Effects of birth order and son preference on utilization of pre- and post-natal health inputs in Punjab

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Abstract

The study planned to determine the roles of birth order and son preference on receiving prenatal, delivery care, and postnatal child health inputs, using cross-sectional data collected by the Multiple Cluster Indicators Study Punjab related to year 2011 from all districts of the Punjab province of Pakistan. Prenatal inputs, safe delivery care, and total child health inputs fall with higher birth order of the child, though these trends are diminished when household socioeconomic controls are added. Prenatal inputs increase with maternal education, household head education, and household wealth. Postnatal inputs have a weaker relationship with both birth order and maternal education. Safe delivery care and total health inputs are higher for families without a prior-born son, demonstrating son-biased fertility stopping behaviours by families.

Keywords: Maternal and child health services, Institutional delivery, Birth order, Gender, Educational status.

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Introduction

Recent research in India suggests that household allocation decisions are key to understanding child malnutrition; not only does height-for-age drop off more steeply with higher birth order (BO) in India than Sub-Saharan Africa, but investments in child and maternal health inputs decline with higher birth order (HBO) as well.[1] Research suggests that this is likely due to lower "take-up" of services with higher birth order as opposed to "access" to them, as access to these services should not vary substantially with birth order. With additional children, family size increases and there is less to spend on each additional child. This resource dilution tends to favour lower birth order (LBO) children at the expense of HBO children when families are unable to save, or if there are unexpected births.[1] Research based on data from the Pakistani province of Punjab also found that height-for-age, weight-for-age, and height-for-weight parameters fall with HBO, utilising data from the district-based Punjab Multiple Indicators Cluster Survey (2011).[2,3]

In addition, families may continue to have children until they achieve their desired number of sons, known as a son-biased fertility stopping (SBFS) rule. A 2017 study showed that parents invest more in prenatal inputs when they do not yet have a son in order to ensure the healthy pregnancy for - hopefully - their eldest son.[1] Research on data from India has shown that child health inputs, including vitamin supplementation and breastfeeding duration, favour male children, and this pattern is more evident once SBFS behaviours are considered.[4] A 2008 study found evidence of gender-selective abortions amongst Indian immigrants to the United States, but no gender gap in prenatal inputs for those pregnancies that are continued to term, except for higher-order births.[5] In rural India, a 2005 study found that girls were less likely to be immunised and that maternal education positively influences the decision to immunise.[6] It has been found in India and Pakistan that breastfeeding duration is longer for HBOs.[7,8] That first-born children receive more prenatal and postnatal inputs is also found in some developed countries.[9] There is some evidence that similar trends may also occur in Pakistan, as an analysis using the Pakistan Demographic and Health Survey (PDHS) found that girls in Pakistan were breastfed for shorter duration than boys, because parents want to try sooner for another child when a daughter is born and breastfeeding reduces fertility.[8]

The fact that the nutritional deficits between children in South Asia and in other populations are evident even at the age of one month suggests that genetics and / or investments before and around the time of birth may play a significant role in understanding child health in South Asia. The current study was planned to determine the roles of BO and son preference on receiving prenatal, delivery care, and postnatal child health inputs.

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Materials and Methods

The cross-sectional study was conducted at the Lahore School of Economics, Lahore, Pakistan, in 2018, after approval from the institutional ethics committee. Data used was taken from the district-based Punjab Multiple Indicators Cluster Survey (MICS-2011).[3] It included 36 districts and 150 tehsils or towns in urban and rural Punjab, with 95,238 households interviewed. The sample selection was designed by the Pakistan Bureau of Statistics (PBS) with technical advice from the United Nations International Children's Emergency Fund (UNICEF). The sample design was constructed in two stages: enumeration areas were chosen from 287 sampling domains, then 12 households were interviewed from each urban and 16 households from each rural enumeration block.[3]

Information on prenatal care and delivery was collected from women on their most recent birth. Before data cleaning, there were data on the number of prenatal visits for 20,530 women, number of tetanus shots from 19,467 women, place of delivery from 25,232 women, and on postnatal visits from 26,128 women. Information was collected on vaccination cards and vitamin A for children aged <3 years and on breastfeeding for children aged <5 years. Before data cleaning, data were available on breastfeeding for 66,657 children, on vaccination card possession for 39,003 children, and on vitamin A doses for 38,267 children. The current study dropped children whose mother was married for >15 years, as the data did not allow matching children aged >14 to their mothers, or to the necessary information for the creation of BO variable. Outliers, defined as children with height-for-age z-score > 5.99 or <-5.99, were also excluded.

According to MICS, mean number of prenatal visits was 4.5±2.87 and mean number of tetanus injections was 2.2±0.71 per pregnancy (Table 1).

The study first estimated the gradient, or slope, of each prenatal health input with respect to child BO while controlling for SBFS behaviours and cluster (enumeration area) fixed-effects. By using dummy variables for "2nd born" and "3rd+born", rather than a single BO variable, the study allowed for a more flexible, non-linear, relationship between BO and health inputs. The coefficients on these BO variables were expected to reveal how the usage of each health input differed for HBO children compared to the first-born. SBFS behaviour was considered present if the estimated coefficient on 'NoElderBro' was found to be positive and significant for prenatal inputs, as it indicated that parents were investing more in the current pregnancy with the potential to produce the couple's first son. The cluster fixed-effects for each enumeration area, defined as a neighbourhood, village, or locality, controlled for unobservable characteristics at the local level that were stable across time, such as health infrastructure and norms regarding their usage. Next, the study included controls for relevant child, parent and household characteristics. Gender and its interactions with BO were not considered in the analysis of prenatal inputs, under the assumption that most parents did not find out the gender of the baby in utero. The specification for prenatal health inputs, including controls for child, parent and household characteristics, was estimated using equation 1, based on a specification similar to one used in a 2017 study:[1]

$$Prenatal\ Input_{if} = \alpha_1 + \alpha_2 2^{nd}Born_{if} + \alpha_3 3^{rd}PlusBorn_{if} + \beta_2 NoElderBro_i + \gamma C_{if} + \lambda M_{if} + \theta_r + \epsilon_{ir}$$

where Prenatal Input was either a count variable, when considering the number of prenatal visits and number tetanus shots, or a dummy-dependent variable taking a value of one if the mother / child received the input, including delivery at a health facility or a postnatal visit; 2^{nd}Born was a dummy variable for a child born at second birth order; 3^{rd}PlusBorn was a dummy variable for children born at third BO and higher;

$\alpha_{2,3}$ were coefficients to measure how the receipt of a health input differed with BO 2 and 3+ respectively compared to the first-born, $NoElderBro_i$ was an indicator variable, taking value=1 if the child had no elder brother, to account for SBFS; C was a vector of child-level controls, M was a vector of mother controls, H was a vector of household controls, and θ_r were cluster-fixed effects.

Postnatal inputs can vary by gender either because child needs are dissimilar by gender or because household

Table-1: Summary Statistics for Pre- and Post-natal Health Inputs.

Variable	Observations	Mean±SD	Min	Max
Total Prenatal Visits	17,649	4.5±2.87	0	36
Total tetanus doses	16,795	2.2±0.71	0	7
Delivery at health facility?	21,116	0.57±0.49	0	1
Postnatal check-up at health facility?	21,049	0.41±0.49	0	1
Ever breastfed?	52,084	0.96±0.19	0	1
Vaccination card?	32,172	0.37±0.48	0	1
Vitamin A dose in last 6 months?	31,396	0.67±0.47	0	1
Sum Total Health Inputs	14,295	3.84±1.43	0	7

decisions about resource allocation differ by gender. Therefore, a gender dummy for girls and interaction terms of gender and BO were included in addition to the variables in the equation cited above in order to capture the possibility that BO effects vary with the gender of the child. Eldest son bias was considered present if the estimated coefficient on NoElderBro was positive and the coefficient on 'girlxNoElderBro' was negative. The coefficient on girlxNoElderBro could also be negative when SBFS diluted the household resources available to daughters.

The study estimated a linear probability model (in case Prenatal Input was a dummy dependent variable) or Ordinary Least Squares (in case Prenatal Input was a count variable) with and without controls for child, parent and household characteristics. The specification for postnatal health inputs, including the controls for child, parent and household characteristics, was estimated using equation 2, based on a specification similar to one used in a 2017 study:[1]

$$\text{Postnatal Input}_{if} = \alpha_1 + \alpha_2 2^{nd}Born_{if} + \alpha_3 3^{rd}PlusBorn_{if} + \beta_1 girl_{if} + \beta_2 NoElderBro_{if} + \beta_4 girlxNoElderBro_{if} + \gamma C_{if} + \lambda M_{if} + \theta_r + \epsilon_{ir}$$

where Postnatal Input was a dummy-dependent variable, taking a value of one when the child had received a postnatal input, which included ever breastfed, have a vaccination card, and received a vitamin A dose in the preceding six months.

A regression was included for total child health inputs, which is a summary measure of the prenatal and

Table-2: Birth Order Gradient of Prenatal Health Inputs and Delivery Care.

	Total prenatal visits		Total Tetanus shots		Delivery at Health Facility		Post-natal visit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2nd born	-0.32***	-0.14	-0.04*	0.15*	-0.08***	-0.1*	-0.06***	-0.17***
	(0.07)	(0.33)	(0.02)	(0.09)	(0.01)	(0.051)	(0.01)	(0.05)
3rd+ born	-0.57***	-0.26	-0.03	0.16*	-0.16***	-0.15***	-0.12***	-0.21***
	(0.08)	(0.331)	(0.02)	(0.09)	(0.01)	(0.051)	(0.01)	(0.05)
No elder brother	0.11	0.07	0.02	0.02	0.02**	0.017*	0.02*	0.02
	(0.07)	(0.07)	(0.02)	(0.02)	(0.01)	(0.010)	(0.01)	(0.01)
Girl							-0.02	-0.02*
							(0.01)	(0.01)
Girl*No elder brother							-0.01	-0.01
							(0.02)	(0.02)
Mother prim ed.		0.13*		0.00		0.05***		0.06***
		(0.070)		(0.02)		(0.01)		(0.01)
Mother middle school		0.31***		-0.02		0.09***		0.067***
		(0.09)		(0.02)		(0.01)		(0.01)
Mother sec ed.		0.58***		-0.03		0.14***		0.12***
		(0.08)		(0.02)		(0.01)		(0.01)
Mother ed.> sec		0.98***		-0.02		0.15***		0.15***
		(0.1)		(0.03)		(0.02)		(0.02)
HH head prim ed.		0.080		0.002		0.015		0.015
		(0.071)		(0.019)		(0.011)		(0.011)
HH head middle school		0.185**		0.019		0.010		0.010
		(0.077)		(0.021)		(0.012)		(0.012)
HH head sec ed.		0.216***		0.002		0.035***		0.036***
		(0.072)		(0.020)		(0.011)		(0.011)
HH head ed.> sec		0.319***		-0.017		0.063***		0.062***
		(0.093)		(0.025)		(0.015)		(0.015)
Wealth score		0.744***		0.027*		0.134***		0.123***
		(0.051)		(0.014)		(0.008)		(0.008)
Observations	17,649	17,411	16,795	16,576	21,116	20,799	21,049	20,733
R-squared	0.01	0.082	0.001	0.008	0.028	0.106	0.016	0.079
Number of HH	6,483	6,455	6,370	6,338	6,752	6,725	6,749	6,722

HH: Household

Source: Authors' calculations; Note: The sample comprises the most recent pregnancy. Standard errors are clustered by enumeration cluster and appear in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1.

postnatal inputs based on the number of prenatal visits and tetanus shots, delivery at a health facility, postnatal visit, breastfeeding, vaccination card, and vitamin A dose. Except for prenatal visits and tetanus shots, all other variables took values of 0 or 1 and were summed. The number of prenatal visits and tetanus shots variables were converted to comparable variables by creating new variables that take a value of 1 if the child's value was greater than the median and 0 otherwise. These converted variables for prenatal visits and tetanus shots were added to the sum of the five other inputs. This way, the total child inputs variable was created, taking a minimum value of 0 and a maximum value of 7. Stata 14 was used for data analysis.

Results

In equation 1, there was a negative BO gradient for the number of prenatal visits, delivery at a health facility, and postnatal visit. When pregnant with a second-born child, the number of prenatal visits a mother received fell by 0.32 visits; in other words, the second-born received nearly one-third of a prenatal visit less as compared to the first-born when most controls were excluded from the model (Table 2, Column 1). This drop increased to 0.57 visits (just over half of a visit) on average for the third-born or HBO. The birth-order gradient became statistically non-significant when household controls were added (Table 2, Column 2). This implied that the fall in prenatal visits with HBO was related to low socio-economic status of the households. There was little, if any, BO gradient in the number of tetanus injections until household controls were added, after which the gradient became positive so that mothers received more of them with later-born children (Table 2, Columns 3-4). The most important factor related to the frequency of prenatal visits was maternal education. Amongst the other control variables included in the regression in Table 2, wealth and household head's education were also positive and significantly related to prenatal visits ($p<0.05$). Specifically, the number of prenatal visits were higher when the household head had completed middle school (+0.19 visits), secondary school (+0.22 visits), or more than secondary schooling

Table-3: Effects of Birth Order on Postnatal Inputs.

	Ever breastfed?		Vaccination card?		Vit A last 6 months?		Total child inputs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2nd born	0.02***	0.02***	-0.04***	-0.05***	0.01	0.01	-0.14***	0.14
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)	(0.2)
3rd+ born	0.02***	0.02***	-0.06***	-0.08***	-0.01	0.02*	-0.32***	0.03
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.05)	(0.2)
Girl	-0.00	-0.00	-0.01	-0.01*	0.00	0.01		
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)		
No elder brother	-0.00	-0.00	0.01	0.00	0.02*	0.01	0.11***	0.08**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)	(0.04)
No elder bro x Girl	0.00	0.00	-0.00	0.00	-0.01	-0.01		
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)		
Mother primary ed.		0.00		0.04***		0.01*		0.15***
		(0.00)		(0.01)		(0.01)		(0.04)
Mother middle school		-0.00		0.04***		0.02		0.21***
		(0.00)		(0.01)		(0.01)		(0.05)
Mother secondary ed.		0.01*		0.04***		0.01		0.35***
		(0.00)		(0.010)		(0.01)		(0.05)
Mother ed.>secondary		0.01**		-0.00		0.01		0.39***
		(0.00)		(0.01)		(0.01)		(0.05)
Observations	52,084	51,428	32,172	31,831	31,396	31,064	14,295	14,209
R-squared	0.00	0.01	0.00	0.07	0.00	0.31	0.02	0.15
Number of HHs	7,132	7,122	7,003	6,991	6,986	6,972	6,040	6,017

HH: Household

Source: Authors' calculations

Note: The sample comprises: for breastfeeding, all children 0-59 mo; for vacc card and vit A, all children up to 36 mo. Total child health inputs data is available for latest pregnancy if child <36 months. It is a summary measure of the prenatal and postnatal inputs based on: the number of prenatal visits and tetanus shots, delivery at a health facility, postnatal visit, breastfeeding, vaccination card, and vitamin A dose, with a minimum value of 0 and a maximum value of 7. Standard errors are clustered by enumeration cluster and appear in parentheses. Asterisks denote level of significance *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The sample of children was restricted to those whose parents were married for 15 years or less only.

(+0.32 visits), as compared to household heads with less than primary school. In addition, an increase in one standard deviation of the wealth distribution was associated with an increase of 0.75 visits. There were also negative BO gradients for likelihoods of delivery in a health facility (Table 2, Columns 5-6) and a postnatal visit (7-8), such that later-born children were less likely to receive these inputs, regardless of whether or not household controls were included in the model. Only in the case of a postnatal visit did the BO gradient become steeper when controls were added. More educated mothers were more likely to deliver in a health facility and to attend a postnatal visit (Table 2, Columns 6, 8). Mothers without a son were 2.4 percentage points more likely to deliver in a health facility (Table 2, Column 5) and daughters were about 2 percentage points less likely to receive a postnatal visit (Table 2, Column 8). There was a small positive BO gradient for the incidence of breastfeeding, and later-born children were more likely to be breastfed (Table 3, Column 1-2). We did not have data on how long each child was breastfed, only whether the child was ever breastfed. There was a shallow, negative BO gradient for having a vaccination card (Table 3, Column 3-4), but there was no clear relationship between vitamin A doses and BO (Table 3, Column 5-6). There also seemed to be no substantial gender discrimination in any of the specifications for postnatal inputs, given that the coefficient on "girl" was insignificant in all but vaccination card, and, even then, it was a small coefficient (Table 3, Column 1-6).

The size and statistical significance of BO gradients in postnatal investments (Table 3, Columns 2, 4, 6) did not change much when household level controls were added, nor was the impact of maternal education very strong.

Finally, the summary measure of all child health inputs related to BO were analysed (Table 3, Column 7-8). Gender was excluded since three out of the seven inputs were determined prenatally, before the child's gender was known to most parents.

Discussion

On average, a child in Punjab was 1.46 standard deviations below the median in height-for-age compared to a reference group child of the same age and gender in 2011. In contrast, the average z-score was -1.51 for children in India and -1.35 in Sub-Saharan Africa.[1] Despite being between India and Africa in height-for-age measures, the level of several child health inputs, like number of prenatal visits, tetanus shots, delivery at a health facility, and postnatal visit, scored higher in Punjab.

For instance, the number of prenatal visits were around 3.8 and 4 for Sub-Saharan Africa and India respectively, and for the number tetanus shots, the figures were 1.4 and 1.8.[1] The likelihood of delivering in a health facility was higher for Punjab than both Sub-Saharan Africa (0.47) and India (0.45) as well.[1] For prenatal visits regarding tetanus shots, the BO gradient in Punjab was shallower than both India and Sub-Saharan Africa.[1] The BO gradient was at par with Africa and less steep than India for delivery at a health facility. Only for postnatal visits did the likelihood in Punjab fall more quickly with BO than India and Africa.[1]

Similar to India,[1] the current study found the first son receiving more health inputs, suggesting SBFS behaviours at play (Table 3, Column 7-8).

Even though Punjab did relatively better in providing child health inputs than the comparison groups of India and Sub-Saharan Africa,[1] the effort did not translate into better outcomes in one of the most important measures of long-term child nutritional status, that is, height-for-age.

In terms of limitations, only data from Punjab was used by the current study, which means the findings cannot be generalised to the whole country.

Conclusion

Maternal education was found to be a very important determinant, and to a lesser extent, wealth and household head's education in eliminating the relationship between HBO and lower usage of prenatal and delivery care services. On the other hand, postnatal inputs were less related to both BO and household characteristics. Health workers providing prenatal care might have a role in encouraging the use of critical services.

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