The impact of Birth spacing, Birth order and meta son-preference in explaining prevalence of underweight among children: Evidence from India

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Abstract

Malnutrition is an informative health indicator and one of the major health issues in India. One of the key channels it operates is through undernutrition or underweight among children. More than half the deaths among the ages of zero-to-five-year Indian children are associated with malnutrition. The country also falls in the category of highest percentiles of malnutrition children among the developing world (UNICEF 2002). This paper has used National Family Health Survey 4 (NFHS)2015-2016 data to understand possible channels that cause children to be underweight in India. Our findings reveal that higher birth order and lower birth spacing is associated with higher probability of children being underweight. The reasons for higher birth order as we understand from our analysis could be due to meta son preferences that exist in Indian households.

1 Introduction

Child malnutrition is a chronic problem and long-lasting challenge. The first National Health Survey in 1992-1993 found that India was the worst performing country on child health indicators. The Survey had concluded that more than half the children four were underweight and stunned. One in every six children was wasted. According to the Global Hunger Index (2020), India placed at the 94th spot among 107 countries. The Global Hunger Index was calculated on the basis of undernourishment of the population, child stunting, wasting and child mortality. The bane of child and maternal malnutrition is responsible for 15% of India's total disease burden. The fourth round of NFHS which was conducted in 2015-2016 shows that the prevalence of underweight, stunted and wasted children under five was at 33.5, 38.4 and 21.0 %.

Many children in India remain under-nutrition especially in the critical age for growth, which is an important cause of children being underweight. It is not only poor nourishment, but also other factors like substandard health care facilities, exposure to communicable disease and fertility decisions that gives rise to millions of children worldwide who face short term effects through wasting and being underweight and stunting in the long term. This paper examines the effect of higher birth order and lower birth spacing on underweight in children.

We build on existing literature to show that higher birth order does correlate with children at a higher order being underweight. Furthermore, lower birth spacing in violation of WHO norms also increases the probability of children being underweight. A possible channel through which this could affect the probability of being underweight is the gendered dimension. When looking at the birth spacing channel, we find that if the previous child is female, then preceding birth interval decreases.

Our paper, however, suffers from endogeneity as it fails to use any of the causal frameworks and the estimates can be best understood as correlations. The identification for analysing the causal effect of any public works program including birth order effects/birth spacing is a challenging task primarily due to the heterogeneity that exists not only at the household level but also at state and community levels. Furthermore, most of the programs or policy experiments conducted by the government facilitate or target a certain group, community leaving randomised controlled experiments impossible. However, we try to reduce endogeneity in our estimates wherever possible with a scope to improve on our results and estimation strategy in the future.

The rest of the paper is organised in the following ways: The section 2 provides literature review, which adds information of different papers on the same topic and prevalent research. Section 3 explains our data, variables and methodology. The section 4 illustrates the results of the paper. Section 5 shows the effects of the previous child being female on birth spacing. The section 6 provides conclusion, limitation and policy implication. In the appendix of the paper the summary statistics and regression tables have been added. The paper ends by showing the references which were used for this paper.

2 Literature Review

To make the hypothesis more stronger we have found literature reviews from different papers on the same topics. Most of the evidence is done in developing countries. From the below paper fews are empirical and some of them are theoretical. These papers show that malnutrition increases after less birth interval and birth spacing.

The paper (**Gendered Effects of Siblings on Child Malnutrition in South Asia: Cross-sectional Analysis of Demographic and Health Surveys from Bangladesh, India, and Nepal)** **,** analyses effect of number and sex of siblings on malnutrition of boys and girls under-5 in South Asia. Using multinomial logistic regression to assess the relationship between number and sex of siblings and malnuitrition outcome. The variables for malnutrition outcomes are wasting, stunting, underweight: based on anthropometric data. The author describes that having more male siblings and more female siblings increased the odds of stunting for boys and girls. But the effect of more than three sisters on severe stunting was significantly stronger for girls than boys. For underweight three or more sisters increased the odds for underweight girls. Having brothers heightens girls' risk for acute malnutrition. On the other hand, multiple sisters increase girl risk for chronic malnutrition. Boys malnutrition are less after siblings. The finding of the paper suggests that son preference, daughter aversion may affect child malnutrition in South Asia.

Another main view in the literature is about physical growth and development. Paper by **Mithun Kumar Acharjee, Md. Nuruzzaman Forhad and Kumar Pial Das** on **(Trend of Birth Spacing Impact on Physical Growth of Children under Age Five: An Analysis Based on Bangladesh Demographic and Health Surveys).** The paper focuses on physical growth and development of a young child during the first few years of life is influenced by many factors including birth spacing. Because a healthy child is vital for quality of life, attaining good health and national productivity. The paper depicts that the spacing between pregnancies can have important health complications for the mother's baby. But the short birth interval should be avoided since a short birth interval increases the risk of intrauterine growth radiation and adversely affects infant nutrient stores at birth and nutrient delivery via breastfeeding. Getting Pregnant within a year of giving birth, increases the risk of low birth weight, uterine rupture, preterm birth and even infant death. Thus the paper emphasizes the issue of low birth spacing is one of the primary reasons for the next birth to be stunted as well as underweight.

Authors, **Agustin et al(**2006), shows that longer and shorter intervals between pregnancies have been associated with increased risk of several adverse perinatal outcomes, such as preterm birth, low birth weight, small for gestational age and perinatal death. The paper argues that short intervals between pregnancies merely designate women at higher reproductive risks, either because of underlying disorders, socioeconomic status or lifestyle factors. The finding of the paper shows that infants born women with interpregency intervals shorter than six months had pooled unadjusted ORS (95% CIs) of 1.77 (1.54-2.04), 2.12 (1.98-2.26), and 1.39 (1.20-1.61) for preterm birth, LBW and SGA respectively compared with infant born to women with intervals of 18 to 23 months. Similarly women with intervals of 6 to 17 months were 8% to 23% more likely to give birth to infants with these adverse outcomes.

Another paper by **Alison and Stephenson on Birth Spacing, Sibling rivalry and child mortality in India** examines the impact of the length of the preceding birth interval on under-two mortality in India. It examines the pathways through which short preceding birth intervals may lead to an increased risk of mortality. The results depict that short preceding birth intervals (o to18 months) are associated with an increased risk of mortality in all three age groups and the effect is particularly marked in the early post-neonatal period. Significant interactions were found between the length of the preceding birth interval, gender and the survival status of the previous child. The significance of these interactions varied with the age of the child. There is evidence to suggest that sibling rivalry is a pathway through which short birth intervals influence mortality, with the death of the previous sibling removing the competition for scarce resources. This results in lower risks of mortality than if the previous sibling was still alive. The greatest risks of an infant following a short birth interval are among those whose previous sibling died, high parities, those with young mothers, and those whose previous sibling was breastfed for a short duration.

The paper by **(Hantamalala Rafalimanana and Charles F. Westoff 2009),** hypothesized that people prefer to avoid short intervals, and if these aspirations are realized, maternal and child mortality and morbidity would reach lower levels, in light of the well-documented the potential effect of spacing preferences on the level of fertility and on the prevalence of short (less than 24 months) birth intervals and child malnutrition are greatest. The covariates of the preferred birth interval have been examined. The paper observed a sharp decline in fertility recently experienced through this research.

A contrary paper by (Coffey, Dean 2021) on a novel fact about neonatal death, or death in the first month of life. Authors identified a large effect of birth order on neonatal mortality that was unique to India. Later born siblings have a steep survival advantage relative to the birth order in the developing countries. The paper shows India's high prevalence of maternal undernutrition. Authors find that Indian mothers exit the underweight body mass at an internationally comparatively high rate as they progress through childbearing.

4 Data

This paper uses National Health and Family Survey 2015-16(NFHS-4) that was conducted under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India. The pan-India survey collects data in a sample size of approximately 572,000 households on a wide spectrum of indicators ranging from population, health and nutrition. For our analysis, we use the Child data comprising data of children below the age of 5.

The sample provides data on both total number of children born and total number of children alive. We restrict our study to only the children alive as the death of previous children could be attributed to various other factors not discussed in this paper- although we do use dead sons as one of the dependent variables in our analysis (Refer to section 3). The latter part of our analysis covers only certain states and only rural areas as we were interested in identifying meta son preference causal channels in explaining underweight among children. Table 1 in the appendix lists the variables we have incorporated in our study.

underweight: As the WHO states, undernutrition can manifest itself in four ways: wasting, stunting, underweight and micronutrient deficiencies. We use underweight as our main variable of interest because there is very limited research in the literature on the same. Most of the work has been on stunting and wasting that manifest itself in the long run whereas underweight reacts to short term behaviour. A child who is underweight may be stunted, wasted or both and thus targeting underweight early on could have spillover effects on other measures of malnutrition as well. Therefore, underweight becomes an important measure at a policy level. A child under 5 is believed to be underweight if their weight for age falls below -2 standard deviations from the median of the World Health Organisation's child growth standards. Our *underweight* variable is a dummy which takes the value of 1 if the weight to age ratio falls below -2 as defined by WHO, otherwise takes the value 0.

birth_interval_cat: The interval between two subsequent pregnancies is captured by the *birth_interval_cat* variable. Shorter intervals between two pregnancies impact the health of the mother which would in turn translate to poor health outcomes for the child. According to WHO, a minimum of two years must be followed between two pregnancies(WHO, 2005). We construct the variable using the preceding birth interval that is given in months in the data. Furthermore, we categorise this variable into four categories to capture the function birth spacing could play in understanding underweight. As the table suggests, 17.8% of the pregnancies happen within 24 months in direct violation of the WHO guidelines.

Birth_order_cat: The children in our dataset have been categorized into five levels of birth order. Category 1 refers to firstborn, category 2 refers to second born and so on with category 5 alluding to a birth order greater than or equal to 5. 36.9% of the children are first born children with the proportion of children falling subsequently in each category.

wealth_index, religion_cat, female, rural: We directly use the wealth index in our categorisation of households in different income brackets based on NFHS findings. We also construct a dummy for females, as there could be gender based discriminations and postpartum care given to children thus impacting undernutrition. We use the religion variable to further create categories taking into account any social factors that may also cause higher birth order or lower birth spacing among pregnancies. These could also allude to stereotypes and other unmeasurable differences among religions(Jayachandran and Pandey,2017) and if at all their potential impact that may bias our results and needs to be controlled for. *Rural* dummy controls for the place of residence that can explain differences in access to healthcare, nutritional food and other factors that may affect underweight among children.

unwanted, previous child female and *contraception*: All these are dummy variables that characterise parent preferences and behaviour further influencing birth order and birth spacing. *Unwanted* takes the value one if the previous child was not wanted and 0 otherwise. An unwanted child might not receive the care needed during pregnancy and thus increase the chances of being undernutrition. 8.97% of the children in our sample were not wanted when they were born. *pre_female* takes the value 1 if the previous child was female and 0 otherwise. *contraception* takes the value 1 if the parents use some form of contraception traditional or modern and 0 otherwise.

Other covariates: We include other variables such as mother's bmi(proxy for mother's health), mother's age, if the household follows open defecation, number of antenatal care visits(takes the value 1 if at least 4, 0 otherwise) education level and exposure to any form of media on family planning. We believed that all these variables would impact our findings and thus controlled for them to reduce bias.

5 Empirical Strategy

Our analysis can be broken down into two stages. In the first stage we attempt to understand the various factors that lead to underweight children under the age of 5. Thereafter, we try to identify one of the causal channels that induce higher birth order or lower birth spacing and suggest policy measures that can be taken to tackle those.

We set up a linear probability model to estimate the effects of birth order and birth spacing between last two pregnancies on underweight as our dependent variable. Our hypothesis is that higher birth order and shorter birth spacing make a child more likely to be underweight. Our main estimating equation is

underweightkd=0+i=14ibirth intervalid+j=25jbirth order+3last female+kXkd+d+kd (1)

last_female has been used to identify any meta son preferences in household decision making. It is a dummy variable that takes the value 1 if the last child in the household was a female and 0 if male. Xkd are all the covariates included to reduce bias in our main estimating variables and d are the district fixed effects to cover any heterogeneity in omitted variables among different districts. Furthermore, we cluster at the district level to have more robust standard errors.

We hypothesize that as i increases, it should be negatively correlated with underweight, j should be positively correlated and 3 also negatively correlated as wanting for a son should cause more underweight.

6 Results

The estimates from equation 1 have been presented in Table 2. We can observe that as the birth order increases, the chances of a child being underweight also increases. Our finding from the second estimating variable birth interval is also consistent with our initial hypothesis and we do see that as the birth spacing increases, the probability of a child being underweight also reduces. Our column 1 gives the values of our coefficients without adding any controls and shows strong correlations between our variables. On adding controls, district fixed effects and clustering the standard errors at the district level we see that the values of our coefficients decrease, reducing the bias but still remain statistically significant. The results on column 1 of table 2, without controls, establish the strong correlation between birth order and being underweight.Moreover, birth spacing category variable shows maternal health channel where longer intervals enable the mother to get sufficient time to replenish her lost strength and health lost in the preceding pregnancy. Shorter intervals leading to poor health of the mother is likely to translate to poor health outcome of the succeeding child.

We can also see that the last_female variable is negatively correlated with underweight and statistically significant in the first two columns. This means that the impact of the last child being female decreases the probability of a child being underweight.With controls, the coefficient is less significant. Households with son-meta-preference are likely to have underweight children because they care more about having male children as opposed to the consequences of multiple pregnancies. This also leads to skewing the sex ratio with more unwanted female children and they could be discriminated in resource allocation, making them more likely to be underweight.

Furthermore, our estimates becoming significant could also be due to the fact that our analysis corresponds to pan India survey values. There are certain states that perform much better than others and thus could lead to biasing our results.

Our other control variables affect the probability of being underweight as we hypothesized. The wealth index gives a disproportionate impact on poorer households compared to comparatively richer households. Open defecation and unwanted child after controlling for fixed effects increase the probability for a child being underweight.

The study adds to the literature by examining the impact of birth order, birth spacing and the sex of the preceding child on being underweight in India. The result of this study supports the hypothesis - that an increased birth order, decreased birth spacing and when the last-born child is a male, the probability of children being underweight in India increases. Further, the paper produces evidence to support the trends outlined in the wealth of literature already available. However, while it attests to the trends found in the existing literature, this paper tries to look at the impact of all three factors (birth order, birth spacing and last child being male) on being underweight.

Limitations and Conclusions

As stated earlier, our paper suffers from the problem of endogeneity and none of our results can be substantiated in the light of causal implications. However, the paper leaves a lot of scope for further research and policy to combat meta son preferences that exist in the Indian households. As we do a pan India survey, our estimates might also not give very strong suggestive implications for states more impacted by meta son preferences and higher birth order.

Sex ratio at last birth has been used to identify the male child preference which looks at the sex of the last child for a woman with completed fertility. But we take a simplistic approach by using the sex of the last born as a proxy for son-preference. However, it can be possible that our variable is not a very good proxy.

Lastly, there are a lot of policies that are being implemented at the central and state level that still remain left to be evaluated. Schemes like beti bachao, beti padhao that started in Haryana Sukanya Samridhi Yojna, Kanyashree and many more, which aims at women empowerment and equality among the two genders could potentially change and in fact transform the way household preferences are made. With NFHS 5 being conducted in 2021, a long panel data could be used evaluating their impact much more rigorously.

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Appendix

Table-1 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
underweight	.	.	.	.	.
0	222596	.655	.476	0	1
1	222596	.345	.476	0	1
birth interval cat	.	.	.	.	.
1	242698	.178	.383	0	1
2	242698	.194	.396	0	1
3	242698	.11	.313	0	1
4	242698	.517	.5	0	1
birth order cat	.	.	.	.	.
1	245081	.369	.482	0	1
2	245081	.31	.462	0	1
3	245081	.161	.368	0	1
4	245081	.08	.271	0	1
5	245081	.08	.272	0	1
unwanted	.	.	.	.	.
0	245081	.897	.303	0	1
1	245081	.103	.303	0	1
rural	.	.	.	.	.
0	245081	.239	.426	0	1
1	245081	.761	.426	0	1
religion cat	.	.	.	.	.
1	245081	.721	.449	0	1
2	245081	.157	.364	0	1
3	245081	.082	.274	0	1
4	245081	.04	.195	0	1
head female	.	.	.	.	.
0	245081	.88	.325	0	1
1	245081	.12	.325	0	1
contraceptive	.	.	.	.	.
0	245025	.6	.49	0	1
1	245025	.4	.49	0	1
family planning info	.	.	.	.	.
0	245081	.442	.497	0	1
1	245081	.558	.497	0	1
female	.	.	.	.	.
0	245081	.523	.499	0	1
1	245081	.477	.499	0	1
last female	.	.	.	.	.

Male	245081	.532	.499	0	1
Female	245081	.468	.499	0	1
pre female	.	.	.	.	.
Male	69637	.482	.5	0	1
Female	69637	.518	.5	0	1
wealth index	.	.	.	.	.
poorest	245081	.261	.439	0	1
poorer	245081	.236	.424	0	1
middle	245081	.2	.4	0	1
richer	245081	.167	.373	0	1
richest	245081	.136	.343	0	1
bmi scaled	242147	21.293	4.578	12.02	99.98
birth weight scaled	245081	4.582	3.127	.5	9.998
women's age in years (from house	245081	27.198	5.138	15	49

Table 2: Explaining stunting in children

	(1) Underweight	(2) Underweight	(3) Underweight	(4) Underweight
Third order birth	0.00436	0.00179	0.0103**	0.0103**
	(0.00378)	(0.00410)	(0.00418)	(0.00430)
Fourth order birth and above	0.0352***	0.0187***	0.0253***	0.0253***
	(0.00455)	(0.00505)	(0.00515)	(0.00525)
5	0.0686***	0.0415***	0.0461***	0.0461***
	(0.00459)	(0.00569)	(0.00588)	(0.00620)
2-3 year interval	-0.0262***	-0.0283***	-0.0240***	-0.0240***
	(0.00329)	(0.00321)	(0.00317)	(0.00315)
3-4 year interval	-0.0582***	-0.0501***	-0.0392***	-0.0392***
	(0.00385)	(0.00379)	(0.00375)	(0.00382)
more than 4 year interval	-0.106***	-0.0738***	-0.0474***	-0.0474***
	(0.00356)	(0.00364)	(0.00364)	(0.00366)
Last child is female	-0.0128***	-0.00885***	-0.00329	-0.00329
	(0.00202)	(0.00281)	(0.00277)	(0.00279)
poorer		-0.0831***	-0.0566***	-0.0566***
		(0.00284)	(0.00301)	(0.00340)
middle		-0.143***	-0.103***	-0.103***
		(0.00306)	(0.00357)	(0.00398)
richer		-0.188***	-0.139***	-0.139***
		(0.00341)	(0.00423)	(0.00468)
richest		-0.241***	-0.183***	-0.183***

		(0.00392)	(0.00501)	(0.00537)
Rural		-0.0335***	-0.0227***	-0.0227***
		(0.00263)	(0.00279)	(0.00327)
Unwanted child		-0.00826**	0.00195	0.00195
		(0.00330)	(0.00330)	(0.00366)
Female		-0.00546*	-0.0100***	-0.0100***
		(0.00280)	(0.00276)	(0.00307)
Mother's BMI		-0.0108***	-0.00922***	-0.00922***
		(0.000225)	(0.000225)	(0.000427)
women's age in years (from household questionnaire)		0.0000619	-0.000924***	-0.000924***
		(0.000253)	(0.000273)	(0.000306)
Birth weight in kilograms		-0.00175***	-0.00181***	-0.00181***
		(0.000338)	(0.000361)	(0.000425)
edu_level			-0.0461***	-0.0461***
			(0.00381)	(0.00377)
open defecation			0.0200***	0.0200***
			(0.00286)	(0.00314)
Child age (in months)			0.00234***	0.00234***
			(0.0000633)	(0.0000802)
Observations	220527	219976	219935	219935
Mean of Dep. Variable	0.344	0.344	0.344	0.344
SD	0.475	0.475	0.475	0.475
District FE	No	No	Yes	Yes
Clustered	No	No	No	Yes

Standard errors in parentheses
Note: Standard errors are clustered at the district level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$