Evaluating the Impacts of Bangladesh's Primary Education Stipend on Childhood Malnutrition

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Undergraduate Honors Thesis

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Abstract

Bangladesh's Primary Education Stipend program (PES) provides a 100 taka monthly stipend to families that enroll their primary school age children in school, effectively doubling the incomes of Bangladesh's poorest households. Considering that poor nutrition can lead to chronic disease outcomes, it is possible that participating households may spend this stipend to improve the nutrition of their children. Two difference-in-difference models are utilized to determine the effect of PES enrollment on height, weight, and BMI via panel data. By applying a variable difference-in-difference estimator, we find that the number of years a child spends eligible for PES benefits results in increases in both height and weights, though the effect was larger for boys. This analysis further reinforces notions that female children have higher likelihoods of suffering from malnutrition than male children.

Introduction

Chronic undernutrition is a fundamental problem in many developing countries. Beyond the physiology, lack of nutritional access is estimated to cost Bangladesh $1 billion (USD) in revenue per year (United Nations, 2014). While individuals of all ages are susceptible to the undernutrition, it is most detrimental to children, whose bodies require adequate nourishment for proper physical growth and cognitive development (Martins et al., 2011). Adverse effects include poor physical growth, hindered ability to pursue work experience, and lower lifetime earning potential (Alderman, Hoddinott, & Kinsey, 2003).

Additionally, malnutrition is associated with poor educational outcomes due to early cognitive defects and reduced attention span (Benson & Shekar, 2006). In a study of 79 countries, every 10% increase in child stunting is associated with a 7.9% decrease in the number of children who complete primary school. Considering the wealth of research marking education as a pivotal agent for breaking the cycle of poverty (Baulch, 2011), addressing childhood undernutrition holds great precedence in developing economies. Recognizing the role of education in economic develop, the government of Bangladesh developed a program to encourage the country's poorest households to send its children to primary school.

An Overview of the Primary Education Stipend Program

Among Bangladesh's early education promotion initiatives is its 1993 Food for Education program (FFE). This program provided a monthly food incentive for households to enroll their children in primary school. In 2003, technical difficulties regarding food distribution forced the Bangladeshi government to replace FFE with the Primary Education Stipend program (PES). PES awards cash stipends to households that send their children to primary school while maintaining a 85% attendance rate. The monthly cash stipends amount to 100 Bangladeshi Taka for households that send one child to primary school (approximately the value of four pounds of rice). This monthly stipend increases to a flat rate of 125 Taka if the household sends more than one child to primary school.

However, not all households can benefit from PES. Individual *upazilas* (administrative districts of Bangladesh) are required to send applications to the Bangladesh national government to be considered for PES funding. Upazilas whose applications are rejected cannot enroll their citizens in PES. Furthermore, in upazilas that are approved for PES participation, each school in approved districts can only enroll 40% of its students in PES. Within these eligible districts, a household's child has to meet at least one of the following criteria to be considered for PES enrollment:

1. belongs to a landless or near-landless household (owning less than half an acre of land)
2. has parents who work as day laborers
3. belongs to a female-headed household (head is widowed, separated, or divorced or husband is disabled)
4. belongs to a household that derives its living from fishing, pottery, weaving, blacksmithing, or cobbling
5. belongs to a household that derives its income from sharecropping (Baulch, 2011)

Completion of the second round of the Bangladesh Integrated Household Survey makes it possible for researchers to evaluate the impacts of PES over time. So far, the few studies that concern PES focus on its effectiveness in improving child education with limited assessments on childhood malnutrition. This thesis seeks to address this disparity by evaluating the impacts of PES in addressing childhood malnutrition. The results of this analysis will provide information assessing whether Bangladeshi children, who have the opportunity of benefiting from educational cash transfers, experience improvements in growth. Policymakers and project coordinators can use these results to improve PES to effectively target children most at risk for undernutrition.

Literature Review

Heady *et al.* (2015) likens Bangladesh as an enigma among South Asian countries in matters of childhood malnutrition. In fact, between 1997 to 2007, the country's childhood stunting rate declined 1.1-1.3% per year (D. D. Headey, 2013). An analysis of panel data finds that the most significant positive contributors to a child's height, standardized by age, are household wealth, paternal and maternal education levels, prenatal doctor visits, birth in a medical facility, and mother's height (Headey, Hoddinott, Ali, Tesfaye, & Dereje, 2015).

Another study focuses on Bangladeshi household practices as they relate to individual, maternal, and public health (Fakir & Khan, 2015). Younger children bear the brunt of malnourishment. These effects are lessened among older children. Within family samples, older siblings are 22.8% less likely to be severely malnourished, 15.5% more likely to be have nourished, and 7.4% more likely to be moderately malnourished. Female children generally have higher chances of being malnourished than male children, perhaps indicative of cultural values attributing males as more valuable to the family.

A one-year increase in maternal education decreases the probability of being severely malnourished by 36.3% for male children and 31.1% for female children. However, having a mother with no education and no knowledge of medical precautions increases the likelihood of being severely malnourished by 42.6% for male children and 46.1% for female children. If a mother reports having no education and does not pursue health improving practices for her children (seeking medical care or actively taking medical advice), the risk of her female children being severely malnourished and prone to impediments to normal growth increases by 63.4% and 36.2% respectively. Maternal possession of a primary school education with a lack of health-seeking practice only increases the chance of a female child being severely malnourished by 5.5%, suggesting the importance of educating girls for successive generations (Fakir & Khan, 2015).

Research implicates the importance of wealth in determining health outcomes of children in Bangladesh. The children of the poorest 20% of Bangladeshi households are 2.7 times more likely to suffer from growth stunting than those of the wealthiest 20% (Hong, Banta, & Betancourt, 2006). Additionally, every additional 1,000 Taka in per capital income decreases the probability of being severely malnourished by 15.4% for male children and 28.3% for female children (Fakir & Khan, 2015).

Of the few studies that address Bangladesh's FFE, almost all focus on educational outcomes rather than issues of nutrition. Only Ahmed and del Ninno (2002) consider malnutritional indicators in their 2002 descriptive report evaluating the impacts of FFE. Their study reaffirms the understanding that women and preschool children have a disproportionately higher risk of being undernourished than other household members. Preschool children in households benefiting from FFE reported poor chronic nutrition problems. However, these deficiencies are less severe than for households whose children do not attend primary school, and thus do not receive the food transfer. Non-FFE beneficiary children who attend an FFE school experience a decrease in the magnitude of malnutritional deficiencies. This suggests that FFE-enrolled children tend to come from households that generally struggle with providing adequate nutrition.

The only economic paper evaluating PES was produced by Baulch (2011). Using the Bangladesh Integrated Household Survey, which I will use in my own analysis, Baulch only found modest impacts of PES on child growth. Though insignificant, PES enrollment was associated with positive changes in age-standardized height and BMI values.

Methodology

Study Design

With completion of the International Food Policy and Research Institute's Bangladesh Integrated Household Survey (BIHS), it is now possible for researchers to evaluate the impacts of PES over time. Completed in 2011, the first round of BIHS evaluated about 6,500 households and their respective occupants on factors such as agricultural practices, dietary intakes, housing and income information, and anthropometric measurements. A second round of BIHS, conducted in 2015, follows up on the original 2011 cohort. As the attrition rate is only 1.26% households per year, these two BIHS datasets provide an excellent opportunity to evaluate changes over times. Particularly, this study will assess the impact of PES enrollment on malnutrition as measured by height and weight.

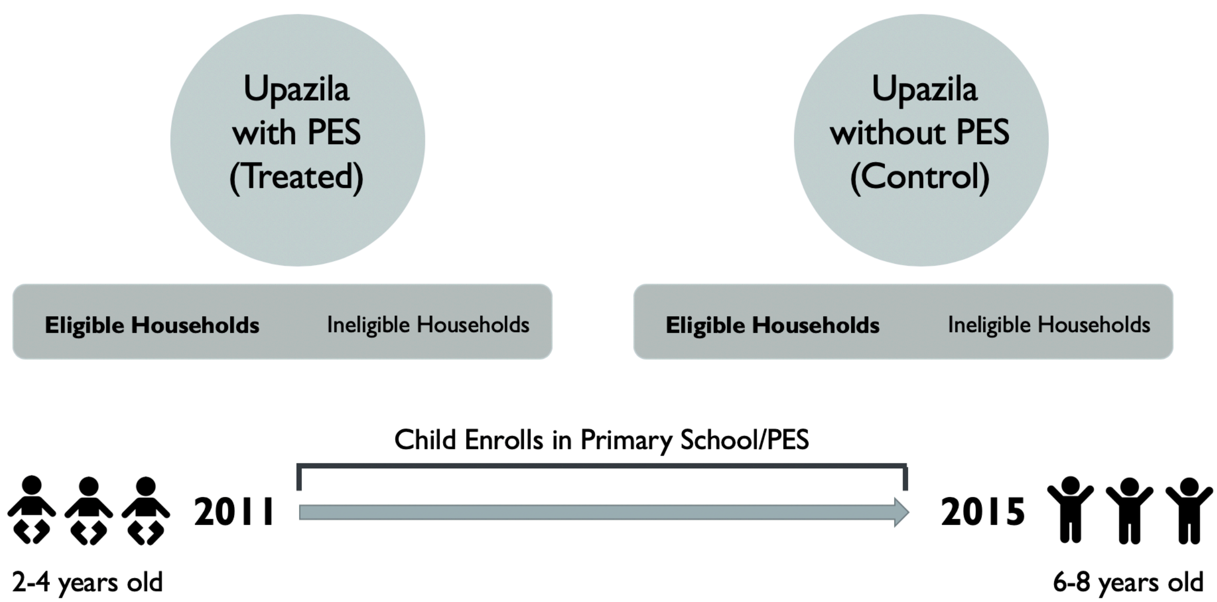

Figure 1. Study design.

Upazilas are not randomly selected for PES participation, rather, the government preferences approving PES funding for Bangladesh's poorer upazilas. Within these poor PES-funded upazilas, the poorest households are targeted for program enrollment. Those enrolled in PES may be selected in ways that bias the program impacts. To address this potential endogeneity I base this analysis only on children who are likely eligible recipients for PES as determined by the prior mentioned PES eligibility criteria. In Figure 1, the populations are interest are noted as "Eligible Households". These particular treatment upazila households have children who will become eligible for PES consideration upon reaching primary school age. Their counterparts in control upazilas would have been eligible for PES had they instead resided in a treatment upazila.

I exploit the panel nature of this dataset to estimate a difference-in-difference model to compare the outcomes for children between ages two and four, who are too young for primary school at a baseline year of 2011, between treatment and control upazilas. These children are followed into 2015 when they are between ages of six and eight (inclusive). By this time, all the children have entered primary school – only treatment upazila children had the opportunity to apply for PES which acts as my treatment effect. All observations in this study are limited to first borne children to ensure that there are no PES induced externalities caused by older siblings who previously enrolled in PES.

The difference-in-difference model assumes that trends in the outcomes for the treatment group would be similar to that of the control group had the treatment group not been treated. This assumption cannot be tested directly. If there was more pre-PES data, I could test whether outcome trends were similar between the treatment and control groups to provide a stronger case that the assumption is true. Instead, I test whether the means of height, weight, and BMI differ between treatment and control upazilas in 2011 observations. As my t-Tests in Table 1 do not find any statistically significant differences, I take on the difference-in-difference assumption.

Table 1 presents the descriptive statistics for regression variables for 2011, and examines whether their values are similar for treatment and control areas prior to the PES effect. I present the means for both treatment control groups, the difference in the means between the groups, and whether these differences are statistically significant. As Table 1 shows that there is no meaningful differences for the outcome variables or pertinent controls, it appears that that pre-PES heights and weights are roughly the same.

Table 1. Descriptive statistics for 2011 observations.

	Treated Upazila			Untreated Upazila			t-Test	
Variables	Mean	SD	*n*	Mean	SD	*n*	Difference	P-value
Height (cm)	93.97	8.46	78	92.45	7.91	97	1.52	0.223
Weight (kg)	12.93	2.24	78	12.57	1.91	98	0.37	0.241
Body Mass Index	14.62	1.57	78	14.73	1.50	97	-0.11	0.645
Age (years)	3.58	0.85	78	3.34	0.88	98	-0.24	0.072
Urban residence	0.09	0.29	74	0.08	0.27	90	0.02	0.703
Household electricity	0.58	0.50	78	0.56	0.50	98	0.02	0.836
Household head educated	0.60	0.49	78	0.64	0.48	98	-0.04	0.586
Monthly household income (thousands of Tk)	6.79	5.04	78	7.82	9.03	98	-1.03	0.294
Children in household	1.33	0.59	78	1.39	0.60	98	-0.05	0.544
Household land ownership (decimals)	198.93	187.15	78	163.90	111.82	98	35.03	0.125

Regressions

My basic difference-in-difference model is the following:

$$Y_{iut} = \beta_0 + \beta_1 treated_u + \beta_2 2015_t + \beta_3 (treated * 2015)_{ut} + \beta_4 \gamma + \beta_5 \boldsymbol{X}_i + \varepsilon_{iut} \text{ (1)}$$

In (1), variable Y represents the anthropometric measures of height, weight, and BMI. Height is used as a measure of long-term growth while weight is indicative of short-term nutrition. BMI is not a very accurate measure of nutritional stability, however, it can be used a general measure for body composition.

The variable *treated* is a dummy referring to whether the child resided in a upazila offering PES. To indicate whether a particular observation was made in survey year 2015, we use the dummy variable "2015". The difference-in-difference estimator is created by multiplying *treated* by "2015". Manipulating different conditions in (1) yields the following means:

$\bar{Y}^{C}_{2011} = \beta_0$, children in upazilas not offering PES in 2011

$\bar{Y}^{T}_{2011} = \beta_0 + \beta_1$, children in upazilas offering PES in 2011

$\bar{Y}^{C}_{2015} = \beta_0 + \beta_2$, children in upazilas not offering PES in 2015

$\bar{Y}^{T}_{2015} = \beta_0 + \beta_1 + \beta_2 + \beta_3$, children in upazilas offering PES in 2015

The coefficient β_3 represents the differences of the impacts of PES in the 2011 and 2015 samples.

It is important to also consider that children of different ages grow at different rates. Fixed-age effect dummy variables, indicated by γ, will be utilized to capture these differences with a baseline age of two years serving as the benchmark. Additional control variables are denoted by $\boldsymbol{X}$.

Due to sample size limitations, I am unable to provide separate regressions evaluating the impacts of PES on children of different age groups. However, the number of years that children are eligible for PES participation depends on the age that they begin primary school. Assuming that all children begin primary school at age 5, I replace the original difference-in-difference estimator with a variable that reflects the number of years a member in a treatment upazila is eligible for PES enrollment in 2015. This variable's value is automatically 0 for all observations in both 2011 and control upazilas in 2015. My PES-eligibility difference-in-difference regression is the following:

$$Y_{iut} = \beta_0 + \beta_1(treated)_u + \beta_2(2015)_t + \beta_3(years\ eligible)_y + \beta_4\gamma + \beta_5\boldsymbol{X}_i + \varepsilon_{iut} \ (2)$$

Results and Discussion

I will now turn our attention to investigating the impacts of living in a PES eligible upazila on childhood growth. For all tables, equations (1-3) represent the basic difference-in-difference regressions, including the age-fixed effects, which are categorized as gender-combined, male only, and female only. Equations (4-6) have the same gender classifications, however, these PES-eligibility regressions focus on the length of PES eligibility on treatment upazila children. Since I am limited by small sample sizes, I focus on magnitudes rather than significance levels.

First, I evaluate how PES affects height as measured in centimeters (Table 2). Among all regression equations, living in a treatment upazila as opposed to a control upazila in 2011 appears to confer a height advantage for boys in both regression types. Girls do not seem to benefit from simply living in a treatment upazila. This is unprecedented as treatment upazilas are thought to have fewer resources for childhood nutrition. However, these treatment upazilas may benefit from other government programs or foreign aid as a result of their especially disadvantaged status.

Consistent with expectations that children grow taller over time, children in control upazilas in 2015 are on average about 21 centimeters taller than they are in 2011. Furthermore, the age-fixed effects account for the fact that four year old children tend to be taller than three year old children. Of course, four and three year old children are taller than the benchmark children at age two. Both regressions types suggest that three year old girls are expected to be about 1.5 centimeters taller than boys. However, the height gap between four year old boys and girls narrows. These effects may simply be a cause of our small sample sizes.

Table 2. Regressions on height – independent variables measured in 2011, unless stated otherwise.

VARIABLES	(1) height	(2) (male) height	(3) (female) height	(4) height	(5) (male) height	(6) (female) height
Treated	0.80	1.81	0.25	0.63	1.54	0.02
	(1.04)	(1.63)	(1.43)	(0.90)	(1.38)	(1.24)
2015	20.90***	21.20***	20.95***	15.82***	12.15**	19.36***
	(1.30)	(1.21)	(2.17)	(2.99)	(5.17)	(4.13)
Treated*2015	-0.43	-0.25	-0.72			
	(1.86)	(2.63)	(2.62)			
Years eligible				1.97	3.66	0.46
				(1.27)	(2.36)	(1.60)
Three years old	5.60***	4.44**	6.11***	5.42***	4.50**	5.99***
	(1.20)	(1.95)	(1.77)	(1.22)	(1.96)	(1.78)
Four years old	12.38***	12.27***	12.38***	11.61***	11.31***	12.16***
	(1.20)	(2.04)	(1.45)	(1.32)	(2.12)	(1.63)
Urban residence	-0.25	-0.66	-0.06	-0.31	-0.12	-0.09
	(0.93)	(1.71)	(1.23)	(0.96)	(1.80)	(1.26)
Household electricity	0.45	0.49	0.35	0.51	0.37	0.43
	(0.85)	(1.24)	(1.20)	(0.85)	(1.25)	(1.23)
Household head	0.04	0.17	0.08	-0.01	0.07	0.06
educated	(0.88)	(1.26)	(1.19)	(0.88)	(1.26)	(1.20)
Monthly household	0.10*	0.14*	0.04	0.11**	0.13*	0.05
income (thousands Tk)	(0.06)	(0.08)	(0.10)	(0.06)	(0.08)	(0.10)
Children in household	-0.57	0.13	-0.94	-0.44	0.15	-0.89
	(0.71)	(0.97)	(1.03)	(0.70)	(0.97)	(1.04)
Land ownership	-0.00*	-0.01*	-0.00	-0.00*	-0.01*	-0.00
(decimals)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	87.26***	87.07***	87.36***	87.47***	87.53***	87.45***
	(1.45)	(2.08)	(2.21)	(1.44)	(2.09)	(2.19)
Observations	239	112	127	239	112	127
R-squared	0.75	0.76	0.76	0.75	0.76	0.76

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The coefficient on the difference-in-difference estimator "treated*2015" states that residing in a treatment upazila is actually a detriment on childhood height. However, no conclusions can be made concerning the difference-in-difference effect due to lack of significance.

The “years eligible” variable accounts for the height effects conferred by an additional year that an observation residing in a treatment upazila spends in primary school, and is thus eligible for PES. This variable is only relevant for children living in treatment upazilas in 2015 and drops out of the regression for children living in control upazilas and all children observed in 2011. I find that each additional year that a boy in a treatment upazila is eligible for PES funding contributes an average of 3.66 centimeters to their height. The effect for girls is only 0.46 cm per year.

This shows that boys directly receive height benefits for living in treatment upazilas as the monthly stipend may be used to purchase more food. This large difference may result from cultural norms considering boys as more worthy for investment than girls. Money may not be spent on properly feeding girls, especially since girls may be married off to another family anyway.

Many of the control variables do not seem to have meaningful impacts on child height. One exception is that household electricity has a modest impact on height determination. Additionally, increases in household monthly income have a significant increase on male child height while the results are near null for females. This supports the idea that households are inclined to invest additional finances on the nourishment of male children over female children. Furthermore, for each child added to the household, the average height of the eldest child, if female, is expected to decrease by almost one centimeter. Boys do not experience the same negative effects, which is further evidence that households generally deem girls a low priority for nutritional investment.

As height is an indicator of long-term malnourishment, these data suggest that boys tend to be well-nourished over long periods of time. Meanwhile, it appears that girls do not receive the same degree of nourishment.

Table 3. Regressions on weight – independent variables measured in 2011, unless stated otherwise.

VARIABLES	(1) weight	(2) (male) weight	(3) (female) weight	(4) weight	(5) (male) weight	(6) (female) weight
Treated	0.09	0.21	-0.07	0.13	0.09	0.06
	(0.29)	(0.41)	(0.41)	(0.27)	(0.38)	(0.40)
2015	5.26***	5.23***	5.45***	3.84***	3.07**	4.42***
	(0.49)	(0.62)	(0.75)	(1.04)	(1.30)	(1.45)
Treated*2015	0.16	-0.26	0.41			
	(0.62)	(0.80)	(0.90)			
Years eligible				0.62	0.83	0.51
				(0.43)	(0.55)	(0.59)
Three years old	1.81***	1.82***	2.00***	1.75***	1.84***	1.94***
	(0.33)	(0.46)	(0.53)	(0.33)	(0.45)	(0.52)
Four years old	3.23***	3.40***	3.17***	2.99***	3.19***	2.94***
	(0.33)	(0.49)	(0.46)	(0.34)	(0.50)	(0.48)
Urban residence	-0.32	0.70	-1.10**	-0.36	0.84	-1.23**
	(0.37)	(0.57)	(0.43)	(0.40)	(0.59)	(0.47)
Household electricity	0.36	0.60	0.08	0.36	0.58	0.12
	(0.27)	(0.37)	(0.39)	(0.26)	(0.37)	(0.39)
Household head educated	0.29	0.38	0.32	0.28	0.35	0.30
	(0.26)	(0.37)	(0.38)	(0.26)	(0.35)	(0.37)
Monthly household income (thousands Tk)	0.04**	0.02	0.03	0.04**	0.02	0.04
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)
Children in household	-0.30	0.25	-0.68*	-0.25	0.25	-0.60*
	(0.23)	(0.23)	(0.35)	(0.22)	(0.23)	(0.34)
Land ownership (decimals)	-0.00	-0.00**	-0.00	-0.00	-0.00**	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	10.93***	10.22***	11.45***	10.96***	10.35***	11.37***
	(0.43)	(0.54)	(0.71)	(0.43)	(0.51)	(0.71)
Observations	240	112	128	240	112	128
R-squared	0.71	0.77	0.69	0.71	0.77	0.69

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 shows the program effects on weight as measured in kilograms. Neither the basic difference-in-difference nor the PES-eligibility regressions show a meaningful weight effect from living in a treatment upazila. Therefore, these data show that the type of upazila one lives in in 2011 does not have an impact on their short-term nutrition, as assessed by weight.

Within the control group, the older children surveyed in 2015 are significantly heavier than the younger children in 2011. This is a comforting indication that children are gaining additional body mass over time. Similar to the height regressions, the age-fixed effects capture the fact that, in 2011, three year old children are significantly heavier than the baseline two year old children, and four year old children are even heavier than the three year old children.

The coefficient on "treated*2015" suggests that the PES treatment effect is unclear on the weights of children in treatment upazilas as the impact on males is a slight positive and that on females is a slight negative.

However, there is some evidence that each additional year spent being eligible for PES benefits result in an average 0.83 kg increase for boys and 0.51 kg for girls. Though the impacts are not significant, it suggests that households in treatment upazilas may be utilizing the cash stipend to provide better short-term nutrition for children. Since the value is larger for male children than for female children, this may reinforce that male children receive more generous nutrition investments relative to girls. This is speculative as the insignificance of these numbers prevents definite conclusions.

Further disparities in weight between genders are observed in regressions (3) and (6). Both shows a significant effect that girls living in urban areas are expected to weight more than one kilogram less than girls in rural areas. Boys in urban areas on average are over half a kilogram heavier than those in rural areas, though the variable does not hold statistical significance. Additionally, for every additional child living in the household, a girl's average weight decreases by more than half a kilogram. Boys do not appear to experience decreases in weight with additional children in their households. These two effects are significant, which raises some concern over the differential feeding conditions between boys and girls.

In order to assess the impacts of PES on overall body composition, we will look at the regressions on BMI displayed in Table 4. BMIs are calculated according to standards provided by the Centers for Disease Control and Prevention (2019) utilizing individual measures of height and weight. Across all regressions, living in a treated upazila has a slightly negative impact on BMI score that is not deemed statistically significant – another likely consequence of my poor sample size.

In these regressions, the basic difference-in-difference estimator may have a slightly positive effect in determining childhood BMI. However, the results are mixed between boys and girls on the "years eligible" variable, suggesting that PES is not a strong predictor of body composition.

These regressions lose significance in differences conferred by fixed-age effects as well as the number of beneficiary years children spend in treatment upazilas. Yet, the variable "2015" retains significance in the BMI regressions. Its negative value indicates a decrease in child BMI with age which translates to natural body thinning over child development.

Table 4. Regressions on BMI – independent variables measured in 2011, unless stated otherwise.

VARIABLES	(1) BMI	(2) (male) BMI	(3) (female) BMI	(4) BMI	(5) (male) BMI	(6) (female) BMI
Treated	-0.17	-0.34	-0.13	-0.08	-0.28	-0.02
	(0.27)	(0.38)	(0.39)	(0.22)	(0.33)	(0.31)
2015	-0.91***	-1.11***	-0.65*	-0.58	-0.58	-0.75
	(0.29)	(0.41)	(0.38)	(0.97)	(1.41)	(1.21)
Treated*2015	0.32	0.18	0.36			
	(0.42)	(0.61)	(0.56)			
Years eligible				-0.06	-0.17	0.12
				(0.37)	(0.55)	(0.45)
Three years old	0.24	0.44	0.40	0.25	0.43	0.39
	(0.31)	(0.44)	(0.45)	(0.31)	(0.45)	(0.45)
Four years old	-0.34	-0.18	-0.36	-0.32	-0.14	-0.42
	(0.29)	(0.46)	(0.39)	(0.31)	(0.47)	(0.42)
Urban residence	-0.29	0.78*	-1.16**	-0.31	0.74*	-1.21***
	(0.31)	(0.41)	(0.44)	(0.31)	(0.43)	(0.45)
Household electricity	0.28	0.44	0.11	0.26	0.44	0.11
	(0.21)	(0.29)	(0.30)	(0.21)	(0.29)	(0.29)
Household head educated	0.21	0.22	0.26	0.21	0.22	0.26
	(0.21)	(0.30)	(0.29)	(0.21)	(0.30)	(0.29)
Monthly household income (thousands Tk)	0.00	-0.02	0.01	0.00	-0.02	0.01
	(0.01)	(0.02)	(0.03)	(0.01)	(0.02)	(0.03)
Children in household	-0.09	0.22	-0.33	-0.09	0.23	-0.31
	(0.17)	(0.26)	(0.22)	(0.16)	(0.25)	(0.21)
Land ownership (decimals)	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	14.55***	14.05***	14.89***	14.51***	14.02***	14.82***
	(0.39)	(0.49)	(0.63)	(0.39)	(0.49)	(0.61)
Observations	239	112	127	239	112	127
R-squared	0.10	0.16	0.15	0.10	0.16	0.14

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Interestingly, living in an urban area appears to have opposite effects for male and female children. In both the basic difference-in-difference and PES-eligibility models, male children in urban areas have are expected to have an average BMI that is 0.78 and 0.74 points higher than those in rural areas. Meanwhile, female children in urban areas may expect a BMI that is lower than that of their rural counterparts by 1.16 points for the basic difference-in-difference model and lower by 1.21 points for the eligible years model.

For female children, experiencing a BMI that is one point lower is a case for concern. It is indicative of urban girls having significant lower body masses relative to their body masses. This, combined with the fact that male children in urban areas receive a BMI increase, reinforces the idea that there may be preferential treatment in feeding boys over girls in urban Bangladeshi communities.

PES appears to have a clear benefit on boys while its impacts on girls are of a lower magnitude. Further research may specifically analyze why male children have a greater benefit from PES enrollment, though it is possible that the sample size is simply too small. As these results show that the program favors the development, the Bangladeshi government may want to experiment with female-only education programs to address the malnourishment gap between boys and girls. Improvements upon the PES model to better address female health may be a viable measure to combat growth inequality between male and female children in Bangladesh.

These results provide evidence that girls unequally suffer from malnutrition with regard to increasing household size as well as simply being born female in urban areas. Cultural forces may be at play as investing in the nourishment male children, who culturally tend to be the breadwinners of many societies, holds precedence over female children, who are eventually married off and leave the household. Future government programming may want to consider how to maneuver cultural traditions in order to ensure that girls do not suffer from unequal nutritional access.

Concluding Remarks

This thesis utilizes two difference-in-difference models to evaluate the PES impact on addressing childhood malnutrition among young children as measured by height, weight, and BMI. Generally, the impact of living in a treatment upazila on anthropometric growth measures is variable. Living in a treatment upazila confers a height advantage for male heights in 2011, indicating that boys receive a beneficial long-term nutritional intake by living in poor treatment upazilas. Perhaps this is the result of other interventions that address poverty in Bangladesh. The height effects were not large for girls. The status of the upazila does not seem to have an effect on determining short-term malnutrition as measured by weight. BMI regression trends suggest that living in a treatment upazila may result in a lower BMI which indicates that these children may be thinner than their rural counterparts. Additional data points may be necessary to achieve significance for this effect.

Using the basic difference-in-difference model, it that PES does not have a clear contribution to the heights and weights of children living in treatment upazilas. I found that the number of years a child in a treatment upazila benefits from PES contributes an increase in the height and weights for children. The magnitude of the effects are greater for boys than for girls. This suggests that PES is an effective intervention for ensuring that boys receive proper nourishment. Cultural factors may play a role in ensuring that girls do not receive equal nourishment to boys. The government of Bangladesh may want to implement education programs directed at addressing malnourishment in girls.

In addition to evaluating the impacts of PES on growth, I explore other factors that contribute to malnutrition. Girls living in urban areas are expected to weigh less than those living in rural areas. Furthermore, for every additional child living within an household, first borne female children are expected to suffer a decrease in average weight while first borne male children do not face such detriments. In the BMI regressions, being a female child in an urban residence results in a stark BMI decrease when compared to their rural counterparts. Male children experience a BMI increase by living in an urban area versus a rural area. These differences in nutritional outcomes between the genders strongly suggests an inequality of treatment between male and female children in Bangladesh society. This reinforces notions mentioned in previous literature stating that being born a female in Bangladesh is its own health handicap.

This study is limited by its small sample size, which may contribute to the lack of significance for many of the variables. A number of lifestyle variables had to be dropped from the final regressions due to a lack of representation among our observations. My difference-in-difference model heavily relies on assumptions of similar trends in growth between treatment and control upazilas. If I had access to another set of data preceding my sample population's participation in PES I could construct a model that may infer whether pre-PES trends were actually similar between upazila types.

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