ANALYZING THE GENDER GAP: THE HOUSEHOLD DETERMINANTS OF THE GENDER BIAS IN NUTRITIONAL OUTCOMES FOR CHILDREN IN INDIA

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ABSTRACT

This paper examines the inter-household gender bias in nutritional outcomes for children in India. Previous studies look at similar relationships and find there to be a multitude of cultural and social factors that influence gender bias within the household. This analysis differs in its usage of a household fixed effects model and its inclusion of households from both rural and urban areas. This study analyzes data from the National Family Health Survey (NHFS) 2005-2006. This method limits the sample to households with only two children, one son and one daughter. This study found there to be differences in the household determinants based on whether the household was located in an urban or rural area. This analysis shows a statistically significant effect of improving the gender bias for rural households located nearby an Anganwadi center. For urban households, mother's body mass index is a statistically significant indicator for a decreased gender bias. When further analyzing only those households with disadvantaged girls, access to media also became a statistically significant influence on improving the gender bias. These results suggest Anganwadi centers and the strengthening of maternal health programs could deeply benefit girls' nutrition levels within the household. Additionally, social messages through media could further improve this gender bias. The focus of these programs, however, should differ for urban and rural households, considering the differences they have in determinants of the gender bias.

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I. INTRODUCTION

In 1990 Amartya Sen famously claimed that the world was without 100 million " missing women", as measured by the unbalanced sex ratios. India, in particular, has been criticized for its increasing imbalance in gender ratio over the last 40 years. In 1961 there were 97.5 girls to every 100 boys. By 2011 this number drastically fell 6% to 91.4 girls to 100 boys. Compared to Western countries, with ratios of 105 girls to 100 boys on average, India is lagging far behind. Many suspect that the gender imbalance is due to India's status as a developing country, however there is reason to believe there are factors other than poverty contributing to this problem. Firstly, India's per capita income has been increasing while the divide in the sex ratio widens. Secondly, Sub-Saharan African countries have similar ratios to Western, developed countries, despite being less economically developed. The fact that mortality rates are significantly higher for women than men shows evidence that at all ages India's societal boy preference causes this gender imbalance (Sen, 1990).

Promoting gender equality is considered "smart economics," and is essential to the economic and social development of India. (World Development Report, 2011) It has been shown that improving years of education in women has a greater wage effect than for men, making it a more efficient method of improving the economy (Schultz, 2002). Additionally when women have good health and access to education, they are able to enter the labor force and provide added wages to their households, increasing total income levels (World Development Report, 2011).

Women's equality also extends into social benefits for the family. When women have more control in the household decision-making process, their children have better health and education outcomes (Fantahun, Berhane, Wall, Byass, Hogberg 2007). Even more directly

related, poor nutritional status of the mother is shown to be significant as a cause of low birth weight in babies. If gender inequality is manifesting itself through depriving girls, they will grow up to be malnourished mothers who give birth to unhealthy and less productive children. (Sen and Osmani, 2003)

Furthermore, analysis of countries with an excess number of males shows these countries are more prone to national and international violence. Young, uncommitted men are often involved in these acts of violence and this problem is exacerbated in countries with low sex ratios. (Hudson and Den Boer, 2005)

India has a great deal to gain in economic and social development through the improvement of their skewed sex ratio resulting from societal son preference. This paper analyzes the possible mothers' and household characteristics that affect the household nutritional gap, one manifestation of the gender bias in India.

II. BACKGROUND

India's extremely low sex ratio is often linked to the excessive deaths of young girls below the age of five (Oster, 2009). The 2011 World Development Report calculates 500,000 " excess deaths," measured by calculating the number of females that would not have died had they been living in a developed country in 2008. (World Development Report, 2011) This is double the number of excess female deaths in Sub–Saharan Africa. Boy preference in the household is an explanation for this bias in gender ratios, and thus the high death rates among girls. Studies on fertility trends have shown women with two sons are far less likely to have any additional children than women with two daughters, proving that this preference exists (Arnold, Choe, Mutharayappa, and Roy, 1997).

Theorized reasons for this son preference include a combination of economic and social reasons that improve the utility for the household (Friedman, Hechter and Kanazawa, 1994). Son preference occurs more prominently when males are considered an economic asset to the household in their contribution to labor and wages, as is the case in Northern India where predominately men are required to work on the farm. On the contrary, sex ratios have been persistently lower than South India, where women are far more utilized on the rice paddies (Kishore, 1993). Additionally, India has particular cultural customs, such as dowry and the patriarchic system, which add to the sons' economic benefits. Families with sons receive dowry payments from their daughter-in-law's family. The patriarchic system dictates that sons remain in their parent's household, and thus may serve as their caretakers in their old age (Vassoff & Vlassoff, 1980). Additionally there are social benefits in the practice of the son carrying on the family name, and often inheritance of the land (Dyson and Moore, 1983).

One way this son preference has manifested itself in the household is through poor health

outcomes for girls. Studies have shown boys are more likely to receive medical attention than girls, particularly greater access to vaccinations, which is a major cause of female mortality at a young age (Oster, 2006). A study on rural households in Maharashtra showed that sons received higher preference even when controlling for type of illness and birth order of the child. Parents were more likely to travel further to care for sons as opposed to daughters, and families spent more money on sons' healthcare than daughters' (Ganatra and Jirve, 1994, Das Gupta, 1987). Even improved access to healthcare didn't translate into more equal health outcomes. Oster shows that initial improved access to vaccines actually increases the gender difference, because boys will tend to receive the benefit of the vaccine at first. Then, as it becomes more inexpensive, girls will begin to receive them. This is further supported by the fact that the gender difference in vaccinations is even greater for women who verbally expressed a greater son preference (Oster, 2009).

Discrimination exists in many aspects of family life, including basic nourishment. In a study done in rural Punjab, Das Gupta finds that boys were more often given milk, and nutrient and fat-rich foods as opposed to girls. Additionally, girls born into families that already had daughters were shown to especially face nutritional neglect (Das Gupta, 1987). A more recent study, using data from all across India, has shown the same result, that girls with older sisters are far more likely to suffer from nutritional stunting than boys born in the same circumstances (Pande, 2003). This type of nutritional discrimination may even start as early as breastfeeding, where there is evidence that boys are breast fed for a longer time than girls, thus receiving many more nutrients during the early, crucial stages of development (Barcellos, Carvalho, and Lleras-Muney 2010). However, this may be true because parents quickly wean their daughters off breast milk in the hopes of a consecutive pregnancy producing a son. In this case, nutritional

neglect is not on purpose, but is still the consequence of son preference (Kuziemko and Jayachandran, 2009). Whether caused by differences in healthcare allocation, decisions made by the parents, or the secondary effects of son preference, nutritional differences prove to be a sufficient indicator of discrimination in the household.

Most studies concerning the gender bias in health have focused on the existence of a health bias, and proving its causality. Research that observes household determinants of gender bias reports ambiguous results. Mother's literacy has shown to improve the gender bias in nutrition (Pal, 1999. Borooah, 2005). However, other studies have shown that in Indian states with higher literacy rates, such as Punjab, boy preference and girl discrimination are even higher (Das Gupta, 1987). Mother's employment and income also have ambiguous effects. When using women's answers to the question of their ideal family composition, women's employment and income were shown to be significant, until controlling for social customs. Once caste and religion were added into the regression, employment of women became insignificant. Also, importantly, it was shown that access to media continued to have a significant affect on boy preference, even when controlling for societal norms (Pande, 2007).

This analysis builds off of Pande's (2007) previous work to understand key household determinants of boy preference. This paper will analyze the gap in nutritional outcomes as a measure for the amount of bias in a household instead of Pande's approach, which uses survey answers of mother's response to ideal number of boys. Nutritional outcomes are the direct manifestation of gender inequality in the household, and may reveal cases where women do not explicitly state boy preference, yet where it is still occurring in the household. The household characteristics of boy preference in India are important because, despite economic growth, banning dowries, changing property law, and banning sex determination by ultrasound, the sex

ratio has been continuously falling (Irudaya, Sudha and Rajan, 1999). Furthermore, this problem is prevalent throughout rich, poor, urban, and rural parts of the country, and has even spread to those states previously admired for their gender equality (Basu, 1999). Gender discrimination due to boy preference is a deeply rooted economic and cultural problem requiring analysis to determine appropriate policy actions.

III. DATA: NATIONAL FAMILY HEALTH SURVEY (NFHS-3)

This analysis uses data from the third version of the National Family Health Survey (NFHS-3). This is a household survey that provides data on indicators of population, health, and education throughout India. It uses multilevel stratified and systemic sampling to collect data in both urban and rural areas of the state. Data covers every member of the household and gathers detailed measures of village characteristics, household characteristics, education indicators, and health indicators. NHFS-3 is a type of Demographic and Health Survey (DHS) which is available on the Measure DHS website.

The NFHS-3 surveyed 230,000 women aged 15-49 and men age 15-54 from December 2005- August 2006. Nutritional, or anthropometric, measurements were recorded for all children born in the five years preceding the survey who were listed in the Household Questionnaire. This round of NFHS well represents all children from all the households chosen to survey, improving the quality of data and analysis that can be conducted.

This analysis utilized limited the sample to households with only two children, both under five years old (so as to have their anthropometric measurements), one son and one daughter. These limitations allow this analysis to use a household fixed effects model to control for any unobservable factors that affect the gender bias. It was also required to further limit to households where the mother is a respondent, thus enabling the measurement of specifically mother's characteristics. This sample will be observed across both rural and urban households.

Trained surveyors measured all children to obtain height and weight data in sample households, improving the accuracy of the anthropometric measures. However, there may be missing data in anthropometric measures, either because the child was not at home at the time of the health investigator's visit or because the mother refused to allow the child to be weighed and

measured. Only 9 percent of the children under age five have nutrition measures missing from the data set. The reason for not being able to measure is accounted for in the data. Also excluded from the analysis are eligible children whose month and year of birth were not known. In addition, the stunting, height to age, measure this study utilizes, height to age, is sensitive to misreporting due to the lack of knowledge of children's ages (NFHS-3 website).

IV. METHODOLOGY

Determinates of the household that have the greatest effect on gender bias will be measured using a household fixed effects regression analysis. The dependent variable of interest is the difference in the son's and daughter's nutrition levels within a household, used as a measure of gender bias within the household. This regression looks specifically at both biological and mothers' and household characteristics that have shown evidence of causing the gender gap.

Nutrition is a useful measure in understanding the gender bias in health because it shows the effects of daily neglect on the part of the family. According to the World Health Organization, it reflects inequitable distribution of food and the lack of medical attention when sick. Height for age, or stunting, is an appropriate measure because it is indicative of the long-term cumulative effects of malnutrition and neglect. (Cogill, 2001)

The model being used is a household fixed effects model:

$$\mathbf{Y_u = (Height\ z\ score_{\ i} - Height\ z\ score_{-i})}$$

$$\mathbf{Y_{u=} = \alpha + } \boldsymbol{mother's\ characteristics}\boldsymbol{\beta_{1i}} \mathbf{++} \boldsymbol{family\ structure}\boldsymbol{\beta_2} \mathbf{+} \boldsymbol{household\ characteristics}\boldsymbol{\beta_{3u}} \mathbf{+} \boldsymbol{Region}\ \boldsymbol{\beta_4}\ \mathbf{+} \boldsymbol{Household\ fixed\ effects}\boldsymbol{\beta_{5u}} \mathbf{+} \boldsymbol{u}$$

The dependent variable in this model will measure the gap in height to age, or stunting, levels between the son and daughter in the household. This allows for the unobservable characteristics for the household to be taken into account, strengthening the understanding of all household characteristics that can affect the gender bias.

This analysis focuses in on the effects of mother's characteristics, family structure, and household characteristics that can affect gender bias in the household. One weakness of this method is that certain legal factors, such as inheritance laws, that have been shown to influence the boy preference, cannot be controlled for. Additionally, this analysis does not look directly at village development characteristics that may also affect the gender bias. However, these can be accounted for in the measurement of some household characteristics, such as access to healthcare (Pande, 2007).

Dependent Variables

$$\mathbf{Y_u = (Height\ z\ score_{\ i} - Height\ z\ score_{-i})}$$

The dependent variable will measure the difference in stunting levels by gender, in a specific household. NFHS measures nutrition as per World Health Organization conventions; it lists the Z score, or how many standard deviations a child is from the median height for age of a reference population. This reference is based on the U.S National Center for Health Statistics. The larger the difference in Z scores, the greater the gender bias in that household. The dependent variable is interval-ratio variable and the model is an Ordinary Least Squares (OLS) regression.

Stunting, or chronic malnutrition, highlights whether there has been continuous neglect or mistreatment of the children, in terms of nutrition. It also shows a lack of health treatment for infections, which can further diminish nutrition.

The interpretation of this variable is based in the sign and magnitude. A positive sign means that the gender gap in stunting disfavors girls in the household and the larger the magnitude of the coefficient, the larger the gap.

Independent Variables

Since this analysis serves as a broad analysis of all household characteristics that may affect the gender bias in nutrition, there are many independent variables of interest. They can be divided into three types: Mother's characteristics, family structure, and household characteristics.

Mother's Characteristics

Access to media is a variable that may improve behaviors towards girls in the household. This analysis accounts for whether the mother has occasional or frequent access to media. Access to media is measured by compiling data on frequency of radio and television use. The introduction of television has been shown to decrease the mothers' reported boy preference in the household. Additionally, even when controlling for village development, media remained a significant and substantive factor in affecting the level of boy preference in the household (Pande, 2007). This is likely due to greater exposure to the outside world and modernized values and behaviors (Oster, 2007). Thus, access to media is likely to positively influence the household in equalizing the gender gap in nutrition.

Mother's educational attainment, more specifically whether she has obtained primary education, above primary, or no education, is another key variable of interest. However, it is difficult to hypothesize the effects of mother's educational attainment on the gender gap in nutrition within the household. Though it has shown, across countries, to improve health outcomes for children, it is difficult to create a causal link, because higher educational attainment is also associated with better socioeconomic indicators (Desai, Soumya, 1998). Micro levels studies have shown that literacy rates in women greatly improve the nutritional balance in the family, however this may not always be the case (Borooah, 2004). However, research has also shown mother's education to have a significant effect on boy preference, particularly when mothers have higher than primary schooling (Pande, 2007). On the other hand, as circumstantial evidence, rural Punjab, one of the most literate states in the country, has the worst gender ratios. It was demonstrated that households in which mothers have more education were actually more likely to discriminate between sons and daughters. (Das Gupta, 1987)

Variables that measure the mother's power and role in decision making in the household are important because the mother's autonomy and decision-making power often has positive affects on the education and health outcomes of the children (Fantahun, Berhane, Wall, Stig Byass, & Hogberg, 2007). Thus, mothers' attainment of her own money has been hypothesized to positively affect daughters. When mothers have more economic control in the household this may heighten the economic desire for daughters because of mothers understanding that woman can actually contribute to the household. However, this does not seem to be true in Punjab, where women have an important role in the labor force, yet still have a strong gender bias. This is because women, although working, do not have the decision making power (Das Gupta, 1987). Once again, it is ambiguous how this variable will affect the gender bias.

Next, certain characteristics of the mother need to be controlled for, including age at first birth and health, or body mass index (BMI), of mother. Undernourished mothers give birth to lower birth weight babies (Rahman, 1993). Thus, BMI of the mother can have a direct effect on the nutrition levels of her children. Mother's age at first birth is included as a biological and medical proximate determinant of child mortality, as a maternal factor that has been shown to influence child's health (Mosley and Chen 1984).

Family planning practices should also be included in the regression, such as whether or not the mother has used contraceptives and if she has ever terminated a child. Although this says little about her preferences, since these could be forced by her husband, it aids in understand the household preference for ideal family composition.

Family structure

Whether the female is the first born of the two children is controlled for as a measure of birth order. Previous research has shown this to be a crucial factor in determining whether or not there will be a gender bias, and how large it is. Often it is the third and fourth girls who are treated poorly, and face the highest probability of child mortality (Pande, 2003; Das Gupta, 1987). This points to a weakness in this study; the gender bias may not be straightforward to measure, because it often occurs in those households with more than two children.

Household composition, whether an extended family or a nuclear family, can influence differences in the decision making power of the mother, particularly if the mothers are young. This can be measured by observing the number of household members. Because none of these

households have more than two children, anything over four members could constitute an extended family. Often, in extended families, the older women, rather than the wife, may share the decision-making power with the husband (Barua & Kurz, 2001). The hypothesis, based on previous results, is that an increased number of family members would consequently increase the gender gap for nutrition in the household.

Household characteristics

Household characteristics such as wealth, water source, religion, and access to health facilities also affect nutrition and the gender gap.

The effect of income, though commonly observed, remains uncertain. It is sometimes noted that increases in income will increase the overall nutritional outcomes of the children, thus eliminating the gender bias. Yet Punjab, one of the richest states in India, shows differences in nutrition based on gender (Das Gupta, 1987). To interpret the effects of income, variables were included that calculated wealth indices based on information on 33 household assets and housing characteristics such as ownership of consumer items, type of dwelling, source of water, and availability of electricity (IIPS, 2007). It is hypothesized that wealth index will not have a significant effect on the gender gap in nutrition. However, it may be true that richer families do have a lower nutrition gap considering that they would have enough economic means to buy enough food for everyone in the household.

Religion measures the effect it has on social and gender norms that promote the gender bias. Specifically, Hinduism supports the sons preference; a dead parent's soul can only attain

heaven if that person has a son to light the funeral pyre, and salvation can be achieved through sons who offer ancestral worship (Vlassof, 1990). Also, surveys suggest that both Hindu and Muslim households want significantly more sons than Christian households (Clark, 2000). Accordingly, variables were included to measure the household religion; Hindu, Muslim, and Other.

Caste affects the gender bias in that it influences the woman's importance and role in the household. Culturally, historically disadvantaged castes and tribes may have less gender rigidity. This is possibly because there are more economic pressures that require mothers and women to work outside the household, which places more value on them than upper caste households would (Rahman and Rao , 2004).

Controls for health access and infrastructure of the household are important because they are key determinants of malnutrition. This includes type of bathroom, water supply, and access to healthcare. Hygiene and sanitation are essential factors that can affect the overall nutrition of the children in the household. The prevalence and duration of infections for children under 5, such as diarrhea, were significantly lower for households that have piped water and toilets (Jalan and Ravallion, 2003). Variables for unprotected water sources and type of toilet were included to capture these effects. Because poor water supply can negatively impact nutrition levels for both children equally, there shouldn't be an impact on gender bias. On the other hand, parents may be more likely to take their ill son to the doctor before their daughter, which also affects the gender bias (Oster, 2006).

In order to capture access to healthcare for the household this analysis includes an indicator variable measuring whether the household is located in close proximity to an Anganwadi Center. These centers, a major aspect of the Integrated Child Services Program (ICDS), are the primary

method of the Government of India's program to combat child hunger and malnutrition. Primarily, and most importantly for this analysis, they work to provide supplementary nutrition to both children below the age of 6 as well as nursing and pregnant women. Anganwadi centers are established in selected villages; most of these are in rural and tribal areas, with only 6 percent in urban slums. However, evaluations and outcome analysis have shown the ICDS program in India to be largely ineffective. Research has also shown that these centers are more likely to be placed in larger villages in less poor regions of the country. They are more likely to be located in villages with electricity and other community development programs, including healthcare programs. (Das Gupta, Lokshin, Gragnolati, Ivaschenko, 2005) Despite the perceived failure of the ICDS program, this is a key variable in understanding overall village development and access to healthcare. As was discovered with vaccination camps, it is hypothesized that proximity to an Anganwadi center will improve the gender bias within the household (Oster, 2007).

Finally, due to the large urban-rural divide this analysis controls for whether the household is located in an urban area or not. It is expected that urban households will face less of a gender bias in nutrition compared to rural households, supported by data that shows urban mothers have a less strong son preference than rural mothers (Clark, 2000).

Region

Region is also included as a measure of cultural norms for boy preference. States in India are historically different in cultural preferences, particularly in their treatment of women and girls. This difference is attributed to cultural and economic reasons. South Indian households have historically practiced endogamous marriage, or marriage within the village, which promoted the greater degree of autonomy enjoyed by women in the household (Dyson and Moore, 1983). Economic reasoning points to the fact that Northern India household utilize far more male labor, while South Indian household employ more women for their labor-intensive crops (Bardhan 1974). However, even the Southern states that have historically had an equal gender ratio now have a more uneven one. To capture this effect, region indicators were created, grouped based on cultural similarities.

Household effects

This household fixed effects model will control for the observable household controls that could affect the gender bias.

V. DESCRIPTIVE STATISTICS

Table 1, below, shows descriptive statistics for stunting, the dependent variables. It displays the average stunting levels for both girls and boys, in addition to the average gap between the two. The average Z –score for stunting in sons is -1.59, and the average Z-score for stunting in daughters is -1.44. On average, based on this sample, children in India are undernourished. And in this sample girls are actually, on average, slightly healthier than boys. However, as shown by the t-statistics, there is no statistically significant difference in the stunting levels between boys and girls.

Table 1: Description of Dependent Variables for Analysis of Gender Gap in Stunting in the Household in India: 2005-2006

Variable	Mean	Standard Deviation	n
Sons	-1.59	1.46	833
Daughters	-1.44	1.51	833
Household gap	-0.15	1.83	833
T stat		[-1.9245]	

H0:mean measure for males is equal to mean measure for females

Table 2 displays the averages and proportions for the explanatory variables. This sample includes 833 households. The sample used in this analysis is not fully representative of India. As the descriptive statistics illustrate, the proportions of wealthy, urban, and other related characteristics is higher than it actually seems to be in India. For example, 45% of the households in this sample are located in urban areas, when in actuality the overall survey shows

only one third of households are in urban centers. Additionally, there is a high proportion of households in the rich and richest wealth index, largely a result of the high number of urban households. In the overall survey, only nine percent of urban households fall in the poor wealth index, while 54 percent fall in the poor index in rural areas (IIPS, 2007). This selection bias will skew regression results; however upon observing results disaggregated by urban and rural areas, key findings can be better illuminated.

Table 2: Description of Explanatory Variables for Analysis of Gender Gap in Stunting and Wasting in the household in India: 2005-2006

Variable	Mean	Standard Deviation	n
Mother's characteristics			
Mother's age	20.62	3.80	833
Mother's BMI	20.15	3.50	833
Uses contraceptives	0.54	0.50	833
Ever terminated pregnancy	0.15	0.35	833
No education	0.30	0.46	833
Primary education	0.17	0.38	833
Above primary education	0.52	0.49	833
Mother has her own money to spend	0.36	0.48	833
No access to media	0.22	0.41	833
Occasional access to media	0.41	0.49	833
Frequent access to media	0.53	0.50	833
Family structure			
Female first born child	0.24	0.43	833
Number of household members	4.80	1.50	833
Household characteristics			
No toilet	0.39	0.48	833
Latrine toilet	0.22	0.42	833
Piped toilet	0.38	0.48	833
Unprotected water source	0.16	0.39	833

Table 2: Description of Explanatory Variables for Analysis of Gender Gap in Stunting and Wasting in the household in India: 2005-2006

Variable	Mean	Standard Deviation	n
Protected water source	0.81	0.39	833
Poor wealth index	0.32	0.47	833
Middle wealth index	0.22	0.41	833
Rich wealth index	0.28	0.45	833
Richest wealth index	0.19	0.39	833
Hindu	0.70	0.46	833
Muslim	0.13	0.34	833
Other	0.02	0.15	833
Disadvantaged caste/ tribe	0.69	0.46	833
Urban	0.45	0.50	833
Household is nearby Anganwadi Center	0.75	0.43	833
Region			
North	0.27	0.45	833
South	0.20	0.40	833
East	0.17	0.36	833
West	0.16	0.36	833
North East	0.21	0.40	833

V. REGRESSION RESULTS

Table 3 depicts four models to address what household characteristics most affect the gender gap in chronic malnutrition, or stunting. Model 1 shows the effect that only mother's characteristics have on the gender gap in stunting. Model 2 includes variables for family structure. Model 3 incorporates household characteristics. And Model 4, the final model, adds in region controls.

Table 3. Regression Results: Observing Determinants of gender bias in Stunting: all sample. India 2005- 2006

	Model 1	**Model 2**	**Model 3**	**Model 4**
Variables	Stunting	Stunting	Stunting	Stunting
Mother's characteristics				
Mother's age	0.0293**	0.0290**	0.0321**	0.0305**
	[0.013]	[0.013]	[0.013]	[0.013]
Mother's BMI	-0.036***	-0.0365***	-0.0183	-0.0197
	[0.013]	[0.013]	[0.014]	[0.014]
Uses contraceptives	0.0861	0.0993	0.1265	0.1178
	[0.094]	[0.095]	[0.097]	[0.100]
Ever terminated pregnancy	0.0767	0.0652	0.045	0.0479
	[0.123]	[0.124]	[0.126]	[0.126]
Primary education	-0.0585	-0.0666	-0.0743	-0.0922
	[0.137]	[0.137]	[0.142]	[0.142]
Above primary education	0.1989*	0.1896	0.2021	0.1891
	[0.117]	[0.116]	[0.126]	[0.127]
Mother has her own money to spend	-0.1125	-0.1089	-0.0622	-0.0559
	[0.092]	[0.092]	[0.094]	[0.095]
Occasional access to media	0.0112	0.0119	-0.0252	-0.0249
	[0.094]	[0.094]	[0.097]	[0.098]
Frequent access to media	-0.0475	-0.0501	-0.0267	-0.0408
	[0.103]	[0.103]	[0.111]	[0.112]
Family structure				
Female first born child		-0.3385***	-0.339***	-0.338***
		[0.104]	[0.106]	[0.106]
Number of household members		0.0202	0.0355	0.0365
		[0.031]	[0.032]	[0.032]
Household characteristics				
Latrine toilet			0.0469	0.0294

Table 3. Regression Results: Observing Determinants of gender bias in Stunting: all sample. India 2005- 2006

Variables	Model 1 Stunting	Model 2 Stunting	Model 3 Stunting	Model 4 Stunting
			[0.143]	[0.147]
No toilet			-0.1098	-0.078
			[0.160]	[0.166]
Unprotected water source			0.2664**	0.2537*
			[0.128]	[0.131]
Poor wealth index			0.4790**	0.4462*
			[0.225]	[0.229]
Middle Wealth Index			0.4616**	0.4308**
			[0.197]	[0.200]
Rich Wealth Index			0.2006	0.1848
			[0.151]	[0.152]
Muslim			-0.0686	-0.0705
			[0.143]	[0.144]
Other			-0.5620*	-0.5829**
			[0.289]	[0.294]
Disadvantaged caste/ tribe			0.1426	0.1165
			[0.106]	[0.108]
Household is nearby Anganwadi Center			-0.137	-0.1657
			[0.118]	[0.121]
Urban			0.2922**	0.2778**
			[0.120]	[0.122]
Region				
Northeast				0.1245
				[0.160]
East				0.0061
				[0.146]
West				0.0235
				[0.145]
South				0.1629
				[0.142]
Constant	-0.0847	-0.0929	-1.0806**	-1.0076**
	[0.323]	[0.363]	[0.496]	[0.503]
Observations	885	885	833	833
Adjusted R-squared	0.0067	0.0118	0.0188	0.0175

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Model 1: mother's characteristics. Model 2: Family structure. Model 3: Household characteristics. Model 4: Region controls

Most significant coefficients maintain significance and direction throughout the inclusion of additional control variables. Adjusted R-squares increase with the addition of family structure and household characteristics, however it does decrease with the addition of region controls. This suggests that region does not add to the explanatory power of the model.

However, mother's body mass index fails to remain significant once household characteristics and then region controls are included. Many factors of household characteristics are what drives both the mother's and children poor nutrition, thus once these are controlled for, the significance on mother's health on the gender gap is diminished (Rahman, 1993).

Additionally, the effect of above primary education loses significance once family structure variables are added in Model 2. This seems to be due to accounting for the birth order of children, which takes away from the significant effect that above primary education of the mother had on the gender gap in stunting.

Finally, once household characteristics and region controls are incorporated (Models 3 and 4) the effect of occasional access to media changes signs, though it is not significant in any of the models. This seems mainly driven by the difference in household characteristics based on whether the household is located in an urban or rural area. In fact, it is difficult to interpret many of the effects of these variables on the gender gap in stunting due to the strong urban- rural divide. Thus, it is essential to observe the analysis separated by urban and rural to understand the different household determinants that drive the gender bias in nutrition. A Chow test is used to verify a significant difference between urban and rural households.

Accordingly, Table 4 below shows three different regressions. Model 1 is the original regression on stunting, Model 2 analyzes only urban households, and Model 3 depicts the analysis for only rural households.

Table 4: Regression Results: Observing Determinants of gender bias for stunting: Urban versus Rural. India 2005- 2006

	All Household	Urban	Rural
Variables	Stunting	Stunting	Stunting
Mother's characteristics			
Mother's age	0.0305**	0.0379*	0.0183
	[0.013]	[0.019]	[0.018]
Mother's BMI	-0.0197	-0.0372**	0.0081
	[0.014]	[0.017]	[0.024]
Uses contraceptives	0.1178	-0.0576	0.2161
	[0.100]	[0.149]	[0.139]
Ever terminated pregnancy	0.0479	-0.0574	0.1141
	[0.126]	[0.172]	[0.184]
Primary education	-0.0922	0.1551	-0.2042
	[0.142]	[0.232]	[0.188]
Above primary education	0.1891	0.5448***	0.0577
	[0.127]	[0.195]	[0.175]
Mother has her own money to spend	-0.0559	-0.0583	-0.1326
	[0.095]	[0.128]	[0.140]
Occasional access to media	-0.0249	0.2125	-0.2002
	[0.098]	[0.139]	[0.141]
Frequent access to media	-0.0408	0.0483	-0.0794
	[0.112]	[0.167]	[0.156]
Family structure			
Female first born child	-0.3379***	-0.0881	-0.5670***
	[0.106]	[0.145]	[0.152]
Number of household members	0.0365	0.0161	0.0281
	[0.032]	[0.043]	[0.048]
Household characteristics			
Latrine toilet	0.0294	-0.0115	0.2194
	[0.147]	[0.182]	[0.245]
No toilet	-0.078	-0.6692***	0.1727
	[0.166]	[0.251]	[0.249]
Unprotected water source	0.2537*	-0.1072	0.2938*
	[0.131]	[0.258]	[0.158]
Poor wealth index	0.4462*	0.5650*	0.5088
	[0.229]	[0.331]	[0.378]
Middle Wealth Index	0.4308**	0.8718***	0.4501
	[0.200]	[0.263]	[0.341]
Rich Wealth Index	0.1848	0.1073	0.4566
	[0.152]	[0.171]	[0.311]
Muslim	-0.0705	0.11	-0.4399*
	[0.144]	[0.180]	[0.237]

Table 4: Regression Results: Observing Determinants of gender bias for stunting: Urban versus Rural. India 2005- 2006

	All Household	Urban	Rural
Variables	Stunting	Stunting	Stunting
Other	-0.5829**	0.0628	-0.8174**
	[0.294]	[0.523]	[0.368]
Disadvantaged caste/ tribe	0.1165	-0.0005	0.1345
	[0.108]	[0.148]	[0.159]
Household is nearby Anganwadi Center	-0.1657	-0.0079	-0.5068**
	[0.121]	[0.141]	[0.235]
Urban	0.2778**		
	[0.122]		
Region			
Northeast	0.1245	0.2124	-0.0247
	[0.160]	[0.235]	[0.225]
East	0.0061	0.4169*	-0.1358
	[0.146]	[0.233]	[0.196]
West	0.0235	0.1199	-0.185
	[0.145]	[0.195]	[0.220]
South	0.1629	0.3022	-0.0395
	[0.142]	[0.185]	[0.221]
Constant	-1.0076**	-0.8844	-0.8986
	[0.503]	[0.640]	[0.791]
Observations	1,666	758	908
R-squared	0.033	0.06	0.054

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Mother's Characteristics

This analysis reveals that a small amount of education for rural mothers may improve the gender gap for girls in the household. However, as soon as these rural mothers obtain higher than primary education, the effect seems to wear off and daughters will have lower nutrition levels than sons in the household. The non-effect of education on improving the gender bias is even more prominent in urban households. Mothers with primary education in urban areas are

shown to have a negative effect on the gender bias, creating worse nutrition outcomes for girls relative to boys. The negative effect of education is statistically significant for mothers in urban areas who have above a primary school education. The reason for this difference in the effects of urban and rural households' education and gender gap is due to the fact that education is more accessible in urban areas, and may be less important in urban areas to truly change the mindset of the mothers and affecting the gender gap. This is illustrated in Table 5, below. The percentage of rural mothers with no education is far greater, at 74 percent, than urban mothers. And urban about 60 percent of urban mothers have above primary education compared to only 40. These results illustrate what many other studies have also proven – that the effect of education on reducing gender bias is mixed and often insignificant (Das Gupta, 1987; Bahn 2004).

Table 5. Percentage of mothers by education level: urban versus rural

	Education level		
Type of residence	**No education**	**Primary education**	**Above primary education**
Urban	26%	37%	58.90%
Rural	74%	63%	41.11%

Comparably to the effect of education, media does not have a statistically significant effect on either urban or rural households in improving the gender bias in stunting levels. In fact, in urban households, both occasional and frequent access to media perpetuates the gender bias, access to media worsens the health of daughters relative to sons. This could be due to the fact that urban households are more likely to be bombarded by media, and therefore immune to its

"modernizing" effects. Notably, occasional access to media predicts a larger gender gap in stunting levels than frequent media access in urban areas. This may offer some evidence that because urban households are much more likely to have access to media, it is the jump from occasional access to frequent access that improves outcomes for girls in the household. Table 6, below, shows the percentages of rural households in the sample that have no access to media compared to the percentage of urban households with no access to media. The stark difference in access between urban and rural areas may reveal why media has such a different effect on rural households (Jensen & Oster, 2007).

Table 6: Percentage of households with no media access: Urban versus Rural

	No media access	
	Urban	Rural
% of households with no access to media	19%	80%

The mother having her own money improves outcomes for girls in the household, though not statistically significant. This is true for both urban and rural households. It is hypothesized that as women are more empowered in the household, it will lead to a weaker boy preference (Pande, 2007). Interestingly, the effect of the mother having her own money to spend is more substantive in improving girls' health rural households as compared to urban households. The reason for this could be similar to the urban and rural differences between education and media urban mothers possibly have more chances and more ability to earn their own money, therefore it may not be a strong measure of their autonomy in the urban household. Oftentimes the mother

does not have the ability to choose how to spend her own money, and there are many other factors occurring in the household that may limit her autonomy (IIPS, 2007).

For urban households, mother's body mass index has a significant effect on improving the stunting levels of girls compared to boys (Model 2). This effect is the opposite of what is seen in rural households (Model 3), which worsens the nutrition levels for girls relative to boys, though it is substantively and statistically not significant. Mother's body mass index directly affects their children's health since mal nourished mothers more likely have low weight babies (Rahman, 1993). However, since mothers body mass index has a significant effect on improving outcomes for girls in the household, it seems there is more than just the effect of the mother's nutritional status. It has been shown that mother's autonomy in the household can lead to higher levels of healthcare utilization, thus better health (Bloom, Wypij, and Das Gupta, 2001). A healthier mother may indicate that she has more autonomy in, which results in improved nutritional status for the daughters.

Mother's age at first birth is also statistically significant in urban households; older mothers have a worse gender gap for girls relative to boys. The fact that this variable is statistically significant for urban households makes sense since it has been shown to be an essential control variable when measuring child health. However, it is unclear why older mothers exhibit more gender bias. Perhaps these older mothers are less modernized, and have far more rigid gender roles.

The effect of family planning variables, though not statistically significant, differs for urban and rural households. In urban households the use of contraceptives and if the mother has ever terminated a pregnancy improve the stunting levels of the daughter relative to the son, thus showing less of a boy preference. This follows theory about the relationship between

contraceptive use and gender bias; families only begin using contraceptives when they are satisfied by the gender composition of their children (Deshpande and Rajaretnam, 2004).

However, in rural households, both the use of contraceptives and if the mother has previously terminated a pregnancy predict daughters having worse stunting levels than sons. It makes sense that women who have ever terminated a pregnancy in rural households would increase the gender bias, because their gender preference might be the cause of the termination. This is supported by the high number of calculated sex specific abortions, which is one of the hypothesized causes for the large gap in the sex ratio (World Development Report, 2011) However, it seems to refute the hypothesis that the mothers use of contraceptives may be indicative of family planning, which is done in order to control the gender. The boy preference in these rural household with mother's having used a contraceptive may be driven by the sheer lack of economic means to feed both children, resulting in the boy in the household having slightly higher nutritional outcomes than the daughter.

Family Structure

Households with first-born females on average have better nutrition outcomes for girls relative to boys. This is statistically significant in the original regression (Model 1), largely because of the first-born female's effect on rural households, which is also statistically significant. This effect is reasonable considering most gender bias has been shown to more strongly affect those children born second or third in the household, particularly if they are girls (Pande, 2007; Das Gupta, 1987). However, in these households, with only two children, we are

unable to measure the true affects of birth order. But this could also be a reflection of the fact that households with first-born females did not employ any type of family planning, due to either lack of access or the lack of a gender preference. In the case where there was no preference, these daughters are presumably better off.

Households with extended families are found to have a better nutrition for the sons relative to daughters, or a higher boy preference. This is in accordance with the theory that in extended family households the mother has less autonomy to make her own decisions (Dyson and Moore, 1983). However, these effects are not statistically or substantively significant for either urban or rural households.

Household characteristics

Both the poor and middle wealth indices show statistically significant effects that these households on average have lower levels of nutrition for girls relative to boys. The statistical significance of these results is largely influenced by urban households, which have significant and substantive effects for poor and middle wealth households. Interestingly, poor urban households have a smaller gender gap than urban middle wealth households. This is probably due to the fact that the standard of living in urban areas is far higher than rural India that a majority of poor households, by urban standards, actually fall in the middle wealth category. (IIPS, 2007) However, the size of the gender gap is smaller for rich households, which implies that for urban households there is some correlation between wealth and gender bias, though weak. This is not the case for rural households where the effect of all wealth indices is relatively the same. These results are in accordance with the theory that in India gender bias goes far

further than merely an economic issue, as many studies have also concluded (Das Gupta, 1987; Pande, 2007; Pande, 2005).

Proximity to a government nutrition facility, or Anganwadi center, improves the stunting levels of girls relative to boys, and is statistically significant for only rural households. The effect differs in magnitude and significance for urban and rural areas because these centers primarily exist in rural areas. However, due to the fact that Anganwadi centers are shown to be an ineffective government program, this positive influence on gender bias could be capturing the importance of overall village development and the existence of community development programs. Both of which are shown to be statistically significant predictors of whether a village has an Anganwadi center. Additionally, though there seemed to be a moderate association between the existence of an Anganwadi center and a Government of India Primary Health Care facility, this doesn't rule out all private health care. It would be logical that villages with better infrastructure and community development programs could in fact have better health care access in general. If this assumption is correct, then Oster's theory about the importance of improving healthcare access seems to be essential in improving the gender bias in nutritional outcomes (Oster, 2007).

Households of disadvantaged castes or tribes have differing effects on the gender gap in stunting levels in the household whether the household is urban or rural. It seems that the effect of being low caste or tribe is non-existent for urban households, though it is slightly more beneficial for girls than for boys. However, for rural households of low caste or tribe the son is seen to have a higher level of stunting relative to the daughter. Though the hypothesis is that lower caste and tribe households may have less gender rigidity, it seems that this may be more

driven by wealth categories. Most low rural low caste and tribal families belong to the lower wealth categories, where there is a larger gender gap in stunting levels that benefits boys.

The effect of the household being of a non-Hindu religion differs between urban and rural households. In rural households (Model 3), religion is statistically significant and shows these non-Hindu households, girls' have relatively better stunting levels than boys. This is in accordance with theory that part of the gender bias in India is perpetuated through Hindu ceremonies and their dependence on sons to continue to perform the religious rituals. Urban households, on the contrary, have insignificant effects, showing that non-Hindu households have sons who are healthier than daughters. The reason for the difference between urban and rural households could be linked to weaker connections to religious customs in urban areas.

The effect of being from a disadvantaged caste or tribe is not significant, and on average these households have poorer nutrition levels for girls relative to boys. This goes against the hypothesis that lower castes and tribes have less rigid gender rules, and thus would face less of a gender gap. This effect also differs between urban and rural households. Arguably, the effect for urban households is so substantively small and insignificant, that it doesn't seem to mean much. Urban households likely have such a small effect for the same reason religion has a small effect on the gender bias; in urban areas caste structure is far less rigid and would likely not affect the gender bias.

Variables controlling for water source and potential pathways for infection differ based on urban and rural households. Overall these variables do not have a statistically significant effect on the gender bias for nutrition. However, for urban households with unprotected water sources, girls have relatively better stunting levels compared to the boy. This is the same effect that is seen with households that have no toilet or latrine toilet. These control variables should in

fact have little effect on the gender bias, since water contamination would be equally damaging to both girls and boys. However, there is a statistically significant improvement for girl's nutrition relative to boys for urban households with no toilet. This result is unexpected, and is probably driven by the low proportion of urban households that have no toilet.

Region

In the overall regression (Model 1) none of the controls for region are statistically significantly different from each other, which challenges the notion that households in South India are more gender equitable. This result could be evidence of the supposed growing gender bias in the South, and the permeation of boy preference throughout previously female empowered areas of the country. Interestingly, the effects of regions on the urban and rural gender gap show that all urban households favor boys relative to girls, while all rural households favor girls relative to boys, compared to the Northern region of India (which historically has the highest boy preference). Households in the Southern part of India, as compared to the Northern region, show worse stunting levels for girls relative to boys in the household, though this is not statistically significant. Furthermore, the effect of households in urban, Eastern India has a statistically significant effect on the gender gap in stunting. This is evidence that the gender bias in nutrition may be more of a problem in urban, rather than rural areas. These results could also be biased due to the relatively small sample, and slightly disproportionate number of households located in each region.

VII. SECONDARY RESULTS

In order to better understand what factors directly affect those households that do have disadvantaged girls, it is important to narrow down the analysis to only households that have lower levels of nutrition for the daughter compared to the son. This can further pinpoint key areas that will help decrease the gender bias and directly relate to the policy implications of this paper

Below is an abridged table depicting the key results of running this analysis. The full regression results can be seen in Appendix A. Model 1 is the original regression, using all households. Model 2 is analysis only observing those households with disadvantaged girls. Models 3 and 4 also analyze households with disadvantaged girls, disaggregated by urban and rural households, respectively. The last two models especially aid in understanding how policies may need to differ to address the differences in social and cultural contexts between urban and rural India.

Table 7. Regression Results: Observing determinants of gender bias for stunting in households with disadvantaged girls: India 2005- 2006

	All Households	*All households with disadvantaged girls*	*Urban households with disadvantaged girls*	*Rural households with disadvantaged girls*
	Model 1	**Model 2**	**Model 3 (Urban)**	**Model 4 (Rural)**
Variables	Stunting	Stunting	Stunting	Stunting
Mother's characteristics				
Mother's BMI	-0.0197	-0.0304**	-0.0465***	-0.0211
	[0.014]	[0.013]	[0.016]	[0.023]
Uses contraceptive	0.1178	-0.1855**	-0.0312	-0.3517**
	[0.100]	[0.094]	[0.145]	[0.140]
Occasional access to media	-0.0249	-0.0805	0.0688	-0.1888

Table 7. Regression Results: Observing determinants of gender bias for stunting in households with disadvantaged girls: India 2005- 2006

	All Households	*All households with disadvantaged girls*	*Urban households with disadvantaged girls*	*Rural households with disadvantaged girls*
	Model 1	**Model 2**	**Model 3 (Urban)**	**Model 4 (Rural)**
Variables	Stunting	Stunting	Stunting	Stunting
	[0.098]	[0.092]	[0.134]	[0.132]
Frequent access to media	-0.0408	-0.2778***	-0.2890*	-0.2075
	[0.112]	[0.107]	[0.163]	[0.148]
Primary education	-0.0922	-0.1474	-0.0984	-0.104
	[0.142]	[0.131]	[0.225]	[0.168]
Above primary education	0.1891	0.0594	0.3262*	-0.0099
	[0.127]	[0.116]	[0.181]	[0.165]
Mother has her own money to spend	-0.0559	-0.0215	-0.1655	0.08
	[0.095]	[0.091]	[0.123]	[0.135]
Household characteristics				
Disadvantaged caste/ tribe	0.1165	-0.2183**	-0.0948	-0.4915***
	[0.108]	[0.102]	[0.138]	[0.161]
Nearby government Anganwadi Center	-0.1657	-0.4020***	-0.2339*	-1.0356***
	[0.121]	[0.111]	[0.136]	[0.221]
Observations	833	385	186	199
Adjusted R-squared	0.0175	0.0724	0.0631	0.1374

Standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Whether the household is located nearby an Anganwadi center, or government nutrition facility, has the largest substantive effect on improving the gender gap between girls and boys in the household. This is the only effect that shows statistical significance throughout both urban and rural households. The magnitude is far larger for rural households, which is expected because they are far more common in rural centers. This outcome supports the previous results from Table 4.

Mother's body mass index is an important factor in improving the stunting levels of girls relative to boys in the household. Though it is true for both urban and rural households, it is

statistically significant and slightly larger in magnitude for urban households. This supports the results discovered in the primary regression in that urban households were also more significantly affected by mother's health.

Notably, this regression shows that the mother's use of contraceptives is statistically and substantively significant in improving the daughter's stunting level relative to the son's and is statistically significant only in rural households. This is contrary to the overall regression results, which show contraceptive use worsen the stunting levels for girls relative to boys in the household. Although it may be the case that contraceptive use indicates family planning, which in rural areas may be strongly linked with boy preference. In general, restricting the number of children in the family seems to be beneficial for girls. This matches previous studies that have shown that families do have a preference for at least one girl, and that it is the often after the second child where there is a steep fall in equity of nutrition (Pande, 2007; Das Gupta, 1987; Pande, 2005).

The results for access to media are interesting; overall households with disadvantaged girls are only slightly affected by occasional access to media, yet are statistically significantly affected by frequent access to media. Most curious is that the statistical significance seems to be drawn primarily from urban households with disadvantaged girls. However, rural households show the same magnitude of effect in improving outcomes for girls relative to boys, and these can be reported with a 84 percent confidence level ($P<0.2$). These results are saying that, on average, media doesn't affect the gender gap within the household. However, for households with disadvantaged girls, it makes a significant difference in improving the chronic malnutrition outcomes for girls relative to boys. These results are supported by Pande's study on boy preference and Oster's study on the permeation of cable television in rural India, showing that

access to media did have a significant effect in reducing the reported boy preference in the household, which could be a useful policy tool.

This regression also illustrates that there is a statistically significant effect for households that are in a historically disadvantaged caste or tribe; this improves the wellbeing of girls relative to boys. As with contraceptive use, this is contrary to the results of the original regression on stunting. This is in agreement with the hypothesis that disadvantaged castes and tribes are have less gender role rigidity due to their higher dependence on any source of income, whether it be from the sons or daughters.

The results for mother's attainment of primary and above primary education reiterate the effects seen in the primary regression. Education doesn't have a statistically significant effect for either urban or rural households. The mother's attaining above primary education in urban households actually shows girls with statistically significantly worse stunting outcomes than boys. This further corroborates the idea that education has little effect on the boy preference, as expressed by the gender bias in nutrition at the household level.

Interestingly, if a rural mother has her own money to spend in these households with disadvantaged girls it is actually less beneficial for the girls in the household. Though this variable is not statistically significant in this regression, it is an interesting outcome that opposes the previous analysis that showed rural households to be more positively affected by having mothers who earn their own money. This could be evidence that it is not simply the mother having her own money, but some unmeasured factor of households with these mothers, and once you control for this factor by restricting the analysis to only households with disadvantaged girls, it is easier to see the true affect of the mother having her own money.

VII. DISCUSSION- THREATS TO VALIDITY

Several aspects of this analysis, which have been somewhat discussed previously, weaken the validity of the results presented. The following section explains some of these issues and their affect on the results.

This analysis utilizes cross sectional analysis, only looking at a snapshot of households from 2005- 2006. This analysis could have been made stronger with the use of a longitudinal data, which would enable the analysis to observe the effects of household factors to the gender gap in nutrition over time. Although previous years of the NFHS do exist, many of the variables used in this analysis were not measured the same way as the most recent survey, thus making them difficult to appropriately match up.

There may also be biases in the analysis due to missing data, particularly assuming there is a non-random pattern of missing data. For the dependent variables measuring the children's height, weight, and age, mothers could have denied the surveyors from measuring their children for specific reasons that are not captured in the survey. Additionally, all if the mother was not home to act as respondent, this may indicate that she is out of the household working, and perhaps more empowered. However, those households without mother respondents were not used in this analysis, because it was necessary to understand the affect of certain characteristics on the mother in particular.

Due to the nature of the survey data, it was difficult to control for all the possible factors involved in the gender gap in nutrition. Some variables were not measured in the survey. For example, there were no variables measuring household access to healthcare, so proximity to government facility was used as a proxy for this. Additionally there seems to be some unobservable factors for which it is difficult to control. For example, there was no variable

available to see previous actions of the mother; if she had aborted a child after discovering it was a girl, or abandoned the child. This may especially be a limitation that skews this analysis, because of the large proportion of urban and rich households that have more access to ultrasound technology.

Another issue in this study is the difficulty in deciphering differences in mother's behavior between her son and daughter. This is essential when accounting for the importance of breast-feeding in affecting child's health. However, any variables measuring breastfeeding did not explain the differences between feeding practices for the son and daughter, which could be a key issue in widening the gender gap.

In order to employ a household fixed effects model, this analysis was restricted to households that have only one son and one daughter, both under the age of five. This causes selection bias; there are certain characteristics of households that decide to, or have only had two children. This selection bias, as discussed earlier, can be seen in the proportion of rural and urban households. The number of urban households is far higher in this sample than actually exist in India, though the separate analysis of urban and rural households may have fixed the problems caused by this bias. Additionally, these households were on average far richer, in higher wealth indices than the average Indian household. Part of this can be attributed to the large number of urban households, which will fall within the higher wealth indices. Another aspect of this bias is that those households with only two children may more often be wealthier households that tend to have a smaller number of children.

The sample selection process also required significantly reducing the sample size to only about 833 households. This may decrease the overall significance of the results and their

reliability in assessing the total population. However, what is gained in accounting for unobservable characteristics of the households may make up for the loss in sample size.

Finally, heteroscedasticity is a common issue in regression analysis because it can negatively affect the statistical significance of the coefficients. The Breush-Pagan/ Cook-Weisberg test revealed no heteroskedasticity within the sample (Appendix B).

VIII. POLICY IMPLICATIONS

The regression analysis clearly demonstrates that there are a multitude of mother's, family, and household characteristics that have an effect in lowering. This analysis further breaks down these factors by urban and rural households, which allows policy makers to better understand some of the contextual factors that influence the gender bias. This implies there should be differences in how urban and rural households are targeted to improve the gender gap in nutrition. Some influential and statistically significant variables such as those that show the effect of cultural importance in the bias are present, and are difficult to target with policy. For example, non-Hindu households have improved biases. This analysis, however, strongly suggests that there are various policies that could potentially be implemented in order to improve the gender bias in nutrition: they are social messages through media, improving village development, family planning programs, and maternal health programs.

The existence of an Anganwagi center showed significant improvements in girls' nutrition levels in rural households in the original regression. And in only households with disadvantaged girls the existence of these centers in significant in both urban and rural areas. However, due to research stating the ineffectiveness of the ICDS program, it is unlikely that the significance of this variable is solely due to these nutrition centers. Rather, the Angwanwadi center can be used as a proxy for overall village development and the existence of additionally community development programs. These results suggest the importance that village development, particularly electrification, may have on improving girls' nutrition. Additionally, village development may imply more options for health care, also an omitted variable being accounted for in the Anganwadi center (Das Gupta, Lokshin, Gragnolati, Ivaschenko, 2005)

The results of the secondary analysis, observing only households with disadvantaged girls, demonstrate the significance of media access across both urban and rural. This outcome supports previous research that suggests the important effect that the natural presence of media has in improving the gender bias. However, the analysis showed the diminishing effects of media; urban households with frequent access to media showed a smaller affect than rural households with frequent access. This implies that countries should go even further than the natural permeation of media. One method could be through social messages through the media, which would better flood households with the concept of equal preference for boys and girls. This could help further the impact of media even in those urban areas where the effect was much smaller in magnitude.

The secondary analysis also demonstrates the importance of mother's body mass index in improving nutrition outcomes for girls in urban households. This provides evidence of the importance of maternal health programs in urban India. Though, as explained previously, this could also be the effect of the association between women's autonomy and health care utilization. Which implies that maternal health might not directly influence the gender bias. This issue would need to be further delved into to better understand the mechanism.

These results show no significance of mother's education, mother control of her own money, and the wealth of the household. Mothers' education is not a significant method of improving the gender bias in nutrition, which contradicts Pande's (2007) research on boy preference and supports Das Gupta's (1987) on female mortality. Furthermore, this analysis actually produces poorer outcomes for girls with educated mothers in urban areas, which further supports the fact that female education programs would not have much affect on the gender bias. Mothers with their own money to spend, and presumably higher autonomy in the household, do

have an effect, though not significant, on improving girls' nutrition. Which indicates more research needs to be done to understand how women's autonomy influences gender bias in nutrition.

Finally, even the highest wealth households showed some amount of gender bias, in both rural and urban areas. This further supports previous research suggesting that economic development cannot solely improve India's gender gap (Pande, 2005; Pande, 2007; Das Gupta; 1987).

IX. CONCLUSION

This analysis reiterates what other studies have also concluded; there are a multitude of factors involved in the gender gap in nutrition in India. Using a household fixed effects model this analysis demonstrates the importance of both mother's characteristics and household characteristics in affecting the gender difference in nutrition. Particularly, the results highlights the importance of context in understanding how factors affect the gender bias; often times the effects were different for urban versus rural households. In the primary regression, religion, caste, and Anganwadi centers show a significant effect on improving outcomes for girls. Further analysis of only households with disadvantaged girls further highlights the importance of access to media, and mother's nutrition in improving the gender gap.

Various studies attempt to understand the driving factors of India's boy preference, and highly skewed sex ratios, and have come to similar conclusions. The next step in solving the issue of India's boy preference is to better understand how and when to intervene with policy programs, in order to improve outcomes for girls. Some of the above policy programs already exist in India, yet are ineffective due to poor targeting and high corruption. Methods such as program evaluation could aid in determining how to successfully implement programs addressing these issues. Additionally, rigorous impact evaluation can help in understand if interventions are successful. Though, the difficult with addressing the gender bias is the number of context specific factors that do affect it, and program evaluation may also be difficult in an of itself due to slow improvements of gender bias after implementation of programs. Nevertheless, now is the time for India to focus programs on improving gender outcomes in hopes that the 2021 census will show an improved gender ratio.

APPENDIX A

Regression Results: Observing determinants of gender bias for stunting in households with disadvantaged girls: India 2005- 2006

	All Households	*All households with disadvantaged girls*	*Urban households with disadvantaged girls*	*Rural households with disadvantaged girls*
	Model 1	**Model 2**	**Model 3**	**Model 4**
Variables	Stunting	Stunting	Stunting	Stunting
Mother's characteristics				
Mother's age	0.0305**	-0.0131	-0.0241	0.0026
	[0.013]	[0.012]	[0.018]	[0.016]
Mother's BMI	-0.0197	-0.0304**	-0.0465***	-0.0211
	[0.014]	[0.013]	[0.016]	[0.023]
Uses contraceptive	0.1178	-0.1855**	-0.0312	-0.3517**
	[0.100]	[0.094]	[0.145]	[0.140]
Has ever terminated a pregnancy	0.0479	0.068	0.2847	-0.1319
	[0.126]	[0.120]	[0.179]	[0.163]
primary education	-0.0922	-0.1474	-0.0984	-0.104
	[0.142]	[0.131]	[0.225]	[0.168]
above primary education	0.1891	0.0594	0.3262*	-0.0099
	[0.127]	[0.116]	[0.181]	[0.165]
mother has her own money to spend	-0.0559	-0.0215	-0.1655	0.08
	[0.095]	[0.091]	[0.123]	[0.135]
occasional access to media	-0.0249	-0.0805	0.0688	-0.1888
	[0.098]	[0.092]	[0.134]	[0.132]
frequent access to media	-0.0408	-0.2778***	-0.2890*	-0.2075
	[0.112]	[0.107]	[0.163]	[0.148]
family structure				
Female first born child	-0.3379***	-0.1696*	-0.0408	-0.2867*
	[0.106]	[0.101]	[0.133]	[0.154]
number of household members	0.0365	0.1156***	0.0668	0.1255***
	[0.032]	[0.033]	[0.052]	[0.044]
household characteristics				
latrine toilet	0.0294	-0.1602	-0.2272	0.088
	[0.147]	[0.132]	[0.167]	[0.230]
no toilet	-0.078	-0.006	-0.269	0.3905
	[0.166]	[0.155]	[0.236]	[0.248]
protected water source	0.2537*	0.0359	-0.1464	0.0893
	[0.131]	[0.117]	[0.228]	[0.141]
poor wealth index	0.4462*	0.2928	0.1558	-0.2154
	[0.229]	[0.208]	[0.310]	[0.361]

Regression Results: Observing determinants of gender bias for stunting in households with disadvantaged girls: India 2005- 2006

	All Households	*All households with disadvantaged girls*	*Urban households with disadvantaged girls*	*Rural households with disadvantaged girls*
	Model 1	**Model 2**	**Model 3**	**Model 4**
Variables	Stunting	Stunting	Stunting	Stunting
middle wealth index	0.4308**	0.0855	0.1381	-0.4881
	[0.200]	[0.178]	[0.225]	[0.333]
rich wealth index	0.1848	0.0098	-0.0327	-0.4482
	[0.152]	[0.141]	[0.164]	[0.297]
Muslim	-0.0705	-0.1038	0.02	-0.255
	[0.144]	[0.134]	[0.171]	[0.233]
Other	-0.5829**	-0.0894	0.4604	0.0048
	[0.294]	[0.316]	[0.603]	[0.387]
Disadvantaged caste/ tribe	0.1165	-0.2183**	-0.0948	-0.4915***
	[0.108]	[0.102]	[0.138]	[0.161]
nearby government nutrition facility	-0.1657	-0.4020***	-0.2339*	-1.0356***
	[0.121]	[0.111]	[0.136]	[0.221]
Urban	0.2778**	0.0256	0	0
	[0.122]	[0.113]	[0.000]	[0.000]
Region				
North East	0.1245	0.028	-0.057	0.1542
	[0.160]	[0.148]	[0.212]	[0.216]
East	0.0061	-0.1956	0.2288	-0.2474
	[0.146]	[0.137]	[0.230]	[0.186]
West	0.0235	-0.0629	0.1194	-0.1827
	[0.145]	[0.141]	[0.192]	[0.218]
South	0.1629	0.1049	0.2542	-0.0141
	[0.142]	[0.136]	[0.177]	[0.215]
Constant	-1.0076**	2.3913***	2.6303***	2.9740***
	[0.503]	[0.473]	[0.626]	[0.737]
Observations	833	385	186	199
adjusted R-squared	0.0175	0.0724	0.0631	0.1374

APPENDIX B

Testing for Heteroskedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of hw5diff

chi2(1) = 0.76
Prob > chi2 = 0.3842

Fail to reject the null hypothesis that there is a constant variance, thus cannot say that the regression is heteroskedastic.

REFERENCES

Arnold Fred , Minja Kim Choe & T.K. Roy (1998*): Son Preference, the Family-building Process and Child Mortality in India*, Population Studies, 52:3, 301-315

Barcellos, Silvia, Carvalho, Leandro and Lleras-Muney, Adriana, (2010), *Child Gender and Parental Investments in India: Are Boys and Girls Treated Differently?* No 756, Working Papers, RAND Corporation Publications Department.

Basu, Alaka Malwade . *Fertility Decline and Increasing Gender Imbalance in India, Including a Possible South Indian Turnaround* . Development and Change Vol. 30 (1999), 237±263

Bhan, Gautam, Bhandari, Nita, Taneja, Sunita Mazumder, Sarmila, and Bahl, Rajiv (2005). *The effect of maternal education on gender bias in care- seeking for common childhood illnesses*. Social Science and Medicine. July 2004. V 60 pg (715-724)

Bloom, Shelah S, Wypij, David and Das Gupta, Monica. *Dimensions of Women's Autonomy and the Influence on Maternal Health Care Utilization in a North Indian City*. Demography Vo, 38 No. 1, 67-78.

Borooah, Vani K. (2004) *Gender bias among children in India in their diet and immunization against disease*. Social Science & Medicine 58 1719–1731

Clark, Sheller (2000). *Son Preference and Sex Composition of Children: Evidence from India*. Demography, Volume 37- Number 1, pg 95-108.

Cogill, Bruce. (2001) *Anthropometric Indicators Measurement Guide*. Food and Nutrition Technical Assistance Project, Academy for Educational Development, Washington DC.

Das Gupta, Monica. (1987) *Discrimination against Female Children in Rural Punjab, India*. Population and Development Review, vol 13 No. 1 pg 77-100

Das Gupta, Monica, Lokshin, Michael, Gragnolati, Michele, Ivaschenko, Oleksiy. (2005) *Improving Child Nutrition Outcomes in India. Can the integrated child development services program be more effective?* World Bank Policy Research Working Paper 3647, June 2005

Desai, Sonalde and Alva, Soumya. (1998) *Maternal Education and Child Health: Is there a Strong Causal Relationship?* Demography, Volume 35- No. 1, pg 71-81

Dyson, Tim, Moore, Mick.(1983) *On Kinship Structure, Female Autonomy, and Demographic Behavious in India*. Population and Development Review. Vol. 9. No.1 Pg 35-60

Fantahun, Mesganaw . Berhane, Yemane, Wall, Stig Byass, Peter , Hogberg, Ulf . (2007) *Women's involvement in household decision-making and strengthening social capital—crucial*

factors for child survival in Ethiopia. Foundation Acta Pædiatrica/Acta Pædiatrica 96, pp. 582–589

Friedman, Debra, Hechter, Michael, and Kanazawa, Satoshi. (1994) *A theory of the value of children* Demography, Springer New York, Volume: 31, Issue: 3 pg 375- 401

Ganatra, B. and Hirve, S. (1994) *Male bias in health care utilization for under- fives in a rural community in western India*. Bulletin of the World Health Organization, 72 (1): 101-104

Jalan, Jyotsna and Martin Ravallion (2003) "Does Piped Water Reduce Diarrhea for Children in Rural India?" *Journal of Econometrics* Vol. 12(1): 153-73.

Jayachandran , Seema and Kuziemko, Ilyana (2009) *Why Do Mothers Breastfeed Girls Less Than Boys? Evidence and Implications for Child Health in India*

Jensen, Robert and Oster, Emily. (2007) *The Power of TV: Cable Television and Women's Status in India*. National Bureau of Economic Research working paper No. 13305. August 2007.

Kishor, Sunita. (1993) *" May God Give Sons to All" Gender and Child Mortality in India*. American Sociological review, 1993, Vol 58. Pg (247-265)

Osmani, Siddiq and Sen, Amartya. (2003) *The Hidden Penalties of Gender Inequality: Fetal origins of Ill-Health*. Economics and Human Biology 1 105–121

Oster, Emily (2009) *Does Increased Access Increase Equality? Gender and Child Health Investments in India* . Journal of Development Economics, Volume 89, Issue 1, Pages 62-76

Oster, Emily. (2009) *Proximate Sources of Population Sex Imbalance in India*. Demography, Volume 46, Number 2, May 2009, pp. 325-339

Pal, Sarmistha. (1999) *Analysis of Childhood Malnutrition in Rural India: Role of Gender, Income, and Other Household Characteristics*. World Development Vol. 27, No. 7, pp. 1151±1171

Pande, Rohini P.(2003) *Selective Gender Differences in Childhood Nutrition and Immunization in Rural India: The Role of Siblings*. Demography, Volume 40 No. 3, pg 395- 418

Pande, Rohini P. and Astone, Nan Marie (2007) *Explaining son preference in rural India: the independent role of structural versus individual factors*. Policy Rev 26:1–29

Rahman, M et al. *Early marriage, poor reproductive health status of mother and child well-being in India*. Journal of Tropical Pediatrics . April 1993. V 39 pg 86-88.

Rajaretnam, T. and Deshpande, R.V.(1994) *The Effect of Sex Preference on Contraceptive Use and Fertility in Rural South India*. International Family Planning Perspectives, Vol 20, No. 3 pg 88-95. September 1994

Rose, Elaina. (1999) *Consumption Smoothing and Excess Female Mortality in Rural India. The Review of Economics and Statistics,* 81(1): 41 – 49

Schultz, T. Paul(2002) *Why Governments Should Invest More to Educate Girls*. World Development Vol. 30, No. 2, pp. 207–225

Sen, Amartya.(1990) *More Than 100 Million Women Are Missing***.** The New York Review of Books.

Sudha, S. and Rajan, S. Irudaya .(1999) *Female Demographic Disadvantage in India 1981 ±1991:*
Sex Selective Abortions and Female Infanticide. Development and Change Vol. 30, 585±618

Gender Equality and Development (2011) World Development Report. The International Bank for Reconstruction and Development / The World Bank

International Institute for Population Sciences (IIPS) and Macro International. (2007). *National Family Health Survey (NFHS-3), 2005–06: India: Volume I*. Mumbai: IIPS.

International Institute for Population Sciences (IIPS) and Macro International. (2007). *National Family Health Survey (NFHS-3), 2005–06: India: Volume II*. Mumbai: IIPS.
Chapter 10 Nutrition and Anaemia. Pg 267- 313.

International Institute for Population Sciences (IIPS) and Macro International.(2007). *National Family Health Survey (NFHS-3), 2005-06, India: Key Findings*. Mumbai: IIPS

National Family Health Survey-3 website: http://www.nfhsindia.org/nfhs3.html#

Valerie M. and Andrea M. den Boer.(2005) *Bare Branches: The Security Implications of Asia's Surplus Male Population*. Cambridge, Mass.: The MIT Press.

Vlassoff, M and Vlassoff, Carol. (1980) *Old Age Security and the Utility of Children in Rural India*. Population Studies. Vol 34. No. 3 pp (487-499)