Effects of Birth Order on Child Nutritional Status

By

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ABSTRACT

Birth order and the associated parental discrimination are evidenced to detrimentally affect a child's long-term nutritional status. This research explores the in depth role of birth order in determining child nutritional status through a between- and intra- family analysis of stunting, wasting, and underweight in children. It further tries to evaluate whether the child's height-for-age varies with gender; and if the drop off in height with each additional birth order can be attributed to pre and post natal health disinvestments in pregnancies and births. The Punjab Multiple Indicator Cluster Survey for 2011, a household-level dataset gathered by the Punjab Bureau of Statistics, provides our sample data. The results of this study imply that birth order has negative effects on child health, with child height and weight gradient monotonically declining with increasing birth order children. Moreover, birth order effects become stronger in larger families, even after controlling for birth spacing. Yet, we find only limited evidence of gender based postnatal disinvestment on mothers in household fixed effects regressions, while no gender specific effects were observed for child health investments.

JEL classifications: D03, D10, D19, I10, I14.

Keywords: Birth order, child health, nutritional status, parental preferences, mother-fixed effects, health investments.

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Abbreviations

CNS	Child Nutritional Status
BO	Birth Order
RBO	Relative Birth Order
HFA	Height-for-Age
WFA	Weight-for-Age
WFH	Weight-for-Height
MICS	Multiple Indicators Cluster Survey
OLS	Ordinary Least Squares
2SLS	Two Stage Least Squares
MFE	Mother Fixed Effects
FFE	Family Fixed Effects
WHO	World Health Organization
NCHS	National Center for Health Statistics

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1. Introduction

1.1 Background and Evolution

A third of total child deaths every year can be attributed to the issue of malnutrition - a "silent killer" (UNICEF, 2012). Despite the alarming statistics, it is still under-recognized and in fact invisible when it comes to the underlying causes of child deaths; hence, referred to as the 'silent killer'. According to the World Health Organization (2013) child growth is known to have become a global measure of children's nutritional status, and the three most widely used indicators of poor growth include the states of being: "stunted", "wasted", and "underweight". Stunting is a case of chronic malnutrition where a child is too short for his/her age; wasting is an acute malnutrition case where the child is too thin for his/her height; and underweight is a state that can be found in both of the other types of malnutrition (Save the Children, 2012).

Out of the three measures, researchers give more importance to stunting, as it is a composite, yet cumulative indicator of nutritional status of children from preconception phase to almost two years of age. Hence, the adverse effects reflected through stunting continue for life, making these children more vulnerable to repeated bouts and enduring threats of infections and diseases. Globally, 80% of the stunted children reside in only 20 countries (Save the Children, 2012). The situation calls for a health emergency to be declared in South Asia as it is home to the worst rates of child malnutrition in the world, with the three countries i.e. India, Pakistan, and Bangladesh accounting for more than half of the world's malnourished children (Mehrotra, 2006).

The majority of the available literature uses common indicators of measuring child malnutrition, which are represented as deviations of a child's long term and current nutritional status from the household mean values, as measured by the z-scores of height-for-age (HFA) weight-for-height (WFH), and weight-for-age (WFA) (see, for instance, Jayachandran and Pande, 2013; Horton 1998; Dance, Rammohan, and Smith, 2008). HFA is common proxy for stunting or long term nutritional status, WFH proxies for wasting or current nutritional status of an individual child, and WFA proxies for the condition of a child being underweight.

In Pakistan, 1200 children under the age of 5 years die every day and 35% of these deaths occur due to malnutrition (UNICEF, 2012). According to recent statistics by WHO (2013) and UNICEF (2012), approximately 43% of Pakistani children under the age of 5 are stunted, 14.8% wasted, and 30.9% underweight. Anthropometry results from the Pakistan National Nutrition Survey (2011) clearly indicate malnutrition to be a more severe problem in rural as compared to urban areas. For instance, of the stunted children, around 46.3 % are found in rural and 36.9% in urban areas across country. Details of the remaining indicators are shown in Figure 1.

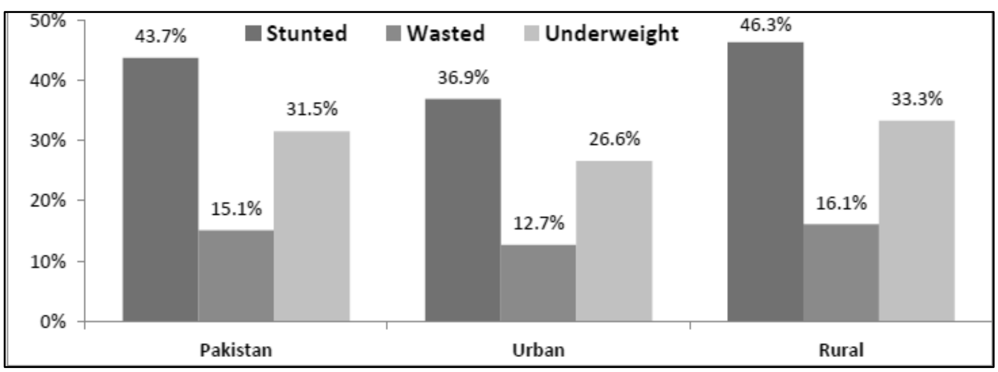

***Figure 1*. Bar graph showing Prevalence of Malnutrition in Pakistan of children less than 5 years of age. From Pakistan National Nutrition Survey, 2011, p.35.**

The importance of studying the effect of birth order on child nutritional status is driven by the role of household decision-making processes and the impact in turn that child malnutrition has on long term outcomes. Firstly, child nutritional status is an indicator of inequalities in household resource allocation (Horton, 1998). Similarly, Jayachandran and Pande (2013) are of the view that household allocation decisions are the most important in driving child malnutrition. Secondly, according to Das Gupta (1987), birth order and the associated parental discrimination, though mostly concentrated in childhood, detrimentally affect a child's long-term nutritional status. This implies that the damage done through malnutrition in the early years of life is largely irreversible, resulting in hampered child cognitive and physical development. Recent literature, however, stresses upon the importance of 'first 1000 days' i.e. from conception to a child's 2 years of age, yet also recognizes that the age when stunting becomes irreversible could vary and that malnourished children could still benefit from supplementary nutrition-specific programs even beyond 2 years of age (Comrie-Thomson, Davis, Renzaho, & Toole, 2014). It is therefore, it is imperative to investigate the determinants of health and nutritional status of children under the age of 5, especially in developing countries where the situation is direr.

The current extent of stunting will determine the needed efforts to reduce it. WHO has calculated the Average Annual Relative Reduction (AARR) rates for 110 countries. If these countries around the world are able to reduce stunting annually by these given rates, the global problem of stunting can be reduced by 40% by the year 2025. Pakistan's 2012-2025 Average Annual Relative Reduction (AARR) rate is specified as 3.7%, while for India, where stunting is currently a greater problem, needs to reduce stunting annually by a lesser degree i.e. 3.5% on average (de Onis, et al., 2013). Secondly, the WHO guidelines have categorized stunting in the form of percentage prevalence ranges in order to classify the severity of malnutrition among children as shown in Table 1. Using Table 1, which shows the percentage of malnourishment in under 5 year olds, it is evident that Pakistan's severity of stunting or chronic malnutrition (43%)

and underweight (30.9%) is “very high” i.e. ≥ 40% and 30% respectively (de Onis & Blössner, 2003). Thus, it deserves to be studied in greater detail.

Table 1 Classification of Percentage of Malnourished Children

	Low (%)	Medium (%)	High (%)	Very High (%)
Stunting	<20	20–29	30–39	≥40
Underweight	<10	10–19	20–29	≥30

Note. **From “The World Health Organization Global Database on Child Growth and Malnutrition: methodology and applications,” by M. de Onis & M. Blössner, 2003, *International Journal of Epidemiology, p.* 518–526**

When scrutinizing the determinants of child health and growth, studies in past have largely focused on nutritional supplements and deficiencies in children, assessing their impact on child nutritional status. Later researchers extended their work to studying the debate on “genes” vs. “environmental factors” affecting child health. Cross-country and household level analyses have been common in earlier research; however, there is a dearth of empirically sound studies which would focus on intra-family investigation of child nutrition in Pakistan. Hence, this research aims to contribute to the existing literature.

The present research is intended primarily to examining the in depth role of birth order in determining child nutritional status within the family. The basic methodology has been taken from Jayachandran and Pande (2013) in their paper on comparison of nutritional status of Indian and African children, yet it has been adapted according to the available data, furthering the analysis with additional possible robustness checks where possible. We conduct first a between-family or inter-family analysis of stunting, wasting, and underweight in children to assess the determinants of child health in reference to birth order. Next, it carries out an intra-family or between-sibling comparison to control for mother and household unobservable characteristics in determining the height and weight gradient with respect to birth order. Third, it tries to evaluate whether the birth order child height varies with gender due to strong parental preference for sons in South Asia. Lastly, it aims to assess if the common belief about the drop off in height with each additional birth order can be attributed to reduced health investments in pregnancies and births as the family size increases.

The paper is divided into five sections. The second section reviews existing literature and empirical studies that have tried to gauge the effects that birth order, parental preferences and allocation decisions have on intra-family child nutritional status. The third section lays out the methodology of the study and the various econometric specifications that have been used to conduct this research, along with theoretical explanation of the variables. It further describes the data that has been used in this research and the sources for each variable. The fourth section presents an analysis of the findings. The fifth section concludes, with a discussion of the results, the limitations of the study, and policy implications.

1.2 Rationale of the Study

Previous studies carried out to study the determinants of child malnutrition in Pakistan either totally omit the impact of birth order, or only include it as one of the many factors affecting child health, without exploring its intricacies (see, for example, Arif, 2004; Afzal, 2012; Arif, Nazir, Satti, and Farooq, 2012; Shehzad, 2006). Thus, for Pakistan’s case, there is an evident paucity of studies when it comes to assessing the role of birth order in presence of liquidity constraints and parental preferences when determining child health. Hence, this research aims to bridge the identified gap.

From a policy perspective, if this study significantly identifies birth order and differing parental preferences with it as a factor, then government awareness programs and various family planning policies can be targeted at improving child health in order to minimize the incidence of child malnutrition in Pakistan.

1.3 Scope of the Research

The present research intends to assess the impact of birth order on child nutritional status, particularly upon stunting among 0-59 months old children in Punjab, Pakistan. It further aims to determine variations in prevalence of malnutrition based upon household allocation choices and gender preferences. The focus of this study is upon households from one province only, which comprises around half of Pakistan's total population, and the study therefore covers a substantial share of Pakistan's children. Punjab also shows higher variability in terms of households' socioeconomic characteristics, which is useful for an econometric analysis particularly regarding that of children across households. Limited in scope, the research may not be applicable across Pakistan due to the divergence in provinces; however, will be representative for the entire population of Punjab.

We use the district based Punjab Multiple Indicators Cluster Survey (2011) for the purpose of analysis. This study is representative of households in Punjab due to its extensive nature. It includes 9 divisions, 36 districts and 150 tehsils or towns in urban and rural Punjab, with 95,238 households interviewed in the year 2011. Alternate sources of data were also explored for the study to be carried out across the country, but a large number of missing observations for anthropometric information in other data sets coupled with an extensive range of variables present in Punjab MIICS 2011, led to the selection of the latter for this research.

2. Literature Review

This section aims to discuss the underlying determinants and explanations for inequalities in child nutrition and health due to incidence of birth order effects. The discussion of literature will help us to develop the research hypotheses for this study.

2.1 Birth Order Effects

To set the stage, it has been shown in the literature that birth order does have a significant impact that cannot be ignored when assessing child nutritional status. The earlier literature on this topic came from the fields of psychology and epidemiology. Yet, it is only recently that economists have also started to investigate the effects of birth order on the economic outcomes of children between and within families.

The majority of literature concludes that there are negative effects of birth order on child nutritional status. In disaggregating the explanations of birth order effects, Jayachandran and Pande (2013) in their comparison between India and Africa's height gradient, observed that birth order effects exist less due to genes and mainly due to the presence of environmental factors. They maintain the view that it is a matter of "Choice, Not Genes" that acts as a main contributor towards birth order effects. This is supported by the finding that first born Indian children are taller, among other tests of birth order effects.

Digging deeper into other potential non-environmental causes of the birth order results, Jayachandran and Pande (2013) found that the results were also not an artifact of mortality selection, because this would require higher infant survival for the later born, but was survival in fact higher for lower birth order children. Alternate possibility could be that a women's innate health was driving the birth order effect, such that women who were unhealthier to begin will would deteriorate more quickly with higher birth order. However, when maternal height was added to the child height estimation, the coefficients on birth order did not change significantly. This implies that maternal height, which is known as a summary measure of a mother's health inputs during her life, has no significant impact on birth order effects. Thus, from the results they deduce that the birth order effects are a result of concurrent choices made by households. Within family, the phenomenon seems related more to "take-up" of services as opposed to "access" to them, as the access rarely changes with birth order. These household and cultural factors were more pronounced in case of India, which is why despite having better economic indicators, Indian children are shorter in height than African children of second and higher birth order.

Collin (2013) similarly finds in his study on rural Ethiopia, deems that differences in outcomes occur due to differences in environment, where resources and time are divided unequally between children. The research also shows that parents discount the future, and favor lower birth order children; hence, also favoring their health outcomes more as they occur sooner than outcomes of higher birth order children.

A similar analysis was conducted by Hatton and Martin (2008) in their research on British children in the 1930s. They maintain that birth order can only affect health outcomes if inequality of resource allocation is present in the household.

From the evidence it is clear that it is the households' contemporaneous choices are driving the birth order and child health patterns. This will form the basis of this research, estimating how birth order affects child nutrition, in light of household allocation choices and preferences. One of the most important explanations for birth order effects is due to "take-up" of services. With additional children, family size increases and there is less to be spent on each additional child in terms of health and educational inputs. This resource dilution naturally favors lower birth order children more than higher birth order children (Jayachandran & Pande, 2013). Also, there is potentially a cultural preference for sons over daughters. This gender preference may heighten the birth order effects on child nutrition and health.

These birth order effects are strongest and statistically significant in the case of stunting, which represents the long term nutritional status of children, and less obvious in the case of wasting, which only represents the current nutritional status (Horton, 1998). It was further demonstrated by Gupta (1987) through a study on rural Punjab in India that birth order effects predominantly affect a child in the early years, resulting in adverse effects on long term nutritional status; thus, hampering a child's future health outcomes most. Recent contributions to literature must also be acknowledged, where targeted, nutrient-specific interventions have proven to be beneficial in recuperating some of the damages generated by inadequate nutritional intake in the early years. According to a WHO report that reviewed available evidence; nutritional supplementation has seen to be particularly effective in developing countries, helping in long term development outcomes of undernourished children. Some of the efficacious interventions include Vitamin A, iron and zinc supplementation (Hill, Kirkwood, & Edmond, 2004). For longer term benefits, these interventions must be coupled with improvements in underlying factors of malnourishment that include empowerment of the mothers, reduction in disease burden, reduced poverty and better education (Bhutta, et al., 2008).

Hypothesis 1: Birth order has a negative effect on nutritional status of pre-school children.

2.2. Favoring Lower Birth Order Children

It is evident that birth order effects exist, but literature proposes contradictory effects for first born children. There are studies that offer reasons for favoring the first born while other studies propose favoring the last born children. However, the results of most find height to decrease monotonically with increasing birth order (Savage, Derraik, Miles, Mouat, Cutfield, & Hofman, 2013).

According to Hatton and Martin (2008), first-born children are naturally favored, as for a certain time they do not have any other sibling to compete with them, so that they get undivided time and resources of their parents. As far as their health is concerned, the study also indicates that lower birth order children may be healthier than higher ones as the mother is fitter, more energetic and younger, while as she ages, having more children would also adversely affect their health.

An added argument for favoring lower birth order children, especially first-born children is that parents consider them to be an old age security, where they would be responsible of taking care of old parents (Bhalotra & Attfield, 1998). Another reason, especially true in case of Pakistan is that a woman usually goes to her parents' house for her first delivery, where she is offered better care and probably a more nutritious diet as well. This may also be one of the reasons for taller and healthier first born children.

However, despite substantiation on biological, cultural, and environmental factors favoring lower birth order children, there also exists a contradictory literature positing the opposite. Dancer et al. (2008) contend that children born later in the birth order have an added advantage as parents are more experienced and aware with each additional pregnancy, making the environment more favorable for the higher birth order children. Girma and Genebo (2002) specifically emphasize that children of lower birth order are at higher risk of stunting because of mother's lack of experience in terms of place and method of delivery, lack of awareness about importance of breast feeding, all of which are important contributors to child nutrition.

Collin (2013) also proposes that discrimination against lower birth order children may also be pronounced in liquidity constrained families where older children are pulled out of school and put into the labor market at a premature age. Nonetheless, Collin (2006) reasons that parents only discriminate until a certain age, after which the differences between the first and the last born children start to diminish and their heights start to converge. This leads to the formation of first subsidiary hypothesis which believes in persistence of birth order related height differences in early years of childhood.

Hypothesis 2: Height of a child decreases monotonically with each additional birth order.

2.3.Birth Order and Gender Discrimination

The inequality in resource allocation due to parental investment decisions may also be driven by gender preference. Mussa (2011) proposes three factors underlying gender bias in children, namely: (i) equity, (ii) efficiency, and (iii) preferences. Equity is when parents try to allocate resources equally amongst all children. Efficiency motive compels parents to allocate resources unequally based upon their returns in future. Thus, for example this way girls may be spent less upon due to the belief that they will not have to financially support their parents in the future. Besides, perhaps better endowed children will be allocated more resources as the returns to investment in that case will be higher. The returns to investments are generally believed to hold true more for sons as compared to daughters (Garg & Morduch, 1998). Preferences primarily involve cultural partiality for sons as compared to daughters due to a number of reasons identified in literature (see Jayachandran and Pande, 2013 for further details).

The strongest out of these motives supports the cultural preference of one gender over the other, contributing towards birth order effects. These cultural preferences of favoring boys over girls is particularly common in South Asia as can be seen in studies conducted by Bhalotra and Attfield (1998), Jayachandran and Pande (2013), Dancer et al. (2008), Hussain et al. (2000), Gupta (1987) and many others. However, it must also be highlighted that the discrimination in children, particularly with regards to investments, is not necessarily a result of cultural preference for sons over daughters, but could also be due to the rational behavior of parents in an attempt to internalize future returns from investment on a particular sex of children. For instance, if parents anticipate more transfers from sons as opposed to daughters or if labor market returns on nutrition vary by sex, then parents may discriminate against daughters in terms of nutrition allocation within families, irrespective of the inherent cultural difference in preferences.

In South Asia, especially India and Pakistan, the notion of sons being preferable to daughters is particularly strong in women with less or no formal education. They consider girls to be a “social and moral liability” for parents, further heightening gender discrimination against girls (Hussain, Fikree, & Berendes, 2000).

In a study by Biswas and Bose (2010) it was found that girls with higher birth order suffered from greater incidence of stunting because they were more likely to be discriminated against. Birth order was observed not to have any significant impact on stunting situation among boys.

Gupta (1987) in her study of selective discrimination against female children in rural Punjab, India, finds that as women age, the desire to have more daughters decreases much more significantly as compared to sons. She contends that after the first month of life, environmental factors affect mortality of children; the mortality rates for females are twice as high as compared to male children. This is due to better care and more attention given to boys. Furthermore, her estimation results prove that when sex differentials by birth order were assessed for child mortality, it revealed that mortality for daughters was higher than for sons, predominantly for children lying in 1^{st}, 2^{nd}, and 3^{rd} birth order. An interesting finding was that 4^{th} and 5^{th} birth order children were given birth mostly in order to get the desired number of boys in family.

This phenomenon is not limited to South Asia. In a study on Malawian children, it was found that gender effects were significantly stronger for weight-for-age as compared to height-for-age. Moreover, boys were noticed to be significantly taller than girls in rural areas, and shorter than girls in urban areas (Mussa, 2011).

These results lead us to believe that South Asian region is especially marred by selective discrimination against daughters by educated as well as uneducated families. To the best of our knowledge, research on birth order and its effects on child nutritional status in presence of household and cultural preferences have not been conducted for Pakistan before. Hence, it is important to test for this hypothesis in our research, as the impact is known to have detrimental health effects throughout the lifetime.

Hypothesis 3: Birth order has a gender-specific effect on child height due to son preference.

2.4. Birth Order and Pre and Post Natal Health Inputs

Following Grossman's (1972) theory on health production function, an individual's initial stock of health (as measured by child nutritional status in this research) depreciates with age, but among other factors, can appreciate with parental investments in health care such as immunization of children. Better educated parents would reduce depreciation and improve nutritional status through efficient production of health input investments.

Therefore, parental investment and allocation decisions have been shown to act as an important determinant, directly affecting child health and education outcomes of children (Rubalcava & Contreras, 2000). As the family size increases, parents find it hard to allocate resources equally amongst all children. According to Mazumder and Almond (2013), when faced with liquidity constraints, especially in rural areas, parents start to follow reinforcing or compensatory behavior. Thus, families with lower socio-economic status, when faced with a situation regarding resource allocation, may be forced to compensate and allocate more towards better endowed children. These endowments can take form of, for instance, birth weight or birth height. They further disaggregated parental behavior with respect to pre- and post-natal investments. Similar evidence of compensatory parental behavior was found for both pre and post natal investments.

As with socioeconomic status, parental investment behavior was also seen to differ according to the education level of parents. Rubalcava and Contreras (2000) conducted research in Chile and observed that when mothers were better educated, they allocated fewer resources towards their children. Fathers were seen to allocate more resources to sons, while mothers allocated more towards daughters. Yet, mothers with a higher education level than their husbands aggregately spent less upon their children. Importance of mother's level of education can also be corroborated as seen for instance in studies by Afzal (2012); Geale (2010); Chen and Li (2009); and Alderman and Garcia (1994).

In consideration of birth order, the earlier sections highlight that children of higher birth order are usually seen to be at a disadvantage due to biological, cultural, and environmental factors favoring lower birth order children more. Hence, following the ‘reinforcing’ behavior as identified by Mazumder and Almond (2013), parents would prefer to allocate more resources towards lower birth order children. These resources can take form of time, attention, and pre and post natal investments.

According to Girma and Genebo (2002) maternal nutritional status directly affects nutritional status of children. For instance, the number of antenatal visits by a mother has a direct impact on stunting of children. Even though, it is obvious that pre and post natal health investments on the mother and child determine nutritional status of child, there is inequality in these investments depending upon parental preferences and behavior.

Jayachandran and Pande (2013) observe a decline in health inputs like prenatal checkups, maternal iron supplementation, and delivery at health facility with higher birth order children. They argue that there is disinvestment on the mother with each additional birth order. This was proved through a comparison of food consumption data of mother and fathers within a household. The estimation results showed that food consumption by fathers did not decline while it did for the mothers. Due to unavailability of data on consumption expenditure on mother and father in any data set for the case of Pakistan, this form of discrimination cannot be empirically verified. However, this study will try to determine the household resource allocation behavior and preferences and assess how they affect child nutritional status, depending upon birth order of children. Added to the analysis, an estimation of the relationship of birth order and prenatal care investment, in light of gender preferences, will also be tested in the subsequent section.

Hypothesis 4: Pre and post natal investments and thus child nutrition declines with higher birth order children.

3. Methodology

This section starts off with an analytical framework followed by a description of the data set used for conducting this research. It then lays out the methodology of the study and the various econometric specifications to be estimated.

3.1 Analytical Framework

Household behavioral models can be used to explain household decision making when it comes to for example preferring and hence, investing more on lower birth order children or on sons compared to daughters due to the reasons identified in the preceding section. Keeping in view the scope of this paper, we will mainly try to theorize the mechanisms through which 'birth order' and 'gender' impact child nutritional status.

This empirical paper follows an extension of an intra-household behavioral model defined by Rubalcava and Contreras (2000), where the household family welfare (W) is a weighted function of each parent's utility i.e. mother's (U_m) and father's (U_f) utility. The resource allocation toward each family member follows a negotiation process within the family, which is captured by the weighting rule (Ω). Parental preferences are observed to be determined by parents' observed and unobserved characteristics as well as each household member's private and public consumption.

$$W = [\,\Omega;\ U^m(X, H, u_m\ u_f, \varepsilon_m, \varepsilon_f),\ U^f(X, H, u_m\ u_f, \varepsilon_m, \varepsilon_f)]$$

$$0 \leq \Omega\ [Y_m, Y_f; (Diff.Edu.)] \leq 1 \qquad (1)$$

In equation (1), Rubalcava and Contreras (2000) have defined X as a vector of household market goods which includes leisure; H represents non-market commodities including child health investments; u_m and uf denote parental (mother's and father's, respectively) observed background characteristics such as their education and age; and ε_m and ε_f represent vectors of parental unobservable characteristics, reflecting their predilection corresponding to child's gender and birth order.

Health of children in the family is dependent not just upon parental preferences in resource allocation, but also on children's own genetic factors and household and other community characteristics, represented by the non-market commodity production function as:

$$H = H(X, X_n, \theta, \eta_p, \eta_c) \quad (2)$$

The production function (H) depends upon market purchased (X) and non-market (X_n) inputs related to child health, for instance food intake, vaccinations, or breastfeeding. Procurement of child health also depends upon a vector of a child's own biological characteristics (θ) like age, gender, and birth-order. Furthermore, other factors as represented by a vector of parental characteristics (η_p) like their human capital, age, experience in relation to birth order, and preference for certain gender etc.; and a vector of community characteristics (η_c) influence a child's health outcome just as much.

The optimal demand for child health and hence the "quality" of a child will depend upon a set of observed and unobserved family and community characteristics, reflecting parental preferences regarding unequal allocation of resources within the household towards child health investments. The subsequent sections of the paper deal with the empirical strategy for estimating child nutritional status.

3.2 Data

This research is an analysis of birth order and other control variables that might have an impact on child nutritional status in a particular household. The primary unit of analysis in this research is an individual child aged 0-59 months (i.e. under 5 years of age) in households of various districts of Punjab.

The District Based Multiple Indicators Cluster Survey (MICS) (2011) with 95,238 households, 137,938 women, and 66,666 children under the age of five is used as the main source of data. In addition to the large sample size, it is a comprehensive data set with a wide range of indicators on socioeconomic as well as nutritional status of households (see, Punjab Bureau of Statistics, 2011, for particulars on sample design).

This research mainly uses three dependent variables which are the deviations of a child's long term and current nutritional status from the household mean values, as measured by standardized z-scores for height-for-age (HFA), weight-for-height (WFH), and weight-for-age (WFA) for children age 0 to 59 months. MICS 2011 includes these variables where HFA proxies for stunting or long term nutritional status capturing wealth effect on child health (Afzal, 2012). Other secondary anthropometric indices to be studied include WFA z-scores, representing information on a child being under- or over-weight and WFH z-scores, due to fluctuations in weight, proxies for wasting or current nutritional status of an individual child. These measures of child nutritional status are subordinate and only supplementary to the primary measure, as for instance underweight is a situation that can be experienced in both states of stunting and wasting and is thus, hard to distinguish (Collin, 2006). Identified in the data set are these indices of HFA, WFH, and WFA expressed in the form of z-scores[1], recommended by World Health Organization (WHO) and the National Center for Health Statistics (NCHS), representing comparison of the sampled children with an international reference population of the same age and gender, for a standardized analysis (de Onis & Blössner, 2003).

However, an important limitation of this data set is that it does not ask for parents' height, especially mother's height which would have helped proxy for a woman's long term nutritional status before adulthood, allowing us to control directly for parental characteristics when studying the impact of birth order on child health (Jayachandran & Pande, 2013). It would have specifically helped in studying the "genes" vs. "environment" explanations of child nutritional status. Also, information on expenditures of the family as a whole and per capita expenditures have been included, while it would have been more useful to study the investment pattern on the mother, if e.g. food expenditures on the mother had also been documented. This would have allowed us to compare how investments in the mother differ with each additional pregnancy. Despite these shortcomings, MICS 2011 is the most recent version of household-level data issued by Punjab Bureau of Statistics. Based upon MICS 2011, data for Punjab (as shown in Table 1) indicates that about 14% of the children are severely stunted, i.e. below −3 SD of the reference group and 20% of the children under 5 are moderately stunted. The mean z-score for height-for-age in the sample is −1.46, which means that on average, a child in Punjab is 1.46 standard deviations (SD) below the median for a reference group child of the same age and gender. WFA statistics show that around 11% of the children are severely underweight, with a child in Punjab having a z-score 1.50 SD below the median for a reference group child. However, the percentage

[1] Children's height and weight are standardized according to the following formula: $Z = (x - \mu)/\sigma$, where x is the raw score and μ and σ are the mean and standard deviation, respectively (World Health Organization, 2010).

of children severely wasted (WFH) is much less in Punjab, i.e. around 4%. Thus, the focus of this study is to analyze stunting and underweight status in greater detail.

Table 2 Nutritional status of children in Punjab (aged 0-59 months)

Variable	Observations	Mean	SD	Min	Max	Moderate (-2 to -2.99 SD)	Severe (< -3 SD)
HFA	62,399	-1.46	1.53	-6	5.97	20.03%	14.34%
WFA	63,083	-1.50	1.22	-5.99	4.94	20.70%	10.57%
WFH	63,376	-.91	1.18	-5	5	11.13%	4.24%

Source: Based on author's calculations

3.3 Empirical Strategy

The study estimates reduced form equations for health or nutritional status of pre-school children (0-59 months) as measured by z-scores for a child's height-for-age (stunting), weight-for-age (underweight), and weight-for-height (wasting), which have already been generated and measured in MICS 2011 according to NCHS and WHO standards[2]. We drop children whose mother was married more than 15 years, since we cannot match children older than age 14 to their mothers, and therefore birth order would be inaccurate for children born to the longest married mothers.

In order to measure the relationship between birth order and child health, the following econometric techniques are used in this study: Ordinary Least Squares (OLS) Regression, Two-Stage Least Squares (2SLS), and a Mother-Fixed Effects (MFE) Model, with primary focus on the latter specification. The forthcoming subsections will present a detailed account of the model using the identified regression specifications.

[2] For greater accuracy of results, z-scores that fall within an improbable range of SD are flagged and hence, dropped from analysis. The flagged ranges for HFA and WFA z-scores are: HFA < –6 and HFA > 6, and WFA < –6 and WFA > 5 (World Health Organization, 2010).

These econometric specifications are used to conduct two main analyses in this research: (i) *between* and (ii) *within* family effects of birth order on nutritional status. First, as part of *between* family assessments, we starts off with a basic OLS regression based on cross-sectional variation to estimate the birth order gradient with respect to child nutritional status (Almond & Mazumder, 2013). We then move on to include various child, mother and household-level variables to control for demographic and socio-economic characteristics of the household.

Second, moving to the main model, in order to study *within* family heterogeneity pertaining to birth order, a mother fixed effects model is estimated, which controls for any unmeasured mother-specific heterogeneity, e.g. mother's height and inherent health. In this model, variables that are common to children born to the same mother, drop out of the analysis. Moreover, when estimating a mother-fixed effects model, it is standard to omit one child families from the sample as has been adopted by studies like Horton (1998), Ejrnæs and Pörtner (2004), and Hatton and Martin (2008).

3.4 Model

3.4.1. Birth Order Effect.

Building up from a basic OLS to a comprehensive mother-fixed effects model, the following variations in specification allow us to test the relationship between birth order and child health, through both *between* and *within* family analyses.

$$\textit{Child Nutritional Status (CNS)} = \beta_0 + \beta_1 \textit{ Birth order} + \textit{Error term}$$

CNS is measured through three dependent variables namely: HFA, WFH, and WFA. Thus, three reduced form equations are estimated for the dependent variables, all regressed on birth order of an individual child, which is the primary explanatory variable. According to some studies birth order is expected to have a non-linear effect on child nutrition, especially after the middle-born child. These first equations use dummy variables to identify birth order of a child.

Stunting:	$HFA_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3_{if} + \alpha_4 BO4_{if} + \alpha_5 BO5plus_{if} + \epsilon_{if}$
Underweight:	$WFA_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3_{if} + \alpha_4 BO4_{if} + \alpha_5 BO5plus_{if} + \epsilon_{if}$
Wasting:	$WFH_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3_{if} + \alpha_4 BO4_{if} + \alpha_5 BO5plus_{if} + \epsilon_{if}$

HFA_{if}: Height for Age for i^{th} child born in f^{th} family
WFH_{if}: Weight for Height for i^{th} child born in f^{th} family
WFA_{if} : Weight for Age for i^{th} child born in f^{th} family
$\alpha_{1,2,3,4,5}$: coefficients to measure how height differs with each birth order
ϵ: error term

Next, we add a set of child, mother, and household controls to the equation. In the subsequent specifications, the main explanatory variable, that is birth order, has been measured in a variety of ways. There are specifications where absolute birth order and squared-birth order are used, while in other specifications, relative birth order (explained below) is used. Finally, we have specifications with dummy variables for higher birth order.

Ejrnæs and Pörtner (2004) used a strategy later employed by Collin (2006); where a *relative* birth order variable was created, where birth order of all children in a family is ranked between 0 and 1.

Relative Birth Order (RBO) only applicable to families with multiple children is calculated as:

$$RBO = \frac{BO-1}{Number\ of\ children-1}$$

RBO = 0 for 1st born children
RBO = 1 for last born children

The basic model of OLS regression with controls representing demographic and socio-economic factors affecting child nutrition will be estimated along with relative birth order and birth order dummies along with absolute birth order, for measuring the relationship of birth order child nutritional status.

Child Nutritional Status (CNS) $= \beta_0 + \beta_1$ *Birth order + Child controls + Mother controls + HH controls+ Error term*

Stunting: $HFA_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3_{if} + \alpha_4 BO4_{if} + \alpha_5 BO5plus_{if} + \gamma C_{if} + M_{if} + \delta X_f + \epsilon_{if}$
Underweight: $WFA_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3_{if} + \alpha_4 BO4_{if} + \alpha_5 BO5plus_{if} + \gamma C_{if} + M_{if} + \delta X_f + \epsilon_{if}$
Wasting: $WFH_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3_{if} + \alpha_4 BO4_{if} + \alpha_5 BO5plus_{if} + \gamma C_{if} + M_{if} + \delta X_f + \epsilon_{if}$

Where, C is a vector of child-level controls, M is a vector of mother controls and X is a vector of household controls. *Child-specific* controls include: Child’s age, child’s age squared, status of illness, gender (dummy for male), birth spacing less than 12 months, and birth year dummies. *Mother-specific controls include:* Mother’s education level, mother’s age at marriage, age at marriage squared, working status of the mother, and log of her own fertility. *Household or family specific* controls include: Education of household head, household region (dummy for urban), wealth score, dummy for landholding family, number of children under age 5 in a household, treatment of water for safer drinking, toilet facility, average monthly per capita expenditure on non-food items (a proxy for income per capita), and district dummies.

Moving on to the main analysis, a mother fixed effects estimation is used, the formation of which is similar to OLS Regression with controls, just that the variables common to all children born to the same mother, that is all the mother and household specific controls aforementioned, drop out of this model.

Child Nutritional Status (CNS) $= \beta_0 + \beta_1$ *Birth order + Child controls+ Mother-Fixed Effects+ Error term*

Stunting: $HFA_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3plus_{if} + \delta C_{if} + M_i + \epsilon_{if}$

Underweight: $WFA_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3plus_{if} + \delta C_{if} + M_i + \epsilon_{if}$

Wasting: $WFH_{if} = \alpha_1 + \alpha_2 BO2_{if} + \alpha_3 BO3plus_{if} + \delta C_{if} + M_i + \epsilon_{if}$

Where, $Ɣ_i$ represents mother-fixed effects and C is a vector of child-specific controls.

3.4.2 Preference for a Son.

To test for the hypothesis that a preference for son can account for birth order effects on child nutritional status, both the OLS and MFE model are estimated including interaction terms of birth order with gender for a sample including all children born (0-14 years) and (precluding MFE) for a sample including second born children only in order to understand parental preferences for a certain gender (Jayachandran & Pande, 2013).

$$(Child\ health)_{if} = \alpha_1 + \alpha_2 2ndChild_{if} + \alpha_3 3rdplusChild_{if} + a_4 Girl + a_5 (2ndChild)*Girl_{if} + a_6 (3rdplusChild)*Girl_{if} + \gamma C_{if} + M_{if} + Ɣ_i + \epsilon_{if}$$

For sample limited to 2nd born children, OLS only:

$$(Child\ health)_{if} = \alpha_1 + \alpha_2 Girl_{if} + \alpha_3\ (Firstborn\ is\ a\ Girl)_{if} + a_4 Girl*(Firstborn\ is\ a\ Girl)_{if} + \gamma C_{if} + \epsilon_{if}$$

Controls in these mother fixed-effects models will be the same child-specific controls as in the basic model.

3.4.3 Households preferences as depicted by pre and post natal investments on the expectant mother with each additional pregnancy.

Through between and within family analyses using OLS and family-fixed effects models, respectively, we estimate the extent to which birth order effects exist due to household contemporaneous choices, such that the pre and post natal investments decline with each additional pregnancy i.e. with higher birth order children in the household. Since, most observations have been collected for last pregnancy, precluding mother fixed-effects, for a deeper analysis of behavioral dynamics within households, a family fixed effects model is used to compare outcomes of cousins or children born to different mothers in the same household.

Pre and post natal health inputs $= \beta_0 + \beta_1$ *Birth order Dummies + Controls + Error term*

Additionally, the following model evaluates a combination of the two explanations vis-à-vis household allocation preferences and cultural preference for a son. Furthermore, by restricting the sample to third pregnancy, we try to assess the supporting hypothesis of whether the gender composition in a family has any role to play when studying household allocation choices regarding a potential disinvestment on the mother with each additional pregnancy.

$$(\text{Pre and post natal health inputs})_{if} = \beta_0 + \beta_1\,\text{Girl} + \beta_2\,(\text{First and second born are girls}) + \beta_3(\text{First and second born include a girl and a boy}) + \beta 4\,(\text{First and second born are girls})*\text{Girl} + \beta 5\,(\text{First and second born include a girl and a boy})*\text{Girl} + \text{Controls} + \text{Error term}$$

Dependent variables for both estimations include: Total pre-natal visits, total tetanus shots, delivery at a health facility, and post natal checkup by a health professional. Controls are the same as in the previous model, and standard errors are clustered by household.

3.4.4 Parental Preferences regarding child health inputs.

As a strategy for further understanding of the explanation regarding cultural and parental preferences dictating behavioral choices, child health inputs are treated as dependents and the effect of birth order along with gender composition is tested upon it, in order to establish if the parental preferences are influenced by birth order, particularly evaluating if parental discrimination against daughters is driving these patterns.

$$(Child\ Health\ inputs)_{if} = \alpha_1 + \alpha_2 2ndChild_{if} + \alpha_3 3rdplusChild_{if} + a_4 Girl +$$
$$a_5 2ndChild*Girl_{if} + a_6 (3rdplusChild)*Girl_{if} + \gamma C_{if} + M_i + Ɣ_i + \epsilon_{if}$$

Dependent variables for within and across family estimations include: (i) Ever breastfed?, (ii) ever vaccinated?, (iii) has vaccination card?, and (iv) given Vitamin A dose in last 6 months. Controls are the same as in the previous model, and standard errors are clustered by household.

3.5 Theoretical Justification and Measurement of Key Variables

The main explanatory variable in all of the models above is birth order of the child. Literature shows that there is no consensus as such on the how to measure of birth order. This study uses absolute birth order, as is common in most of the previously conducted studies. So, birth order dummies have been formed where birth order 1 is the reference group. Some studies only use dummies for the 2nd birth order and for children born with 3rd or higher birth order (Jayachandran & Pande, 2013). In our study, birth order dummies till rank 5 and higher have been employed. Higher rank of birth order represents younger children in the household. For measurement of the variable, only live births are used as opposed to all children ever born (alive or deceased), and so not representing the actual order in which each child was born. Thus, Collin (2006) points out that this way a 3rd born child to two deceased older siblings will have the same rank as the 1st born child in another family; both will have birth order ranking as 1. Birth order is calculated by ranking the observed children by age and assigning them a birth order number based on that ranking (this way giving the same number to twins). We then use age-ranking as a proxy for birth order, however omitting each child's "sibling history" as emphasized by Collin (2006).

Illness is a dummy variable created for whether the child suffers from diarrhea or any other illness related to cough in last two weeks. A child suffering from any illness has serious econometric implications in the models. Illness is a channel through which birth order affects height as later born children are more prone to disease due to for example crowding in home; hence, logically there is simultaneity issue between any illness and HFA (Hatton & Martin, 2008). Collin (2006) found that that this variable may still not pose a serious econometric threat as inclusion of illness variable did not significantly change the regression coefficients for his study. However, it could remove omitted variable bias and also act as a proxy for all non-nutritional inputs that could heighten the impact of birth order on child height. However, in this study illness is instrumented by interaction term of (non-self) community average for incidence of illness and child's age.

In order to capture non-linearity, squared terms for child's age in months and mother's age is also included (Mussa, 2011). These variables have observed to be significant in previous literature. According to Ibrahim (1999) a child's growth is observed to have been hampered when the mother is 40-44 years in age. This could also be a reason why higher birth order children are shorter in height. Horton (1998) finds positive effects of mother's age on a child's height-for-age, while the effect is insignificant in the research conducted by Senauer and Garcia (1991). Mother's age at marriage is used as opposed to mother's age because mother's age is correlated with child's age.

Mother's and household head's level of education have been shown to be an important contributing factor to child health. There is plethora of literature available that stresses the direct and indirect effects of mother's and household head's education on child nutrition. Ibrahim (1999) also observes that stunting is significant and highly responsive to mother's education.

This signifies that mother's level of education can reduce any negative or heighten any positive effects when analyzing the relationship between family size and child health. This relationship is also confirmed by Geale (2010). As father's education has not been asked for in the data set, household head's level of education will be included in our controls as a proxy (Afzal, 2012).

A dummy for whether a family holds any land is also included as birth order is observed to have a noticeable impact in landholding families (Ejrnæs & Pörtner, 2004). Another household specific variable is the family size as depicted by the 'number of children under age 5'. Birth order estimation without the inclusion of family size variable can lead to methodological issues as higher birth order represents a bigger family size because of the inherent correlation between the two variables (Hatton & Martin, 2008). Hence, we control for family size using log of mother's own fertility, and later by reporting most results for same size families.

Gender of a child has important health and economic implications. Thus, an interaction term of sex of the child and birth order is included in order to capture the possibility of how birth order effects upon child health vary with sex of child (Mussa, 2011).

A child control for birth spacing less than 12 months has been included to account for the associated negative health impact for children born with a close enough interval (Rutstein, 2008) For instance, when a mother has two children close together (less than a year apart) then there can be health impacts on the subsequent children, because the mother's body is depleted after birth and short birth spacing does not allow her body to fully replenish itself.

4. Analysis

4.1 Effects of Birth Order on Child Nutritional Status

Between-Family Analysis

In order to study the birth order (BO) patterns *across families*, to test our first hypothesis, we started off with a basic OLS regression for establishing the gradient of birth order with respect to child nutritional status (CNS). Through the magnitude of birth order gradient, we find direct negative correlation between BO and CNS (Table 3). As expected, the increasing negative magnitude shows that all three indicators seem to worsen with increasing BO. However, when moving towards higher BO, the correlations worsen at an increasing rate showing inconsistency, and hence a possible non-linearity in the estimated relationship.

Table 3 Correlations of birth order with child health measures - Trends

VARIABLES	(1) HFA	(2) WFA	(3) WFH
Birth order 2	-0.003	-0.088***	-0.099***
	(0.018)	(0.015)	(0.015)
Birth order 3	-0.018	-0.121***	-0.137***
	(0.022)	(0.018)	(0.017)
Birth order 4	-0.105***	-0.194***	-0.156***
	(0.025)	(0.020)	(0.019)
Birth order 5 or higher	-0.270***	-0.350***	-0.235***
	(0.029)	(0.024)	(0.022)
Constant	-1.403***	-1.363***	-0.790***
	(0.016)	(0.013)	(0.013)
Observations	41,454	41,888	41,849
R-squared	0.003	0.007	0.003
Adjusted R-squared	0.00321	0.00662	0.00311

Source: author's calculations

Note: The sample comprises children age 1-59 months with anthropometric data. Standard errors are clustered by household and appear in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1. For more accurate analysis, sample of children was restricted to families with more than one child and to those whose parents were married for 15 years or less only.

In order to capture non-linearity, absolute birth order and birth order squared terms were included in the OLS regression, as shown in Tables 4, 5, and 6. Relative birth order (RBO) was also tested as an alternative way to capture non-linearities (see Ejrnæs & Pörtner, 2004; and Collin, 2006). In an attempt to remove some of the bias introduced by omitted variables, we next control for observables, that are a set of child-specific, mother-specific, and household-specific demographic and socio-economic factors correlated with child health[3].

For the case of stunting, we observe from Table 4 that all three specifications of birth order (represented by each column) are significant and bear the expected negative relationship with HFA. Jayachandran and Pande (2013) found similar, though stronger, estimates across families with HFA decreasing with increasing birth order; yet, the only controls they added were survey year and child age dummies. In this research we try to control for a set of child, mother and household factors, the signs of all of which are as expected e.g. positive correlations of child nutritional status with mother and household head's level of education[4], landholding families, wealth score, average expenditure per capita on non-food items etc; nearly all of them have statistically significant correlations, except for mother's working status and toilet facility at home (detailed results with coefficents of the control variables are shown in Appendix Table 1).

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[3] Child controls include: age, age squared, illness status, gender, birth spacing less than 12 months, and birth year dummies (2007-2011). Mother controls include: mother's education level, age at marriage, age at marriage squared, working status and log of own fertility. Household controls include: household head's education level, dummy for urban region, landholding status, wealth score, number of children under 5 years within the household, treatment of water for safer drinking, toilet facility, average monthly non-food per capita expenditure as a proxy for income per capita, and dummies for 36 districts of Punjab.

[4] We tried to capture the heterogeneity in birth order and nutritional status results by mother's education. Tables 4, 7, 8, and 9 (see later) were tested with controls for mother's education interacted with birth order dummies. The results for coefficients of BO dummies gained much more significance, yet were fairly insignificant for their interaction term controls. Hence, they are not reported in the paper.

Table 4 OLS Regression: Height-for-Age

VARIABLES	(1) All controls	(2) All controls	(3) All controls
Birth order	-0.048**		
	(0.021)		
Birth order squared	0.001		
	(0.003)		
Relative birth order		-0.178***	
		(0.050)	
2nd child			-0.102***
			(0.020)
3rd child			-0.112***
			(0.023)
4th child			-0.129***
			(0.026)
5th child or higher			-0.216***
			(0.031)
Child controls	yes	yes	yes
Mother controls	yes	yes	yes
HH controls	yes	yes	yes
Observations	41,008	34,078	41,008
Adjusted R-squared	0.128	0.131	0.128

Note: The sample comprises children age 1-59 months with anthropometric data. Standard errors are clustered by household and appear in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Tables 5 and 6 below provide the results for underweight (WFA) and wasting (WFH), respectively. The birth order/CNS relationship with all three child health measures is strong and significant in presence of all child, mother, and household specific controls. Detailed results for HFA, WFA, and WFH, along with all controls have are presented in Appendix Tables 1, 2, and 3, respectively. Though, the results are more pronounced for HFA, showing a greater BO gradient than WFA or WFH.

Table 5 OLS Regression: Weight-for-Age (WFA)

VARIABLES	(1) All controls	(2) All controls	(3) All controls
Birth order	-0.030*		
	(0.017)		
Birth order squared	-0.001		
	(0.003)		
Relative birth order		-0.126***	

		(0.041)	
2nd child			-0.071***
			(0.016)
3rd child			-0.087***
			(0.018)
4th child			-0.102***
			(0.021)
5th child or higher			-0.178***
			(0.025)
Child controls	yes	yes	yes
Mother controls	yes	yes	yes
HH controls	yes	yes	yes
Observations	41,435	34,456	41,435
Adjusted R-squared	0.104	0.101	0.104

Note: The sample comprises children age 1-59 months with anthropometric data. Standard errors are clustered by household and appear in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1; d =
Source: author's calculations

Table 6 OLS Regression: Weight-for-Height (WFH)

VARIABLES	(1) All controls	(2) All controls	(3) All controls
Birth order	-0.019		
	(0.017)		
Birth order squared	0.000		
	(0.003)		
Relative birth order		-0.075*	
		(0.040)	
2nd child			-0.030*
			(0.016)
3rd child			-0.054***
			(0.018)
4th child			-0.053**
			(0.021)
5th child or higher			-0.088***
			(0.024)
Child controls	yes	yes	yes
Mother controls	yes	yes	yes
HH controls	yes	yes	yes
Observations	41,351	34,363	41,351
Adjusted R-squared	0.0370	0.0363	0.0369

Note: The sample comprises children age 1-59 months with anthropometric data. Standard errors are clustered by household and appear in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1; d =
Source: author's calculations

As a cause of concern, higher birth order is also indicative of a larger family size. Family size is indicative of the fertility of the couple and is measured as a mother's total number of live births (which we measure for children 0-14 years of age). It is expected to be endogenous as parents follow a Quantity-Quality tradeoff, suggesting that if families choose more children, they also choose lower average quality for reasons not associated with resource constraints. Thus, the OLS results were tested for subsamples of families with same number of children as a robustness check for stunting, shown in Table 7 below. It is evident that BO holds a significant negative relationship with HFA, with the negative magnitude of the gradient increasing with higher BO children, even when controlling for family size. For greater accuracy on birth order magnitudes, the sample was restricted to families with 2, 3, and 4 children only because of lack of HFA data for lower birth order children in 5 children families. The apparent Quantity-Quality tradeoff can be gauged from our results, as the second birth order children in 2 children families seem to be healthier than the second born in 3 children families. Similar pattern can be observed for third born children in 4 children families having much worse nutritional status than the third born in 3 children families; pointing more so towards height disadvantage of higher birth order children in bigger families.

Table 7 OLS Results for same size families

Dependent variable: Height-for-Age

VARIABLES	(1) All families	(2) 2 children	(3) 3 children	(4) 4 children
2nd child	-0.102***	-0.132***	-0.234***	-0.093
	(0.020)	(0.032)	(0.044)	(0.118)
3rd child	-0.112***	-	-0.207***	-0.456***
	(0.023)		(0.059)	(0.125)
4th child	-0.129***	-	-	-0.473***
	(0.026)			(0.137)
5th child or higher	-0.216***	-	-	-
	(0.031)			
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	yes	yes	yes	yes
Observations	41,008	13,256	12,300	8,332
Adjusted R-squared	0.128	0.125	0.131	0.125

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Within-Family Analysis

For the purpose of identifying birth order effects, this subsection is our main empirical estimation, which examines whether child health varies within households and across siblings, specifically due to their ordinal position. We try to deal with potential endogeneity due to reverse causality for illness of the child, which captures whether the child was ill with diarrhea or any other illness related to cough in past 2 weeks. Child's illness status is expected to be endogenous if children with below average HFA are more susceptible to illness. We instrument for child illness with an interaction of the non-self, community average for the incidence of illness with child's age, because it is likely that younger children are usually more protected and kept inside the house while older children go out to play and are thus more vulnerable to the incidence of illness in a community. Logically, it is a valid instrument as some studies argue that incidence of illness at the community level tends to affect a household's likelihood of the same (see for instance, Alderman & Garcia, 1994; Afzal, 2012). It is reasonable to assume that community health can affect the nutrition of a child only through individual health status. This is because the incidence of illness in a community does not mean reduced calories or care or vaccinations available to children within the household; therefore it would only make more sense to affect nutritional status through the channel of their health status, justifying the exclusion restriction. Hence, employing the instrumental variable, we also estimate the model using a 2SLS approach, as shown by column (2), Table 8.

Moving towards our main analysis, mother-fixed effects estimation relates differences in nutritional status between siblings to differences specifically in birth order. The unobserved variables may cause bias in the birth order coefficient, even after controlling for those variables that can be observed. Thus, mother-fixed effects model looks at differences between siblings, proving to be a stronger way to estimate birth order effects within families (Horton, 1998). Through this strategy we also control for genetic makeup of the mother like her height and weight information, which were controlled for explicitly in Jayachandran and Pande (2013).

Column (3) of Table 8 shows our results controlling for mother fixed effects. The BO results are significant and comparable to the OLS results showing negative signs. However, the birth order coefficients are significantly higher than OLS and 2SLS estimates. A possible explanation for the downward bias in OLS and 2SLS results can be omitted variables that are correlated with both birth order and nutritional status. For instance, unobserved factors like completed family size (Horton, 1998), mother's inheritance from genetic factors, health knowledge, preferences toward child's well-being and other environmental factors are likely to cause bias in the birth order coefficient, which would not be fully resolved even after controlling for other observable factors e.g. current family size. Hence, a stronger way to estimate birth order effect as opposed to age effects would be to take differences between multiple children born to the same mother (mother-fixed effects model). This removes measured and unmeasured, family- and mother-level variables biasing the birth order coefficients, and therefore showing stronger effects. It is evident through the higher birth order magnitudes that the outcomes are more pronounced within households, and even more so in comparison to a mother fixed effects analysis done by Jayachandran and Pande (2013). It shows that the HFA decreases with increasing BO as the magnitude increases when higher BO children are compared to the first child. The detailed results for all controls are given in Appendix Table 4. The coefficient of gender is significantly negative, showing that female children are healthier; this analysis will be elaborated upon in the subsequent sections.

Table 8 Within family analysis: Height-for-Age (HFA)

VARIABLES	(1) OLS	(2) 2SLS	(3) MFE
2nd child	-0.102***	-0.097***	-0.355***
	(0.020)	(0.022)	(0.041)
3rd child	-0.112***	-0.114***	-0.696***
	(0.023)	(0.026)	(0.074)
4th child	-0.129***	-0.127***	-1.071***
	(0.026)	(0.029)	(0.109)
5th child or higher	-0.216***	-0.198***	-1.433***
	(0.031)	(0.034)	(0.148)
Gender (male=1, female=0)	-0.051***	-0.055***	-0.064***
	(0.014)	(0.016)	(0.018)
Child controls	yes	yes	yes
Mother controls	yes	yes	no
HH controls	yes	yes	no
Observations	41,008	32,453	41,424
Number of mothers	-	-	23,981
Adjusted R-squared	0.128	0.128	0.124

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1.[5]
Source: author's calculations

Furthermore, a between sibling analysis was also carried out for WFA and WFH in Appendix Tables 5 and 6, respectively. Even though the results for WFH are not as conclusive, HFA and WFA results indicate that a child's nutritional status worsens with increasing birth order. Other results show that female children of the family seem to be healthier. Negative relationship of child's age in months and positive of age squared with child health, depict that nutritional status has a non-linear relationship with a child's age.

Mother fixed effects (MFE) results for HFA were also checked for robustness by restricting the sample to families with same number of children, again only restricting it to children from 2, 3, and 4 children families, as shown in Table 9 below. These results conform to

[5] Child controls include: age, age squared, illness status, gender, birth spacing less than 12 months, and birth year dummies (2007-2011). Mother controls include: mother's education level, age at marriage, age at marriage squared, working status and log of own fertility. Household controls include: household head's education level, dummy for urban region, landholding status, wealth score, number of children under 5 years within the household, treatment of water for safer drinking, toilet facility, average monthly non-food per capita expenditure as a proxy for income per capita, and dummies for 36 districts of Punjab.

the earlier results in terms of a negatively increasing relationship of HFA with birth order. We also notice lower birth order children e.g. the second born within larger families being healthier than second birth order children within smaller families. However, interestingly, gender effects (explained in greater detail in subsequent sections) are significant in small size families while no significant partiality for girls is seen in families with more than two children. The coefficient for birth spacing is negative and highly significant, showing that HFA is expected to be adversely affected if a mother has children close together (with a gap of less than a year).

Table 9 Mother fixed effects results for same size families

Dependent variable: Height-for-Age (HFA)

VARIABLES	(1) All families	(2) 2 children	(3) 3 children	(4) 4 children
2nd child	-0.355***	-0.762***	-0.465***	-0.393***
	(0.041)	(0.120)	(0.076)	(0.134)
3rd child	-0.696***	-	-0.958***	-1.152***
	(0.074)		(0.144)	(0.182)
4th child	-1.071***	-	-	-1.867***
	(0.109)			(0.260)
5th child or higher	-1.433***	-	-	-
	(0.148)			
Gender	-0.064***	-0.115***	-0.037	-0.064
(male=1, female=0)	(0.018)	(0.032)	(0.032)	(0.043)
Birth spacing ≤ 12 months	-0.239***	0.035	-0.093*	-0.171***
	(0.029)	(0.084)	(0.051)	(0.059)
Child controls	yes	yes	Yes	yes
Mother controls	no	no	No	no
HH controls	no	no	No	no
Observations	41,424	13,405	12,418	8,406
Number of mothers	23,981	8,148	7,093	4,943
Adjusted R-squared	0.124	0.111	0.123	0.142

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Thus, the results from OLS, 2SLS and MFE estimations, both across and within households support our hypotheses that birth order has negative effects on child nutritional status and that child height decreases monotonically with higher birth order children.

4.2 Preference for sons influencing birth order effects

To test for the hypothesis on parental preference for sons and discrimination against daughters, which is the most common explanation in South Asia particularly in India, the model used, tries to examine the relation of birth order with nutritional status for children of each gender through the mother fixed-effects analysis. The results of this model help us to understand the dynamics of son preference within households.

Our focus lies upon stunting, so we start with HFA, studying the preference for sons with a sample including all children ever born (see Table 10). From a basic OLS regression (column 1), with all controls, we move on to a 2SLS regression (column 3) with all child, mother and HH controls, to finally a MFE model (column 4) with child controls only. The table demonstrates that HFA significantly decreases with increasing BO, yet the coefficient of girl is insignificant meaning that we do not find evidence that girls are discriminated against. On the other hand, in the case in India discrimination was found, with a large and negative coefficient for Indian girls in the paper by Jayachandran and Pande (2013). Also when BO is interacted with gender, the results mostly remain insignificant, particularly for MFE, showing that BO effects exist within a household, but regardless of the child's gender.

Table 10 Preference for sons: Height-for-Age (HFA)

VARIABLES	(1) no controls	(2) OLS	(3) 2SLS	(4) Mother FE
2nd child	-0.052*	-0.136***	-0.138***	-0.148***
	(0.028)	(0.028)	(0.032)	(0.039)
3rdplus child	-0.145***	-0.176***	-0.172***	-0.292***
	(0.028)	(0.028)	(0.032)	(0.057)
Girl	-0.021	-0.011	-0.011	0.011
(girl=1, boy=0)	(0.032)	(0.030)	(0.034)	(0.038)
2ndchild*Girl	0.098**	0.072*	0.086*	0.071
	(0.041)	(0.039)	(0.044)	(0.050)
3rdplus child*Girl	0.088**	0.078**	0.076*	0.073

	(0.038)	(0.036)	(0.041)	(0.047)
Child controls	-	Yes	yes	Yes
Mother controls	-	Yes	yes	No
HH controls	-	Yes	yes	No
Observations	41,454	41,008	32,453	41,424
Adjusted R-squared	0.00143	0.128	0.128	0.119
Number of mothers	-	-	-	23,981

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Similar results were observed for WFA and WFH as well. With sample including all children ever born, the WFA is observed to be worsening with increasing birth order, and gender of the child witnessed to having no significant impact on WFA or WFH (see Appendix Tables 7 and 8, respectively).

As a stronger robustness check, we restrict the sample to families with same number of children to see if the results show any different pattern. Focusing on HFA results (see Table 11), there exists a consensus regarding HFA decreasing with increasing birth order, yet a contrasting pattern in gender-specific results can be seen based upon the family size. For the most part, there does not appear to be a strong gender bias against girls. Girls do slightly worse on average in three child families, but third-born girls do better than third-born boys (Table 11, column 2). There is no evidence of gender discrimination in four child families (column 3).   Checking for robustness of WFA and WFH, the results illustrated similar, yet less noticeable effects, with anthropometric indicators worsening with increasing birth order, and existence of little evidence for gender-specific birth order effects in smaller families (see Appendix Tables 9 and 10 for detail).

Table 11 Mother fixed effects: same size families

Dependent variable: Height-for-Age (HFA)

VARIABLES	(1) All families	(2) 3 children	(3) 4 children
2nd child	-0.148***	-0.535***	-0.085
	(0.039)	(0.092)	(0.170)
3rdplus child	-0.292***	-1.120***	-0.495***
	(0.057)	(0.153)	(0.175)
Girl	0.011	-0.153**	-0.040
(girl=1, boy=0)	(0.038)	(0.077)	(0.217)
2ndchild*Girl	0.071	0.134	0.105
	(0.050)	(0.092)	(0.236)
3rdplus child*Girl	0.073	0.326***	0.124
	(0.047)	(0.093)	(0.220)
Child controls	yes	yes	yes
Mother controls	no	no	no
HH controls	no	no	no
Observations	41,424	12,418	8,406
Adjusted R-squared	0.119	0.125	0.130
Number of mothers	23,981	7,093	4,943

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Furthermore, in order to assess the gender-specific effects of birth order on child height based upon gender of older sibling, the sample was restricted to second born children only, precluding mother fixed effects as only one child per mother was considered. Results from Table 12 show that gender in itself is significant and the positive sign suggests that girls do well, contrasting with the a large and negative coefficient for Indian girls as shown by Jayachandran and Pande (2013). However, column (3) shows that a child is worse off being a girl following an elder sister, than being a girl born to an elder brother, close enough to the results obtained by Jayachandran and Pande (2013) for Indian children based upon the gender of their older sibling[6].

[6] The results of Table 12 were also tested with an additional control for whether the third born child is a boy. This addition led to insignificant coefficients for gender and its BO combinations shown in Table 12. This leads us to believe that parents are probably not diluting resources available to all children in a desire to have a son after two daughters.

Though, on average a girl with an older sister does as well as an average boy, since the positive of being a girl (0.13) and negative of being the girl with an elder sister (-0.11) essentially balance each other out.

Table 12 Preference for sons: sample of 2nd born children only

Dependent variable: Height-for-Age (HFA)

VARIABLES	(1) no controls	(2) OLS	(3) 2SLS
Girl	0.111***	0.099***	0.128***
(girl=1, boy=0)	(0.038)	(0.035)	(0.040)
Firstborn is a girl	0.022	0.029	0.045
	(0.037)	(0.035)	(0.040)
Firstborn is a girl*Girl	-0.069	-0.081	-0.112**
	(0.053)	(0.050)	(0.057)
Child controls	-	Yes	yes
Mother controls	-	Yes	yes
HH controls	-	Yes	yes
Observations	12,878	12,730	10,003
Adjusted R-squared	0.000563	0.128	0.131

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

In case of second born children, when tested for other anthropometric indicators of WFA and WFH (shown in Appendix Tables 11 and 12, respectively), similar results were obtained in terms of second born girls being favored more than 2nd born boys, yet no significant relationship of birth order with child health was observed in presence of gender. The results so far rule out the hypothesis of gender-specific birth order effects on child nutritional status.

4.3 Do households prefer to disinvest on the mother with each additional pregnancy?

Findings regarding resource constraints militate against each other. It is logical to believe that with each additional child, the resources to be spent on mother and children get diluted, leaving less to be spent on them. The contrary argument is also logical and supported by a few studies, that over time the financial situation of the household may improve; and thus, more can then be spent on children and the mother (Mussa, 2011). Hence, in this section we tried to examine if there is a decrease in pre and post natal inputs with each additional pregnancy due to reasons associated with either resource constraints or gender preference, explaining why higher birth order children are less healthy and, therefore shorter in height.

To set the stage for analysis, four of the pre and post natal health investments were treated as dependent variables, as shown in Table 13. Since the information was just collected for last delivery, we start with a between family analysis. When the three pre and the one post natal health investment indicators were regressed upon birth order dummies, in presence of all child, mother, and household specific controls, we observe that for delivery at a health facility and postnatal checkup by a health professional, the outcomes worsened with each additional pregnancy. However, regarding prenatal investments like total number of prenatal visits made and the number of tetanus shots taken by the mother, there was almost no significant results according to birth order, except for number of pre-natal visits for the fifth child. The behavioral pattern based upon gender of children will be analyzed later in the section.

Table 13 Effects of Birth Order on HH preferences, regarding investments on expectant mothers *across* HHs

VARIABLES	(1) Total Prenatal Visits	(2) Total Tetanus shots	(3) Delivery at health Facility?	(4) Postnatal checkup by Health professional?
2nd child	-0.324	-0.018	-0.135***	-0.117*
	(0.282)	(0.081)	(0.052)	(0.062)
3rd child	-0.377	-0.022	-0.159***	-0.126**
	(0.283)	(0.081)	(0.052)	(0.062)
4th child	-0.460	-0.044	-0.198***	-0.173***
	(0.285)	(0.082)	(0.053)	(0.062)
5th child or higher	-0.644**	-0.057	-0.235***	-0.191***
	(0.286)	(0.083)	(0.053)	(0.062)
Child controls	Yes	yes	yes	yes
Mother controls	Yes	yes	yes	yes
HH controls	Yes	yes	yes	yes

Observations	12,271	11,704	15,058	15,009
Adjusted R-squared	0.205	0.0518	0.210	0.162

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

For a deeper understanding of gender based analysis and how it might change the pattern of household allocation choices for the mother, we particularly studied investment patterns for the third pregnancy across households, given the gender composition of first and second born children. The specification used for this analysis has been adapted from Jayachandran and Pande (2013) who used it to study fertility patterns, yet we find it applicable in this case. We look to see if third pregnancies are treated differently depending on the gender of the first two children. There may be greater disinvestment in prenatal care when the optimal gender composition of offspring has been reached. Compared to the outcome of first two children being sons, we test whether "first two are girls", or "first two children include a boy and girl", affect the prenatal investment. For example, if a son is desired, greater pre-natal investments may be expected if the first two children were girls.

Nonetheless, no conclusive comment can be made regarding gender preference influencing investments patterns as shown in Table 14. To our surprise, the results contrast with the widely known phenomenon of general preference for son dictating most household allocation decisions in South Asian countries, as the disinvestment with higher pregnancy across households is apparently not affected by the gender of elder siblings. Gender interactions were deliberately omitted for the prenatal investments as the child's gender is usually unknown and thus including them would have given spurious results.

Table 14 Gender-specific preferences regarding investments on mothers *across* HHs

Sample: Third born children only

VARIABLES	(1) Total Prenatal visits	(2) Total tetanus shots	(3) Delivery at health facility?	(4) Postnatal checkup by health professional?
Girl	-	-	-	0.003
				(0.028)
First and second born are girls	-0.144	0.007	-0.005	-0.002
	(0.130)	(0.033)	(0.020)	(0.028)
First and second born include a girl and a boy	0.042	0.008	0.006	0.020
	(0.100)	(0.029)	(0.017)	(0.024)
First and second born are girls*Girl	-	-	-	-0.022
				(0.039)
First and second born include a girl and a boy*Girl	-	-	-	0.012
				(0.034)
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	yes	yes	yes	yes
Observations	3,640	3,468	4,339	4,323
Adjusted R-squared	0.200	0.0547	0.201	0.155

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

As a stronger robustness check, we tested the same results with a family fixed effects model, comparing last born children of different mothers within the same household. The birth order results (Appendix Table 13) were only significant for prenatal visits generally worsening with higher order pregnancies, but slightly favoring the third and fourth child in comparison with the second, which could be attributed to more experience and awareness with time. After the fourth child, as observed earlier, parents seem to disinvest on the mother anyway, possibly due to resource constraints.

However, when we restricted the sample to third born children within households i.e. third pregnancy of mothers within the same household through a family fixed effects model, we observe girls being discriminated against in terms of postnatal investments on the mother (Table 15). Interestingly, the results also show that the mother will be disinvested upon in terms of both pre- and post-natal investments if she has had two daughters as opposed to having had two older sons, which is the opposite result compared to what we expected. Though, if she has had a girl and boy then the third pregnancy is not discriminated against in terms of investments. Thus, we observe disinvestment on the mother when parents are able to make an informed decision i.e. in case of post natal health care.

Table 15 Gender-specific preferences regarding investments on mothers *within* HHs

Sample: Third born children only

VARIABLES	(1) Total Prenatal visits	(2) Total tetanus shots	(3) Delivery at health facility?	(4) Postnatal checkup by health professional?
Girl	-	-	-	-0.131*
				(0.068)
First and second born are girls	-2.567**	0.137	-0.291**	-0.369**
	(1.278)	(0.374)	(0.142)	(0.163)
First and second born include a girl and a boy	2.583**	-0.112	0.066	0.198
	(1.019)	(0.248)	(0.082)	(0.135)
First and second born are girls*Girl	-	-	-	0.197***
				(0.076)
First and second born include a girl and a boy*Girl	-	-	-	-0.043
				(0.086)
Child controls	yes	Yes	yes	yes
Mother controls	yes	Yes	yes	yes
HH controls	yes	Yes	yes	yes
Observations	3,651	3,478	4,354	4,338
Number of HHs	3,588	3,410	4,277	4,262
Adjusted R-squared	0.378	0.157	0.192	0.364

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1

Source: author's calculations

4.4. Parental Preferences regarding child health inputs

According to the research conducted by Jayachandran and Pande (2013), it has been established that in India, preference for sons is a major underlying factor of the resultant household contemporaneous choices and investment preferences for children, both of which together lead to differences in nutritional status across siblings. Similar patterns were expected in case of Punjab, reported later in this section.

We examine how birth order affects parental preference regarding child health inputs including breastfeeding, vaccination, and vitamin supplementation across families as most of these inputs were collected for children born only in the last 3 years. This precluded mother fixed effects reducing the sample size considerably, and thereby an OLS regression was run to determine the trend across families, as reported in Table 16. The only significant results were observed for whether the child was ever breastfed and whether the vaccination card was being maintained. The table below shows that the outcomes for whether the child was ever breastfed stayed positive for birth order variables, signifying that with time, parents usually become more aware about the importance of breastfeeding. Birth order combinations with gender showed insignificant results suggesting that birth order effects exist irrespective of a child's gender. As a robustness check, same specification was estimated for child health inputs across households with 3 and 4 children separately, but revealed similar results regarding insignificance of gender specific outcomes (as shown in Appendix Tables 14 and 15, respectively).

Table 16 Parental preference regarding child health inputs *across* HHs

VARIABLES	(1) Ever Breastfed?	(2) Ever Vaccinated?	(3) Vaccination Card?	(4) Vitamin A dose in last 6 months
2^{nd} child	0.024***	0.007	-0.044***	0.011
	(0.004)	(0.009)	(0.015)	(0.013)
3^{rd}plus child	0.022***	0.007	-0.073***	-0.000
	(0.004)	(0.008)	(0.015)	(0.013)
Girl	-0.001	0.001	0.017	-0.015
(girl=1, boy=0)	(0.005)	(0.009)	(0.018)	(0.016)
2^{nd}child*Girl	-0.001	-0.004	-0.030	0.014
	(0.006)	(0.012)	(0.021)	(0.018)
3^{rd}plus child*Girl	0.002	-0.010	-0.030	0.028
	(0.005)	(0.011)	(0.020)	(0.017)
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	yes	yes	yes	yes
Observations	43,434	16,139	24,935	24,344
Adjusted R-squared	0.00806	0.0921	0.116	0.198

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05,

* p<0.1
Source: author's calculations

The model was also tested with family fixed effects for cousins within the same household to control for any unmeasured household characteristics, but similar results were observed as those across households (see Table 17) i.e. presence of birth order effects for breastfed and vaccination card, irrespective of a child's gender. For a more convincing argument regarding child health inputs being affected by birth order irrespective of their gender, we tried to study the impact on investments of just second born children, given the gender of their older sibling as shown in Appendix Table 16. Family fixed effects were estimated to study the impact of second birth order children born to different mothers within the same household and the results confirm that there is no particular evidence for gender based disinvestment in subsequent births.

Table 17 Parental preference regarding child health inputs *within* HHs

VARIABLES	(1) Ever Breastfed?	(2) Ever Vaccinated?	(3) Vaccination Card?	(4) Vitamin A dose in last 6 months
2nd child	0.018***	-0.010	-0.022	0.035*
	(0.004)	(0.019)	(0.019)	(0.018)
3rdplus child	0.016***	-0.009	-0.026	0.029
	(0.005)	(0.024)	(0.027)	(0.025)
Girl	0.002	-0.019	-0.004	-0.032*
(girl=1, boy=0)	(0.005)	(0.020)	(0.020)	(0.019)
2ndchild*Girl	-0.001	0.018	-0.003	0.014
	(0.006)	(0.025)	(0.025)	(0.024)
3rdplus child*Girl	-0.003	-0.014	-0.031	0.020
	(0.006)	(0.023)	(0.024)	(0.023)
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	yes	yes	yes	yes
Observations	43,434	16,139	24,935	24,344
Adjusted R-squared	0.00806	0.0921	0.116	0.198

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

The reason for including ‘ever vaccinated’ and ‘vaccination card’ variables separately was to try to examine the access vs. take-up issue of health services. As the ever vaccinated variable also includes any door-to-door free health services introduced by the government, the vaccination card is more to do with take-up of services where parents specially maintain vaccination cards for their children and indicate that the child is being regularly vaccinated. Significant and worsening with higher birth order within and across households, our results conform to results obtained by Jayachandran and Pande (2013) where it is usually the issue of take-up as opposed to access of child health inputs.

5. Conclusion

This paper presents a comprehensive analysis of birth order effects on child nutritional status for children in Punjab, Pakistan. In consonance with the existing literature, our results point towards strong birth order effects for all three anthropometric measures: HFA, WFA, and WFH. These effects were robust and essentially stronger when tested with mother fixed effects for an intra-family analysis, ruling out any selection reservations.

We add to the literature by testing similar results for same size families, finding that birth order effects become stronger in larger families, even after controlling for birth spacing. Furthermore, when disinvestment patterns were studied for successive pregnancies and births in disaggregation, we find only limited evidence of gender based postnatal disinvestment on mothers in household fixed effects regressions, while no gender specific effects were observed for child health investments.

6. Discussion

The findings of this paper cannot be directly compared in terms of birth order gradient with findings of our focal paper by Jayachandran and Pande (2013) because of differences in the controls; yet there exists evident similarity in many aspects. First, birth order has negative effects on child health. Second, the child height and weight gradient monotonically declines with increasing birth order for children. Third, investments in successive pregnancies and births decline with higher birth order children.

The results for children in Punjab to some degree contrast with Indian and African children, particularly regarding gender-specific effects of birth order. Whereas most of the stunting pattern in India is dictated by preference for sons, in this study we do not find considerable support for the explanations for discrimination against girls in terms of health investments. In fact, girls appear healthier in nearly all of our specifications. It is important to highlight that the discussions of bias against girls might be exaggerated, which is an important finding for a South Asian country.

Conclusively, a cause of serious concern is that Jayachandran and Pande (2013) found stronger child height gradient for India in comparison with African children; yet, in this study even though the gradient for children in Punjab is weaker than that of Indian children in OLS, still stronger birth order effects exist in fixed effects specifications. Moreover, this study needs to be examined beyond Punjab for other provinces too in order to better target the inhibiting factors and improve the situation of child health across Pakistan. The scope of this could be expanded across the country, using the recently available Pakistan Demographic and Health Survey (2012-13) which would additionally allow us to control for mothers' anthropometric indicators.

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8. Appendix

Table 1: OLS Regression for Height-for-Age (HFA)

VARIABLES	(1) All controls	(2) All controls	(3) All controls	(4) All controls
Birth order	-0.039***	-0.048**		
	(0.006)	(0.021)		
Birth order squared		0.001		
		(0.003)		
Relative birth order			-0.178***	
			(0.050)	
2nd child				-0.102***
				(0.020)
3rd child				-0.112***
				(0.023)
4th child				-0.129***
				(0.026)
5th child or higher				-0.216***
				(0.031)
Child characteristics				
Age (months)	-0.028***	-0.028***	-0.031***	-0.028***
	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Illness status [d]	-0.098***	-0.098***	-0.101***	-0.098***
	(0.019)	(0.019)	(0.020)	(0.019)
Gender [d]	-0.051***	-0.051***	-0.062***	-0.051***
(male=1, female=0)	(0.014)	(0.014)	(0.016)	(0.014)
Birth spacing ≤ 12 months	-0.158***	-0.157***	-0.140***	-0.145***
	(0.020)	(0.020)	(0.021)	(0.021)
Birth year - 2007	0.046	0.047	0.083**	0.047
	(0.033)	(0.033)	(0.041)	(0.033)
Birth year - 2008	0.036	0.036	0.127**	0.036
	(0.046)	(0.046)	(0.056)	(0.046)
Birth year - 2009	0.054	0.055	0.154**	0.055
	(0.059)	(0.059)	(0.071)	(0.059)
Birth year - 2010	0.218***	0.219***	0.349***	0.220***
	(0.071)	(0.071)	(0.083)	(0.071)
Birth year - 2011	0.693***	0.693***	0.820***	0.691***
	(0.085)	(0.085)	(0.095)	(0.085)
Mother characteristics				
Education level	0.093***	0.093***	0.100***	0.093***
	(0.008)	(0.008)	(0.008)	(0.008)
Age at marriage	0.028**	0.028**	0.031**	0.028**
	(0.014)	(0.014)	(0.015)	(0.014)
Age at marriage	-0.000	-0.000	-0.000	-0.000

Squared	(0.000)	(0.000)	(0.000)	(0.000)
Working status [d]	0.012	0.012	0.005	0.012
	(0.029)	(0.029)	(0.031)	(0.029)
Log(mother's fertility)	0.287***	0.286***	0.285***	0.279***
	(0.053)	(0.053)	(0.057)	(0.053)
HH characteristics				
Head's education level	0.051***	0.051***	0.051***	0.051***
	(0.007)	(0.007)	(0.007)	(0.007)
Region [d]	-0.081***	-0.081***	-0.094***	-0.082***
(urban=1, rural=0)	(0.022)	(0.022)	(0.024)	(0.022)
Landholding family [d]	0.153***	0.153***	0.152***	0.154***
	(0.019)	(0.019)	(0.021)	(0.019)
Wealth score	0.250***	0.250***	0.246***	0.251***
	(0.017)	(0.017)	(0.018)	(0.017)
No. of children under	-0.012	-0.012	-0.031***	-0.014
5 yrs in a HH	(0.009)	(0.009)	(0.010)	(0.009)
Safer drinking water [d]	0.070*	0.070*	0.057	0.070*
	(0.036)	(0.036)	(0.039)	(0.036)
Toilet facility [d]	-0.033	-0.033	-0.016	-0.034
	(0.026)	(0.026)	(0.028)	(0.026)
Avg monthly per capita expenditure	0.025***	0.025***	0.026***	0.025***
(non-food)	(0.009)	(0.009)	(0.010)	(0.009)
D2	-0.111**	-0.111**	-0.070	-0.111**
	(0.056)	(0.056)	(0.059)	(0.056)
D3	-0.174***	-0.174***	-0.171***	-0.174***
	(0.056)	(0.056)	(0.059)	(0.056)
D4	-0.470***	-0.470***	-0.459***	-0.470***
	(0.072)	(0.072)	(0.077)	(0.072)
D5	0.129**	0.130**	0.124*	0.130**
	(0.065)	(0.065)	(0.069)	(0.065)
D6	-0.132**	-0.132**	-0.137**	-0.130**
	(0.060)	(0.060)	(0.065)	(0.060)
D7	-0.138*	-0.138*	-0.133*	-0.139*
	(0.073)	(0.073)	(0.076)	(0.073)
D8	-0.035	-0.035	0.006	-0.034
	(0.048)	(0.048)	(0.051)	(0.048)
D9	-0.161**	-0.160**	-0.158**	-0.158**
	(0.067)	(0.067)	(0.073)	(0.067)
D10	-0.161***	-0.161***	-0.161***	-0.160***
	(0.057)	(0.057)	(0.061)	(0.057)
D11	-0.001	-0.001	0.014	-0.001
	(0.063)	(0.063)	(0.068)	(0.063)
D12	-0.038	-0.038	-0.020	-0.038
	(0.052)	(0.052)	(0.056)	(0.052)
D13	-0.038	-0.037	-0.037	-0.036
	(0.058)	(0.058)	(0.062)	(0.058)
D14	0.075	0.075	0.086	0.076
	(0.080)	(0.080)	(0.089)	(0.080)
D15	-0.020	-0.019	0.036	-0.018
	(0.070)	(0.070)	(0.076)	(0.070)

D16	0.143**	0.143**	0.176***	0.144**
	(0.059)	(0.059)	(0.064)	(0.059)
D17	-0.093	-0.093	-0.022	-0.092
	(0.058)	(0.058)	(0.062)	(0.058)
D18	-0.134**	-0.134**	-0.125**	-0.133**
	(0.056)	(0.056)	(0.060)	(0.056)
D19	0.084	0.084	0.128**	0.084
	(0.060)	(0.060)	(0.064)	(0.060)
D20	-0.007	-0.007	-0.003	-0.007
	(0.068)	(0.068)	(0.072)	(0.068)
D21	-0.183***	-0.182***	-0.166**	-0.182***
	(0.061)	(0.061)	(0.066)	(0.061)
D22	-0.084	-0.084	-0.032	-0.084
	(0.056)	(0.056)	(0.060)	(0.056)
D23	-0.019	-0.020	0.071	-0.019
	(0.060)	(0.060)	(0.066)	(0.060)
D24	-0.087	-0.087	-0.086	-0.088
	(0.080)	(0.080)	(0.083)	(0.080)
D25	-0.037	-0.037	0.019	-0.035
	(0.065)	(0.065)	(0.069)	(0.065)
D26	0.257***	0.257***	0.251***	0.258***
	(0.080)	(0.080)	(0.086)	(0.080)
D27	0.212***	0.213***	0.215**	0.212***
	(0.078)	(0.078)	(0.085)	(0.078)
D28	0.034	0.034	0.050	0.034
	(0.064)	(0.064)	(0.067)	(0.064)
D29	0.110**	0.110**	0.131**	0.113**
	(0.056)	(0.056)	(0.061)	(0.056)
D30	0.076	0.077	0.135**	0.079
	(0.064)	(0.064)	(0.068)	(0.064)
D31	0.082	0.083	0.075	0.086
	(0.078)	(0.078)	(0.082)	(0.078)
D32	0.049	0.050	0.043	0.051
	(0.065)	(0.065)	(0.068)	(0.065)
D33	0.081	0.081	0.087	0.083
	(0.052)	(0.053)	(0.056)	(0.053)
D34	0.199***	0.199***	0.221***	0.200***
	(0.064)	(0.064)	(0.069)	(0.064)
D35	0.144*	0.144*	0.142*	0.145*
	(0.078)	(0.078)	(0.082)	(0.078)
D36	0.126	0.126	0.176*	0.128
	(0.089)		(0.097)	(0.089)
Constant	-1.950***	-1.936***	-2.032***	-1.943***
	(0.180)	(0.183)	(0.201)	(0.180)
Observations	41,008	41,008	34,078	41,008
R-squared	0.129	0.129	0.132	0.129
Adjusted R-squared	0.128	0.128	0.131	0.128

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1; d = dummy variable (yes=1, no=0)

Source: author's calculations

Table 2: OLS Regression for Weight-for-Age (WFA)

VARIABLES	(1) All controls	(2) All controls	(3) All controls	(4) All controls
Birth order	-0.034***	-0.030*		
	(0.005)	(0.017)		
Birth order squared		-0.001		
		(0.003)		
Relative birth order			-0.126***	
			(0.041)	
2nd child				-0.071***
				(0.016)
3rd child				-0.087***
				(0.018)
4th child				-0.102***
				(0.021)
5th child or higher				-0.178***
				(0.025)
Child characteristics				
Age (months)	-0.005*	-0.005*	-0.007**	-0.005*
	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Illness status [d]	-0.113***	-0.113***	-0.121***	-0.113***
	(0.015)	(0.015)	(0.016)	(0.015)
Gender [d]	-0.035***	-0.035***	-0.041***	-0.035***
(male=1, female=0)	(0.011)	(0.011)	(0.013)	(0.011)
Birth spacing ≤ 12 months	-0.097***	-0.098***	-0.088***	-0.090***
	(0.016)	(0.016)	(0.017)	(0.017)
Birth year - 2007	0.069***	0.069***	0.093***	0.070***
	(0.027)	(0.027)	(0.033)	(0.027)
Birth year - 2008	0.083**	0.083**	0.150***	0.084**
	(0.037)	(0.037)	(0.045)	(0.037)
Birth year - 2009	0.119**	0.119**	0.199***	0.120**
	(0.048)	(0.048)	(0.057)	(0.048)
Birth year - 2010	0.185***	0.184***	0.286***	0.185***
	(0.057)	(0.057)	(0.067)	(0.057)
Birth year - 2011	0.280***	0.280***	0.384***	0.278***
	(0.068)	(0.068)	(0.076)	(0.068)
Mother characteristics				
Education level	0.075***	0.075***	0.080***	0.076***
	(0.006)	(0.006)	(0.007)	(0.006)
Age at marriage	0.013	0.013	0.017	0.013
	(0.011)	(0.011)	(0.012)	(0.011)
Age at marriage	-0.000	-0.000	-0.000	-0.000
Squared	(0.000)	(0.000)	(0.000)	(0.000)
Working status [d]	0.037	0.037	0.030	0.037
	(0.024)	(0.024)	(0.025)	(0.024)

Log(mother's fertility)	0.250***	0.251***	0.249***	0.245***
	(0.044)	(0.044)	(0.047)	(0.044)
HH characteristics				
Head's education level	0.033***	0.033***	0.034***	0.033***
	(0.005)	(0.005)	(0.006)	(0.005)
Region [d]	-0.090***	-0.090***	-0.097***	-0.091***
(urban=1, rural=0)	(0.018)	(0.018)	(0.019)	(0.018)
Landholding family [d]	0.168***	0.168***	0.169***	0.169***
	(0.016)	(0.016)	(0.017)	(0.016)
Wealth score	0.222***	0.222***	0.222***	0.223***
	(0.014)	(0.014)	(0.015)	(0.014)
No. of children under	-0.019***	-0.019**	-0.028***	-0.020***
5 yrs in a HH	(0.007)	(0.007)	(0.008)	(0.007)
Safer drinking water [d]	0.059**	0.059**	0.054*	0.059**
	(0.030)	(0.030)	(0.032)	(0.030)
Toilet facility [d]	-0.027	-0.027	-0.020	-0.028
	(0.021)	(0.021)	(0.023)	(0.021)
Avg monthly per capita expenditure	0.026***	0.026***	0.029***	0.026***
(non-food)	(0.010)	(0.010)	(0.011)	(0.010)
D2	-0.137***	-0.137***	-0.111**	-0.137***
	(0.046)	(0.046)	(0.050)	(0.046)
D3	-0.221***	-0.221***	-0.209***	-0.221***
	(0.046)	(0.046)	(0.050)	(0.046)
D4	-0.430***	-0.430***	-0.442***	-0.430***
	(0.060)	(0.060)	(0.065)	(0.060)
D5	0.105*	0.105*	0.126**	0.106*
	(0.056)	(0.056)	(0.060)	(0.056)
D6	-0.075	-0.075	-0.090*	-0.074
	(0.050)	(0.050)	(0.054)	(0.050)
D7	-0.009	-0.009	-0.021	-0.010
	(0.060)	(0.060)	(0.064)	(0.060)
D8	-0.019	-0.019	0.011	-0.019
	(0.041)	(0.041)	(0.044)	(0.041)
D9	-0.081	-0.081	-0.083	-0.080
	(0.057)	(0.057)	(0.062)	(0.057)
D10	-0.156***	-0.156***	-0.157***	-0.156***
	(0.049)	(0.049)	(0.052)	(0.049)
D11	-0.119**	-0.120**	-0.104*	-0.119**
	(0.055)	(0.055)	(0.059)	(0.055)
D12	0.022	0.022	0.036	0.022
	(0.043)	(0.043)	(0.046)	(0.043)
D13	0.146***	0.146***	0.158***	0.147***
	(0.050)	(0.050)	(0.054)	(0.050)
D14	0.118*	0.118*	0.111	0.118*
	(0.067)	(0.067)	(0.072)	(0.067)
D15	0.006	0.006	0.017	0.007
	(0.056)	(0.056)	(0.059)	(0.056)
D16	0.109**	0.109**	0.122**	0.110**
	(0.046)	(0.046)	(0.050)	(0.046)

D17	0.034	0.034	0.077	0.034
	(0.047)	(0.047)	(0.050)	(0.047)
D18	-0.107**	-0.107**	-0.100**	-0.107**
	(0.047)	(0.047)	(0.050)	(0.047)
D19	-0.005	-0.005	0.025	-0.005
	(0.051)	(0.051)	(0.055)	(0.051)
D20	-0.123**	-0.123**	-0.126**	-0.123**
	(0.056)	(0.056)	(0.060)	(0.056)
D21	-0.103**	-0.103**	-0.091*	-0.103**
	(0.051)	(0.051)	(0.055)	(0.051)
D22	-0.163***	-0.163***	-0.136***	-0.163***
	(0.047)	(0.047)	(0.050)	(0.047)
D23	-0.170***	-0.169***	-0.140***	-0.169***
	(0.049)	(0.049)	(0.054)	(0.049)
D24	-0.127**	-0.127**	-0.112*	-0.128**
	(0.061)	(0.061)	(0.064)	(0.061)
D25	-0.187***	-0.187***	-0.156***	-0.186***
	(0.052)	(0.052)	(0.056)	(0.052)
D26	0.037	0.037	0.017	0.038
	(0.061)	(0.061)	(0.066)	(0.061)
D27	-0.088	-0.088	-0.080	-0.088
	(0.067)	(0.067)	(0.072)	(0.066)
D28	-0.220***	-0.220***	-0.211***	-0.220***
	(0.049)	(0.049)	(0.051)	(0.049)
D29	0.102**	0.101**	0.117**	0.103**
	(0.047)	(0.047)	(0.051)	(0.047)
D30	0.137**	0.137**	0.190***	0.139**
	(0.056)	(0.056)	(0.061)	(0.056)
D31	0.114*	0.113*	0.151**	0.116*
	(0.065)	(0.065)	(0.070)	(0.065)
D32	0.101*	0.101*	0.106*	0.102*
	(0.059)	(0.059)	(0.061)	(0.059)
D33	0.119***	0.118***	0.121**	0.120***
	(0.044)	(0.044)	(0.048)	(0.044)
D34	-0.049	-0.049	-0.055	-0.049
	(0.057)	(0.057)	(0.061)	(0.057)
D35	0.078	0.078	0.083	0.079
	(0.059)	(0.059)	(0.064)	(0.059)
D36	-0.023	-0.023	0.016	-0.023
	(0.072)	(0.072)	(0.080)	(0.072)
Constant	-1.877***	-1.884***	-2.004***	-1.885***
	(0.145)	(0.148)	(0.164)	(0.145)
Observations	41,435	41,435	34,456	41,435
R-squared	0.106	0.106	0.103	0.106
Adjusted R-squared	0.104	0.104	0.101	0.104

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
d = dummy variable (yes=1, no=0)
Source: author's calculations

Table 3: OLS Regression for Weight-for-Height (WFH)

VARIABLES	(1) All controls	(2) All controls	(3) All controls	(4) All controls
Birth order	-0.019***	-0.019		
	(0.005)	(0.017)		
Birth order squared		0.000		
		(0.003)		
Relative birth order			-0.075*	
			(0.040)	
2nd child				-0.030*
				(0.016)
3rd child				-0.054***
				(0.018)
4th child				-0.053**
				(0.021)
5th child or higher				-0.088***
				(0.024)
Child characteristics				
Age (months)	0.008***	0.008***	0.007**	0.008***
	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	-0.000*	-0.000*	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Illness status [d]	-0.083***	-0.083***	-0.088***	-0.082***
	(0.015)	(0.015)	(0.016)	(0.015)
Gender [d]	-0.064***	-0.064***	-0.064***	-0.065***
(male=1, female=0)	(0.011)	(0.011)	(0.013)	(0.011)
Birth spacing ≤ 12 months	-0.005	-0.005	-0.001	-0.002
	(0.016)	(0.016)	(0.017)	(0.017)
Birth year - 2007	0.093***	0.093***	0.088***	0.094***
	(0.028)	(0.028)	(0.034)	(0.028)
Birth year - 2008	0.138***	0.138***	0.155***	0.138***
	(0.038)	(0.038)	(0.045)	(0.038)
Birth year - 2009	0.106**	0.106**	0.126**	0.106**
	(0.049)	(0.049)	(0.057)	(0.049)
Birth year - 2010	0.040	0.040	0.070	0.040
	(0.057)	(0.057)	(0.066)	(0.057)
Birth year - 2011	0.045	0.045	0.076	0.045
	(0.068)	(0.068)	(0.076)	(0.068)
Mother characteristics				
Education level	0.025***	0.025***	0.024***	0.025***
	(0.006)	(0.006)	(0.007)	(0.006)
Age at marriage	-0.005	-0.005	-0.001	-0.005
	(0.011)	(0.011)	(0.012)	(0.011)
Age at marriage	0.000	0.000	-0.000	0.000
Squared	(0.000)	(0.000)	(0.000)	(0.000)

Working status [d]	0.046**	0.046**	0.039*	0.046**
	(0.022)	(0.022)	(0.024)	(0.022)
Log(mother's fertility)	0.071*	0.071*	0.062	0.068
	(0.041)	(0.041)	(0.045)	(0.041)
HH characteristics				
Head's education level	0.007	0.007	0.007	0.007
	(0.005)	(0.005)	(0.006)	(0.005)
Region [d]	-0.074***	-0.074***	-0.074***	-0.074***
(urban=1, rural=0)	(0.017)	(0.017)	(0.019)	(0.017)
Landholding family [d]	0.100***	0.100***	0.104***	0.100***
	(0.015)	(0.015)	(0.016)	(0.015)
Wealth score	0.106***	0.106***	0.112***	0.107***
	(0.013)	(0.013)	(0.014)	(0.013)
No. of children under	-0.020***	-0.020***	-0.023***	-0.020***
5 yrs in a HH	(0.006)	(0.006)	(0.008)	(0.006)
Safer drinking water [d]	0.021	0.021	0.028	0.021
	(0.029)	(0.029)	(0.031)	(0.029)
Toilet facility [d]	-0.035*	-0.035*	-0.038*	-0.035*
	(0.020)	(0.020)	(0.022)	(0.020)
Avg monthly per capita expenditure	0.014*	0.014*	0.015*	0.014*
(non-food)	(0.007)	(0.007)	(0.008)	(0.007)
D2	-0.098**	-0.098**	-0.093*	-0.098**
	(0.045)	(0.045)	(0.048)	(0.045)
D3	-0.116**	-0.116**	-0.104**	-0.116**
	(0.045)	(0.045)	(0.050)	(0.045)
D4	-0.100*	-0.100*	-0.131**	-0.101*
	(0.055)	(0.055)	(0.060)	(0.055)
D5	0.078	0.078	0.123**	0.079
	(0.052)	(0.052)	(0.057)	(0.052)
D6	0.087*	0.087*	0.068	0.088*
	(0.048)	(0.048)	(0.051)	(0.048)
D7	0.133**	0.133**	0.118**	0.132**
	(0.054)	(0.054)	(0.057)	(0.054)
D8	0.029	0.029	0.035	0.029
	(0.040)	(0.040)	(0.043)	(0.040)
D9	0.064	0.064	0.057	0.065
	(0.056)	(0.056)	(0.061)	(0.056)
D10	-0.051	-0.051	-0.055	-0.050
	(0.046)	(0.046)	(0.049)	(0.046)
D11	-0.163***	-0.163***	-0.155***	-0.162***
	(0.052)	(0.052)	(0.054)	(0.052)
D12	0.114***	0.114***	0.118**	0.114***
	(0.043)	(0.043)	(0.047)	(0.043)
D13	0.273***	0.273***	0.290***	0.273***
	(0.049)	(0.049)	(0.053)	(0.049)
D14	0.274***	0.274***	0.281***	0.274***
	(0.070)	(0.070)	(0.077)	(0.070)
D15	0.045	0.045	0.008	0.045
	(0.059)	(0.059)	(0.064)	(0.059)

D16	0.064	0.064	0.054	0.065
	(0.045)	(0.045)	(0.050)	(0.045)
D17	0.165***	0.165***	0.156***	0.165***
	(0.049)	(0.049)	(0.052)	(0.049)
D18	-0.007	-0.007	-0.007	-0.006
	(0.045)	(0.045)	(0.049)	(0.045)
D19	-0.051	-0.051	-0.043	-0.050
	(0.050)	(0.050)	(0.054)	(0.050)
D20	-0.016	-0.016	-0.004	-0.016
	(0.059)	(0.059)	(0.064)	(0.059)
D21	0.009	0.009	0.013	0.009
	(0.049)	(0.049)	(0.053)	(0.049)
D22	-0.125***	-0.125***	-0.133***	-0.124***
	(0.044)	(0.044)	(0.048)	(0.044)
D23	-0.107**	-0.107**	-0.129**	-0.107**
	(0.050)	(0.050)	(0.056)	(0.050)
D24	-0.016	-0.016	-0.012	-0.016
	(0.059)	(0.059)	(0.065)	(0.059)
D25	-0.196***	-0.196***	-0.197***	-0.196***
	(0.050)	(0.050)	(0.055)	(0.050)
D26	-0.041	-0.041	-0.043	-0.041
	(0.063)	(0.063)	(0.067)	(0.063)
D27	-0.229***	-0.229***	-0.219***	-0.229***
	(0.064)	(0.064)	(0.070)	(0.064)
D28	-0.239***	-0.239***	-0.243***	-0.238***
	(0.052)	(0.052)	(0.056)	(0.052)
D29	0.089*	0.089*	0.100*	0.090*
	(0.046)	(0.046)	(0.051)	(0.046)
D30	0.141**	0.141**	0.158***	0.142**
	(0.056)	(0.056)	(0.061)	(0.056)
D31	0.126*	0.126*	0.177***	0.127*
	(0.065)	(0.065)	(0.069)	(0.065)
D32	0.105*	0.105*	0.120**	0.106*
	(0.056)	(0.056)	(0.060)	(0.056)
D33	0.117***	0.117***	0.113**	0.117***
	(0.043)	(0.043)	(0.046)	(0.043)
D34	-0.189***	-0.189***	-0.207***	-0.189***
	(0.057)	(0.057)	(0.062)	(0.057)
D35	0.018	0.018	0.033	0.019
	(0.056)	(0.056)	(0.061)	(0.056)
D36	-0.108	-0.108	-0.104	-0.108
	(0.069)	(0.069)	(0.076)	(0.069)
Constant	-0.973***	-0.973***	-1.027***	-0.982***
	(0.141)	(0.144)	(0.159)	(0.141)
Observations	41,351	41,351	34,363	41,351
R-squared	0.038	0.038	0.038	0.038
Adjusted R-squared	0.0370	0.0370	0.0363	0.0369

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
d = dummy variable (yes=1, no=0)
Source: author's calculations

Table 4: OLS, 2SLS, and Mother Fixed Effects for Height-for-Age (HFA)

VARIABLES	(1) OLS	(2) 2SLS	(3) MFE
2nd child	-0.102***	-0.097***	-0.355***
	(0.020)	(0.022)	(0.041)
3rd child	-0.112***	-0.114***	-0.696***
	(0.023)	(0.026)	(0.074)
4th child	-0.129***	-0.127***	-1.071***
	(0.026)	(0.029)	(0.109)
5th child or higher	-0.216***	-0.198***	-1.433***
	(0.031)	(0.034)	(0.148)
Child characteristics			
Age (months)	-0.028***	-0.029***	-0.035***
	(0.003)	(0.004)	(0.004)
Age squared	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Child Illness [p, d]	-0.098***	0.116	-0.113***
	(0.019)	(0.084)	(0.027)
Gender [d]	-0.051***	-0.055***	-0.064***
(male=1, female=0)	(0.014)	(0.016)	(0.018)
Birth spacing ≤ 12 months	-0.145***	-0.153***	-0.239***
	(0.021)	(0.023)	(0.029)
Birth year - 2007	0.047	0.080**	0.205***
	(0.033)	(0.038)	(0.045)
Birth year - 2008	0.036	0.079	0.414***
	(0.046)	(0.052)	(0.067)
Birth year - 2009	0.055	0.118*	0.480***
	(0.059)	(0.067)	(0.087)
Birth year - 2010	0.220***	0.284***	0.802***
	(0.071)	(0.079)	(0.103)
Birth year - 2011	0.691***	0.769***	1.469***
	(0.085)	(0.094)	(0.120)
Mother characteristics			
Education level	0.093***	0.094***	
	(0.008)	(0.009)	
Age at marriage	0.028**	0.028*	
	(0.014)	(0.015)	
Age at marriage	-0.000	-0.000	
Squared	(0.000)	(0.000)	
Working status [d]	0.012	-0.004	
	(0.029)	(0.032)	
Log(mother's fertility)	0.279***	0.302***	
	(0.053)	(0.059)	
HH characteristics			
Head's education level	0.051***	0.051***	
	(0.007)	(0.007)	

Region [d]	-0.082***	-0.098***
(urban=1, rural=0)	(0.022)	(0.025)
Landholding family [d]	0.154***	0.158***
	(0.019)	(0.021)
Wealth score	0.251***	0.268***
	(0.017)	(0.019)
No. of children under	-0.014	-0.012
5 yrs in a HH	(0.009)	(0.010)
Safer drinking water [d]	0.070*	0.036
	(0.036)	(0.041)
Toilet facility [d]	-0.034	-0.017
	(0.026)	(0.028)
Avg monthly per capita expenditure	0.025***	0.020**
(non-food)	(0.009)	(0.010)
D2	-0.111**	-0.132**
	(0.056)	(0.057)
D3	-0.174***	-0.150**
	(0.056)	(0.062)
D4	-0.470***	-0.464***
	(0.072)	(0.073)
D5	0.130**	0.155**
	(0.065)	(0.066)
D6	-0.130**	-0.111*
	(0.060)	(0.062)
D7	-0.139*	-0.115
	(0.073)	(0.076)
D8	-0.034	-0.016
	(0.048)	(0.053)
D9	-0.158**	-0.098
	(0.067)	(0.073)
D10	-0.160***	-0.154***
	(0.057)	(0.060)
D11	-0.001	0.071
	(0.063)	(0.070)
D12	-0.038	-0.029
	(0.052)	(0.057)
D13	-0.036	-0.016
	(0.058)	(0.062)
D14	0.076	0.075
	(0.080)	(0.082)
D15	-0.018	0.093
	(0.070)	(0.085)
D16	0.144**	0.161**
	(0.059)	(0.072)
D17	-0.092	-0.053
	(0.058)	(0.062)
D18	-0.133**	-0.108*
	(0.056)	(0.063)
D19	0.084	0.145**
	(0.060)	(0.068)
D20	-0.007	0.108

	(0.068)	(0.084)	
D21	-0.182***	-0.137**	
	(0.061)	(0.068)	
D22	-0.084	-0.027	
	(0.056)	(0.060)	
D23	-0.019	0.096	
	(0.060)	(0.078)	
D24	-0.088	0.062	
	(0.080)	(0.091)	
D25	-0.035	-0.008	
	(0.065)	(0.072)	
D26	0.258***	0.322***	
	(0.080)	(0.095)	
D27	0.212***	0.241***	
	(0.078)	(0.082)	
D28	0.034	0.175**	
	(0.064)	(0.075)	
D29	0.113**	0.179***	
	(0.055)	(0.066)	
D30	0.079	0.097	
	(0.064)	(0.071)	
D31	0.086	0.131	
	(0.078)	(0.098)	
D32	0.051	0.021	
	(0.065)	(0.071)	
D33	0.083	0.090*	
	(0.052)	(0.054)	
D34	0.200***	0.214***	
	(0.064)	(0.065)	
D35	0.145*	0.185**	
	(0.078)	(0.089)	
D36	0.128	0.246**	
	(0.089)	(0.099)	
Constant	-1.943***	-2.123***	-1.093***
	(0.180)	(0.203)	(0.139)
Observations	41,008	32,453	41,424
R-squared	0.129	0.130	0.125
Adjusted R-squared	0.128	0.128	0.124
Number of mothers	-	-	23,981

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
p = predicted value; d = dummy variable (yes=1, no=0)
Source: author's calculations

Table 5: OLS, 2SLS, and Mother Fixed Effects for Weight-for-Age (WFA)

VARIABLES	(1) OLS	(2) 2SLS	(3) MFE
2^{nd} child	-0.071***	-0.071***	-0.204***
	(0.016)	(0.018)	(0.032)
3^{rd} child	-0.087***	-0.092***	-0.417***
	(0.018)	(0.021)	(0.058)
4^{th} child	-0.102***	-0.099***	-0.677***
	(0.021)	(0.024)	(0.086)
5^{th} child or higher	-0.178***	-0.166***	-0.941***
	(0.025)	(0.028)	(0.117)
Child characteristics			
Age (months)	-0.005*	-0.006*	-0.013***
	(0.003)	(0.003)	(0.003)
Age squared	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Child Illness $^{p, d}$	-0.113***	0.062	-0.136***
	(0.015)	(0.069)	(0.021)
Gender ^{d}	-0.035***	-0.035***	-0.041***
(male=1, female=0)	(0.011)	(0.013)	(0.014)
Birth spacing ≤ 12 months	-0.090***	-0.096***	-0.174***
	(0.017)	(0.019)	(0.023)
Birth year - 2007	0.070***	0.098***	0.182***
	(0.027)	(0.030)	(0.035)
Birth year - 2008	0.084**	0.122***	0.356***
	(0.037)	(0.042)	(0.051)
Birth year - 2009	0.120**	0.182***	0.429***
	(0.048)	(0.054)	(0.067)
Birth year - 2010	0.185***	0.237***	0.533***
	(0.057)	(0.065)	(0.080)
Birth year - 2011	0.278***	0.335***	0.730***
	(0.068)	(0.077)	(0.093)
Mother characteristics			
Education level	0.076***	0.076***	
	(0.006)	(0.007)	
Age at marriage	0.013	0.016	
	(0.011)	(0.012)	
Age at marriage	-0.000	-0.000	
Squared	(0.000)	(0.000)	
Working status ^{d}	0.037	0.020	
	(0.023)	(0.026)	
Log(mother's fertility)	0.245***	0.254***	
	(0.044)	(0.049)	
HH characteristics			
Head's education level	0.033***	0.032***	
	(0.005)	(0.006)	

Region [d]	-0.091***	-0.100***
(urban=1, rural=0)	(0.018)	(0.021)
Landholding family [d]	0.169***	0.172***
	(0.016)	(0.018)
Wealth score	0.223***	0.241***
	(0.014)	(0.016)
No. of children under	-0.020***	-0.022***
5 yrs in a HH	(0.007)	(0.008)
Safer drinking water [d]	0.059**	0.029
	(0.030)	(0.035)
Toilet facility [d]	-0.028	-0.018
	(0.021)	(0.023)
Avg monthly per capita expenditure	0.026***	0.021**
(non-food)	(0.010)	(0.010)
D2	-0.137***	-0.151***
	(0.046)	(0.048)
D3	-0.221***	-0.197***
	(0.046)	(0.051)
D4	-0.430***	-0.431***
	(0.060)	(0.062)
D5	0.106*	0.123**
	(0.056)	(0.057)
D6	-0.074	-0.067
	(0.050)	(0.052)
D7	-0.010	0.013
	(0.060)	(0.063)
D8	-0.019	0.004
	(0.041)	(0.045)
D9	-0.080	-0.034
	(0.057)	(0.063)
D10	-0.156***	-0.165***
	(0.049)	(0.051)
D11	-0.119**	-0.088
	(0.055)	(0.062)
D12	0.022	0.039
	(0.043)	(0.047)
D13	0.147***	0.157***
	(0.050)	(0.054)
D14	0.118*	0.112*
	(0.067)	(0.068)
D15	0.007	0.050
	(0.056)	(0.069)
D16	0.110**	0.161***
	(0.046)	(0.056)
D17	0.034	0.066
	(0.047)	(0.051)
D18	-0.107**	-0.112**
	(0.047)	(0.054)
D19	-0.005	0.054
	(0.051)	(0.057)
D20	-0.123**	-0.077

	(0.056)	(0.069)	
D21	-0.103**	-0.087	
	(0.051)	(0.057)	
D22	-0.163***	-0.128**	
	(0.047)	(0.050)	
D23	-0.169***	-0.149**	
	(0.049)	(0.064)	
D24	-0.128**	-0.087	
	(0.061)	(0.068)	
D25	-0.186***	-0.177***	
	(0.052)	(0.058)	
D26	0.038	0.106	
	(0.061)	(0.070)	
D27	-0.088	-0.050	
	(0.066)	(0.071)	
D28	-0.220***	-0.048	
	(0.049)	(0.057)	
D29	0.103**	0.129**	
	(0.047)	(0.056)	
D30	0.139**	0.139**	
	(0.056)	(0.064)	
D31	0.116*	0.108	
	(0.065)	(0.080)	
D32	0.102*	0.073	
	(0.059)	(0.064)	
D33	0.120***	0.128***	
	(0.044)	(0.046)	
D34	-0.049	-0.029	
	(0.057)	(0.058)	
D35	0.079	0.097	
	(0.059)	(0.069)	
D36	-0.023	0.066	
	(0.072)	(0.079)	
Constant	-1.885***	-2.037***	-1.405***
	(0.146)	(0.167)	(0.110)
Observations	41,435	32,789	41,857
R-squared	0.106	0.102	0.032
Adjusted R-squared	0.104	0.101	0.0312
Number of mothers	-	-	24,097

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1; p = predicted value; d = dummy variable (yes=1, no=0)
Source: author’s calculations

Table 6: OLS, 2SLS, and Mother Fixed Effects for Weight-for-Height (WFH)

VARIABLES	(1) OLS	(2) 2SLS	(3) MFE
2nd child	-0.030*	-0.071***	0.036
	(0.016)	(0.018)	(0.032)
3rd child	-0.054***	-0.092***	0.030
	(0.018)	(0.021)	(0.058)
4th child	-0.053**	-0.099***	-0.000
	(0.021)	(0.024)	(0.085)
5th child or higher	-0.088***	-0.166***	-0.033
	(0.024)	(0.028)	(0.116)
Child characteristics			
Age (months)	0.008***	-0.006*	0.006*
	(0.003)	(0.003)	(0.003)
Age squared	-0.000*	0.000***	-0.000
	(0.000)	(0.000)	(0.000)
Child Illness [p, d]	-0.082***	0.062	-0.088***
	(0.015)	(0.069)	(0.022)
Gender [d]	-0.065***	-0.035***	-0.063***
(male=1, female=0)	(0.011)	(0.013)	(0.015)
Birth spacing ≤ 12 months	-0.002	-0.096***	-0.055**
	(0.017)	(0.019)	(0.024)
Birth year - 2007	0.094***	0.098***	0.084**
	(0.028)	(0.030)	(0.038)
Birth year - 2008	0.138***	0.122***	0.169***
	(0.038)	(0.042)	(0.056)
Birth year - 2009	0.106**	0.182***	0.138*
	(0.049)	(0.054)	(0.072)
Birth year - 2010	0.040	0.237***	-0.009
	(0.057)	(0.065)	(0.086)
Birth year - 2011	0.045	0.335***	-0.010
	(0.068)	(0.077)	(0.099)
Mother characteristics			
Education level	0.025***	0.076***	
	(0.006)	(0.007)	
Age at marriage	-0.005	0.016	
	(0.011)	(0.012)	
Age at marriage	0.000	-0.000	
Squared	(0.000)	(0.000)	
Working status [d]	0.046**	0.020	
	(0.022)	(0.026)	
Log(mother's fertility)	0.068	0.254***	
	(0.041)	(0.049)	
HH characteristics			
Head's education level	0.007	0.032***	
	(0.005)	(0.006)	

Region [d] (urban=1, rural=0)	-0.074***	-0.100***
	(0.017)	(0.021)
Landholding family [d]	0.100***	0.172***
	(0.015)	(0.018)
Wealth score	0.107***	0.241***
	(0.013)	(0.016)
No. of children under 5 yrs in a HH	-0.020***	-0.022***
	(0.006)	(0.008)
Safer drinking water [d]	0.021	0.029
	(0.029)	(0.035)
Toilet facility [d]	-0.035*	-0.018
	(0.020)	(0.023)
Avg monthly per capita expenditure *(non-food)*	0.014*	0.021**
	(0.007)	(0.010)
D2	-0.098**	-0.151***
	(0.045)	(0.048)
D3	-0.116**	-0.197***
	(0.045)	(0.051)
D4	-0.101*	-0.431***
	(0.056)	(0.062)
D5	0.079	0.123**
	(0.052)	(0.057)
D6	0.088*	-0.067
	(0.048)	(0.052)
D7	0.132**	0.013
	(0.054)	(0.063)
D8	0.029	0.004
	(0.040)	(0.045)
D9	0.065	-0.034
	(0.056)	(0.063)
D10	-0.050	-0.165***
	(0.046)	(0.051)
D11	-0.162***	-0.088
	(0.052)	(0.062)
D12	0.114***	0.039
	(0.043)	(0.047)
D13	0.273***	0.157***
	(0.049)	(0.054)
D14	0.274***	0.112*
	(0.070)	(0.068)
D15	0.045	0.050
	(0.059)	(0.069)
D16	0.065	0.161***
	(0.045)	(0.056)
D17	0.165***	0.066
	(0.048)	(0.051)
D18	-0.006	-0.112**
	(0.045)	(0.054)
D19	-0.050	0.054
	(0.050)	(0.057)
D20	-0.016	-0.077

	(0.059)	(0.069)	
D21	0.009	-0.087	
	(0.049)	(0.057)	
D22	-0.124***	-0.128**	
	(0.044)	(0.050)	
D23	-0.107**	-0.149**	
	(0.050)	(0.064)	
D24	-0.016	-0.087	
	(0.059)	(0.068)	
D25	-0.196***	-0.177***	
	(0.050)	(0.058)	
D26	-0.041	0.106	
	(0.063)	(0.070)	
D27	-0.229***	-0.050	
	(0.064)	(0.071)	
D28	-0.238***	-0.048	
	(0.052)	(0.057)	
D29	0.090*	0.129**	
	(0.046)	(0.056)	
D30	0.142**	0.139**	
	(0.056)	(0.064)	
D31	0.127*	0.108	
	(0.065)	(0.080)	
D32	0.106*	0.073	
	(0.056)	(0.064)	
D33	0.117***	0.128***	
	(0.043)	(0.046)	
D34	-0.189***	-0.029	
	(0.057)	(0.058)	
D35	0.019	0.097	
	(0.056)	(0.069)	
D36	-0.108	0.066	
	(0.069)	(0.079)	
Constant	-0.982***	-2.037***	-1.063***
	(0.142)	(0.167)	(0.113)
Observations	41,351	32,789	41,773
R-squared	0.038	0.102	0.029
Adjusted R-squared	0.0369	0.101	0.0284
Number of mothers	-	-	24,120

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1; p = predicted value; d = dummy variable (yes=1, no=0)
Source: author’s calculations

Table 7: Preference for sons: Weight-for-Age (WFA)

VARIABLES	(1) no controls	(2) OLS	(3) 2SLS	(4) Mother FE
2nd child	-0.124***	-0.100***	-0.094***	-0.074**
	(0.022)	(0.023)	(0.026)	(0.030)
3rdplus child	-0.214***	-0.127***	-0.125***	-0.128***
	(0.022)	(0.023)	(0.026)	(0.044)
Girl	-0.013	-0.002	0.002	-0.007
(girl=1, boy=0)	(0.026)	(0.025)	(0.028)	(0.030)
2ndchild*Girl	0.075**	0.061*	0.049	0.086**
	(0.034)	(0.032)	(0.037)	(0.040)
3rdplus child*Girl	0.039	0.036	0.034	0.049
	(0.031)	(0.030)	(0.034)	(0.037)
Child controls	-	yes	yes	yes
Mother controls	-	yes	yes	no
HH controls	-	yes	yes	no
Observations	41,888	41,435	32,789	41,857
Adjusted R-squared	0.00400	0.104	0.100	0.0266
Number of mothers	-	-	-	24,097

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Table 8: Preference for sons: Weight-for-Height (WFH)

VARIABLES	(1) no controls	(2) OLS	(3) 2SLS	(4) Mother FE
2nd child	-0.104***	-0.035	-0.026	-0.148***
	(0.023)	(0.023)	(0.026)	(0.039)
3rdplus child	-0.162***	-0.059**	-0.055**	-0.292***
	(0.022)	(0.023)	(0.026)	(0.057)
Girl	0.056**	0.063**	0.074***	0.011
(girl=1, boy=0)	(0.025)	(0.025)	(0.028)	(0.038)
2ndchild*Girl	0.012	0.012	-0.011	0.071
	(0.033)	(0.032)	(0.036)	(0.050)
3rdplus child*Girl	-0.004	-0.003	-0.015	0.073
	(0.030)	(0.030)	(0.034)	(0.047)
Child controls	-	yes	yes	yes
Mother controls	-	yes	yes	no
HH controls	-	yes	yes	no
Observations	41,849	41,351	32,783	41,424
Adjusted R-squared	0.00312	0.0369	0.0371	0.119
Number of mothers	-	-	-	23,981

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Table 9: Mother fixed effects for same size families
Dependent variable: Weight-for-Age (WFA)

VARIABLES	(1) All families	(2) 3 children	(3) 4 children
2^{nd} child	-0.074**	-0.326***	-
	(0.030)	(0.070)	
3^{rd}plus child	-0.128***	-0.696***	-0.255***
	(0.044)	(0.118)	(0.066)
Girl	-0.007	-0.124**	0.013
(girl=1, boy=0)	(0.030)	(0.059)	(0.073)
2^{nd}child*Girl	0.086**	0.113	-
	(0.040)	(0.071)	
3^{rd}plus child*Girl	0.049	0.200***	0.013
	(0.037)	(0.073)	(0.079)
Child controls	yes	yes	yes
Mother controls	no	no	no
HH controls	no	no	no
Observations	41,857	12,545	8,502
Adjusted R-squared	0.0266	0.0291	0.0352
Number of mothers	24,097	7,136	4,970

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Table 10: Mother fixed effects for same size families
Dependent variable: Weight-for-Height (WFH)

VARIABLES	(1) All families	(2) 3 children	(3) 4 children
2^{nd} child	0.027	-0.023	-
	(0.032)	(0.074)	
3^{rd}plus child	0.054	-0.085	0.031
	(0.046)	(0.127)	(0.072)
Girl	0.032	0.018	0.015
(girl=1, boy=0)	(0.032)	(0.062)	(0.078)
2^{nd}child*Girl	0.059	0.073	-
	(0.042)	(0.075)	
3^{rd}plus child*Girl	0.027	0.024	-0.008
	(0.040)	(0.077)	(0.084)
Child controls	yes	yes	yes
Mother controls	no	no	no
HH controls	no	no	no
Observations	41,773	12,521	8,502
Adjusted R-squared	0.0285	0.0300	0.0355
Number of mothers	24,120	7,134	4,975

Note: Clustered robust standard errors by HHs appear in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Table 11: Preference for sons: sample of 2nd born children only

Dependent variable: Weight-for-Age (WFA)

VARIABLES	(1) no controls	(2) OLS	(3) 2SLS
Girl	0.083***	0.084***	0.079**
(girl=1, boy=0)	(0.030)	(0.028)	(0.032)
Firstborn is a girl	0.033	0.043	0.032
	(0.030)	(0.029)	(0.033)
Firstborn is a girl*Girl	-0.043	-0.056	-0.064
	(0.042)	(0.041)	(0.046)
Child controls	-	Yes	yes
Mother controls	-	Yes	yes
HH controls	-	Yes	yes
Observations	13,008	12,858	10,099
Adjusted R-squared	0.000526	0.101	0.103

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Table 12: *Preference for sons: sample of 2nd born children only*

Dependent variable: Weight-for-Height (WFH)

VARIABLES	(1) no controls	(2) OLS	(3) 2SLS
Girl	0.068**	0.076***	0.055*
(girl=1, boy=0)	(0.029)	(0.029)	(0.033)
Firstborn is a girl	0.045	0.050*	0.018
	(0.030)	(0.030)	(0.033)
Firstborn is a girl*Girl	-0.001	-0.009	0.008
	(0.041)	(0.041)	(0.046)
Child controls	-	Yes	yes
Mother controls	-	Yes	yes
HH controls	-	Yes	yes
Observations	12,985	12,824	10,089
Adjusted R-squared	0.000949	0.0283	0.0289

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations

Table 13: Family fixed effects for BO effects on HH preferences: investments on expectant mothers

VARIABLES	(1) Total Prenatal visits	(2) Total Tetanus shots	(3) Delivery at health facility?	(4) Postnatal checkup by Health professional?
2nd child	-1.992***	-0.033	-0.029	-0.113
	(0.614)	(0.060)	(0.077)	(0.109)
3rd child	-1.543**	-0.010	-0.069	-0.137
	(0.632)	(0.067)	(0.076)	(0.114)
4th child	-1.994***	-0.015	-0.147*	-0.179
	(0.684)	(0.084)	(0.089)	(0.119)
5th child or higher	-2.546***	-0.081	-0.077	-0.152
	(0.738)	(0.088)	(0.093)	(0.119)
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	no	no	no	no
Observations	12,321	11,751	15,123	15,074
Number of HHs	11,753	11,207	14,427	14,384
Adjusted R-squared	0.111	0.0541	0.0371	0.0456

Note: Clustered robust standard errors in parentheses.
Source: author's calculations

Table 14: Parental Preferences *across* families, regarding child health inputs

Sample: Families with **3** children

VARIABLES	(1) Ever breastfed?	(2) Ever vaccinated?	(3) Vaccination Card?	(4) Vitamin A dose in Last 6 months
2nd child	0.033***	0.019	-0.060	0.084
	(0.009)	(0.035)	(0.078)	(0.068)
3rdplus child	0.039***	0.005	-0.061	0.043
	(0.010)	(0.036)	(0.079)	(0.069)
Girl	0.015	-0.052	0.137	-0.017
	(0.011)	(0.070)	(0.098)	(0.087)
2ndchild*Girl	-0.016	0.044	-0.123	0.000
	(0.012)	(0.070)	(0.100)	(0.089)
3rdpluschild*Girl	-0.014	0.042	-0.158	0.037
	(0.011)	(0.070)	(0.099)	(0.087)
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	yes	yes	yes	yes
Observations	13,061	4,605	7,172	6,999
Adjusted R-squared	0.0101	0.0947	0.120	0.198

Note: Clustered robust standard errors in parentheses.
Source: author's calculations

Table 15: Parental Preferences *across* families, regarding child health inputs

Sample: Families with **4** children

VARIABLES	(1) Ever breastfed?	(2) Ever vaccinated?	(3) Vaccination Card?	(4) Vitamin A dose in Last 6 months
2nd child	0.028	-	-	-0.149
	(0.031)			(0.092)
3rdplus child	0.035	0.016	0.101	-
	(0.032)	(0.045)	(0.072)	
Girl	-0.009	-0.018*	0.157	0.124
	(0.042)	(0.010)	(0.107)	(0.110)
2ndchild*Girl	0.011	0.072	-	-
	(0.042)	(0.047)		
3rdpluschild*Girl	0.011	-	-0.177	-0.144
	(0.043)		(0.109)	(0.111)
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	yes	yes	yes	yes
Observations	8,856	3,177	4,725	4,614
Adjusted R-squared	0.0108	0.0931	0.122	0.205

Note: Clustered robust standard errors in parentheses.
Source: author's calculations

Table 16: Parental preference regarding child health inputs *within* HHs

Sample: Second born children (cousins)

VARIABLES	(1) Ever Breastfed?	(2) Ever Vaccinated?	(3) Vaccination Card?	(4) Vitamin A dose in last 6 months
Girl	0.019	0.004	-0.021	0.039
(girl=1, boy=0)	(0.018)	(0.036)	(0.059)	(0.056)
Firstborn is a girl	-0.016	0.028	0.108*	0.117**
	(0.017)	(0.048)	(0.060)	(0.057)
Firstborn is a girl*Girl	-0.015	0.046	-0.065	-0.089
	(0.029)	(0.057)	(0.083)	(0.082)
Child controls	yes	yes	yes	yes
Mother controls	yes	yes	yes	yes
HH controls	no	no	no	no
Observations	13,503	5,095	8,199	7,993
Number of HHs	12,925	4,953	7,924	7,728
Adjusted R-squared	0.0203	0.191	0.0840	0.205

Note: Clustered robust standard errors in parentheses. Asterisks denote level of significance *** p<0.01, ** p<0.05, * p<0.1
Source: author's calculations