The Impact of Alternative Food for Education Programs on Child Nutrition in Northern Uganda*

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Abstract:

We investigate the nutritional benefits of two FFE programs using a randomized field experiment conducted in Northern Uganda in 2005-07. We estimate the impacts on anthropometric status and anemia prevalence of an in-school feeding program (SFP) and a take-home rations (THR) program conditional on school attendance in a sample of 2100 primary-school-age children. We also examine program effects on intrahousehold resource allocation reflected in the anthropometric status of preschooler siblings. Results show no impact of either program on change in BMIZ or on anemia prevalence of 6-13 year old children on average. However, both programs reduced anemia prevalence (Hb<11.0 g/dL) of females age 10-13, by 17-19 percentage points. Preschool-age children in the SFP group had a significant 0.363 z-score improvement in HAZ compared to the control group, while no comparable effect was observed from THR. Results suggest that both intrahousehold redistribution and direct spillovers contributed to this impact on preschoolers.

JEL Codes: O1, I12, I38
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1. Introduction

The primary goal of most Food for Education (FFE) programs, including meals served in school and take-home rations conditional on school attendance, is to encourage children to attend school. However, providing food rather than cash transfers conditional on school participation may support other secondary goals of FFE programs. When students are hungry or malnourished, providing them with food may help them to concentrate so that they are better able to learn. Similarly, if the food transfers are fortified with micronutrients like iron that are known to affect cognitive development, the programs may have even greater lasting effects on health and welfare into adulthood.

This paper examines the empirical foundations for these two effects by investigating whether an in-school feeding program (SFP) and a take-home rations (THR) program conditional on school attendance had an effect on anthropometric status or iron status and anemia of primary-school age children in Northern Uganda. The meals provided were both large enough in terms of energy consumption (over 1000 kcal/child/day), and apparently nutritious enough (providing 99 percent of iron requirements and two thirds of requirements of other essential nutrients) to present a plausible setting for testing these necessary conditions for nutrition to play an important role in contributing to the broader impacts of FFE programs on learning and cognitive development.

Some evidence indicates that the impact of FFE programs on nutrition may be quite small (Grillenberger et al. 2003; Van Stuijvenberg et al. 1999; Powell et al. 1998). As a result, these programs have raised criticism from many nutritionists because they intervene after the critical period from prenatal care to age 2, when the physical growth and development are at their fastest, so the potential for impact is greatest. These relatively small impacts, at a cost of roughly $20-35 per child per year, indicate that FFE programs are not cost-effective from a nutrition perspective. However, this argument ignores the potential gains to human capital from the education and learning benefits. Jamison et al. (1993, 2006) show that FFE programs can reduce short-term hunger and micronutrient deficiencies, which can increase cognitive function and resistance to intestinal and respiratory infections.[2] The latter effect could increase school attendance and learning by reducing morbidity. Thus, if the nutritional benefits of FFE programs are small, but are a critical link to the learning and cognitive outcomes, then the cost effectiveness of these FFE nutrition investments may be considerably higher than suggested by the nutrition benefits alone.

FFE programs may also provide an important nutritional intervention during an often overlooked critical growth period. With delayed starts to schooling and repeated grades, many children in primary schools in developing countries have already reached adolescence. As adolescents can gain as much as 15 percent of adult height and 50 percent of adult weight, their energy requirements are very high during this period. Adolescent girls, in particular, have high nutrient and micronutrient demands. Although malnourished adolescent girls do catch up to well-nourished girls during puberty, their growth is delayed. This delay can mean that a malnourished girl is not finished growing at the time of her first pregnancy (Gillespie and Flores 2000), which can increase the risk of complications and of maternal and infant death.[3]

In this paper, we investigate the nutritional benefits of two FFE programs from Northern Uganda using a randomized field experiment conducted in 2005-07. We present estimates of the impact of the SFP and THR programs on anthropometry and anemia for primary-school age children (age 6-13) and sub-samples of these children based on age, gender and location. We also investigate whether the programs had significant impacts on the anthropometric status of younger siblings in the households of these SFP and THR beneficiaries. We consider the implication of the findings for evidence on the impact of the FFE programs on education outcomes and for the design of FFE programs.

[2]A considerable body of literature suggests that both educational attainment and cognitive ability improve adult productivity and earnings. For a review of literature linking educational attainment and wages, see Psacharopoulos (1994) and Psacharopoulos and Patrinos (2004); see, for example, Cawley, Heckman, and Vytlacil (2001) for evidence of cognitive ability's effect on wages.
[3] Moreover, Adair (1999) that shows that children aged 2–12 in the Philippines who were previously stunted experienced catch-up growth.

2. How FFE Programs Affect Nutritional Status

While the primary goal of Food-for-Education programs is to increase school participation, there are key nutritional concerns for school-age children that these programs may also address. Primarily, FFE programs can be used to reduce short-term hunger that may decrease concentration or energy levels or increase susceptibility to infection.[4] School-feeding programs also may be well-timed to address protein, energy and micro-nutritional needs prior to and during the adolescent growth spurt. Since children in developing countries are often delayed in their progression through school, targeting primary schools could be an effective way of increasing energy intake among a large proportion of pre-adolescent and adolescent children. Finally, FFE programs can also be used to address micronutrient deficiencies in children that are linked to several cognitive or health-related problems. This paper focuses on the second two elements by examining potential improvements to anthropometric and hemoglobin status.

Anthropometric Status

The anthropometric outcomes considered in this paper are body mass index (BMI) z-scores (BMIZ), weight-for-height z-scores (WHZ), and height-for-age z-scores (HAZ). All of these indicators reflect the effects of nutrient intake, diet quality and morbidity on physical stature, but each measures different aspects of under- or over-nutrition.[5] The BMIZ and WHZ score are age-adjusted measures of weight controlling for height. BMI is calculated as weight in kilograms divided by the square of height in meters. Weight-for-height is weight in kilograms divided by height in meters. The z-score version of these indicators normalizes the measures for comparability and scales them relative to average values in a reference population. For example, the BMIZ score is calculated by subtracting BMI by mean BMI in a reference population, and then dividing this difference by the standard deviation of BMI in the reference population. Both WHZ and BMIZ detect recent nutritional or health status – including nutritional deficiencies and morbidity. BMIZ is more sensitive than WHZ to extreme values in height. Height-for-age, on

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[4] Adelman, Alderman, Gilligan and Lehrer (2008) show that FFE programs can improve cognitive and learning outcomes, however, they do not show whether nutrition or school attendance is the mechanism driving these improvements.

[5] Over-nutrition was not a factor in our sample. The mean baseline BMIZ was .61 standard deviations below the reference median; only 8 children in our baseline sample had BMIZ greater than 2.

the other hand, measures long-term nutritional intake and morbidity or nutritional deficiencies during critical periods of a child's growth.

There are biological and behavioral challenges to improving anthropometric outcomes of school-age children. Since growth velocity and the physiological development related to cognitive development are greatest *in utero* and in the first 2 years of life, the impacts of improved nutrition during that period are also greatest. Several studies have shown that these early life influences translate into improved adult health, improved cognitive functioning, increased schooling attainment and, ultimately, increased adult productivity and earnings. Whether meaningful gains in anthropometric status and cognitive development can be achieved from improvements in nutrition during primary school years (age 6-13) is a matter of debate (World Bank, 2006). While the biological capacity to respond to nutrition interventions is not as great during school-age years as before, household behavioral responses may also mitigate nutritional investments made during these later periods. The following discusses the potential biological responses to increasing caloric intake in this age group and the challenges that the two FFE modalities face in actually increasing consumption among the targeted children.

The school-age period is largely considered too late to improve HAZ measures, or at least to recover from growth-retardation due to early-childhood malnutrition (Behrman, Alderman and Hoddinott 2004; Martorell 1995; Martorell, Khan and Schroeder 1994). However, children entering the early stages of puberty have sufficiently higher energy, protein and iron demands compared to younger children. Providing sufficient food for children at this stage is essential to support the rapid height and weight growth associated with puberty. Inadequate calorie intake during this stage may lead to slower growth rates and reduced muscle mass (Spear 2002). On the other hand, poorer nutrition may extend the growing period while reducing the growth rate, leading to no net change in height (Delisle et al. 2001).

More likely, food for education programs can improve weight outcomes, potentially detectable by changes in BMIZ, WHZ or WAZ. However, even changes in these measures may be difficult to detect. Improving diet quality or calorie intake may also increase a child's activity level, leading to no net change in weight, but to an improvement in overall health not reflected in anthropometry. One concern about providing additional food to children is that children who are already at a healthy weight for their age and height may gain an unhealthy amount of weight. Therefore, increases in BMIZ or WHZ should not necessarily be interpreted as *improvements* in health without comparison to the baseline anthropomorphic status. However, there is sufficient evidence of returns to body size in the labor market that programs that increase BMIZ in a previously deficient population may be warranted.

The physiological issues mentioned above are based on the assumption that food supplied by FFE programs actually reaches the intended recipient. A criticism of in-school feeding programs is that parents may feed their children less at home knowing that they received a meal during the school day, leading to a net increase in calorie intake for the target child below that of the transfer. Jacoby (2002) refers to the share of the school feeding transfer that "sticks" to the target child as the "intrahousehold flypaper effect". He shows that for a sample of children from the Philippines, this flypaper effect was quite large. Using a similar method, Ahmed (2004) also finds a large flypaper effect in Bangladesh. This evidence suggests that concerns about redistribution of school feeding transfers to other household members may be overstated. The usual concern about this redistribution is that the school feeding transfer is used to make additional calories available to adult household members, who are not likely to be in greater nutritional need, and who may not benefit as much from the transfers. However, if parents are redistributing food away from the primary school age child toward siblings under age two who have greater capacity to benefit from the additional nutrition, this behavior may have higher aggregate welfare consequences in a social welfare sense. Also, even if the net increase in calorie consumption of the target child is small, the micronutrient status of that child may still improve if the quality of the SFP food is better than what the child eats at home. For take-home rations programs, these concerns about small flypaper effects are magnified because there is no mechanism to ensure that households provide the rations to the school-age child.[6,7]

Traditional intra-household resource allocation models predict that food received from FFE programs will be treated exactly as an increase in income equivalent to price times quantity minus some transactions costs (Becker 1973; Samuelson 1956). In effect, FFE transfers would be allocated to household members in the same way that any household-level income change would. More recent allocation models suggest that the individual household member receiving

[6] See Adelman, Gilligan and Lehrer (2008) for a more complete review of this issue and the discussion that follows.
[7] Reallocating food or resources to other household members may be the most efficient use of the transfer for the household. In particular, freeing up resources for preschool-age children, for whom the consequences of malnutrition are greatest, may be a better use of limited household resources. Nonetheless, it should be noted that the *targeted* child may not receive the full amount of the transfer, thus mitigating potential nutritional (and resulting cognitive) gains.

the transfer matters to how it is allocated amongst household members (Chiappori 1988, 1992; Manser and Brown 1980; McElroy and Horney 1981, among others), but these models make no predictions about how resources given to children will be allocated. These models, along with the traditional household allocation models, also predict that as long as FFE programs provide *inframarginal* food transfers (equal or less in quantity to what the child would have consumed in the absence of the program), they will have the same impact on consumption regardless of whether they are provided in-school or as take-home rations. Other evidence suggests that transfers provided to children may be treated differently than income transfers to other household members. Transfers directed at children may generate a labeling effect (Kooreman 2000) in which parents' preferences towards child goods increase as a result of the transfer. Ultimately, how households end up responding to FFE transfers is an empirical question.

Hemoglobin and Anemia Prevalence

Deficiencies in dietary intake of iron, vitamin A, and zinc are major forms of micronutrient malnutrition that together represent a significant share of the overall cost of all forms of malnutrition (citation). FFE programs provide an opportunity to improve the micronutrient status of school age children, if the food provided is rich in micronutrients. As a result, many FFE programs include micronutrient fortified foods as a component of the transfer.

The Northern Uganda FFE program transfers included beans, a moderate source of iron, and micronutrient fortified corn-soy-blend (CSB) in its basket of transfers. CSB is fortified with iron in sufficient density (17.5 mg iron per 100g CSB[8]) that the quantity of CSB provided was enough to meet 99 percent of a child's iron requirements, and two-thirds of requirements of several other micronutrients. We focus on the impact of the programs on beneficiary children's iron deficiency and anemia.

Anemia is major health problem that is estimated to affect one half of all school age children in developing countries (Stoltzfus et al. 1997). The primary causes of anemia are dietary iron deficiency, infections including from diseases such as malaria and hookworm, deficiencies of other key micronutrients (vitamin A and B_{12}), and some inherited conditions (WHO/CDC 2004; Stoltzfus et al. 2000). Iron deficiency with or without anemia has serious

[8] USAID Commodities Reference Guide, January 2006.

health consequences, including increased mortality risk to pregnant woman and their infants, decreased work capacity, and impaired mental and physical development (WHO/CDC 2004; Beard and Connor 2003). Reducing iron deficiency (with and without anemia) has been shown to improve cognitive development in children (see McCann and Ames 2007) and to increase school participation (Bobonis, Miguel and Puri-Sharma 2006). These benefits for cognitive development and schooling are closely aligned with the goals of food for education programs, so it is sensible to include iron fortified foods as part of any FFE program. Similarly, deworming has been shown to increase iron status (Stoltzfus et al. 1998) and boost school participation (Miguel and Kremer 2004). As a result, deworming is also included as a complementary program with many FFE programs.

In both rounds of the Northern Uganda survey, iron status was assessed by hemoglobin, using blood obtained by finger prick and reading hemoglobin using a Hemocue analyzer for all children age 6 months - 17 years in the sample. Mean hemoglobin of children age 6-13 in the baseline survey was 11.6 g/dL. We define anemia (mild-to-severe) as hemoglobin concentration below a threshold level of 11.0 g/dL, following Stoltzfus et al. (1997). This threshold is lower than the 12.0 g/dL used elsewhere because of the evidence that anemia thresholds should be lower for people of African origin (WHO/CDC 2004). We also reduced the hemoglobin concentrations by 0.1 g/dL for all but a few observations in the sample to adjust for the effects of elevation (which ranged from 950 m – 1200 m) above 1000 m on hemoglobin measurement (Nestel, 2002). We define moderate-to-severe anemia as hemoglobin concentration < 9.0 g/dL.

In the sample from Northern Uganda, the prevalence of anemia at baseline in children age 6-13 was 29.1 percent.[9] There was no significant difference in mean hemoglobin concentrations or anemia prevalence by treatment group at baseline (Table 1). The prevalence of moderate-to-severe anemia was 3.4 percent at baseline.

[9] Using the higher threshold of 12.0 g/dL, anemia prevalence among 6-13 year olds was 46.3 percent at baseline.

3. Evaluation Strategy

The Identification Strategy

The evaluation uses an experimental, randomized, prospective design. A prospective study collects data before the interventions begin and after a period of implementation. This makes it possible to control for pre-program child and household characteristics and to observe changes in outcome variables during the interventions. The experimental design was achieved by randomly assigning the similarly eligible IDP camps, which serve as the catchment area for primary schools in most cases, to the intervention or "treatment" groups (SFP, THR or control).

The random assignment of IDP camps into treatment groups makes it possible to place a causal interpretation on estimated impacts. The intuition is that if access to the program is random within a group of similarly eligible IDP camps, beneficiary or treatment status cannot be correlated with the outcomes. As a result, any observed differences in average outcomes over time between the treatment groups and the control group must be a result of the program. When access to the program is not random, measures of program impact based on a comparison of mean outcomes between program beneficiaries and a nonexperimental comparison group may be biased due to selection effects.[10] Selection effects are caused by characteristics of the IDP camps or households that are correlated with the outcomes of interest and with the probability of receiving the intervention. Typically there are two causes of selection effects: (i) targeting of the program to communities based on factors affecting the outcome, and (ii) actions by the community or the household that affect participation in the program, either through lobbying the government or organization providing the treatment, or through the household's decision to participate.

Random assignment of IDP camps to the interventions eliminates potential bias from program targeting or lobbying, but bias from sampling error or from household selection effects may still exist. Sampling error arises when, by chance, there are differences in mean preprogram outcomes or relevant household characteristics between the treatment and control group after the

[10] Heckman and Smith (2005) and Heckman, Ichimura and Todd (1997) describe how randomizing program access eliminates selection bias and identifies causal impacts of the program.

randomization.[11] In a large sample of IDP camps sampling error would be small, but in moderate sized samples some sampling error may exist. This can be checked by testing for equality of mean outcomes in the baseline sample. Gilligan, Adelman and Lehrer (2006) present such tests on the 2005 baseline survey data for various outcomes and household characteristics. We summarize some of the results below in Table 1.

If the randomization is effective and sampling error is not a concern, the impact of the program on outcome *Y* can be measured by the average difference in outcomes between the treatment group T and the comparison group C after implementation,

(1) $$\Delta^{SD} = E\left[Y_1^T - Y_1^C\right],$$

where the subscript 1 refers to the period after program implementation. This is sometimes referred to as a "single difference" (SD) estimator of program impact, since it compares only post-program outcomes. If the presence of sampling error leads to differences in outcomes by treatment group before the program (period 0), unbiased impacts can be calculated using a treatment group "difference-in-differences" (DID) impact estimate. This is calculated as the average "before-and-after" change in the outcome for individuals in an intervention group minus the comparable average change in the outcome for the control group (or alternative treatment group),

(2) $$\Delta^{DID} = E\left[\left(Y_1^T - Y_0^T\right) - \left(Y_1^C - Y_0^C\right)\right].$$

In the impact estimates constructed here, a child's treatment status is determined by age and by the treatment assignment of the IDP camp in which she resides. This measure of program impact represents the effect of offering *access* to the program, rather than the effect of *participation* in the program (Burtless, 1995). The effect of participation in a program is harder to measure because program managers can control access to the program (unless people are willing to migrate to gain access), but once the program is available households control the decision to participate. In the evaluation literature, measures of the impact of access to a program are

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[11] This is equivalent to flipping a coin ten times and getting eight "heads." The expectation is for an equal probability of heads and tails, but this is not always achieved in finite samples.

referred to as 'intent to treat' impact estimates, while measures of the impact of participation are referred to as the average impact of the 'treatment on the treated.' Intent to treat measures of program impact are typically lower than measures of the impact of the treatment on the treated because impacts are reduced whenever a potential beneficiary decides not to participate.

In some cases, it is appropriate in impact analysis to control for other factors that may affect program impact even in randomized experiments. One such case arises when other exogenous or independent events, such as economic shocks, occur during the program with different frequency or intensity across the treatment groups. Failure to control for such events in the analysis would lead to misleading attribution of program impact. A second case arises when there are systematic differences in household preprogram characteristics that may affect program outcomes, even if there is no difference in average preprogram outcomes themselves. In this case, controlling for the effect of these preprogram characteristics in the analysis may be justified and can improve the precision of the impact estimates. In these cases, impacts can be estimated conditional on a vector of pretreatment characteristics or contemporaneous shocks, *X*,

(3) $$\Delta^{DID|X} = E\left[\left(Y_1^T - Y_0^T\right) - \left(Y_1^C - Y_0^C\right) | \, X\right].$$

Econometric Specification

Regression analysis was used to estimate the impact of the SFP and THR programs. This is a convenient way to estimate differences in mean outcomes, to test for statistical significance, and to control for other factors when necessary. Let T_1 represent access to the SFP program and T_2 represent access to the THR program. The single difference impact of the programs in (1) can be estimated as

(4) $$Y_{ic} = \beta_0 + \beta_1 T_1 + \beta_2 T_2 + \varepsilon_{ic},$$

where

Y_{ic} is the outcome for the *i*th child in camp *c*

T_1 =1 if the child resides in a camp assigned to the SFP program, 0 otherwise

T_2 =1 if the child resides in a camp assigned to the THR program, 0 otherwise

ε_{ic} is the unobserved child and camp specific error term.

If the randomization was effective, leading to no difference in mean outcomes before the programs, estimating (4) on outcomes measured after the programs have been implemented provides a well-identified estimate of the impact of the SFP program in β_1 and of the THR program in β_2.

If preprogram data on outcomes are available, and particularly if sampling error results in differences in these outcomes before the programs, DID estimates in (2) can be obtained by estimating

$$(5) \qquad Y_{ict} = \beta_0 + \beta_1 T_1 + \beta_2 T_2 + \beta_3 R_2 + \beta_4 T_1 R_2 + \beta_5 T_2 R_2 + \varepsilon_{ict},$$

where

R_2 indicates the second survey round, conducted after program implementation

Y_{ict} is the outcome for the ith child in camp c in period t

ε_{ict} is the unobserved child-, camp-, and period-specific error term.

Here β_4 is the DID estimate of the impact of the SFP program on the change in the outcome before and after the program began and β_5 is the DID estimate of the impact of the THR program on the change in the outcome. Conditional impact estimates such as those in (3) can be obtained by adding a term for X in equation (5).

4. The Northern Uganda FFE Programs and Survey Data

The FFE Survey Sample

To analyze health impacts of the FFE programs in Lira and Pader Districts, household survey and health data were collected in October and November 2005 before the programs began and then again in March and April 2007 after the programs had been in place in treated camps for up to 14 months.[12] Prior to the start of this evaluation, World Food Programme was operating FFE programs in at least 13 districts,[13] serving over 400,000 students. WFP decided to expand the program, beginning in 2006, to 74,000 more students living in Lira and Pader districts, which allowed us to conduct a prospective randomized evaluation of the program in this region.

Nearly all of the rural population of Lira and Pader districts was living in Internally Displaced Persons camps at of the start of the evaluation, so the programs were targeted at Learning Centers (LCs), which are conglomerations of displaced primary schools sharing space and resources, within the camps. Most camps had only one learning center, which hosted an average of 6.9 schools.[14] While some schools within the center maintained independent student records, schools worked in partnership for instruction due to teacher shortages and space constraints. In practice, most learning centers functioned as one large school, with enrollments ranging from near 200 to over 5,000. Patongo Camp had the largest overall enrollment with 16,500 students, though spread over all camp learning centers. In cases where a camp had more than one learning center or an independent school in addition to the learning center, students could also enroll in, or at least attend, any school or learning center within the camp. Therefore, it was decided that treatment should be assigned at the camp level to minimize non-compliance and administrative difficulties associated with trying to identify which school a given child "should" attend.

The WFP budget allowed for expansion to up to 74,000 additional students. Camps were assigned randomly, stratified by district, to one of three groups – in-school feeding, take home rations, or control – until the quota was reached.[15] The resulting sample included 31 camps – 11 in the in-school feeding group and 10 in each of the take home rations and control groups. Table 1 shows the assignment and enrollments for each camp in the sample. The average enrollment is higher in the control than in either treatment because the two largest camps were selected into the

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[12] Most households in our data reported starting school feeding in February 2006; interviewing occurred in March and April 2007.

[13] At the time, Uganda had 56 districts. Since then, 2 "redistricting" efforts have increased the number of districts to 84.

[14] Most camps were built on or near the grounds of a primary school. In some cases, this primary school served as a "host" to the other displaced schools and was incorporated into the LC. In other camps, the original school did not become a part of the learning center.

[15] In camps with more than one LC, all of the LCs were grouped for the selection.

control at random.[16] Households were selected within each camp from a camp-level "revalidation" census conducted by WFP in June 2005. Forty households in each camp were randomly sampled from among households with school age children (age 6-17). On average, 29.3 households were interviewed per camp. Two factors affected the response rate. First, while WFP took great measures to ensure that the census was accurate, the 2005 census included a large number of false household rosters that were used to obtain more food rations. Second, due to security reasons, data collection was usually limited to one day per camp, so we could not interview households if the head of household and spouse were away during the study day.[17]

As the security situation improved in 2006, many households left the IDP camps to return home or to move to smaller satellite camps. The FFE programs followed households to their new locations. Although 70 percent of households moved between the baseline and second survey rounds, 81 percent of baseline households were re-interviewed in 2007.

The FFE Interventions

One of two interventions, School Feeding Program (SFP) or Take-Home Rations (THR), was randomly introduced to learning centers during the first term (February through April) of 2006. The children in SFP camps receive daily in-school meals, which consisted of a mid-morning snack of corn-soya-blend and a lunch of beans and rice or posho (maize-meal), oil and salt. The snack and meal combined consists of approximately 1049 kcals of energy, 32.6 gm protein, and 24.9 gm fat; meals also provided 99 percent of children's daily iron-requirements and at least two-thirds of other vitamin and mineral requirements. Children in the THR camps receive an equivalent amount of food (approximately 21-days worth) one time per month conditioned on monthly school attendance.

While the nutritional elements are the same between the 2 interventions, the demands of the interventions vary for schools, households and children. Schools participating in SFP must

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[16] Two control camps ended up sufficiently close to SFP camps that when the SFP programs began, children from these camps started to attend school in the SFP camps. Therefore, WFP decided to reassign those camps to the SFP group. One other camp was dropped due to a non-random change in assignment. Finally, another camp turned out to actually be 2 camps – one receiving SFP and the other receiving nothing. We reassigned households based on whether they were in the SFP or control camp. Households did not relocate from the control to the SFP camp.

[17] Movement outside the camp was rare, particularly in Pader. In Kalongo camp, data collection was conducted over several days. Households interviewed on the first day did not differ from households that were more difficult to find in terms of age of the household head, household size, number of school-age children or number of preschool age children. However, households that were more difficult to track were more likely female-headed.

have food storage and cooking facilities, latrines and hand-washing facilities. Households are also required to provide wood for fuel and USH 200 (US$ 0.12) per month per child to pay cooks. WFP has started working with some schools to plant trees at the schools for fire wood as part of a food-for-assets program. In most schools, households also have to provide their children with bowls for the mealtimes. Children attending school on a given day could receive both the snack and the meal. It was observed however, by enumerators and WFP staff that even children not attending school sometimes received school feeding as it was difficult to exclude children during serving times. The physical demands on schools and households are lower for THR participants, though the time demands may increase. Since WFP delivers and distributes food directly to the children one-time per month, schools are not required to have cooking or food storage facilities. And since food is consumed outside school, they are not required to have water and sanitation facilities. However, since receiving THR is conditioned on 85% attendance by the pupil, teachers are required to keep careful attendance records.

It is important to note that at the beginning of the intervention, WFP provided monthly general food rations to all camp residents as well. The size of the ration varied by household size, but not by household composition.[18] These rations, which provided 75 percent of caloric need to Pader households, 50 percent of need to most Lira households and 25 percent need to a few Lira households, were the major food source for most households in our sample. The composition of general food rations is very similar to that of the FFE rations, so FFE may increase food availability to treated households, but not necessarily the type.

On August 29, 2006, the Ugandan Government and the Lord's Resistance Army signed a temporary peace treaty.[19] In Lira, the District Disaster Management Committee responded by beginning to close down some camps in the most stable areas. World Food Programme also offered "resettlement packages," which contained 3-months' rations and some farming supplies to ease the movement back to the village. Most of this resettlement occurred before the planting season, so even as households moved back to the villages, they were still largely dependent on this resettlement food aid. Despite the random placement of the treatments, children in our Lira sample from SFP and THR camps were more likely to have received resettlement packages by

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[18] Since ration size did not vary by household composition, a household with one adult and three children would receive the same-size ration as a household with two adults and two children.
[19] http://news.bbc.co.uk/1/hi/world/africa/country_profiles/1069181.stm

the interview date. However, among children in our sample receiving resettlement packages, children in SFP camps received the package on average 2-months before those from the control, while children from THR camps received the package 2.5 months *after* the control.

The impacts of peace negotiations were different in Pader. Prior to the start of the peace talks, the Government began a "decongestion" process in larger camps. Originally, Pader camps were set up at the sub-county level (usually one camp per sub-county); decongestion created "satellite" camps at the parish-level (the next smallest administrative unit). By the time of our survey, 24 percent of Pader households resurveyed had moved into satellite camps. WFP included building schools and school-feeding facilities as part of their food-for-assets programs, so when facilities became available, schools also moved from the main camps to the satellites. Schools from treated camps continued to receive treatments in the satellites, with the gap in provision of transfers averaging about 3 weeks.

Survey Instruments

The household instrument included a household roster and questions on housing conditions, education, morbidity, immunizations and deworming, consumption, assets, employment, agriculture, credit, mother and child time use, and food aid and other aid receipt. The baseline instrument also included questions about the household's displacement experiences.

Data to assess aspects of nutritional status were also collected for children ages 6-months to 17-years and on their mothers or primary female caretakers. The data included height or length (for children under 24-months), weight and hemoglobin status.

In addition to the household questionnaire, we also collected height and weight data and a measure of hemoglobin status for all children age 6-months to17-years and on their mothers. Data were collected by 7 nurses in the baseline and 8 in the follow up survey. All nurses went to each camp to limit biases that may arise from subtle variations in nurses' techniques. Additionally, all nurses participated in a 10-14 day training, which focused on standardizing data collection across patients and nurses. Height data were collected using height-boards; weight data were collected using solar scales. For children who were too young to stand on their own, the nurses calculated the weight by subtracting the mother's weight standing alone from her weight while holding the child.

Hemoglobin status was measured on site using a Hemocue analyzer. This analyzer uses a drop of blood from a finger prick and can report hemoglobin concentration in the field in a few minutes.[20] Using the Hemocue analyzer allowed us to do all blood analysis from the field, so we did not have to carry any samples back with us. We could also provide parents with immediate feedback about their iron status or their children's iron status. In cases where we detected severe anemia, we could even treat the subject by providing deworming or supplements or by taking the subject to a local health center. In the baseline, children or women who were not pregnant with hemoglobin below 7 g/dl and pregnant women with hemoglobin below 9 g/dl were treated in the field or taken for treatment at a health center. Treated observations were dropped from the sample. In the follow up, observations below this cut-off were referred or taken to a health center, but observations with hemoglobin below 12 were treated with iron tablets and deworming in the field. These observations were not dropped since the treatment did not impact the data collected.

5. Results

Anthropometry

We examined a sample of 2159 children ages 6-13 in 31 Lira and Pader IDP camps. At the baseline, 86.4 percent of children were enrolled in primary school; 92.6 percent were enrolled in primary school in the follow up. Among children assigned to the in-school-feeding treatment group (SFP), 82.2 percent reported receiving at least 1 day of school feeding and those who received school feeding reported an average of 145.7 school feeding days during the treatment period.[21] Sixty-five percent of children in the take home rations (THR) group reported at least 1 month of rations, with an average of 4.2 months of rations.

During the treatment period, average BMIZ did not change significantly for children in the control group. Table 2 shows that changes in BMIZ in both treatments were also not

[20] Refusal was not a serious problem for this sample. In the baseline, only 4.3 percent of subjects had anthropometric measures taken but no hemoglobin data; in the resurvey, only 1.2 percent had missing hemoglobin data. [Note: did not look at why missing – refused or did the nurse just miss the kid/ran out of supplies, etc.]
[21] Note that 8.9 percent of the control group also received school meals, with an average of 50.1 days of school feeding; no one in SFP or control groups reported receiving THR. As a robustness check on results reported here, we repeated the analysis omitting control group children who received school feeding; there was minimal impact on the final results.

significantly different from changes in the control group. Thus, we can report no impact of the either treatment on the sample as a whole. When looking at subsets of the sample, we find no detectable impacts of either program among 10-13 year olds, but find a significant negative impact of THR on 6-9 year olds. SFP has a weakly significant negative impact on children in this age group. We find no detectable impacts of the programs among male children or children living in Lira District among 6-13 year olds, but find negative impacts among female children and children living in Pader District, though some of these effects are only weakly significant.

The finding of some negative impacts of the FFE programs on child anthropometry is surprising and suggests that other factors may play a role. In the event that there were systematic differences between the treatment groups and the control group at baseline, despite the random assignment, conditioning on baseline characteristics or exposure to infection may control for some of these differences and reveal different impact patterns. Conditioning may also increase the efficiency of impact estimates. We chose to condition on the number of days in the past month that a child had a fever or diarrhea as measures of morbidity. In one specification each, these variables showed a significantly negative relationship with BMIZ, as we would expect (Table 3). The number of preschool-age siblings in the household also has an expected negative and significant sign, though the number of school-age children does not seem to have an impact on outcomes. Mother's education also has a significant positive effect on BMIZ in some specifications. The variable "days since last GFD" was included due to the finding that GFD stopped significantly earlier in Lira SFP camps than in Lira control camps, potentially increasing food insecurity among these households. In only one specification BMIZ falls significantly with the number of days since the last GFD. Despite the detected impacts that these controls have on BMIZ, Table 3 shows no virtually change in estimated impacts of SFP and THR on BMIZ, suggesting that treatment assignments were truly random.[22]

Although we cannot identify the presence of other factors that can explain the negative estimated impacts of the programs on BMIZ, we interpret this seemingly negative result with caution. There is nothing inherent in the design of the SFP and THR programs that suggests they could negatively affect the nutrition of school children. With this in mind, one-tailed hypothesis

[22] Due to missing observations, particularly in the mother's education variable, the sample sizes used in the conditioned estimates of Table 3 are lower than those of Table 2. Rerunning the estimates from Table 2 using the samples from Table 3 does not change the results reported in Table 2.

tests that changes in BMIZ were larger in the FFE groups than in the control groups would lead to the conclusion that the programs had no impact on child anthropometry.

A problem with using BMIZ as an outcome is that average changes in BMIZ do not necessarily reflect average improvements in population health. For example, if the bulk of changes to BMIZ occur among children who are already healthy, then the overall health of the population may not actually be improving. On the other hand, if changes to BMIZ are small, but move children from an unhealthy weight to a healthier weight, then the benefits to the population may be quite large. A measure that better reflects the impact of the FFE programs on malnutrition is the change in prevalence of children with very low BMIZ.

At baseline, a very small proportion of children in our sample (6 percent) had very low BMIZ (<-2) (see Table 1 and Figure 1).[23] There was no significant impact of either SFP or THR on the change in prevalence of low BMIZ among 6-13 year olds in our sample (Table 4). There is a significantly larger increase (of 7 percent) in the prevalence of younger children (age 6-9) with low BMIZ in the THR program than in the control group from 2005-07. This is countered with a relative decrease in prevalence between THR and controls of similar magnitude among 10-13 year olds, though this is not significant at conventional levels.

We also analyzed the impact of the programs on change in HAZ scores, though it would be difficult for the programs to have a significant impact on height in this age group. We found no impact of either program on HAZ for school-age children; neither DID impact estimate for SFP (-0.128) nor THR (-0.162) is significantly different from zero. Even amongst children ages 10-13 who are more likely to see improvements in HAZ due to increased caloric intake, there was no detectable impact of either program.

It appears as though the drops in average BMIZ scores in some subsets of the treated groups compared to the control group reflect improvements in the control group. Figure 1 shows that in Pader, the distribution of BMIZ in the control groups shifts right over time, while the distribution stays roughly the same among SPF children and shifts left slightly for THR children. The difference in means over time within each treatment is significant only for the control group. Children in the control group appear to be experiencing improvements that children in the treatment groups are not.

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[23] Obesity was not a problem in our sample. Only 10 children – 8 in the baseline and 2 in the follow up had BMIZ greater than 2.

It is unclear what is driving improvements in control that neither treatment group is experiencing. Qualitatively, households in our Pader control sample were most likely out of all groups in Pader and Lira to report improved food security over the past year (50 percent of children in the Pader control sample come from households reporting an improvement in food security); Pader control households also were significantly more likely to report a food security improvement compared to Pader SFP households (33 percent). The percentage of children in the Pader control coming from households reporting improved food security was also larger than for children in the Pader THR group (44 percent), however, the difference is not significant. The data do not reveal what may have lead to the higher prevalence of improved food security for these control households despite the provision of FFE in the treatment areas.

In Lira, the mean BMIZ is declining over time in both treatments and the control; differences in these declines are not significant. We suspect that the overall decline is arising from the termination of GFD in many camps prior to the first harvest. A lower proportion of households in the Lira control group report that food security has improved in the past year (31.2 percent) compared to households in the Pader control. Differences in Lira across treatment groups are not significant.

Anthropometry of Preschool-age Siblings

As discussed in section 2, households may respond to FFE programs by reallocating resources within the household. Given the large potential gains from improving nutrition for very young children, we looked at the possibility of any reallocation or even potential program spillover to younger, preschool-age siblings. For example, preschool-age children may accompany older siblings to school for meals or parents could reallocate some portion of the food that they give to school age children at home to the preschool age siblings. We investigate the potential for such effects by examining changes in HAZ for preschool-age children, age 6-59 months. Mean HAZ for these children in the baseline survey was -1.17 z-scores. We also report results for WAZ and WHZ.

Table 5 shows that preschool-age children in SFP camps had a significant 0.363 z-score improvement in HAZ compared to the control group. This gain was primarily concentrated among the younger preschoolers, age 6-35 months, whose height is most responsive to changes in nutrition. SFP lead to a 0.589 z-score improvement in HAZ for these younger preschoolers, a large effect. Within the broader sample of preschoolers age 6-59 months, impacts were concentrated on boys (0.615) and in Lira (0.987). A significant negative effect was detected for children in the THR group in Pader. This outcome may be due to changes in the sample composition in THR camps in Pader not seen in other camps: the mean age and proportion of boys in THR fell over time. We detected no impact of either program on WAZ or WHZ in any of the groups shown in Table 5.

It is somewhat surprising that the SFP had a greater impact on the anthropometry of preschool siblings of beneficiaries than the THR program because it is much easier for parents to reallocate FFE food transfers to other household members in THR than in SFP. The intended size of the transfer, at more than 1000 kcal/child/day, is large enough that it would be difficult for parents to redistribute nearly this much food energy away from and SFP beneficiary child at other meals at home. Another possibility is that children receiving SFP meals bring some of the food home and it is given to younger siblings, but observations in the field did not indicate this was a common practice. This suggests that many preschoolers were accompanying their siblings to school in the SFP program. We investigate other information from the survey to learn more about these effects.

In the household survey, parents indicated that 30.9 percent of children receiving school meals through the SFP ate less at home on days when school meals are provided. This figure seems low, but parents may have been reluctant to admit providing less food to a child at home. Among those whose children ate less at home on days with school meals, the vast majority (84.7 percent) acknowledged that this made more food available for other household members. If food for less than one third of school children is redistributed to other household members, this supports the observation that some preschoolers gained access to SFP meals by showing up at school. However, the results in Table 5 show that impacts on preschoolers were greater for the younger children, under age 3 years. These children would have been less likely to walk to school than the 3-4 year olds in this group, though most schools in IDP camps were nearby with average walking times of only 10 minutes. The larger impact children under 3 may also derive from their greater ability to respond to the additional food. In the end, there is evidence for moderate intrahousehold redistribution of food, and some support for direct spillovers of SFP meals to preschoolers.

Hemoglobin and Anemia Prevalence

Figure 2 shows kernel density graphs of the distribution of hemoglobin concentrations of 6-13 year olds in the sample in rounds 1 and 2 by treatment group. In IDP camps that received SFP, the distribution of hemoglobin did not change substantially from 2005-07. In IDP camps receiving THR transfers, there is more of an improvement in hemoglobin with a thinning of the lower tail of the distribution and a widening to the right around the mode. In control group IDP camps, the pattern of improvement in hemoglobin is similar to that in camps receiving THR, but the shift of the distribution to the right is even greater. This unexpected pattern suggests a trend of improvement in iron status in control group camps that is not reflected in SFP camps, nor is it as large in THR camps. However, we must first investigate how this trend is reflected in changes in anemia prevalence.

Table 6 presents DID estimates of the impact of the SFP and THR programs on change in the mean anemia prevalence of 6-13 year olds from 2005-07. Column 1 shows that the two programs had no impact on mean anemia prevalence for school-age children in the IDP camps. It is worth examining whether this result varies by age and gender, as found by Stoltzfus et al. (1997) for a sample of children from Zanzibar. Column 2 shows no impact of the FFE programs on anemia prevalence of 6-9 year olds, though the point estimates are positive. However, the THR program lead to a significant reduction in anemia prevalence of 13 percentage points among children age 10-13 (column 3). This is a large effect, given that anemia prevalence of 10-13 year olds in the control group at baseline was 19 percent. Results in columns 8-9 show that this effect of THR on 10-13 year olds is primarily driven by a steep 17.2 percentage point reduction in anemia prevalence for females receiving THR in this age group. SFP also had a large effect, reducing anemia prevalence in 10-13 year old females by 19.2 percentage points. This suggests a very important role of FFE programs that provide iron fortified foods in protecting the hemoglobin status of females as they reach the age of menarche. The results show no impact of the programs on anemia prevalence of females or males on average because of an absence of effects among younger children. Differentiating impacts by district, SFP contributes to a weakly significant increase in anemia prevalence in Pader. In Lira, the point estimates have the expected negative sign but are not significant.

In Table 7, we check whether accounting for health events or behavioral factors changes the conclusions about the lack of impact of the FFE programs on anemia prevalence, or about the presence of an effect of the THR program for 10-13 year olds. We condition the estimates on several variables that may affect anemia prevalence, including a dummy variable for Pader district, the child's age in months, whether the child was ever dewormed, whether the child had a fever in the last month, whether the child had diarrhea in the last month, whether the child sometimes sleeps under a mosquito net and whether the child sometimes wears shoes. Health behaviors that should reduce anemia prevalence include deworming (by reducing worm loads), wearing shoes (by reducing hookworm infections), and sleeping under a mosquito net (by reducing malaria infections). The presence of fever or diarrhea both indicate infection and so may be correlated with higher anemia prevalence. After conditioning on these variables, the significant impact of the THR program in reducing anemia prevalence of 10-13 year olds has disappeared (column 3). No other specification shows significant impacts of the FFE programs on anemia prevalence at standard significance levels. The specifications show that anemia prevalence is declining in age and is generally increasing in the presence of a fever. In the sample of 6-13 year olds, sleeping under a mosquito net and wearing shoes are both correlated with a significant reduction in anemia prevalence. It is not clear why any of these illnesses or behaviors should be correlated with the presence of either program, but controlling for these factors eliminates the beneficial effect of THR on anemia prevalence for 10-13 year olds.

Table 8 shows the impact of the SFP and THR programs on moderate-to-severe anemia prevalence, defined as hemoglobin concentration below 9.0 g/dL. We must point out first that the prevalence of moderate-to-severe anemia is low in these data, averaging 3.4 percent at baseline. As for mild-to-severe anemia from Table 6, THR appears to reduce moderate-to-severe anemia prevalence among 10-13 year olds. This effect is driven by a THR-induced reduction in moderate-to-severe anemia prevalence in females at this age of 4.8 percentage points. The estimated impact of SFP on moderate-to-severe anemia prevalence on females is 2.5 percentage points, though this effect is only weakly significant. When conditioning on the same health, age and location variables used in Table 7, the significant effect of THR on 10-13 year olds on average is eliminated (results not shown).

6. Conclusions

A commonly-cited premise of FFE programs is that by improving the nutritional status of undernourished children while they are learning, the programs may improve the students' concentration to help them learn, and may lead to physiological improvements that improve cognitive development by improving iron status and access to other micronutrients. This paper tests two of the necessary conditions of this premise by examining whether the SFP and THR programs in Northern Uganda improved anthropometric status or anemia prevalence from 2005-07. We find virtually no support for either outcome in our data. Measures of anthropometry including BMIZ and HAZ show no positive impact of either program on nutritional status of primary school age children. For anemia prevalence, the THR program appeared to contribute to a significant reduction in the prevalence of mild-to-severe and moderate-to-severe anemia in 10-13 year olds, but this effect was eliminated by controlling for other health shocks and behaviors, which brings that result into doubt.

This finding creates a puzzle because elsewhere (Adelman et al., 2008) in work joint with Kim Lehrer, we found that the SFP and THR programs had significant impacts on some measures of learning achievement and cognitive development. It may be that the additional food provided by these transfers did indeed help students to concentrate and learn better, but that these gains are not captured in anthropometric status. However, other literature suggests that reducing iron deficiency anemia was likely to be the pathway to explain the impact of the SFP and THR transfers on cognitive development. It may be that the failure to validate this pathway is due to imprecision in the data.

One important result of this study is that the SFP program had a large and statistically significant impact on the anthropometric status (HAZ) of preschooler siblings of primary-school SFP beneficiaries. Apparently, these younger children had greater capacity to benefit from the additional household food availability created by the SFP because they were still in a period of relatively rapid physical growth. Anecdotal and other evidence suggests that preschool-age siblings of SFP beneficiaries sometimes accompany their older siblings to school in order to receive the school meals. Support for this practice is provided by the fact that impacts on preschoolers were larger in the SFP program than in THR, where intrahousehold redistribution would have been easier. Still, there must have been some intrahousehold redistribution for the youngest children, who are less likely to travel to school, to be able to benefit from the SFP program. Indeed, the survey data show that nearly one third of parents of SFP beneficiary children acknowledge redistributing food at home away from children receiving meals at school.

This impact of SFP on preschooler nutrition lends credence to the argument that such transfers would have greater nutritional impact if targeted to younger children. However, preschoolers often cannot take advantage of the education-related benefits of school because of their young age, so it is not clear whether the broader benefits of school feeding experienced by their older siblings (Alderman et al, 2008; Adelman et al., 2008) could be achieved at a similar magnitude by these younger children. There is some evidence that similar preschool programs affect education outcomes. Vermeersch and Kremer (2004) show an effect of preschool meals on preschool participation in Kenya and Paxson and Schady (2005, 2007) show an impact of cash transfers on cognitive development of preschoolers in Ecuador. An important policy question is whether these types of interventions on preschoolers have comparable implications for adult outcomes to increasing school participation, learning and cognitive development during primary school.

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Table 1: Baseline Child and Household Characteristics by Treatment Group, 2005

	SFP	THR	CON	SFP-THR	SFP-CON	THR-CON
Male	0.50	0.49	0.48	0.009	0.021	0.012
				(0.034)	(0.038)	(0.040)
Age (months)	119.95	119.50	116.92	0.453	3.029	2.576
				(2.033)	(2.249)	(2.386)
Age (years)	9.59	9.61	9.42	-0.024	0.175	0.199
				(0.183)	(0.207)	(0.216)
10 years or older	0.49	0.50	0.46	-0.007	0.026	0.033
				(0.034)	(0.038)	(0.039)
Mother's highest education level achieved	1.84	1.93	2.26	-0.091	-0.423*	-0.331
				(0.188)	(0.110)	(0.245)
Mother's height	162.91	162.70	163.04	0.213	-0.132	-0.345
				(0.567)	(0.570)	(0.597)
WAZ	-0.74	-0.73	-0.88	-0.012	0.143	0.155
				(0.102)	(0.111)	(0.117)
HAZ	-0.87	-0.83	-0.95	-0.038	0.075	0.114
				(0.096)	(0.107)	(0.113)
BMIZ	-0.60	-0.59	-0.63	-0.012	0.023	0.035
				(0.061)	(0.071)	(0.074)
Days normal activity missed due to illness	2.10	2.23	2.14	-0.130	-0.036	0.095
in the last month				(0.285)	(0.304)	(0.315)
Days with fever in the last month	0.95	1.13	1.14	-0.187	-0.192	-0.005
				(0.177)	(0.193)	(0.226)
Days with cough in the last month	2.20	1.92	2.27	0.274	-0.071	-0.344
				(0.303)	(0.343)	(0.323)
Days with diarrhea in the last month	0.36	0.43	0.50	-0.066	-0.134	-0.068
				(0.106)	(0.135)	(0.155)
Ever dewormed	0.81	0.75	0.72	0.052*	0.088***	0.036
				(0.029)	(0.034)	(0.036)
No deworming in last 6 months	0.40	0.45	0.51	-0.055	-0.117***	-0.061
				(0.041)	(0.045)	(0.047)
Male head of household	0.73	0.80	0.78	-0.066*	-0.046	0.020
				(0.029)	(0.032)	(0.013)
Age of head of household	42.58	42.42	41.37	0.165	1.207	1.042
				(1.050)	(0.926)	(1.306)
Household size	6.59	6.49	6.63	0.097	-0.047	-0.144
				(0.127)	(0.143)	(0.156)
Household size 6-13	2.54	2.52	2.59	0.017	-0.052	-0.069
				(0.066)	(0.080)	(0.085)
Household size under 6	1.41	1.35	1.42	0.060	-0.007	-0.067
				(0.070)	(0.079)	(0.082)
Birth order	2.32	2.20	2.29	0.127*	0.031	-0.095
				(0.078)	(0.088)	(0.092)
Number of children (0-17)	4.62	4.44	4.60	0.174	0.020	-0.153
				(0.108)	(0.873)	(0.134)

continued...

	SFP	THR	CON	SFP-THR	SFP-CON	THR-CON
Height	132.55	132.73	130.83	-0.182	1.716	1.898
				(1.033)	(1.144)	(1.231)
Weight	28.52	28.70	27.70	-0.180	0.827	1.007
				(0.607)	(0.665)	(0.715)
Any disability	0.05	0.02	0.04	0.026*	0.012	-0.014
				(0.013)	(0.015)	(0.014)
Uses mosquito net	0.13	0.24	0.14	-0.112***	-0.007	0.105***
				(0.027)	(0.026)	(0.030)
Usually wears shoes	0.20	0.17	0.16	0.032	0.036	0.004
				(0.027)	(0.029)	(0.030)
Drinks tea with meals	0.03	0.02	0.01	0.016	0.019	0.003
				(0.011)	(0.011)	(0.010)
Distance to nearest water source (meters)	268	301	223	-33.171	44.672	77.843**
				(30.162)	(28.860)	(33.422)
Days since last WFP general food delivery	29.59	20.40	26.85	9.185	2.736***	-6.449***
				(1.688)	(2.135)	(2.334)
Stunted	0.22	0.20	0.22	0.023	-0.001	-0.024
				(0.028)	(0.032)	(0.032)
BMI < -2 z-scores	0.06	0.06	0.09	0.001	-0.030	-0.030
				(0.017)	(0.021)	(0.021)
Hemoglobin (g/dL)	11.66	11.68	11.56	-0.016	0.096	0.112
				(0.148)	(0.161)	(0.156)
Anemia prevalence (Hb < 11 g/dL)	0.279	0.290	0.311	-0.012	-0.032	-0.021
				(0.037)	(0.051)	(0.048)
Ill for less than 1 week in the last month	0.87	0.86	0.85	0.008	0.023	0.016
				(0.023)	(0.027)	(0.028)
Main source of drinking water: borehole	0.85	0.81	0.86	0.037	-0.010	-0.047
				(0.026)	(0.027)	(0.029)
Main source of drinking water: water tank/truck	0.00	0.02	0.00	-0.023***	-0.004	0.020**
				(0.008)	(0.004)	(0.009)
Main source of drinking water: protected well	0.11	0.15	0.08	-0.040*	0.025	0.065**
				(0.023)	(0.022)	(0.025)
Main source of drinking water: other	0.05	0.02	0.06	0.027**	-0.011	-0.038***
				(0.012)	(0.017)	(0.016)
N	466	389	272			

Notes: Standard errors in parenthesis, robust to clustering on baseline IDP camps.
*significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table 2: Average Impact of SFP and THR on BMIZ

	Children age 6-13	Children age 6-9	Children age 10-13	Children age 6-13			
				Female	Male	Pader district	Lira district
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
School meals	-0.128	-0.268*	0.014	-0.310**	0.064	-0.225*	0.038
	(0.157)	(0.151)	(0.201)	(0.138)	(0.257)	(0.113)	(0.192)
Take-home rations	-0.162	-0.382**	0.044	-0.256*	-0.058	-0.371***	0.103
	(0.136)	(0.156)	(0.166)	(0.129)	(0.256)	(0.109)	(0.170)
Observations	2159	1158	1001	1099	1060	1105	1054
R-squared	0.00	0.01	0.01	0.01	0.00	0.01	0.02
Test equality of impacts (p-value)							
H_0: SFP = THR	.672	.202	.831	.628	.313	.069*	.526

Notes: Standard errors in parentheses robust to clustering at baseline IDP camp level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1: Distribution of BMIZ by District and by Treatment Group

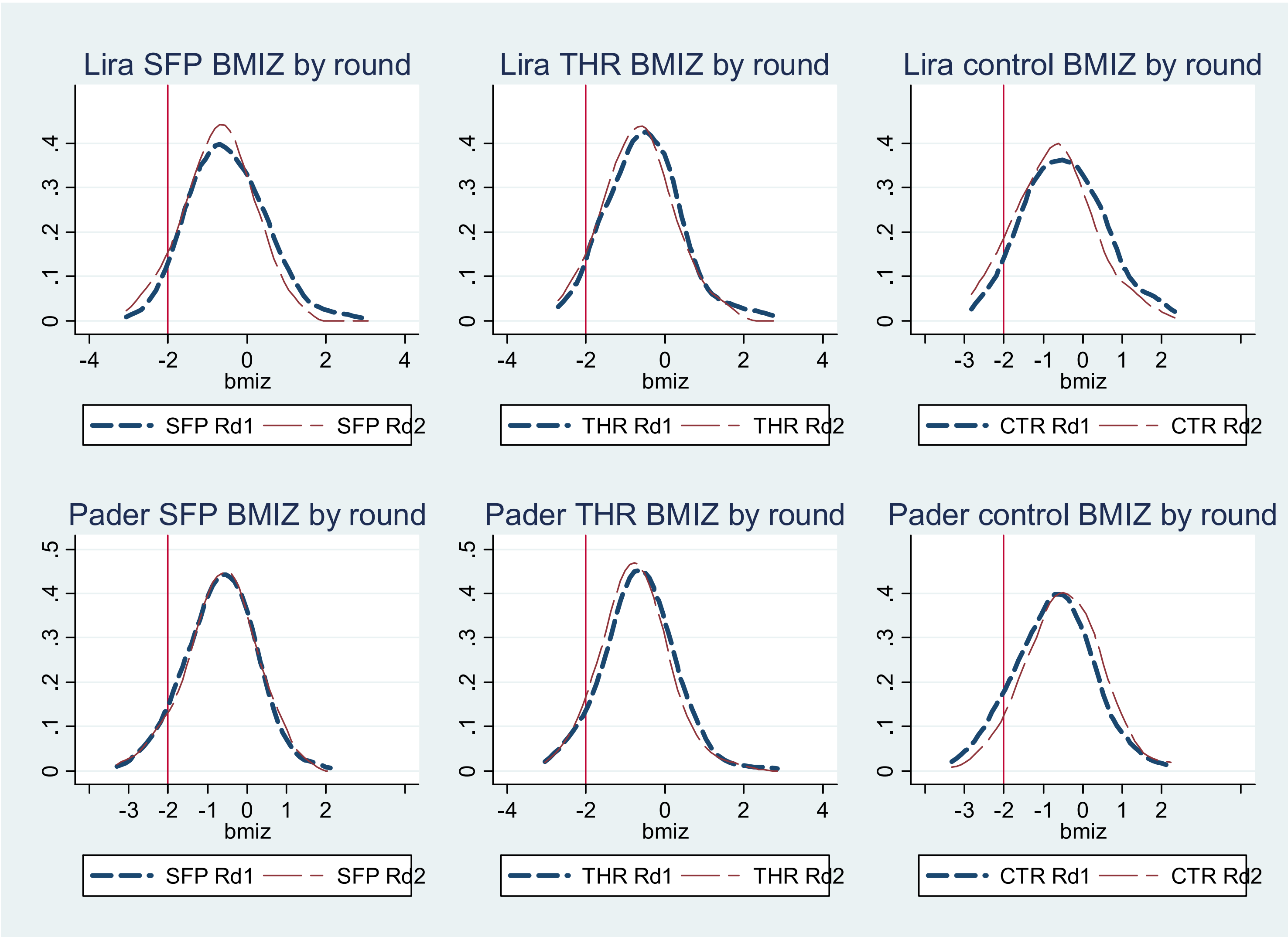

Table 3: Impact of SFP and THR on BMIZ, Conditional on Child and Household Characteristics

	Children age 6-13	Children age 6-9	Children age 10-13	Children age 6-13			
				Female	Male	Pader district	Lira district
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Conditional impacts							
School meals	-0.141	-0.294*	0.008	-0.314***	0.042	-0.282**	0.009
	(0.154)	(0.165)	(0.184)	(0.103)	(0.264)	(0.123)	(0.207)
Take-home rations	-0.174	-0.406**	0.057	-0.306**	-0.031	-0.416***	0.069
	(0.134)	(0.149)	(0.164)	(0.129)	(0.249)	(0.129)	(0.153)
Conditioning variables							
Days with fever in the last month	-0.032	-0.017	-0.124*	0.020	-0.075	0.039	-0.118
	(0.058)	(0.060)	(0.065)	(0.062)	(0.077)	(0.095)	(0.068)
Days with diarrhea in the last month	-0.064	-0.003	-0.101	-0.295***	0.189	-0.020	-0.178
	(0.085)	(0.114)	(0.111)	(0.101)	(0.119)	(0.099)	(0.148)
Number of household members, age 0-5	-0.049**	-0.058**	-0.076**	-0.043	-0.051**	-0.020	-0.083***
	(0.019)	(0.022)	(0.035)	(0.031)	(0.023)	(0.027)	(0.022)
Number of household members, age 6-13	-0.020	-0.027	0.003	-0.022	-0.017	-0.037	-0.006
	(0.028)	(0.031)	(0.031)	(0.032)	(0.045)	(0.038)	(0.040)
Days since last GFD	-0.000	-0.000	-0.001	-0.001***	0.000	0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mother's highest education level achieved	0.020	0.034**	-0.004	0.008	0.031*	-0.010	0.052***
	(0.012)	(0.016)	(0.017)	(0.012)	(0.018)	(0.015)	(0.016)
Observations	2025	1086	939	1027	998	1018	1007
R-squared	0.01	0.02	0.02	0.03	0.02	0.02	0.04
Test equality of impacts (p-value)							
H_0: SFP = THR							

Notes: Standard errors in parentheses robust to clustering at baseline IDP camp level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Impact of SFP and THR on the Prevalence of Low BMIZ, PR(BMIZ<-2)

	Children age 6-13	Children age 6-9	Children age 10-13	Children age 6-13			
				Female	Male	Pader district	Lira district
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
School meals	0.015	0.031	-0.001	0.057	-0.029	0.015	0.005
	(0.035)	(0.027)	(0.056)	(0.037)	(0.052)	(0.041)	(0.043)
Take-home rations	0.001	0.074**	-0.077	0.019	-0.020	0.033	-0.038
	(0.032)	(0.029)	(0.047)	(0.037)	(0.046)	(0.039)	(0.043)
Observations	2159	1158	1001	1099	1060	1105	1054
R-squared	0.00	0.01	0.01	0.00	0.00	0.00	0.01
Test equality of impacts (p-value)							
H_0: SFP = THR	.531	.062*	.048*	.251	.783	.576	.174

Notes: Standard errors in parentheses robust to clustering at baseline IDP camp level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Impact of SFP and THR on HAZ of Preschool Siblings of Beneficiaries

	Children age 6-59 months	Children age 6-35 months	Children age 36-59 months	Children age 6-59 months			
				Female	Male	Pader district	Lira district
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
School meals	0.363*	0.589*	0.137	0.0637	0.615**	-0.231	0.987***
	[0.19]	[0.31]	[0.29]	[0.24]	[0.27]	[0.17]	[0.24]
Take-home rations	-0.335	-0.132	-0.447	-0.446	-0.347	-0.826***	0.249
	[0.22]	[0.35]	[0.32]	[0.28]	[0.27]	[0.23]	[0.32]
Observations	1024	515	509	474	550	549	475
R-squared	0.02	0.02	0.02	0.03	0.03	0.03	0.02
Test equality of impacts (p-value)							
H_0: SFP = THR	.004***	.053*	.040**	.020**	.003***	.019**	.053*

Notes: Standard errors in parentheses robust to clustering at baseline IDP camp level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 2: Distribution of Hemoglobin by Treatment Group and by Round

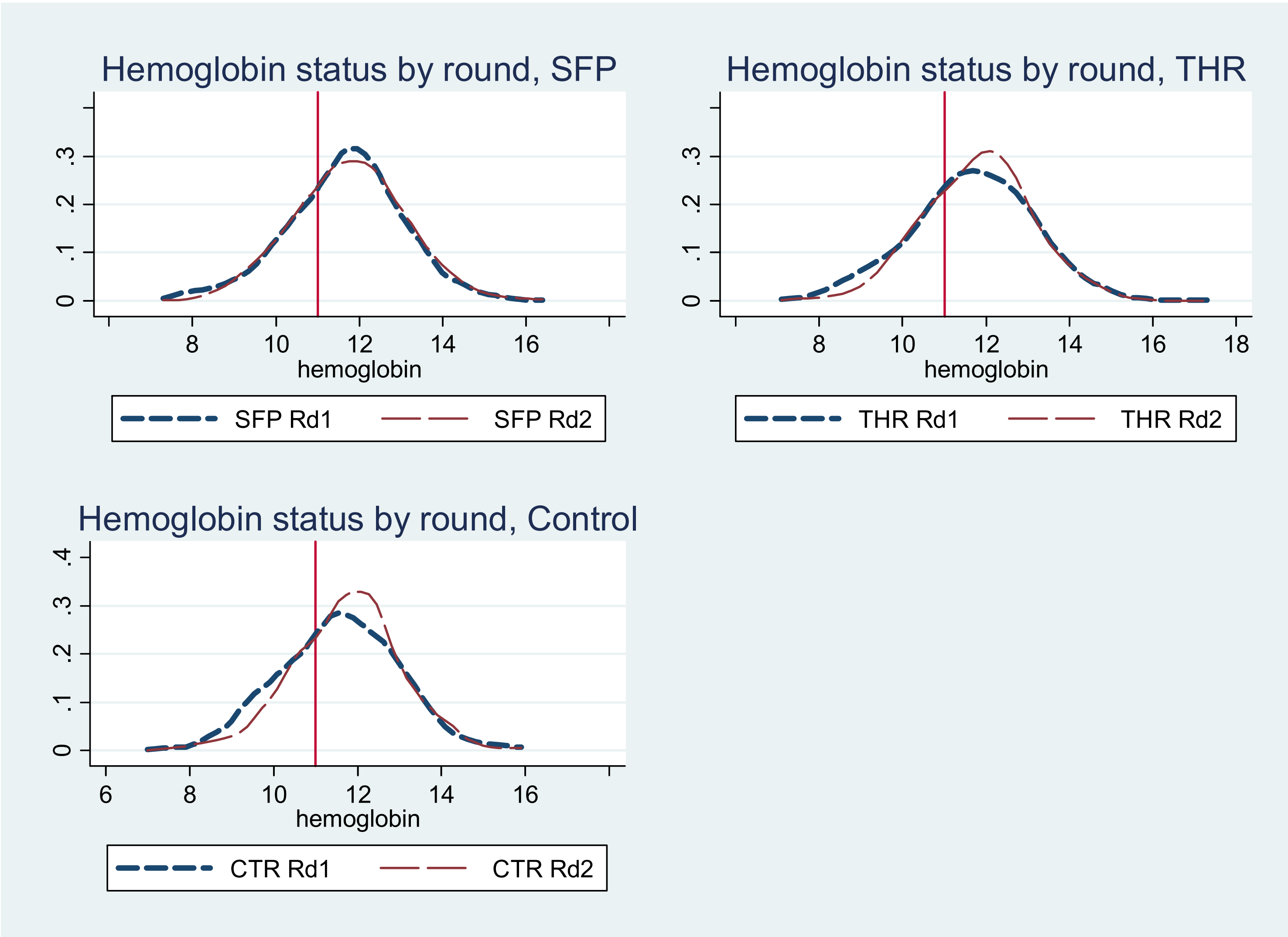

Table 6: Average Impact of SFP and THR on Anemia Prevalence, 2005-07

	Age 6-13	Age 6-9	Age 10-13	Age 6-13				Age 10-13	
				Female	Male	Pader district	Lira district	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
School meals	0.039	0.150	-0.096	0.016	0.062	0.164*	-0.070	-0.192**	-0.004
	(0.071)	(0.089)	(0.069)	(0.074)	(0.079)	(0.090)	(0.097)	(0.073)	(0.084)
Take-home rations	0.020	0.138	-0.130**	0.028	0.014	0.081	-0.058	-0.172**	-0.093
	(0.071)	(0.090)	(0.058)	(0.094)	(0.079)	(0.096)	(0.093)	(0.083)	(0.082)
Observations	2253	1211	1042	1146	1107	1155	1098	509	533
R-squared	0.002	0.009	0.005	0.006	0.003	0.007	0.006	0.018	0.006

Notes: Anemia defined as hemoglobin concentration below 11 g/dL. Estimates are difference-in-difference (DID) impact measures of the difference in the change in mean anemia prevalence from 2005-07 between the relevant FFE program and the control group. Standard errors in parentheses robust to clustering at baseline IDP camp level. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Impact of SFP and THR on Anemia Prevalence, Conditional on Location and Child Health Characteristics, 2005-07

	Children age 6-13	Children age 6-9	Children age 10-13	Children age 6-13			
				Female	Male	Pader district	Lira district
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Conditional Impacts							
School meals	0.071	0.165*	-0.027	0.030	0.110	0.185*	-0.040
	(0.064)	(0.091)	(0.063)	(0.063)	(0.089)	(0.095)	(0.074)
Take-home rations	0.043	0.126	-0.041	0.050	0.039	0.098	-0.032
	(0.057)	(0.087)	(0.049)	(0.085)	(0.084)	(0.089)	(0.065)
Conditioning variables							
Pader district	0.025	0.001	0.054	0.018	0.029		
	(0.026)	(0.024)	(0.037)	(0.032)	(0.039)		
Age in months	-0.002***	-0.002*	-0.002**	-0.002***	-0.002***	-0.001***	-0.003***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Whether ever received	-0.015	-0.016	-0.008	-0.037	0.004	-0.056	0.035
deworming	(0.038)	(0.057)	(0.043)	(0.049)	(0.062)	(0.057)	(0.052)
Days with fever in the	0.083***	0.105***	0.051*	0.071**	0.093**	0.062	0.103**
last month	(0.026)	(0.037)	(0.030)	(0.033)	(0.035)	(0.040)	(0.037)
Days with diarrhea in the	-0.011	0.040	-0.063*	-0.080*	0.072	0.010	-0.047
last month	(0.035)	(0.056)	(0.036)	(0.046)	(0.067)	(0.046)	(0.071)
Whether sometimes sleeps	-0.048**	-0.040	-0.064*	-0.029	-0.068	-0.044	-0.051
under mosquito net	(0.022)	(0.030)	(0.036)	(0.032)	(0.041)	(0.026)	(0.040)
Whether sometimes	-0.048**	-0.057*	-0.040	-0.053**	-0.047	-0.058	-0.045**
wears shoes	(0.019)	(0.031)	(0.030)	(0.025)	(0.033)	(0.034)	(0.018)
Observations	1865	1007	858	948	917	962	903
R-squared	0.032	0.030	0.020	0.037	0.037	0.029	0.048

Notes: Anemia defined as hemoglobin concentration below 11 g/dL. Estimates are difference-in-difference (DID) impact measures of the difference in the change in mean anemia prevalence from 2005-07 between the relevant FFE program and the control group. Standard errors in parentheses robust to clustering at baseline IDP camp level. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Impact of SFP and THR on Moderate-to-Severe Anemia Prevalence, 2005-07

	Age 6-13	Age 6-9	Age 10-13	Age 6-13				Age 10-13	
				Female	Male	Pader district	Lira district	Female	Male
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
School meals	-0.003	-0.005	0.001	-0.015	0.009	0.010	-0.018	-0.025*	0.027
	(0.019)	(0.025)	(0.017)	(0.020)	(0.022)	(0.028)	(0.022)	(0.015)	(0.029)
Take-home rations	-0.016	0.007	-0.042**	-0.018	-0.014	0.001	-0.036	-0.048**	-0.038
	(0.019)	(0.023)	(0.019)	(0.020)	(0.026)	(0.026)	(0.025)	(0.021)	(0.029)
Observations	2253	1211	1042	1146	1107	1155	1098	509	533
R-squared	0.003	0.005	0.014	0.003	0.004	0.003	0.004	0.028	0.017

Notes: Moderate-to-severe anemia defined as hemoglobin concentration below 9.0 g/dL. Estimates are difference-in-difference (DID) impact measures of the difference in the change in mean anemia prevalence from 2005-07 between the relevant FFE program and the control group. Standard errors in parentheses robust to clustering at baseline IDP camp level. * significant at 10%; ** significant at 5%; *** significant at 1%