Neo-natal death of firstborn indicates if the firstborn child of the mother died in the first month of birth and is 0 otherwise. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7: Maternal Health-Seeking Behavior and the Birth Order Effects: Sex Preference

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Institutional delivery		Health professional		Non-health professional		Traditional birth attendant	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Birth order (#)								
2	-0.051***	-0.048***	-0.039***	-0.036***	0.039***	0.037***	0.024***	0.022***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
3	-0.048***	-0.041***	-0.030***	-0.028***	0.029**	0.031***	0.007	0.012
	(0.011)	(0.010)	(0.011)	(0.010)	(0.012)	(0.011)	(0.010)	(0.010)
Birth order (#) × Male								
2 × Male	0.001		0.001		0.006		0.002	
	(0.005)		(0.004)		(0.005)		(0.004)	
3 × Male	-0.004		-0.008		0.022**		0.022**	
	(0.011)		(0.011)		(0.011)		(0.009)	
Birth order (#) × First born is male								
2 × First born is male		-0.005		-0.004		0.009**		0.005*
		(0.003)		(0.003)		(0.004)		(0.003)
3 × First born is male		-0.018		-0.015		0.022*		0.016
		(0.011)		(0.011)		(0.011)		(0.010)
Observations	111,000	111,000	111,000	111,000	111,000	111,000	111,000	111,000
R-squared	0.782	0.782	0.791	0.791	0.835	0.835	0.808	0.808
F stat	26.76	33.06	16.57	20.34	18.03	22.28	10.75	12.27
Mean of dependent variable	0.830	0.830	0.846	0.846	0.293	0.293	0.151	0.151

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(2)), whether the delivery was assisted by a healthcare professional (columns (3)-(4)), whether the delivery was assisted by a non-healthcare professional (columns (5)-(6)), and whether the delivery was assisted by a traditional birth attendant (columns (7)-(8)), respectively. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Traditional birth attendant is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant. Birth order indicates the birth rank of the child. Male is an indicator variable that is 1 if the gender of the child is male and is 0 otherwise. First child male is an indicator variable that is 1 if the first child born to the mother is a male and is zero otherwise. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8: Birth Order Effects and Support Infrastructure Expansion: 2009-2014

VARIABLES	Institutional delivery				Health professional	
	(1)	(2)	(3)	(4)	(5)	(6)
Later born	-0.066***	-0.066***	-0.068***	-0.073***	-0.059***	-0.062***
	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)
New road	-0.053		-0.054*	-0.051	-0.041	-0.042
	(0.033)		(0.033)	(0.034)	(0.032)	(0.032)
Road upgrade	-0.016		-0.016	-0.022	-0.001	-0.004
	(0.025)		(0.025)	(0.026)	(0.023)	(0.024)
Bank branch			0.010	0.003	0.002	0.006
			(0.022)	(0.025)	(0.017)	(0.021)
Later born × New road	0.020**		0.020**	0.020*	0.007	0.007
	(0.010)		(0.010)	(0.011)	(0.010)	(0.010)
Later born × Road upgrade	0.002		0.003	0.005	0.003	0.002
	(0.009)		(0.009)	(0.010)	(0.009)	(0.009)
Later born × Bank branch		0.017*	0.017*	0.028**	0.019**	0.025**
		(0.009)	(0.009)	(0.011)	(0.008)	(0.010)
Observations	47,288	47,288	47,288	42,127	47,288	42,127
R-squared	0.783	0.783	0.783	0.785	0.791	0.792
F stat	12.42	19.35	10.05	10.03	7.687	7.307
Mean of dependent variable	0.776	0.776	0.776	0.766	0.800	0.790

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(4)) and whether the delivery was assisted by a healthcare professional (columns (5)-(6)). Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Later born is an indicator variable indicating whether the child is a second or a third born. New road indicates whether a new road under the PMGSY program was constructed in the village. Road upgrade indicates whether an existing road was upgraded under the PMGSY program in the village. Bank branch indicates whether a bank branch was available in the village. Each column represents regression results from a separate regression. Results in column (4) and column (6) are pertain to subsample of households that are located in regions classified as rural by the DHS. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 9: Institutional Delivery, Birth Order and Child Vaccination at Birth

VARIABLES	BCG		Polio		Hepatitis		Atleast one	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Institutional delivery	0.039***	0.037***	0.127***	0.123***	0.109***	0.109***	0.040***	0.037***
	(0.007)	(0.008)	(0.010)	(0.011)	(0.010)	(0.011)	(0.007)	(0.008)
Birth order (#)								
2	-0.017**	-0.026***	-0.019*	-0.020*	-0.009	-0.009	-0.011	-0.018**
	(0.008)	(0.009)	(0.011)	(0.012)	(0.012)	(0.014)	(0.008)	(0.009)
3	-0.034**		-0.004		0.018		-0.026*	
	(0.016)		(0.021)		(0.023)		(0.016)	
Institutional delivery × Birth order (#)								
2	0.025***	0.029***	0.026***	0.032***	0.034***	0.036***	0.018***	0.022***
	(0.006)	(0.007)	(0.009)	(0.010)	(0.010)	(0.010)	(0.006)	(0.007)
3	0.052***		0.028		0.038*		0.043***	
	(0.015)		(0.019)		(0.020)		(0.015)	
Sibsize	3	2	3	2	3	2	3	2
Observations	67,226	56,348	67,228	56,362	66,004	55,332	65,844	55,198
R-squared	0.759	0.777	0.755	0.772	0.774	0.789	0.765	0.782
F stat	17.62	19.47	43.51	51.52	39.07	43.60	16.60	15.99
Mean of dependent variable	0.904	0.910	0.761	0.770	0.622	0.634	0.912	0.917

Note: The dependent variables are indicator variables indicating whether the child received the Polio (columns (1)-(2)), DPT (columns (3)-(4)), Hepatitis (columns (5)-(6)), or at least one (columns (7)-(8)) of these vaccination doses which are administered at the time of birth. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Birth order indicates the birth rank of the child. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Appendix

Table A1: Sibsize and Birth Order in the Main Sample

	Birth order			
Children ever born	1	2	3	Total
1	106,895	0	0	106,895
2	47,648	47,648	0	95,296
3	5,312	5,312	5,312	15,936
Total	159,855	52,960	5,312	218,127

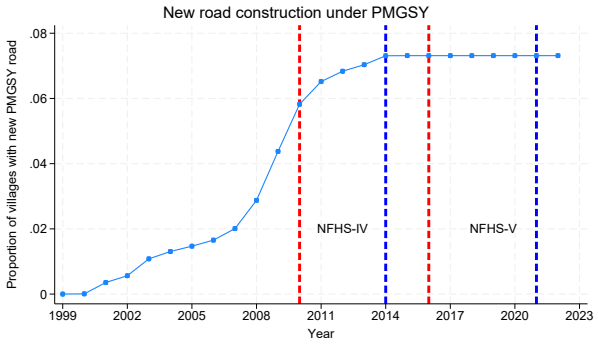
Note: The table cross tabulates the sibsize and the birth order of children born to mothers who started child bearing in the reference period. Sibsize is the total count of children born to a mother. Birth order represents the birth rank of the child.

Table A2: Sibsize and Birth Order in Kids-Recode

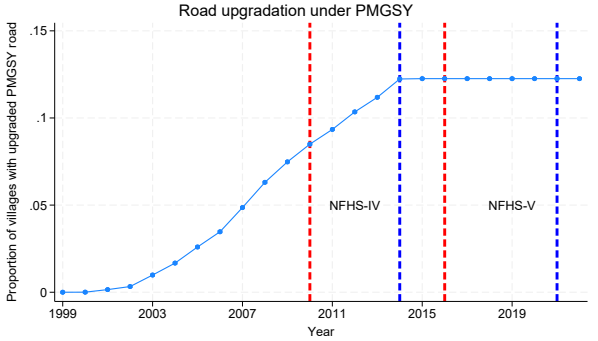
	Birth order					
Children ever born	1	2	3	4	5+	Total
1	1,06,895	0	0	0	0	1,06,895
2	47,725	1,09,558	0	0	0	1,57,283
3	5,337	23,845	56,377	0	0	85,559
4	172	2,461	11,821	27,517	0	41,971
5+	1	94	1,180	6,256	32,376	39,907
Total	1,60,130	1,35,958	69,378	33,773	32,376	4,31,615

Note: The table cross tabulates the sibsize and the birth order of children born to all the surveyed mothers in the DHS data. Sibsize is the total count of children born to a mother. Birth order represents the birth rank of the child.

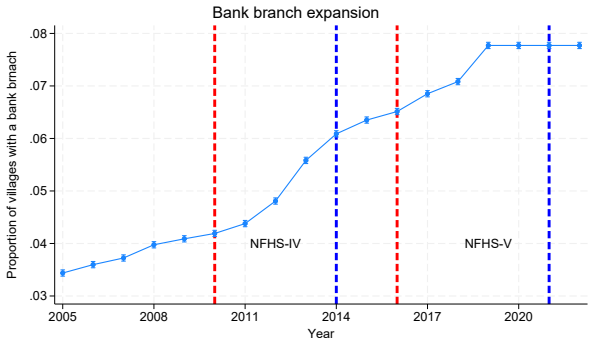
Figure A1: Road and Banking Infrastructure



(a) Expansion of new rural roads under PMGSY



(b) Upgradation of existing roads under PMGSY



(c) Availaility of a bank branch: After 2005 RBI policy

Note: Based on data from SHRUG database. Figure A1a depicts the proportion of villages that benefitted, through the construction of a new road, under the Pradhan Mantri Grameen Sadak Yojana (PMGSY) since its announcement in the year 2000 till 2015. Figure A1b depicts the proportion of villages that benefitted, through the upgradation of an existing road, under the Pradhan Mantri Grameen Sadak Yojana (PMGSY) since its announcement in the year 2000 till 2015. Figure A1c depicts the (proportion) expansion of banked villages in India after the new banking expansion policy in 2005. The red and blue bars in each sub-figure indicate the reference recall period of NFHS IV and NFHS-V, respectively.

Table A3: Maternal Health-Seeking Behavior and Birth Order Effects for Mothers with Exactly 2 Births

VARIABLES	Institutional delivery	Public		Private
		Hospital	Other facility	
	(1)	(2)	(3)	(4)
Panel A: Facility delivery				
Birth order (#)				
2	-0.042***	-0.025***	0.010*	-0.027***
	(0.005)	(0.005)	(0.006)	(0.005)
Observations	95,024	95,024	95,024	95,024
R-squared	0.802	0.863	0.854	0.851
F stat	30.78	13.36	2.091	14.24
Mean of dependent variable	0.844	0.279	0.350	0.214
	Health professional	Doctor	Nurse	Others
	(1)	(2)	(3)	(4)
Panel B: Formal healthcare assistance				
Birth order (#)				
2	-0.032***	-0.030***	0.005	0.006***
	(0.005)	(0.006)	(0.006)	(0.002)
Observations	95,024	95,024	95,024	95,024
R-squared	0.810	0.866	0.839	0.811
F stat	18.70	13.44	0.394	3.629
Mean of dependent variable	0.858	0.553	0.600	0.0249
	Non-health professional	Traditional birth attendant	Friend	Others
	(1)	(2)	(3)	(4)
Panel C: Informal healthcare assistance				
Birth order (#)				
2	0.046***	0.019***	0.037***	0.006***
	(0.006)	(0.005)	(0.004)	(0.002)
Observations	95,024	95,024	95,024	95,024
R-squared	0.849	0.823	0.858	0.808
F stat	31.39	9.010	34.76	5.116
Mean of dependent variable	0.279	0.126	0.184	0.0158

Note: The dependent variables in Panel A are whether the child was delivered in an institutional facility (column (1)), in a public hospital (column (2)), in other public health facilities (column (3)), or in a private hospital (column (4)), respectively. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Public hospital category includes all government or municipal hospitals. Other public health facility category includes community health centres, public health centres, government dispensaries, urban health centres, or health subscentres. Private hospital category includes any private hospitals, maternity homes, clinics or any other private health facility. The dependent variables in Panel B indicate if the child was delivered under the supervision of any healthcare personnel (column (1)), doctor (column (2)), nurse (including an auxiliary nursing midwife, or an accredited social health activist) (column (3)), or any other medically trained health professional (column (4)), respectively. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, nurse, or any other health personnel. The dependent variables in Panel C indicate if the child was delivered under the supervision of any non-healthcare personnel (column (1)), traditional birth attendant (column (2)), friend/relatives (column (3)), or any other non-health professional (column (4)), respectively. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Birth order indicates the birth rank of the child. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A4: Maternal Health-Seeking Behavior and Birth Order Effects with Short Birth Spacing

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Institutional delivery		Health professional		Non-health professional	
	(1)	(2)	(3)	(4)	(5)	(6)
Birth order(#)						
2	-0.042***	-0.046***	-0.032***	-0.055***	0.046***	0.075***
	(0.005)	(0.013)	(0.005)	(0.012)	(0.006)	(0.014)
Birth order(#) × Short birth spacing						
2 × Short birth spacing		0.002		0.013**		-0.017**
		(0.007)		(0.006)		(0.008)
Observations	95,024	95,024	95,024	95,024	95,024	95,024
R-squared	0.802	0.802	0.810	0.810	0.849	0.849
F stat	30.78	20.57	18.70	13.49	31.39	22.61
Mean of dependent variable	0.844	0.844	0.858	0.858	0.279	0.279

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(2)), whether the delivery was assisted by a healthcare professional (columns (3)-(4)), and whether the delivery was assisted by a non-healthcare professional (columns (5)-(6)), respectively. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Short birth spacing is an indicator variable that is 1 if the birth spacing between the firstborn and the secondborn child of the mother is less than 34 months. Birth order indicates the birth rank of the child. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A5: Maternal Health-Seeking Behavior and Birth Order Effects when Comparing Last Born with Next-to-Last Born

VARIABLES	Institutional delivery		Health professional		Non-health professional	
	(1)	(2)	(3)	(4)	(5)	(6)
Last born	-0.024***	-0.012***	-0.015***	-0.007***	0.031***	0.024***
	(0.004)	(0.002)	(0.004)	(0.002)	(0.004)	(0.002)
Sibsize(#)						
2		-0.047***		-0.036***		0.033***
		(0.002)		(0.002)		(0.002)
3		-0.107***		-0.086***		0.081***
		(0.003)		(0.003)		(0.003)
4		-0.160***		-0.132***		0.119***
		(0.005)		(0.004)		(0.005)
Observations	166,264	383,698	166,264	383,698	166,264	383,698
R-squared	0.807	0.225	0.814	0.183	0.842	0.156
F stat	21.91	167.70	9.85	129.90	24.86	100.20
Mean of dependent variable	0.784	0.831	0.807	0.848	0.330	0.287

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(2)), whether the delivery was assisted by a healthcare professional (columns (3)-(4)), and whether the delivery was assisted by a non-healthcare professional (columns (5)-(6)), respectively. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife and an accredited social health activist), or any other health personnel. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Last born is an indicator variable that is 1 if the child is the last-born child of the mother, and is 0 if the child is the next-to-last-born child of the mother. Sibsize is the total count of children born to a mother. Results in columns(1), (3), and (5) are estimated using equation (1) and the 'Kids Recode' dataset (see Table A2 for details). Results in columns(2), (4), and (6) are estimated using equation (2) and the 'Kids Recode' dataset. Each column represents regression results from a separate regression. Regression specification in columns (1), (3), and (5) includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. Regression specification in columns (2), (4), and (6) includes cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, an indicator for the child's gender, and dummies for the sibship size. It also includes controls for the mother's literacy; linear, quadratic, and cubic of the cohort month-year of mother's birth; household's wealth index; and a district-rural region interaction indicator indicating whether the region is classified as a rural region in that district. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A6: Birth Order Effects and Support Infrastructure Expansion: 2009-2015

VARIABLES	Institutional delivery				Health professional	
	(1)	(2)	(3)	(4)	(5)	(6)
Birth order (#)						
2	-0.067***	-0.067***	-0.068***	-0.073***	-0.059***	-0.060***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)
3	-0.070***	-0.069***	-0.072***	-0.078***	-0.057***	-0.058***
	(0.017)	(0.017)	(0.017)	(0.019)	(0.016)	(0.017)
Birth order(#) × New road						
2 × New road	0.020*		0.020*	0.020*	0.007	0.007
	(0.010)		(0.010)	(0.011)	(0.010)	(0.010)
3 × New road	0.030		0.029	0.026	-0.000	0.008
	(0.028)		(0.028)	(0.028)	(0.028)	(0.029)
Birth order(#) × Road upgrade						
2 × Road upgrade	0.001		0.002	0.005	0.003	0.002
	(0.009)		(0.009)	(0.010)	(0.009)	(0.009)
3 × Road upgrade	0.007		0.008	0.013	0.007	0.006
	(0.022)		(0.022)	(0.023)	(0.020)	(0.021)
Birth order(#) × Bank branch						
2 × Bank branch		0.016*	0.016*	0.026**	0.019**	0.024**
		(0.009)	(0.009)	(0.011)	(0.008)	(0.010)
3 × Bank branch		0.025	0.026	0.062*	0.020	0.040
		(0.027)	(0.027)	(0.031)	(0.024)	(0.029)
Observations	47,288	47,288	47,288	42,127	47,288	42,127
R-squared	0.783	0.783	0.783	0.785	0.791	0.792
F stat	8.354	12.98	6.783	6.776	5.143	4.901
Mean of dependent variable	0.776	0.776	0.776	0.766	0.800	0.790

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(4)) and whether the delivery was assisted by a healthcare professional (Columns (5)-(6)). Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable indicating whether the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. New road indicates whether a new road under the PMGSY program was constructed in the village. Road upgrade indicates whether an existing road was upgraded under the PMGSY program in the village. Bank branch indicates whether a bank branch was available in the village. Birth order indicates the birth rank of the child. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A7: Birth Order Effects and Support Infrastructure Expansion: 2009-2019

VARIABLES	Institutional delivery				Health professional	
	(1)	(2)	(3)	(4)	(5)	(6)
Later born	-0.052***	-0.053***	-0.053***	-0.058***	-0.044***	-0.047***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Later born × New road	0.011*		0.011*	0.013*	0.001	0.002
	(0.006)		(0.006)	(0.007)	(0.006)	(0.006)
Later born × Road upgrade	-0.006		-0.006	-0.006	0.000	-0.002
	(0.007)		(0.007)	(0.007)	(0.006)	(0.006)
Later born × Bank branch		0.005	0.005	0.007	0.012**	0.012**
		(0.005)	(0.005)	(0.007)	(0.005)	(0.006)
Observations	88,912	88,912	88,912	79,742	88,912	79,742
R-squared	0.781	0.781	0.781	0.783	0.790	0.792
F stat	19.89	29.95	15.65	16.25	9.986	9.793
Mean of dependent variable	0.827	0.827	0.827	0.819	0.842	0.835

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(4)) and whether the delivery was assisted by a healthcare professional (Columns (5)-(6)). Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Later born is an indicator variable indicating whether the child is a second or a third born. New road indicates whether a new road under the PMGSY program was constructed in the village. Road upgrade indicates whether an existing road was upgraded under the PMGSY program in the village. Bank branch indicates whether a bank branch was available in the village. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A8: Maternal Health-Seeking Behavior and Birth Order Effects: Robustness to Measurement Error

VARIABLES	Institutional delivery (1)	Health professional (2)	Non-health professional (3)	Traditional birth attendant (4)
Birth Order (#)				
2	-0.050***	-0.037***	0.042***	0.020***
	(0.005)	(0.005)	(0.006)	(0.005)
3	-0.048***	-0.033***	0.043***	0.012
	(0.010)	(0.010)	(0.011)	(0.009)
Observations	99,548	99,548	99,548	99,548
R-squared	0.787	0.795	0.837	0.811
F stat	43.55	24.68	26.05	12.11
Mean of dependent variable	0.828	0.844	0.293	0.137

Note: The dependent variables are whether the child was delivered in an institutional facility (columns (1)-(2)), whether the delivery was assisted by a healthcare professional (columns (3)-(4)), and whether the delivery was assisted by a non-healthcare professional (columns (5)-(6)), respectively. Institutional delivery is a dummy variable that is 1 if the child was born in a formal facility, including both public and private facilities. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Birth order indicates the birth rank of the child. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A9: Institutional Delivery, Birth Order, and Vaccination Post Birth

VARIABLES	Polio1		Dpt1		Hepatitis1		Atleast one	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Vaccinations due by first 6-weeks post birth								
Institutional delivery	0.027***	0.029***	0.037***	0.034***	0.014	0.015	0.025***	0.022***
	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)	(0.010)	(0.007)	(0.008)
Birth order (#)								
2	-0.001	-0.003	-0.002	-0.006	0.003	0.009	-0.004	-0.007
	(0.009)	(0.011)	(0.009)	(0.010)	(0.011)	(0.012)	(0.008)	(0.009)
3	0.010		0.019		0.033		0.009	
	(0.019)		(0.020)		(0.023)		(0.017)	
Institutional delivery × Birth order (#)								
2	0.004	0.002	0.002	0.003	0.000	-0.008	0.005	0.004
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.009)	(0.006)	(0.007)
3	-0.002		-0.013		-0.014		-0.003	
	(0.016)		(0.018)		(0.020)		(0.015)	
Sibsize	3	2	3	2	3	2	3	2
Observations	67,228	56,362	66,892	56,060	66,100	55,408	65,894	55,228
R-squared	0.752	0.769	0.769	0.784	0.761	0.775	0.771	0.787
F stat	3.691	4.352	6.052	6.696	1.565	0.742	3.950	3.528
Mean of dependent variable	0.852	0.860	0.848	0.857	0.766	0.775	0.884	0.891

Panel B: Vaccinations due by first 10-weeks post birth

	Polio2		Dpt2		Hepatitis2		Atleast one	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Institutional delivery	0.030***	0.033***	0.042***	0.036***	0.015	0.011	0.034***	0.034***
	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.011)	(0.008)	(0.009)
Birth order (#)								
2	-0.001	0.000	-0.011	-0.015	-0.003	-0.003	-0.010	-0.011
	(0.011)	(0.012)	(0.010)	(0.011)	(0.012)	(0.013)	(0.009)	(0.011)
3	0.006		0.010		0.027		-0.014	
	(0.022)		(0.021)		(0.024)		(0.019)	
Institutional delivery × Birth order (#)								
2	-0.000	-0.009	0.003	0.002	-0.000	-0.008	-0.001	-0.006
	(0.009)	(0.010)	(0.008)	(0.009)	(0.009)	(0.010)	(0.008)	(0.008)
3	-0.011		-0.034*		-0.035*		-0.018	
	(0.020)		(0.019)		(0.021)		(0.018)	
Sibsize	3	2	3	2	3	2	3	2
Observations	67,228	56,362	66,892	56,060	66,100	55,408	65,894	55,228
R-squared	0.761	0.776	0.780	0.793	0.770	0.783	0.782	0.795
F stat	3.261	3.399	6.572	6.132	1.148	0.609	4.860	5.667
Mean of dependent variable	0.782	0.793	0.789	0.801	0.704	0.715	0.830	0.840

Note: The dependent variables in Panel A are whether the child received the first dose of Polio (columns (1)-(2)), DPT (columns (3)-(4)), Hepatitis (columns (5)-(6)), or at least one (columns (7)-(8)) of the vaccination doses due by the end of the first six weeks after the child's birth. The dependent variables in Panel B are whether the child received second dose of the Polio (columns (1)-(2)), DPT (columns (3)-(4)), Hepatitis (columns (5)-(6)), or at least one (columns (7)-(8)) of the vaccination doses due by the end of the first ten weeks after the child's birth. Institutional delivery is a dummy variable that is 1 if the child was delivered in a formal facility, including both public and private facilities. Each column represents regression results from a separate regression. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A10: Maternal Health-Seeking Behavior and Birth Order Effects: Excluding Uttar Pradesh and Bihar

VARIABLES	Institutional delivery	Public		Private
	(1)	(2)	(3)	(4)
Panel A: Institutional delivery				
Birth order (#)				
2	-0.045***	-0.034***	0.009	-0.019***
	(0.005)	(0.006)	(0.006)	(0.005)
3	-0.048***	-0.044***	0.012	-0.016
	(0.011)	(0.011)	(0.012)	(0.010)
Observations	81,486	81,486	81,486	81,486
R-squared	0.798	0.854	0.852	0.852
F stat	27.08	14.71	2.099	6.812
Mean of dependent variable	0.849	0.312	0.340	0.197
Panel B: Formal supervision				
	Health professional	Doctor	Nurse	Others
	(1)	(2)	(3)	(4)
Birth order (#)				
2	-0.035***	-0.029***	-0.005	0.003
	(0.005)	(0.006)	(0.007)	(0.002)
3	-0.040***	-0.020	-0.014	0.005
	(0.011)	(0.012)	(0.013)	(0.004)
Observations	81,486	81,486	81,486	81,486
R-squared	0.807	0.859	0.837	0.804
F stat	16.61	10.78	0.501	0.778
Mean of dependent variable	0.863	0.586	0.579	0.0232
Panel C: Informal supervision				
	Non-health professional	Traditional birth attendant	Friend	Others
	(1)	(2)	(3)	(4)
Birth order (#)				
2	0.042***	0.018***	0.028***	0.006***
	(0.006)	(0.005)	(0.005)	(0.002)
3	0.051***	0.016*	0.040***	0.008**
	(0.012)	(0.009)	(0.009)	(0.003)
Observations	81,486	81,486	81,486	81,486
R-squared	0.841	0.811	0.852	0.794
F stat	18.91	7.138	13.09	4.999
Mean of dependent variable	0.255	0.108	0.173	0.0127

Note: The dependent variables in Panel A are whether the child was delivered in an institutional facility (column (1)), in a public hospital (column (2)), in other public health facilities (column (3)), or in a private hospital (column (4)), respectively. Public hospital category includes all government or municipal hospitals. Other public health facility category includes community health centres, public health centres, government dispensaries, urban health centres, or health subscentres. Private hospital category includes any private hospitals, maternity homes, clinics or any other private health facility. Institutional delivery is a dummy variable that is 1 if the child was born in a formal facility, including both public and private facilities. The dependent variables in Panel B and Panel C indicate the type of supervision received by the mother while delivering her child. Dependent variables in Panel B indicate if the child was delivered under the supervision of a healthcare personnel (column (1)), doctor (column (2)), nurse (incldiung an auxiliary nursing midwife, or an accredited social health activist) (column (3)), or any other medically trained health professional, respectively. Health professional is a dummy variable that is 1 if the delivery was assisted by either a doctor, or a nurse (including an auxiliary nursing midwife, or an accredited social health activist), or any other health personnel. Dependent variables in Panel C indicate if the child was delivered under the supervision of a non-healthcare personnel (column (1)), traditional birth attendant (column (2)), friend/relatives (column (3)), or any other non-health professional (column (4)), respectively. Each column represents regression results from a separate regression. Non-health professional is a dummy variable that is 1 if the delivery was assisted by a traditional birth attendant, or a friend/relative, or any other person. Each regression specification includes mother fixed effects, cohort-month-year and district-cohort-year fixed effect of the child's birth cohort, survey-round-year fixed effect, and an indicator for the child's gender. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.