Resources, stimulation, and cognition: How transfer programs and preschool shape cognitive development in Uganda

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Abstract:

Recent evidence shows that early childhood is a critical period for investments in human capital and that micronutrient deficiency and inadequate stimulation are major causes of impaired child development in poor countries. Transfers to households linked to preschool participation may improve cognitive and noncognitive development in early childhood, but there is limited evidence, all of it from Latin America. Using a randomized controlled trial design in Karamoja, Uganda, we examine the impacts of two transfer modalities – cash transfers or multiple-micronutrient-fortified food transfers – linked to preschool enrollment on child cognitive and noncognitive development. We find that food transfers have no significant impacts, but cash transfers cause significant increases in cognitive measures, by about 0.33 standard deviations relative to the control group. We also explore mechanisms and find plausible evidence for cognitive impacts of cash through both a nutrition pathway (cash improves diet and hygiene, leading to reduction in anemia and improved cognition) and a stimulation pathway (cash increases contributions to preschool teachers, leading to improved preschool capacity and higher child preschool attendance, implying higher quantity and quality of exposure to stimulation). We find that food has no significant impacts on these intermediate outcomes and consider which contextual factors may lead to its limited effects relative to cash.

1. Introduction

Recent evidence shows that early childhood is a critical period for investments in human capital. While the unique importance of the first 1000 days of life for nutrition investments has been well established, growing evidence demonstrates that the subsequent years preceding school age are also a critical window in which cognitive and noncognitive abilities develop quickly and are highly responsive to intervention (Cunha and Heckman 2007; Heckman 2006). Returns to investment in cognitive and noncognitive development have been found to be higher during pre-school ages than at any time later in life, and early deficits are strong predictors not only of reduced school-readiness in the short term but of poor health, education, and labor market outcomes in adulthood (Grantham-McGregor 2007; Behrman et al, 2006; Alderman et al, 2006; Heckman 2006). In poor countries, micronutrient deficiency (particularly iron-deficiency anemia) and inadequate stimulation are cited as major causes of impaired child development at these pre-school ages (Walker et al. 2007). The loss associated with preventable deficits in child development in poor countries is estimated at 20% of adult income (Grantham-McGregor 2007). Taken together, these findings have spurred growing interest in developing countries in promoting adequate nutrition and stimulation during early childhood. However, little is known about what intervention approaches are effective in increasing these investments.

In this paper, we use a randomized experiment to assess how cognitive and noncognitive development in Uganda are affected by provision of food or cash transfers linked to children's enrollment in preschool. There is considerable scope for these interventions to improve children's development. Food or cash transfers could increase the quality and quantity of children's food consumption, leading to reduced illness (including reduced iron-deficiency anemia) and improved mental alertness, thereby improving cognition through a nutrition pathway. Transfers could also increase preschool participation, increasing the quality and quantity of stimulation to which children are exposed, improving cognitive development through a stimulation pathway. Parents could additionally use the resources to make other complementary investments in their children, such as through health inputs, that would improve cognitive development. Our key questions are thus whether the food and cash treatments each have impacts on child development, how the impacts compare between the food and cash modalities, and through what mechanisms impacts appear to occur.

To rigorously analyze the comparison across modalities, in collaboration with the World Food Programme and UNICEF, we randomly assigned 98 preschools (called "Early Childhood Development centers" or "ECD centers") in the Karamoja sub-region of Uganda to one of three treatment arms: food, cash, or control. The ECD centers were very informal prior to the intervention, usually taking place under a tree with only a trained volunteer caregiver. While the centers and caregivers were intended to be supported through community contributions, prior to the intervention, contributions were very rare. Through the intervention, over the course of approximately 12 months on roughly 6-week cycles, households with a child aged 3-5 years enrolled in the ECD center at baseline received a food ration, a cash transfer, or no transfer, according to the ECD center's assignment. The food ration consisted of multiple-micronutrient fortified corn soy blend, Vitamin A fortified oil, and sugar (1200 calories per day per child, with 99% of daily iron requirements), while the cash transfer was set to the amount necessary to purchase the food ration in the market (25,500 UGX or roughly $10.25 over the 6 weeks). Using rich longitudinal data on a sample of households in all three intervention arms, including individual assessments of target children in those households, we estimate impacts of the food and cash treatment arms on children's cognitive and noncognitive development. We find that while cash did not significantly affect our noncognitive measure, the cash treatment arm caused significant increases in cognitive measures for children aged 3-5 years. Cash linked to preschool increased several individual cognitive domain scores (visual reception, receptive language, and expressive language) by about 0.3-0.4 standard deviations, and it increased a total cognitive score by about 0.33 standard deviations. However, food had no significant impacts on overall cognitive or noncognitive scores and even appeared to decrease some domains of cognitive development.

To understand these differences in impact, we then explore plausible mechanisms by assessing impacts on intermediate outcomes. We find convincing evidence that cash may have had impacts through both nutrition and stimulation pathways. In particular, relative to the control, cash caused significant improvements in children's diet quality (66% increase in meat/eggs and 100% increase in dairy) and hygiene (more latrines, shelters, and handwashing facilities in ECD centers), as well as in anemia status (10 ppt decrease in any anemia and 9.6 ppt decrease in moderate/severe anemia). These patterns are consistent with the possibilty that the improvements in diet and hygiene reduced iron-deficiency anemia, leading to improved mental alertness and improved cognition. In addition, relative to the control, cash caused significant increases in how often ECD centers were open (about 2.4 days more per week) and how often children attended ECD centers (about 1.9 days more per week). Cash also significantly increased how much parents contributed to ECD centers (about 16 ppt more households contributing, an average of three times higher value of contributions) and significantly improved the infrastructure of the ECD centers themselves (e.g., about 20 ppt more households reporting the ECD center has a shelter). These observations are consistent with the possibility that parents in cash centers contributed a share of their cash transfers to the ECD centers, which served both to increase caregiver incentives and to improve ECD center infrastructure, leading to increased ECD center operation and child participation, resulting in greater quantity and quality of exposure to stimulation. Food, however, had no significant impacts on any of these intermediate outcomes, with indications that the food rations were not perceived as valuable and were not used to contribute to ECD centers.

Our results are a substantial contribution to filling the knowledge gap on the efficacy of early childhood interventions in promoting cognitive and noncognitive development. Currently there is a growing literature, largely based on evidence from the U.S., indicating preschool participation can have considerable impacts on children's cognitive and noncognitive development (see Heckman (2006) for a review). There is also limited evidence from developing countries on the effects of food rations or cash transfers on early childhood cognitive and noncognitive outcomes (e.g., Paxson and Schady, 2010; Macours et al, 2012), largely from Latin America. However, there is very little evidence from any context on complementarities between resource transfers and preschool for child development, or on rigorous comparisons of how food and cash transfers affect child development. To our knowledge, the most closely related study to ours is Vermeersch and Kremer (2004), in which they randomly assign school meals to preschools in Kenya. Their finding that school meals improved children's cognitive scores only if the child's teacher was trained is also consistent with our finding. Looking across both their context and ours, a possibility emerges that transfers linked to preschool improve children's cognitive development only when the preschool has sufficient capacity (or when the transfers themselves can be used to increase the preschool's capacity).

Our study also contributes evidence to to a question with great relevance in the design of social protection programs: what are the relative benefits of providing assistance in the form of food vs. cash? While provision of food transfers is the World Food Programme's dominant modality, there is growing interest in provision of cash transfers. Theory suggests that which modality is more effective in improving a given outcome (or whether there is any difference) depends on context.[1] Thus, it is an empirical question whether, in a given context, food or cash is more effective in improving specific outcomes. While a substantial body of evidence demonstrates impacts of food transfers (e.g., Barrett and Maxwell 2005), and a separate body of evidence demonstrates impacts of cash transfers (Adato and

[1] For example, these factors include whether the food transfer is inframarginal or extramarginal, what degree of transaction costs are incurred in selling food transfers for cash or in using cash to buy food, what quality and quantity of foods are included in the transferred food basket relative to the foods available for purchase in markets, what alternative uses of cash are locally available, how food transfers and cash transfers are allocated within the household and controlled by various household members, etc.

Hoddinott 2010; Fiszbein and Schady et al. 2009), there is very limited evidence directly comparing impacts of the two modalities in the same setting (Hidrobo et al, 2012; Ahmed et al, 2009; Gentilini, 2007; Webb and Kumar, 1995). This study (part of a multi-country study supported by the World Food Programme to evaluate alternative modalities to food assistance) provides a rigorous comparison of relative impacts, keeping all factors other than transfer modality as similar as possible across groups. As part of our exploration of impact pathways, we also consider which contextual factors may have led cash transfers to be more effective than food transfers, and under what hypothetical circumstances food transfers may have had larger impacts.

The paper proceeds as follows. Section 2 describes the ECD centers supported by UNICEF and the WFP program to provide food and cash transfers to households with children enrolled in these ECD centers. Section 3 summarizes the randomized controlled trial (RCT) design of the program. Section 4 describes the survey data used to assess impacts of the food and cash transfers. Section 5 describes our estimation methods. Section 6 presents our empirical findings on the impact of food and cash on cognitive and noncognitive development, as well as on "intermediate" outcomes, then explores plausible impact pathways and heterogeneity of impact. Section 7 concludes with discussion.

2. Program context

2.1 The UNICEF-Supported ECD Programs in Karamoja

Since 2007, UNICEF has supported early childhood development (ECD) centers for preschool-age children in the Karamoja region of Northern Uganda. The primary goal of these ECD centers is to improve school readiness among pre-school age children, in a context where primary school enrollment is low and often delayed. The ECD centers are informally structured, taking the form of a group of children from the community gathered under the supervision of a caregiver in a typically informal setting, such as under a tree. Officially, only children aged 3-5 are eligible to attend ECD centers. However, many younger children (mostly 2-year-olds) and some older children (mostly 6-year-olds) also attend centers. Prior to WFP's introduction of transfers, there was no food provided to children at any of the UNICEF-supported ECD centers.

The ECD caregivers are volunteers from the community, trained by the community-based organization Community Support for Capacity Development (CSCD), through funding provided by UNICEF and overseen by the DEOs. By government decree, ECD center caregivers cannot be directly remunerated by the government in any way except through training. Communities are encouraged both to contribute gifts to the caregiver as compensation for the caregiver's services and to provide materials for the ECD center, with the intent that ECD centers become self-sustained through the community rather than relying on government or outside support. In practice, however, community contributions to the caregiver rarely occurred prior to the intervention, and caregivers cited lack of incentives and lack of instructional materials as serious challenges in running the centers. Each center is typically run by two to three different caregivers who take turns leading instruction on different days of the week, though there is only one caregiver leading the instruction on any given day. Each center has one head caregiver who manages administrative matters. In addition, each ECD center is supported by a local Management Committee that oversees hiring of caregivers and management of the center. Monthly meetings between caregivers and parents are held at each ECD center, but attendance of parents at these meetings was often low prior to the intervention.

While caregivers typically do not have previous teaching experience and often do not have prior experience working with children, their training is quite comprehensive and covers a range of topics including but not limited to: milestones in child growth and development, activities for children at different development stages, managing learning materials, and child health and safety. Typical activities at the centers include the caregiver leading the children in singing, dancing, learning numbers, learning local customs, and taking short trips to familiarize children with their community. Based on our informal conversations, most caregivers seem to be well-trained in choosing age-appropriate activities, are well aware of their role in the child's development, and are committed to their responsibility to instruct the children.

Beyond the presence of caregivers, the centers typically have very little in terms of infrastructure or learning materials. A few centers are housed in a physical structure or have access to some sort of shelter, but the majority of centers has no physical structure and instead meets under a tree. Most centers do not have access to a latrine or access to water, and most caregivers do not have access to instructional materials besides sticks, pebbles and other natural materials.

Enrollment on the books for the ECD centers is often much higher than actual attendance at the centers. Based on conversations with caregivers, centers at which roughly 150 children were enrolled often had only about 40 children in attendance on a normal day. Caregivers are asked to record children's daily attendance in attendance registers distributed by CSCD, though some caregivers are illiterate. The quality of attendance records varies.

Typically, in areas with ECD centers, there is one ECD center per village or *local council* (LC1), situated at a reasonably central point and within walking distance for most children. Schedules for the centers vary. Most operate five days a week, from Monday to Friday, but some meet for fewer days. Many centers are intermittently closed, often due to caregiver absence. Although the centers have been operating officially since 2007, many have had extended periods of inactivity in the interim. On days that the centers are open, children usually arrive around 8:00 in the morning and return home by noon. According to caregivers, even on days that the centers are open, children sometimes leave early due to heavy rain or because the children becoming hungry and inattentive.

2.2 The WFP Food and Cash Transfer Intervention Linked to ECD Center Participation

The districts of Kaabong, Kotido and Napak in Karamoja sub-region were selected as the locations where WFP would provide cash and food transfers to randomly-selected UNICEF-supported ECD centers already under operation. (See the map in Figure 1, reproduced from UN OCHA.) These districts were considered appropriate because UNICEF had an established presence there and had been supporting ECD centers in the sub-region since 2007. In addition, food insecurity is high in the Karamoja sub-region. It was thus possible to identify a population of preschool children with potential capacity to respond to food and cash transfers with changes in preschool participation and child development outcomes.

Beneficiaries of the intervention included all households with a child aged 3-5 years who at baseline was enrolled in an ECD center assigned to food or cash transfers. Households received one transfer for each child who fulfilled these criteria, such that one household could receive multiple transfers.

Starting in April 2011, WFP introduced cash and food transfers to the UNICEF-supported ECD centers in order to provide incentives for ECD center participation and to allow us to evaluate impacts of the two transfer modalities. As described in Section 3 below, we randomly assigned each center into one of three groups according to an experimental design: (1) cash, (2) food, or (3) control.

The food and cash transfer sizes were substantial, making it plausible that there could be impacts on child development. In the food treatment arm, the transfer consisted of a highly nutritious food basket of approximately 1200 calories per child per day, including multiple-micronutrient fortified corn soy blend ("CSB", including 99% of daily iron requirements), Vitamin-A fortified oil, and sugar[2]. In

[2] We note that there were other programs operating in Napak, Kotido, and Kaabong districts that provided CSB during the course of the study. These programs included the ongoing General Food Distribution, the Maternal Child Health and Nutrition programs, and the Community-based Supplementary Feeding Programs. However, all of these activities were operating in all of our study districts. Due to the stratified randomization, which we show in Section 4.3 was effective in balancing baseline characteristics, household receipt of any of these programs is also very likely balanced across the food, cash, and control communities and unlikely to interfere with the randomized design of the study.

the cash treatment arm, the transfer per child for each 6-week cycle was 25,500 UGX (roughly $10.25 USD), equal to the estimated amount of cash required to purchase a basket similar to the food transfer according to a market survey conducted shortly before the intervention started. These transfer sizes represented meaningful increases to household resources, given that prior to the intervention, households reported an average monthly value of food consumption of approximately 28,200 UGX.

Transfers were scheduled to be distributed in 6- to 8-week cycles for both modalities. Food transfers were distributed by truck through the Generalized Food Distribution system, while cash transfers were sent through electronic transfer of funds to cards (redeemable at mobile money agents) given to children's parents. It was intended that, during the course of the study, beneficiary households would receive six cycles of transfers.

In practice, the frequency of transfers varied over the course of the intervention. In many cycles, cash delivery was delayed relative to food delivery, largely because cash was a new modality for WFP in Karamoja and incurred initial complications, while food delivery had been ongoing in the area for many years. Moreover, some children who were intended beneficiaries were indvertently omitted from beneficiary lists for the first three cycles across both food and cash modalities, such that they received three rather than six distributions. We return to discusing the implications of these details for our evaluation in Section 6.3.

We also note that WFP had originally intended to introduce some form of incentives to ECD caregivers, to provide them motivation to continue instruction in the face of possibly higher work burdens, since the number of children attending centers would likely increase in response to the transfers. It was also perceived that, since the centers were the focal point for providing transfers, it was advisable in terms of social dynamics to give caregivers a concrete indication that their role was important. These incentives were to be provided at all centers – in control, as well as in food and cash groups – such that any change in quality of caregiver instruction would occur uniformly across treatment and control groups. In practice, providing incentives to caregiver was complicated by the Government of Uganda's Distriction Education Office requirement that caregivers not be directly compensated by external parties, but be supported solely by the community. Only one incentive could be provided through the study intervention: a small payment to caregivers for attending a training on filling out attendance registers, in which reimbursement slightly exceeded travel costs and a per-diem.

3. Evaluation Design

3.1 Study Design

Our strategy for estimating the impacts of the cash and food transfers linked to ECD centers relies on the randomized design of the study. Because the total number of ECD centers is relatively large, random assignment of ECD centers to the food, cash, and control groups makes it likely that, on average, households will have similar baseline characteristics across treatment arms. If balancing in baseline characteristics is achieved, the probability that a household receives the transfers (and whether the transfer is cash or food) is uncorrelated with these baseline household characteristics, minimizing sources of bias. As a result, it is reasonable to interpret average differences in households' outcomes across the groups after the intervention as being truly caused by, rather than simply correlated with, receiving the treatments.

Our final randomization sample included 98 ECD center "clusters" across Kaabong, Kotido, and Napak districts. The clusters of ECD centers were constructed based on consultations with district representatives regarding which ECD centers were so near by each other that they should be clustered together in assigning treatment. By grouping centers very near each other and treating the grouping as a single cluster for the randomization, we guaranteed that there would be minimal incentive for children to migrate from their home center to another nearby center in order to access the treatments. This measure reduced the likelihood that, in particular, children in ECD centers assigned to the control group might walk to a neighboring ECD center assigned to the food or cash group, leading to "contamination" of the control group and weakening of the study design.

Randomized assignment of these 98 ECD center clusters to the food, cash, or control arms was stratified by location. In consultation with district representatives, strata were defined to be the full districts in Napak and Kotido and were defined to be subdistricts for the more spatially diverse Kaabong district.[3] Stratified randomization guaranteed that, within each stratum, each of the treatment arms would be represented roughly equally. Doing so prevented the case where, by chance, most centers assigned to a certain treatment fell in a particular area, while most centers assigned to another treatment fell in another area with very different characteristics (in which case, location-specific characteristics would be correlated and confounded with receipt of treatment). In total, 11 strata were

[3] We stratified only to the extent deemed necessary; while areas within the districts of Napak and Kotido were considered relatively similar to one another, subdistricts within the district of Kaabong were judged different enough to merit finer stratification. In a few cases, small, neighboring sub-districts in Kaabong that were considered similar were grouped into a single stratum for the randomization.

defined over the three districts (1 in Napak, 1 in Kotido, and 9 in Kaabong), with an average of about 9 ECD clusters in each stratum.[4]

The randomization led to 35 ECD center clusters assigned to the food treatment group, 31 ECD center clusters assigned to the cash treatment group, and 32 ECD center clusters assigned to the control group. If a cluster included multiple ECD centers, all centers received transfers if that cluster was assigned to a treatment. However, we randomly selected only one out of the multiple centers in each cluster for inclusion in our sample, since sampling more than one from the same cluster would have implications for statistical power. Therefore, our final sample for data collection included 98 distinct ECD centers.

4. Data

4.1 Data collection

To evaluate the interventions, we collected longitudinal data on households across the food, cash, and control groups. In August-September 2010, prior to the baseline survey, enrollment lists were collected from each of the 98 ECD centers across the three districts of Kotido, Kaabong and Napak. From these enrollment lists, for each ECD center, approximately 25 households with an enrolled child aged 3-5 years were randomly sampled for the baseline survey.

The baseline survey was conducted in September-October 2010. It included 2,568 households with an enrolled child aged 3-5.[5] We refer to the enrolled child aged 3-5 years in each sampled household as the "Baseline Index Child" (BIC).[6] A detailed household questionnaire was administered to each of these households, including demographic and socioeconomic information, information on food consumption, and information on children's ECD participation and schooling.

[4] An initial randomization was conducted using 109 ECD center clusters thought to be run by UNICEF. After it was discovered that some of these centers were in fact run by a different organization, the relevant clusters were dropped and some replacement UNICEF centers were added, to bring the total to 98 ECD center clusters. Another randomization was conducted for the additional centers, maintaining the original stratified design.

[5] For each of the 98 ECD centers, drawing on other lists sought from community leaders, approximately 5 households with at least one child aged 3-5 years but no child attending the ECD center were also sampled. The purpose of collecting information on these children was to study enrollment effects. However, for our analysis in this paper, we do not focus on the sample of children not enrolled in ECD centers at baseline.

[6] The BIC was identified during the course of the baseline survey, and the enumerator confirmed the child's age based on reported birthdate for that child. If there were multiple enrolled children aged 3-5 years in a sampled household, one was randomly selected by the enumerator to serve as the BIC for that household.

Of the approximately 25 households per ECD center cluster, in a randomly-selected 20 households, we also conducted individual assessments on the BIC.[7] The child assessment for the BIC included measurements of anthropometry, as well as a series of interactive cognitive and noncognitive tests. The cognitive test items were drawn from age-appropriate sections of the Mullen Scales of Early Learning and KABC-II test instruments, adapted for the Ugandan context by a team of psychologists at Makerere University.[8] The items took the form of simple games played by a trained enumerator with the child (matching pictures, stringing beads, responding to spoken instructions or questions, etc). Domains of cognitive development included visual reception, fine motor, expressive language, and receptive language. Appendix A includes additional details on selection and refinement of the cognitive instruments.

We additionally included one measure of noncognitive ability – a "Sticker Test" of patience, or ability to delay gratification (based loosely on the Marshallmallow Test (Mischel et al, 1972). For this Sticker Test, we gave children one sticker before collecting anthropometry measurements, then asked children if they would like to receive one more sticker immediately or alternatively to receive two more stickers after we finished measuring them, and recorded their response after giving them the stickers.[9]

An endline survey was conducted in March-April 2012, successfully re-interviewing 2,461 of the 2,568 households with an enrolled child aged 3-5 years at baseline. Household surveys and child assessments were re-administered in nearly identical form, with some additions to capture experiences with the program.[10] In addition, at endline, children's hemoglobin levels were also measured, using a finger-prick and Hemocue analyzers, in order to test for anemia.[11]

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[7] We conducted individual child assessments in on ly a subset of sample households, rather than in all sample households, due to field budget and time constraints.

[8] All cognitive and noncognitive tests were developed with the guidance of Dr. Paul Bangirana, a psychologist at Makerere University. The Mullen Scales of Early Learning (appropriate for children ages 3-5 years) and the KABC-II test (appropriate for children ages 5 years and older) have been used extensively by Dr. Bangirana and co-authors to study cognitive ability in Ugandan children.

[9] We note that recent evidence (Kidd et al, 2013) shows that the classic marshmallow test, on which our sticker test was based, may have captured stability of environment rather than patience. Therefore our sticker test may not be an effective measure of noncognitive ability as we intended.

[10] At endline, we also included additional test items in the child assessment, in order to include age-appropriate items for children who had aged out of the 3-5 years range between baseline and endline. These included additional cognitive items from KABC-II and an additional noncognitive measure, the "Head-Toes-Knees-Shoulders" test of self-regulation (Ponitz, McClelland, et al., 2008). However, for the analysis in this paper, we focus on the sample of children who remained within the 3-5 years age range at both baseline and endline, and who therefore took the same battery of test items at both baseline and endline.

[11] Hemoglobin level could not be measured at baseline due to field cost constraints.

In our sample of households with an enrolled child aged 3-5 years at baseline, the implied attrition rate over 18 months is 4.18 percent , which is quite low given the remote and rugged study locations in Karamoja.[12] As described in Appendix B, attrition analysis demonstrates that attrition was balanced with respect to key characteristics of the sample. The probability of attrition was not significantly correlated with treatment assignment, and the distribution of key outcome variables or child age did not differ at baseline between the sample of households that later attrited and the sample of households that remained in the study.

4.2 Cognitive and noncognitive indicators

We use children's responses to the cognitive and noncognitive items described above to construct outcome measures of cognitive and noncognitive development. Appendix A describes the rationale we use to construct these, as well as the checks we do to assess their validity as meaningful outcome measures. For cognitive development, the key consideration is how to meaningfully aggregate responses across many different items. As described in the appendix, we construct several versions of aggregates and make our selection based on empirically testing their sensitivity and robustness in terms of detecting expected patterns. Our preferred indicators for cognitive development outcomes are raw scores over all items in each domain, as well as a total raw score over all domains. For ease of interpretation, we standardize these raw scores to z-scores, taking the control group as the reference population at both baseline and endline. We do so by subtracting the control group's mean from each score, then dividing by the the control group's standard deviation. Impacts on the resulting z-scores can be interpreted as the change in each cognitive score in terms of standard deviations of the counterfactual distribution without intervention.

For the noncognitive item, we follow the rationale of Mischel et al. (1972) in characterizing the ability to delay gratification as the measure of noncognitive development. Therefore, we construct the noncognitive outcome as an indicator for whether the child chose to delay receiving stickers in order to receive two rather than one.

[12] The low attrition rate also indicates that, although some households in Karamoja live a semi-pastoralist lifestyle—moving with their cattle in search of grazing grounds—the households in our sample are settled. Indeed, most of the households lived in gated manyatas (groupings of households surrounded by a sturdy fence made of briars), and have invested in building their compounds. They are thus settled enough to maintain a long-term connection with a particular ECD center.

4.3 Balancing of baseline characteristics and descriptive statistics

Before presenting impact estimates, we note that a large set of baseline characteristics – including the indicators for our key cognitive and noncognitive measures – show very few statistically significant average differences across our treatment arms. These statistics indicate that the randomization was quite effective in achieving balance at baseline. Table 1 shows the average values of a small subset of these indicators by treatment group at baseline, along with tests of whether the mean is balanced across treatment groups. Appendix C shows similar balancing tests for many additional indicators.

Table 1, Panel A, shows the key cognitive and noncognitive indicators on which we focus in this paper. The tests show that these measures are well balanced at baseline. Differences in means between each pair of intervention arms are not statistically significantly different from zero. Panel B shows balance in basic household demographics, in terms of household size and the number of household members aged 3-5 years (which reflects the number of children eligible for transfers). Panel C shows balance in measures of monthly values of food and nonfood consumption. Panel D shows balance in indicators related to patterns of household food consumption, including daily calories consumed per capita in the last 7 days and how many daily meals children usually eat in a bad month. Panel E shows balance in mother's reports of prevalence rates of various types of illness among children aged 3-5, including those having any illness, those havingcough/cold/flu/fever, those having diarrhea, and those having malaria. Panel F shows balance in the number of days the household's ECD center was open and the number of days a child attended in the past 7 days. These statistics, as well as those in Appendix C, show that randomization successfully balanced a wide range of characteristics over treatment groups. The results on various types of illness in Panel E in particular give confidence that, although we were unable to collect blood samples at baseline to demonstrate balance in anemia, prevalence of anemia was also very likely balanced at baseline.

In addition, since understanding the typical diet in Karamoja is useful in interpreting our impact estimates, we present descriptive statistics on children's dietary patterns in the control group. Table 2 shows, for the control group, the frequency with which children ages 3-5 years consumed various food groups in the 7 days prior to the endline survey. Again, these patterns reflect what we expect would be the counterfactual pattern of children's food frequencies in our treatment groups at endline, had they not received the treatments, taking into account any seasonal factors during the endline survey. We see that, based on the last 7 days before the endline survey, children age 3-5 in the control group consumed a fairly limited diet. They consumed starches nearly every day (about 6 days); consumed leafy green vegetables most days (about 4 days); and consumed nuts/seeds and beer/beer residue[13] fairly regularly (about 2 days). However, they consumed meat/eggs, dairy, orange fruits/vegetables, other vegetables, other fruit, and corn soya blend quite infrequently. The nonzero but low consumption of corn soya blend is of note, reflecting that while there were other programs distributing it in Karamoja, the average quantities distributed were likely fairly small.

5. Estimation Strategy

For all of the analysis in this paper, we run estimates relying on double-difference and ANCOVA specifications using both baseline and endline data, as well as on single-difference specifications. We find very similar results, as would be expected in a randomized study with baseline balancing achieved (See Appendix D).

We present the single-difference estimates throughout the paper for several reasons. First, as shown in Section 4.2 and Appendix C, we are able to empirically confirm that all key outcomes (other than anemia, for which we were unable to collect baseline information) and a large range of other child and household characteristics were well-balanced at baseline. Second, when we do estimate impacts using an alternate specification such as ANCOVA that controls for baseline values, we find nearly identical results as shown in Appendix D.[14] These checks give us confidence that the randomization did achieve balance and the intervention arms are in fact very similar prior to the intervention. Finally, given that we do not have baseline information on anemia and can estimate only single-difference impacts for that outcome, we prefer to remain consistent in our main specifications across other outcomes as well.

We estimate single-difference impacts using a simple regression specification. Denoting the outcome at endline as Y_{i1}, the indicator for assignment to the food treatment as $FOOD_i$, and the indicator for assignment to the cash treatment as CASH, our estimation specifications takes the general form,

$$(1) \quad Y_{i1} = \beta_0 + \beta_1 FOOD_i + \beta_2 CASH_i + \varepsilon_i .$$

[13] It is common in Karamoja to make a local homebrewed weak beer out of sorghum and to consume the beer residue as well. Both young children and adults consume these.

[14] Appendix D also discusses why ANCOVA is our preferred specification for controlling for baseline information, based on low autocorrelations in our outcomes. McKenzie (2010) shows that when autocorrelation is low, there is a substantial gain in statistical power from estimating an ANCOVA specification rather than a difference-in-difference specification.

In each specification, we also include dummy variables for children's age in months at endline, in order to non-parametrically account for patterns in our outcome variables by age. Since there is potential for child development to differ considerably by small differences in age among very young children, the dummies are included to capture this variation and improve precision of estimates. The specification is flexible enough to take into account relationships between outcomes and age that are not linear and include discontinuities at particular ages.

In all cases, we focus our estimation on children falling within the age range of 3-5 years (36-71 months) throughout the study. Because these children were in the target age range throughout, they had maximum exposure to ECD centers and transfers. Since the baseline and endline surveys were 18 months apart, this restriction corresponds to estimating impacts on children that were aged 36-53 months at baseline and 54-71 months at endline.

6. Results

6.1 Impacts on cognitive and noncognitive development

We first analyze impacts of the treatments on children's cognitive and noncognitive development. For each cognitive and noncognitive outcome, we estimate impacts of receiving food transfers or receiving cash transfers, relative to receiving no transfers in the control group. As noted above, in all our estimates, we include age-in-months dummies non-parametrically. For each estimated specification, we also run a Wald F-test to determine whether the estimated impacts of food and cash are statistically different from each other.

Table 3 shows impacts on the cognitive and noncognitive scores. We find very few significant impacts of food transfers on the cognitive items among BIC's aged 54-71 months, other than a weakly significant or significant *reduction* in the visual reception and expressive language domains. However, we find that cash transfers cause significant increases in cognitive z-scores: in visual reception, in receptive language, in expressive language, and in the total cognitive score. Moreover, the changes are of considerable magnitude, representing increases of 0.31 standard deviations in visual reception, 0.39 standard deviations in receptive language, 0.45 standard deviations in expressive language, and 0.33 standard deviations in the total cognitive score.

We see no significant impact of the food or cash transfers on the noncognitive measure. As noted above, however, this lack of impact is not conclusive evidence that transfers linked to preschool did not have noncognitive impacts, given recent evidence from Kidd et al (2013) complicating the interpretation of the classic marshmallow test.

6.2 Evidence on potential pathways

Given the differences in cognitive impacts between food and cash transfers, we explore potential mechanisms that may generate these differences. There are several reasons to expect that food or cash transfers could affect children's cognitive development. As discussed above, the cognitive impacts of transfers could potentially come through a stimulation pathway. They could increase children's ECD participation[15], as well as potentially the quality of the ECD centers if households use any of the transfers to improve the centers, both of which could increase the quantity and quality of stimulation child are exposd to, improving children's cognitive development. Cognitive impacts of transfers could also come through a nutrition pathway. Transfers could improve diet quality or hygiene, leading to reductions in micronutrient deficiency including anemia, resulting in reduced mental alertness and fatigue, and thereby improved cognition. We next explore the evidence in our data for these mechanisms.

6.2.1 Evidence for stimulation pathway: impacts on ECD center participation

We first consider evidence for a stimulation pathway. We construct several measures of children's ECD center participation. We use parents' self-reports on children's participation, including questions that ask, for each child, how many days the ECD center the child usually attends was open in the past 7 days (where "open" means that the caregiver was present) and how many days the child attended in the past 7 days. The outcomes we construct are unconditional. That is, if an ECD center was closed throughout

[15] The WFP ECD transfer scheme was linked to ECD center enrollment with the intent of encouraging children's attendance at ECD centers. There are several reasons to expect that food or cash transfers could affect ECD participation. In the original plan for the intervention, both food and cash transfers were intended to be conditional on children's regular attendance at the ECD center. Parents in treatment communities were sensitized on this conditionality. The conditionality was later dropped due to problems monitoring attendance; however, it is not clear whether parents were made aware that transfers were no longer conditional on ECD center attendance. Moreover, it was intended that new enrollees to the ECD centers would be included on WFP's beneficiary lists. While it is not clear that this addition of new enrollees occurred regularly in practice, the possibilty may have induced some parents to start sending children who had not attended before. It is also possible that, due to receiving food or cash transfers, a child would feel less hungry or more prepared in some other way to attend the ECD center, improving attendance. Additionally, if some component of the transfers are given to ECD caregivers or contributed toward improving the center, the resulting improvements in caregiver motivation and access to facilities in the ECD center may induce parents to send their children to the ECD centers more frequently.

the past 7 days, it is included in the estimates as being open for 0 days; if a child has never attended an ECD center during the school year, the child is included in the estimates as having attended 0 days.

Table 4 shows impacts of food and cash transfers on reports of how many days in the past 7 days the ECD center was open and how many the child attended. We find no significant impacts of food transfers. However, we find that cash transfers cause highly significant increases in parents' report of the number of days their child's ECD center was open, by about 2.4 days in the past 7 days. Cash transfers also cause highly significant increases in parents' reports of the child's attendance in the past 7 days, an increase of about 1.9 days. These impacts imply potentially more exposure to stimulation for children receiving cash transfers.

We further assess whether there is evidence of any treatment impacts on ECD centers themselves that may generate impacts on children's participation. Our data collection includes a range of questions on households' experience with the ECD centers. Table 5 shows the mean responses to questions at endline on experiences with ECD centers, as well as the differences in mean responses by treatment arm. Responses of food-recipient households in general look very similar to responses of control households. The exception is on reported quality of the teaching/activities at the ECD center; both food-recipient and cash-recipient report significantly better quality than control households, and the difference in responses between food-recipient and cash-recipient households is insignificant. However, we find that cash-recipient households report significantly different experiences than food-recipient or control households in a range of dimensions. Notably, relative to food-recipient or control households, cash-recipient households report a significantly higher value of gifts given to the ECD caregiver as payment for volunteering. The average value of total gifts to the caregiver in the year 2012 reported by cash households is about 980 UGX, which is about 4% of the total value of one 25,500 UGX cash transfer. This amount is meaningful and is about three times higher than the average reported by the food or control households. Significantly higher proportions of cash-recipient households also report that their community's ECD center has a shelter, access to a latrine, or access to hand-washing facilities. These changes are notable, as they reflect considerable improvements in hygiene at the ECD centers and possibly reduced potential for infection. Cash-recipient households are also more likely to report other materials at the ECD center, and moreover report attending ECD center meetings themselves, indicating that cash induced greater support to the centers in terms of community involvement as well.

Table 6 shows the breakdown of the type of gift that the household reports giving to the ECD caregiver, if any, by treatment group. We see that, relative to food-recipient and control households, cash-recipient households are much less likely to report giving no gift to the ECD caregiver and much more likely to report giving a cash gift.

We note that these responses form a coherent story for a stimulation pathway to explain the differing cognitive impacts for children in cash-recipient households, relative to food-recipient or control households. Relative to food-recipient households, cash-recipient households are much more likely to report that they gave gifts to the ECD caregiver, that these gifts were in the form of cash and of substantial value, that their children's ECD centers had shelters, latrines, and/or hand-washing facilities, and that they attended ECD meetings. If cash-recipient households are more likely to contribute a portion of their transfers to the ECD than food-recipient households, and if these contributions serve to improve caregivers' motivation, the environment of the ECD center, and parents' involvement with the ECD center, these factors may in turn affect how often the ECD center operates and how often children attend. For example, if caregivers are more motivated, they may be more likely to operate the center more regularly; if the ECD center has better facilities (e.g., a shelter in case of rain), children may be more likely to attend given that the center is open; if parents are more involved with the ECD center, they may be more likely to motivate both the caregiver and their children. All of these possibilities imply cash contributions being used in a way that improves the ECD center's capacity and also increases children's participation. Children in cash households being exposed to greater quantity and quality of stimulation in turn forms a plausible mechanism for the cognitive impacts we see for those children.

6.2.2 Evidence for nutrition pathway: impacts on diet quality and anemia incidence

We next consider evidence for the transfers improving diet quality. In our surveys, for each child aged 1-7 years, mothers were asked, "In the past 7 days, how many days [CHILD] eat [FOOD]?" across 11 food groups. Table 7 presents the impact of the food transfers and the cash transfers on the frequency of children's consumption of various types of foods. We see that food transfers had no significant impact on any of the types of foods included, while cash transfers significantly increased the frequency of consumption of starches (0.549 days/week), significantly increased the frequency of consumption of meat and eggs (0.511 days/week), and significantly increased the frequency of consumption of dairy (0.329 days/week). Given limited diets at baseline, the increases from cash in consumption of meat and eggs (66%) and in dairy (100%) reflect considerable improvements in diet quality.

Notably, the results show no impact of food transfers (or cash transfers) on the frequency of consumption of CSB by children in the past 7 days. This finding is somewhat surprising given that the CSB is the largest component of the food rations. However, we also note that, as further discussed in

Section 6.3, the timing of transfer distributions differed between food and cash, such that food households may have run out of their last transfer by the time of the endline survey.

We also consider evidence for the transfers reducing rates of infection. In our surveys, for each target child, mothers were asked, "Has [NAME] had diarrhea in the past 15 days?" and "Does [NAME] have worms?" Table 8 presents the impact of the food transfers and the cash transfers on the incidence of these reports. We see that food transfers had no significant impact on any of the types of foods included, while cash transfers significantly increased the frequency of consumption of starches (0.549 days/week), significantly increased the frequency of consumption of meat and eggs (0.511 days/week), and significantly increased the frequency of consumption of dairy (0.329 days/week). Given limited diets at baseline, the increases from cash in consumption of meat and eggs (66%) and in dairy (100%) reflect considerable improvements in diet quality. We note that the impacts of cash transfers on improved hygiene and sanitation at ECD centers shown in Section 6.2.1 are consistent with these findings. Given that cash transfers increased investment in latrines, shelters, and handwashing facilities at ECD centers, they may have reduced preschool children's exposure to infection.

We finally consider evidence for the transfers reducing incidence of anemia. [16] We use the Hemocue measurements of hemoglobin levels to construct indicators for prevalence of anemia, using cutoffs following WHO standards to define no anemia, mild anemia, moderate anemia, or severe anemia. Table 9 shows impacts on incidence of any anemia and of moderate/severe anemia. We find that food transfers cause no significant impacts. However, cash transfers cause a weakly significant reduction in incidence of any anemia, by 10 percentage points, and cause a significant reduction in incidence of moderate/severe anemia, by 9.6 percentage points.

Notably, these results align with the impacts found on diet quality and illness rates, as well as with the overall impacts on cognitive development. Cash transfers caused significant improvements in diet, including increased intake of meat, eggs, and dairy, which could plausibly result in the substantial reductions we see in moderate/severe anemia. Cash transfers also caused significant reductions in reported rates of diarrhea and worms which, if indications of reduced infection, could also cause reductions in anemeia. Reductions in anemia could, in turn, plausibly reduce mental fatigue and improve memory and concentration, leading to the improvements in cognitive scores we find. Thus, we find plausible evidence for the cognitive impacts of cash transfers to come through a nutrition pathway.

[16] Anemia status is characterized by the concentration of hemoglobin in the blood. Hemoglobin concentration can be affected by many factors. However, the two key determinants of hemoglobin concentration are iron stores in the body (as determined by cumulative dietary iron intake over time) and presence of infection (which induces the body to withhold iron and reduce its bioavailability, since bacteria require iron to reproduce).

6.3 Explaining differences in impact by modality

The above analysis suggests that cash transfers affected cognitive development, and these effects plausibly occurred through nutrition and stimulation pathways, while food transfers did not significantly affect the intermediate or final outcomes. We explore here what underlying factors may have led to these differences by modality. In particular, we assess why the impacts of food transfers may have been so limited relative to the impacts of cash.

First, we consider beneficiaries' experiences in receiving the transfers. By design, it was intended that food and cash beneficiaries would receive exactly the same number of transfers (six cycles), delivered at exactly the same frequency. Figure 2 shows a breakdown of beneficiary households' self-reports on how many transfers they had received in total at the time of the endline survey. We see that most report receiving far fewer than the six transfers intended by this time, with the majority reporting that they had received three transfers. These patterns in self-reports are consistent with implementation records. As noted in Section 2.2, many beneficiary children were known to receive only three transfer cycles rather than six, due to initial omission from WFP's beneficary lists. Nonetheless, we see that the breakdown of numbers of transfers is quite similar across food and cash modalities. Therefore, it is unlikely to be the case that a differing number of transfers by modality drives the limited impacts for food beneficiaries relative to cash beneficiaries.

Figure 3 shows a breakdown of beneficiary households' self-reports on the number of days since they last received a transfer at the time of the endline survey. We see that there is variation within modality, but food beneficiaries report a considerably longer lag since receiving the last transfer than cash beneficiaries.

The difference in timing across modalities reported by beneficiaries is in fact consistent with WFP's own records of its delivery schedule. Figure 4 shows the schedule of food and cash transfers distributed in Kaabong district (where the majority of our sample resides) fro m April 2011 to August 2012, as well as its overlap with the endline survey. We see that cash started late, due to delays in initial startup of the new transfer modality, but that the sixth cycle of cash overlapped the endline survey, while the sixth cycle of food preceded the start of the endline survey by approximately a month.

Table 10 shows the statistical significance of these differences by modality. We see that the average difference in number of transfers received between the food and cash groups is statistically significant but very small, suggesting that the initial omissions and reverification for the beneficary lists played out similarly across the two modalities.

Meanwhile, the difference by modality in average number of days since the last transfer is both statistically significant and quite large. Food beneficiaries report an average of about 57 days since the last transfers, while cash beneficiaries report only about 40 days. Given that the food transfers were intended to cover 6 weeks or 42 days, this observation suggests that the last food transfer may have run out by the time of the endline survey and may have not been reflected in questions about food consumption in the 7 days prior to the survey. We conclude that while food and cash households were exposed to roughly similar numbers of transfers on average, the effects of the food transfers may have been more likely to fade out by endline than the effects of the cash transfers.

The difference in timing by modality leads to some challenges in interpreting the differential impacts of food and cash transfers on cognitive development. In particular, we cannot conclusively infer that the limited impacts of food relative to cash were due to the modality itself, as opposed to food having similar impacts to cash but with those impacts more likely to fade out by endline due to the longer lag since the last transfer.

However, we note that while it is plausible that effects could fade out quickly for some outcomes, such as those related to food consumption in the last seven days, they would be less likely to fade out so quickly for child health and development outcomes like anemia incidence and cognitive measures. Given that we would expect hemoglobin levels and cognitive development to be cumulative, we perceive the lack of significant impact from food as indicating that we would likely not have found large and significant impacts on these outcomes even with a shorter lag.

Given that fade-out seems unlikely to fully explain the differences in impact by modality, we also consider other factors. One possibly relevant factor relates to the nature of CSB itself. Since it is not regularly sold in markets, it is potentially hard to sell for cash. Indeed, virtually no households report selling the CSB, and on average, it is reported that about 95% of the distributed CSB is consumed by the beneficiary households. CSB also does not appear to be highly valued by households in Karamoja. Despite its nutritional content, 64% of households report preferring maize flour to CSB when both are available at the same price. This observation suggests that CSB may, for example, be difficult to use as a contribution to the ECD center caregiver, which closes off a potential mechanism for improvements in hygiene and stimulation. A second factor may relate to the nature of cash. Household are "cash-strapped" in Karamoja, while food rations are widely available through other programs, making cash potentially very valuable. Survey responses also suggest that cash is easier to use in diverse ways. For example, cash beneficiary households report using the last cash transfer received for food purchases (on average, 41% of the transfer amount spent on staples and 12% on nonstaples including meat), but also for nonfood consumption (23%), savings (16%), giving voluntarily or out of obligation to relatives or neighbors (4%), repaying debts (2%), and using for other needs (2%).[17]

Thus, bearing in mind the caveat that some impacts from food may have faded out given the time since transfer receipt, we note that differences in timing of transfer receipt are unlikely to fully explain the differences of impact we find between food and cash transfers. The balance of our evidence suggests that, even if timing had been similar across modalities, cash transfers linked to ECD enrollment would have had broader impacts on child development outcomes than food transfers linked to ECD enrollment.

7. Conclusion

A growing body of evidence demonstrates the importance of early investments in children's cognitive and noncognitive development. In poor countries, micronutrient deficiency and inadequate stimulation are cited as major causes of developmental deficits at preschool ages. However, there is little evidence on what kinds of interventions can effectively increase investments in nutrition and stimulation at these ages. We contribute to filling this knowledge gap by assessing the relative impacts of food and cash transfers linked to children's preschool enrollment on cognitive and noncognitive development in Karamoja, Uganda, as well as exploring potential mechanisms for impact.

Results from our randomized controlled trial study show that food transfers caused no significant increases in cognitive measures or our noncognitive measure. However, while cash also had no significant impact on our noncognitive measure[18], cash caused significant increases in several individual cognitive domain scores (about 11 percentage points or 0.3-0.4 standard deviations in visual reception, receptive language, and expressive language domains) as well as in an overall cognitive score (about 9 percentage points or 0.33 standard deviations). We then explore potential mechanisms for these differences in cognitive impacts, by assessing treatment impacts on intermediate factors. We find convincing evidence for two potential mechanisms for the impacts of cash transfers on cognitive development: a nutrition pathway and a stimulation pathway. We find that cash increases children's

[17] The categories of giving to relatives or neighbors or of using for other needs would likely cover the ECD contributions.

[18] We note that lack of impact on our noncognitive measure is not conclusive evidence that transfers linked to preschool did not have noncognitive impacts. As noted above, recent evidence (Kidd et al, 2013) shows that the classic marshmallow test, on which our sticker test was based, may have captured stability of environment rather than patience and therefore may not measure noncognitive ability as we intended.

diet quality (particularly intake of meat/eggs and dairy), improves hygiene and sanitation in ECD centers, and reduces incidence of anemia. These findings are consistent with a story that improved nutrition and reduced illness lead to reduced anemia and improved cognition. We also find that cash increases children's participation in ECD centers, both increasing the number of days the centers operate and the number of days children attend, and that moreover cash transfers cause increases in households' cash contributions to ECD center caregivers. These findings are consistent with the possibility that the cash contributions from households improve caregiver motivation and are used to improve the ECD center infrastructure, leading the centers to operate more and children to attend more, improving the overall quantity and quality of stimulation to which children are exposed. We find that food has no significant impacts on any of these intermediate factors, suggesting that food's lack of significant impacts on cognitive development may be explained by its ineffectiveness at improving nutrition or stimulation.

We interpret the limited impacts of food as potentially driven by several factors. Household responses in our data indicate that the main component of the food ration – highly nutritious multiple-micronutrient-fortified corn soy blend – is not highly valued in the local context, with most households preferring regular maize meal. Because CSB is not a food regularly available in markets, and very few households in our sample report buying CSB, it is also likely to be difficult to sell the food ration for cash. Moreover, many households in Karamoja receive CSB through other WFP programs as well (e.g., the General Food Distribution, the Maternal and Child Health and Nutrition program, and food for work programs), while cash is scarce forhouseholds. These observations suggest that the food ration may not be perceived as valuable enough to give as a contribution to ECD center caregivers and that it was more challenging to use food rations than cash transfers to improve the capacity of the ECD centers (in terms of caregiver motivation, infrastructure, and hygiene and sanitation). We also document that, despite efforts to deliver food and cash transfers on the same schedule, timing did differ in practice, with the last cash transfer delivered closer to the endline than the last food transfer. We consider that there may have been some impacts from food that faded out by endline due to the longer lag, but perceive it as unlikely that impacts on cumulative outcomes such as cognitive development and anemia could have fully faded so quickly. We therefore interpret the balance of evidence as suggesting that, even if differential timing had not been an issue, cash transfers linked to ECD enrollment would have had broader impacts on child development than food transfers linked to ECD enrollment.

Our findings have several important implications. We find convincing evidence that cash transfers linked to preschool enrollment can significantly improve children's cognitive development during ages 3-5, potentially by improving both nutrition and stimulation. We also find results suggesting that the limited impact in our study from food transfers linked to preschool may relate to the initially low capacity of the preschools. Based on Vermeersch and Kremer's (2004) finding that school meals in Kenyan preschools improved children's test scores only if the teacher was experienced, we note that there is evidence that preschool capacity can affect the effectiveness of transfers. Vermeersch and Kremer note in their study that provision of school meals increased class size and displaced teaching time, potentially explaining why children without well-trained teachers did not improve. We see a potentially similar story in our results. We see evidence in our data that the food transfers increased overall child enrollment in ECD centers but could not be used to increase the capacity of the ECD centers.[19] Meanwhile, the cash transfers also increased child enrollment in ECD centers, but could be used to expand the ECD centers' capacity (in the form of both caregiver incentives and improved infrastructure), such that the capacity was more likely able to withstand the increased burden. Taken together with Vermeersch and Kremer (2004), these findings suggest a broader result that while transfers linked to preschool have considerable potential to increase cognitive development in young children, it is crucial that there is sufficient investment in the preschools themselves to ensure capacity to support a transfer program.

[19] The issue of preschool capacity gives a plausible mechanism for how linking food transfers to preschool could even cause the small reductions we see in certain cognitive cognitive domains, for a child already enrolled in the preschool relative to the counterfactual of that same child enrolled in the absence of transfers. While attendance anecdotally increased at both the food and cash centers, only the cash centers were able to increase their capacity. The food centers meanwhile were likely to have experienced overcrowding without extra resources to increase capacity. Given that the food treatment appeared not to meaningfully improve children's nutritional status or exposure to stimulation, this small potential detriment may have been sufficient to yield a small negative impact on net.

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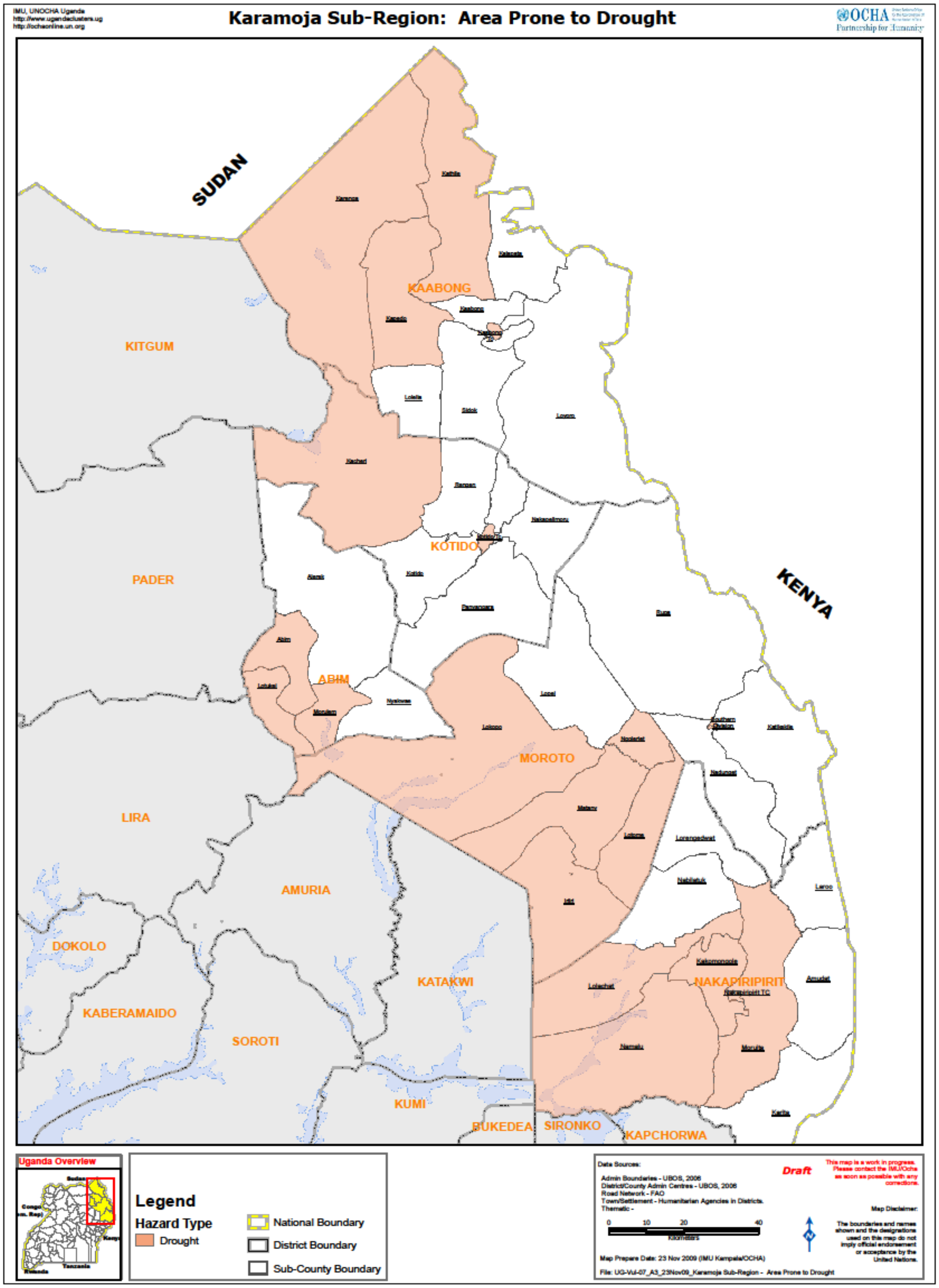
Figure 1: Map of Karamoja Sub-Region, Uganda



Notes: This map was created before the district of Napak was created as a distinct district from within the district of Moroto. We acknowledge UNOCHA as the source for this map

Figure 2. Number of transfer cycles received at the time of the endline survey, by modality, according to beneficiary self-reports

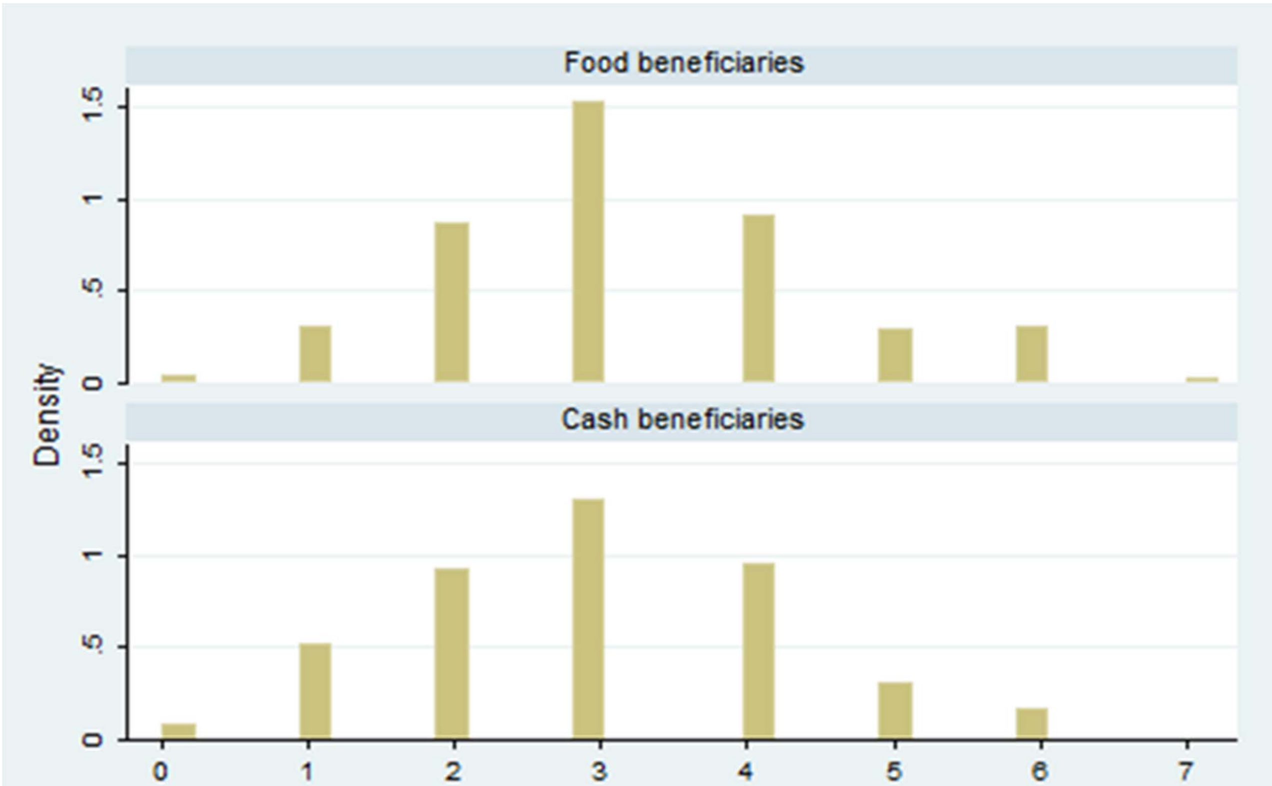


Figure 3. Number of days since last transfer was received at the time of the endline survey, by modality, according to beneficiary self-reports

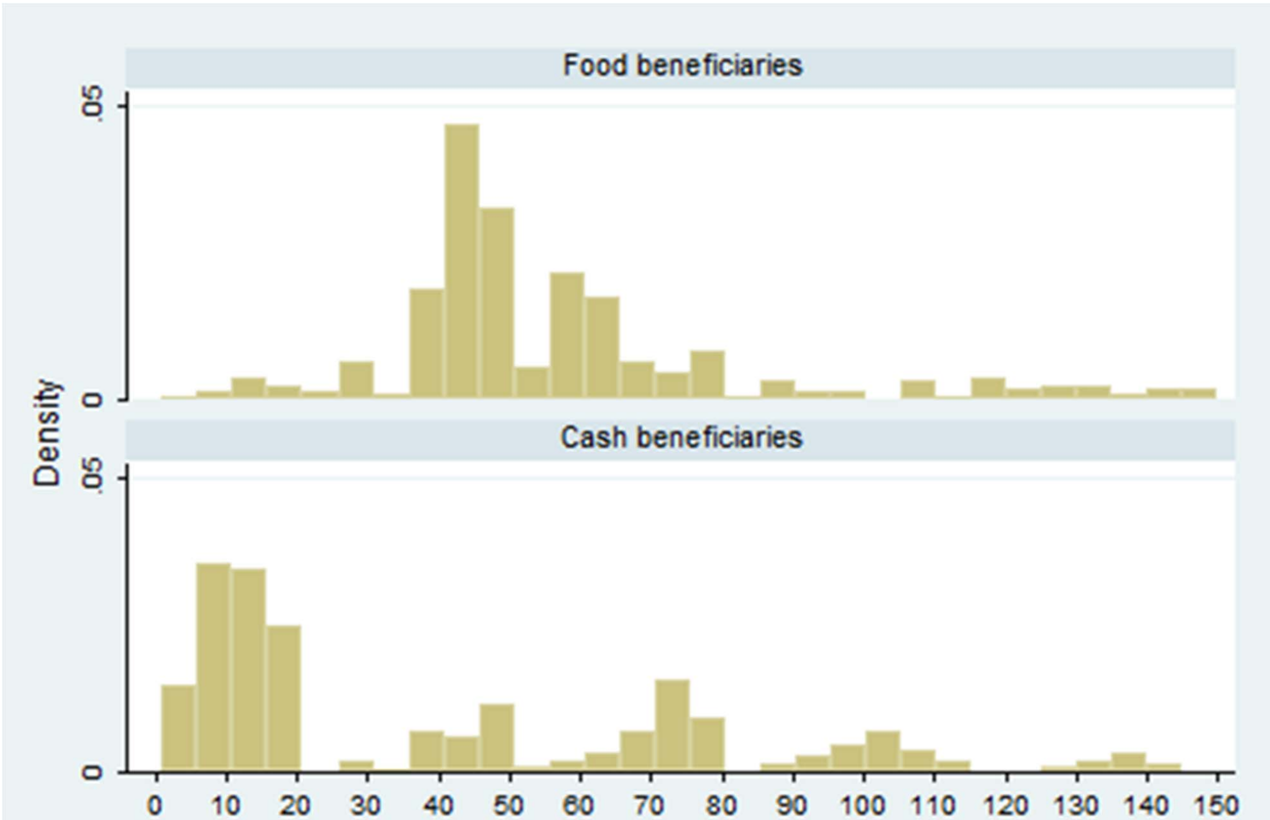


Figure 4. Schedule of WFP food and cash transfers in Kaabong District, 2011-2012

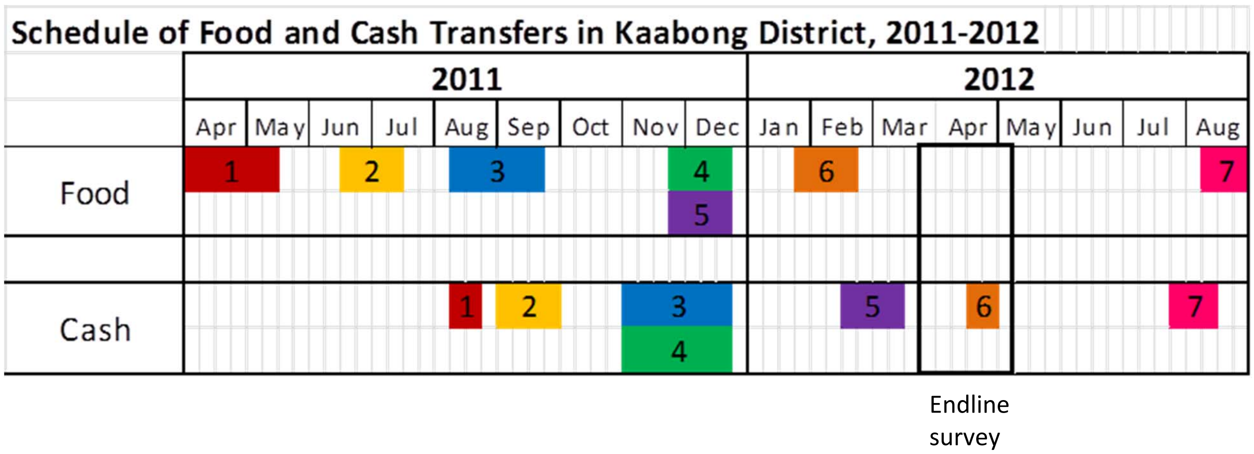


Table 1. Balancing of baseline characteristics across treatment groups

	Mean values 2010			Difference in means		
	Food	Cash	Control	Food -Control	Cash - Control	Food – Cash
PANEL A: COGNITIVE AND NONCOGNITIVE MEASURES FOR CHILDREN AGE 54-71 MONTHS AT ENDLINE (N=681)						
Visual reception z-score	0.022	0.108	0.006	0.016	0.102	-0.086
	(0.084)	(0.100)	(0.096)	(0.133)	(0.142)	(0.134)
Fine motor z-score	0.026	0.066	-0.004	0.029	0.070	-0.040
	(0.080)	(0.112)	(0.116)	(0.144)	(0.164)	(0.140)
Receptive language z-score	-0.193	-0.056	0.014	-0.207	-0.070	-0.136
	(0.084)	(0.103)	(0.099)	(0.132)	(0.144)	(0.134)
Expressive language z-score	-0.031	0.000	-0.006	-0.025	0.006	-0.031
	(0.080)	(0.086)	(0.080)	(0.112)	(0.115)	(0.119)
Cognitive total z-score	-0.068	0.044	0.034	-0.101	0.010	-0.111
	(0.095)	(0.114)	(0.109)	(0.149)	(0.162)	(0.153)
Sticker test	0.768	0.648	0.734	0.033	-0.086	0.120*
	(0.045)	(0.042)	(0.042)	(0.062)	(0.060)	(0.062)
PANEL B: HOUSEHOLD DEMOGRAPHICS (N=2560)						
Total number of household members	6.324	6.190	6.311	0.014	-0.121	0.135
	(0.084)	(0.100)	(0.112)	(0.142)	(0.156)	(0.129)
Number of members aged 3-5	1.360	1.398	1.380	-0.020	0.019	-0.038
	(0.020)	(0.022)	(0.018)	(0.028)	(0.029)	(0.030)
PANEL C: HOUSEHOLD MONTHLY VALUE OF CONSUMPTION (‘000 UGX) (N=2560)						
Food consumption per capita	33.4	24.0	26.7	6.7	-2.7	9.4
	(195.0)	(27.3)	(37.4)	(10.5)	(2.7)	(10.5)
Nonfood consumption per capita	3.2	3.0	3.2	0.0	-0.2	0.2
	(9.0)	(5.8)	(5.0)	(0.6)	(0.6)	(0.7)
PANEL D: HOUSEHOLD FOOD CONSUMPTION PATTERNS (N=2560)						
Daily calorie intake per capita in last 7 days	1,953	2,061	2,201	-248	-140	-108
	(1,999)	(2,561)	(2,910)	(0,160)	(0,210)	(0,168)
Meals/day for children in a bad month	1.636	1.656	1.622	0.013	0.034	-0.020
	(0.040)	(0.047)	(0.037)	(0.057)	(0.063)	(0.063)
PANEL E: CHILD ILLNESS (N=2560)						
Children age 3-5 with any illness in last 4 weeks	0.380	0.358	0.391	-0.011	-0.033	0.023
	(0.031)	(0.025)	(0.031)	(0.044)	(0.040)	(0.040)
Children age 3-5 with cough/etc in last 4 weeks	0.284	0.260	0.286	-0.002	-0.026	0.024
	(0.026)	(0.020)	(0.028)	(0.039)	(0.035)	(0.033)
Children age 3-5 with diarrhea in last 4 weeks	0.152	0.135	0.138	0.014	-0.003	0.017
	(0.019)	(0.014)	(0.020)	(0.029)	(0.025)	(0.024)
Children age 3-5 with malaria in last 4 weeks	0.234	0.221	0.253	-0.019	-0.032	0.013
	(0.028)	(0.022)	(0.030)	(0.043)	(0.038)	(0.036)
PANEL F: ECD CENTER PARTICIPATION (N=2560)						
Days ECD center was	4.446	3.931	4.056	0.390	-0.124	0.514

open in past 7 days	(0.174)	(0.343)	(0.296)	(0.370)	(0.466)	(0.396)
Days child attended in past 7 days	3.124 (0.182)	2.728 (0.262)	2.583 (0.254)	0.541 (0.330)	0.145 (0.371)	0.396 (0.324)

Table 2. Food frequency of consumption over the last 7 days, for children age 3-5 years, Control group, 2012

Number of days child consumed [FOOD] in the past 7 days	
Starches	5.69
	(2.00)
Leafy green vegetables	3.90
	(2.53)
Meat and eggs	0.66
	(1.18)
Dairy	0.20
	(0.98)
Orange fruit and vegetables	0.13
	(0.56)
Other vegetables	1.02
	(1.82)
Other fruit	0.34
	(1.29)
Corn soya blend (CSB)	0.29
	(1.08)
Nuts and seeds	2.58
	(2.67)
Snacks	0.06
	(0.39)
Beer and beer residue	1.52
	(2.18)

Notes: Estimates are baseline means with standard deviations in parentheses.

Table 3. Impacts of food or cash transfers on cognitive and noncognitive measures of BIC's age 54-71 months

	COGNITIVE Z-SCORES					NON-COGNITIVE SCORE
	Visual reception	Fine motor	Receptive language	Expressive language	Cognitive total	Sticker test
Food	-0.203*	-0.058	-0.161	-0.233**	-0.160	-0.047
	(0.121)	(0.117)	(0.129)	(0.118)	(0.120)	(0.084)
Cash	0.307**	0.145	0.387**	0.446***	0.330**	0.090
	(0.143)	(0.154)	(0.158)	(0.145)	(0.164)	(0.084)
Observations	681	658	680	680	656	668
F-Test: Food=Cash	5.13 **	0.91	0.76	5.20 **	9.75 ***	0.91
p-value	0.0260	0.3427	0.3867	0.0251	0.0025	0.3427

Notes: Standard errors in parentheses, corrected for stratified design and clustering. * p < 0.1 ** p < 0.05; *** p < 0.01. All estimations include children's age-in-months dummies as covariates.

Table 4. Impacts of food or cash transfers on participation in ECD centers

	# days ECD center open in past 7 days	# days child attended ECD in past 7 days
Food	-0.009	0.393
	(0.156)	(0.301)
Cash	2.431***	1.919***
	(0.374)	(0.427)
Observations	753	814
F-Test: Food=Cash	32.75 ***	5.60 **
p-value	0.0000	0.0202

Notes: Standard errors in parentheses, corrected for stratified design and clustering. * p < 0.1 ** p < 0.05; *** p < 0.01. All estimations include children's age-in-months dummies as covariates.

Table 5. Differences in experience with ECD centers during the year 2012, by treatment group

	Mean responses, 2012			Differences in Mean Responses		
	Food	**Cash**	**Control**	**Food - Control**	**Cash - Control**	**Food - Cash**
Minutes to the ECD center by normal means	21.765	19.620	24.687	-2.922	-5.067	2.146
	(22.039)	(20.805)	(28.905)	(3.419)	(3.394)	(2.452)
Total value of gifts to the ECD caregiver	383.329	980.403	318.243	65.085	662.159***	-597.074***
	(1882.430)	(1663.323)	(1176.669)	(95.370)	(163.790)	(168.248)
Anyone in HH helps operate/manage the ECD center	0.238	0.254	0.221	0.017	0.033	-0.016
	(0.426)	(0.435)	(0.415)	(0.033)	(0.033)	(0.036)
Anyone in HH has gone to ECD center meeting in 2012	0.643	0.717	0.563	0.080*	0.154***	-0.074**
	(0.479)	(0.451)	(0.496)	(0.042)	(0.039)	(0.035)
Quality of teaching/activities at ECD center (1=Excellent, 4=Poor)	1.969	1.952	2.208	-0.238***	-0.256***	0.017
	(0.537)	(0.540)	(0.672)	(0.064)	(0.071)	(0.044)
ECD center has a shelter	0.707	0.861	0.655	0.051	0.206***	-0.155**
	(0.456)	(0.346)	(0.476)	(0.075)	(0.064)	(0.067)
ECD center has access to a latrine	0.665	0.887	0.605	0.060	0.282***	-0.221***
	(0.472)	(0.317)	(0.489)	(0.082)	(0.063)	(0.071)
ECD center has hand-washing facilities	0.240	0.382	0.220	0.020	0.162**	-0.142**
	(0.428)	(0.486)	(0.415)	(0.066)	(0.074)	(0.066)
ECD center has chalk boards for children	0.327	0.350	0.303	0.023	0.046	-0.023
	(0.469)	(0.477)	(0.460)	(0.054)	(0.057)	(0.053)
ECD center has books	0.172	0.242	0.215	-0.043	0.027	-0.070*
	(0.378)	(0.429)	(0.411)	(0.047)	(0.049)	(0.037)
ECD center has toys	0.167	0.248	0.250	-0.082	-0.001	-0.081
	(0.374)	(0.432)	(0.433)	(0.055)	(0.060)	(0.052)
ECD center has musical instruments	0.074	0.079	0.050	0.024	0.029	-0.005
	(0.262)	(0.270)	(0.217)	(0.022)	(0.022)	(0.027)
ECD center has paper and pencils	0.142	0.194	0.200	-0.058	-0.006	-0.053
	(0.349)	(0.396)	(0.400)	(0.044)	(0.050)	(0.038)
ECD center has pictures	0.340	0.343	0.354	-0.014	-0.012	-0.002
	(0.474)	(0.475)	(0.479)	(0.055)	(0.063)	(0.055)
ECD center has beads	0.074	0.066	0.092	-0.019	-0.027	0.008
	(0.261)	(0.248)	(0.290)	(0.027)	(0.027)	(0.022)
ECD center has other materials	0.063	0.130	0.039	0.024	0.091**	-0.067*
	(0.243)	(0.336)	(0.193)	(0.024)	(0.037)	(0.038)

Table 6. Type of gift given to the ECD caregiver, by treatment group

Type of gift given to ECD caregiver	Treatment		
	Food	Cash	Control
Cash gift given	14.80%	31.09%	13..47%
Food gift given	3.73%	6.59%	2.99%
No gift given	79.84%	57.84%	80.41%
Other gift given	1.63%	4.48%	3.13%
Observations	858	759	735

Table 7. Impacts of food and cash transfers on child food frequency, 2012

	Starches	Other fruit
Food	0.223	-0.081
	(0.154)	(0.098)
Cash	0.549***	0.096
	(0.133)	(0.188)
H_0: Food=Cash	0.006***	0.289
N	2704	2702
	Leafy green vegetables	**CSB**
Food	-0.174	0.209
	(0.267)	(0.157)
Cash	0.166	-0.016
	(0.308)	(0.116)
H_0: Food=Cash	0.246	0.117
N	2708	2699
	Meat and eggs	**Nuts and seeds**
Food	0.021	0.008
	(0.113)	(0.026)
Cash	0.511***	0.100
	(0.122)	(0.097)
H_0: Food=Cash	0.000***	0.386
N	2702	2690
	Dairy	**Snacks**
Food	-0.071	-0.003
	(0.077)	(0.314)
Cash	0.329*	-0.255
	(0.173)	(0.307)
H_0: Food=Cash	0.014**	0.348
N	2702	2702
	Orange fruit and vegetables	**Beer and beer residue**
Food	0.047	0.015
	(0.071)	(0.184)
Cash	0.034	-0.198
	(0.055)	(0.198)
H_0: Food=Cash	0.842	0.229
N	2702	2703
	Other vegetables	
Food	-0.127	
	(0.149)	
Cash	0.212	
	(0.180)	
H_0: Food=Cash	0.052*	
N	2701	

Notes: Estimated impacts of food and cash are average intent-to-treat effects on the number of days the child consumed that food in the past 7 days, using the sample of children in households participating in an ECD center at baseline. All models control for child age in months (not shown). Standard errors in parentheses. H_0: Food=Cash is an F-test that the impact of food and cash are equal (p-values reported). *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Table 8. Impacts of food or cash transfers on reported child illness rates, 2012

	Whether child had diarrhea in past 15 days	Whether child had worms
Food	-0.015	0.018
	(0.016)	(0.013)
Cash	-0.039**	-0.025***
	(0.015)	(0.010)
Observations	814	812
F-Test: Food=Cash	2.01	11.38***
p-value	0.1598	0.0011

Notes: Standard errors in parentheses, corrected for stratified design and clustering. * p < 0.1 ** p < 0.05; *** p < 0.01. All estimations include children's age-in-months dummies as covariates.

Table 9. Impacts of food or cash transfers on incidence of anemia

	Any anemia	Moderate/severe anemia
Food	0.017	0.012
	(0.053)	(0.039)
Cash	-0.100*	-0.096**
	(0.054)	(0.040)
Observations	702	702
F-Test: Food=Cash	4.17 **	7.76 ***
p-value	0.0443	0.0066

Notes: Standard errors in parentheses, corrected for stratified design and clustering. * p < 0.1 ** p < 0.05; *** p < 0.01. All estimations include children's age-in-months dummies as covariates.

Table 10. Number of transfers received and days since last transfer, as reported by food and cash beneficiaries

At the time of the endline survey…	**Food**	**Cash**	**Difference**
Number of transfers that beneficiaries report receiving in the last 16 months	3.22	2.97	0.25***
	(0.05)	(0.06)	(0.08)
Estimated days since beneficiaries report last receiving a transfer	56.59	40.33	16.26***
	(1.08)	(1.66)	(1.93)
Number of observations	**665**	**575**	

Notes: Mean values reported with standard errors in parentheses below means. * indicates significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level.

Appendix A:

Choice of cognitive and noncognitive indicators, and adaptations to local context:

We choose indicators of children's cognitive and noncognitive development guided by the following considerations. We choose outcome measures that are:

(1) In a domain shown from previous research to be a strong determinant of future outcomes in educational attainment and the labor market,
(2) In a domain with a clear counterpart to skills related to school-readiness,
(3) In a domain that has been shown from previous research to (or that may reasonably be expected to) be responsive to cash transfers, iron-fortified food transfers, or ECD participation.

The final selection of items analyzed in this paper that we include in outcome measures for cognitive and noncognitive development fall into the following domains:

(1) *Visual reception*: ability to receive information through visual stimulus
   - Matching pictures
   - Sorting items by color and shape
(1) *Receptive language*: ability to receive information through language and respond accordingly
   - Following simple spoken instructions
   - Answering simple spoken "general knowledge" questions
(3) *Expressive language*: ability to express information through language
   - Answering simple spoken "open-ended" questions
(4) *Fine motor*: ability to coordinate small-muscle movements (for example, gripping and manipulating a pencil with fingers)
   - Drawing simple shapes using a pencil
   - Stringing beads
(5) *Executive function*: ability to react to novel situations, which includes ability to delay gratification, self-regulation, sustained attention, and persistence
   - Ability to delay gratification (Sticker test)

All cognitive and noncognitive tests were developed with the guidance of Dr. Paul Bangirana, a psychologist at Makerere University. The Mullen Scales of Early Learning (appropriate for children ages

3-5 years) and the KABC-II test (appropriate for children ages 5 years and older) have been used extensively in previous work by Dr. Bangirana and co-authors to study cognitive ability in Ugandan children.

Items were drawn from the tests based on several considerations:

- captured a domain of child development likely to be affected by attendance at the ECD centers, receipt of food transfers, and/or receipt of cash transfers
- age-appropriate and culturally-appropriate
- relatively quick to administer
- could be adapted to use locally-available materials and could be translated to the local language while retaining assessment of the same underlying skill
- relatively easy to administer for enumerators after an intensive but short training

Adaptations were made to items drawn from the Mullen Scales of Early Learning and KABC-II to suit the local context – for example, replacing test materials with similar locally-familiar items so as not to be distracting. Enumerators were all locals from Karamoja, were trained to administer the assessments in Na'Karimojong (the language spoken throughout Karamoja), and worked together during the training to standardize the translation from English. Efforts were made to assign enumerators to their local districts, in order to facilitate children's understanding in cases of any small differences in dialect.

As noted above, recent evidence (Kidd et al, 2013) shows that the classic marshmallow test, on which our sticker test was based, may have captured stability of environment rather than patience. Therefore our sticker test may not be an effective measure of noncognitive ability as we intended.

Refinement of indicators between baseline and endline:

We also validated individual cognitive items in the Mullen test before including them in the endline survey. For each Mullen item, we analyzed baseline scores and chose to re-administer only items that met the following criteria:

(1) Appeared to be sensitive to small differences in children's underlying ability, as gauged by properties of scores:

(a) variation in scores, rather than discrete degenerate distributions with nearly all children failing or nearly all children succeeding,

(b) increasing probability of successful completion of the item by a child's age in months per logistical regression,

(c) lower probability of successful completion of the item among malnourished children.

These factors suggested that the item may be sensitive enough to allow detection of small program impacts.

(2) Appeared to capture information distinct from other items already included (e.g., not highly correlated with other included items).

Use of raw scores as cognitive outcome measures:

We choose to use raw scores as our key outcome measures based on several considerations. In reviewing relevant literature, we found relatively little consensus on how best to use item response theory to construct an aggregate cognitive measure out of children's responses to individual test items. This issue seemed especially to be the case when the full original test could not be administered due to field time limitations, rather only a subset of items, since the original scoring and norming could no longer be used.

On the advice of colleagues who have worked on developing ECD assessment tools for Africa, we then ran several statistical tests to assess the validity of using a raw score. We first confirmed using baseline information (as mentioned above in 1b), for each individual test item eventually re-administered and included in our raw score, that the probability of a child completing the item increased smoothly with age in months. This property suggested that the item was at minimum capturing differences in cognitive development that we would expect , indicating that it picked up some meaningful ability. We next confirmed using baseline information (as mentioned above in 1c), for each individual test item eventually re-administered at endline and included in our raw score, that the probability of a child completing the item significantly differed between malnourished children and non-malnourished children (as measured by stunting), controlling for child age. This property suggested that the item was not purely picking up age effects but could also distinguish ability within an age between children who we would expect to differing developmental status. Given that these two properties were satisfied, we perceived that the item was potentially relevant to include in a raw score, since the probability of completing the item appeared to meaningfully increase with ability. Thus, we have relative confidence that summing over these items yields a raw score that also meaningfully increases with ability.

We note that we also ran impact estimates on cognitive development using a slightly different aggregate measure – the first component of principal components analysis over all scores – and found very similar results. Thus our results on cognitive impacts do not appear to be very sensitive to the specific aggregate cognitive measure used.

Construction of z-scores for cognitive outcome measures:

As discussed above, we use the control group as the reference population from which to construct standardized z-scores for the cognitive measures. For both baseline and endline, we subtract the control group's mean from each score, then divide by the the control group's standard deviation. Figures X and X below show the distributions of the standardized cognitive total scores in the control group at baseline and endline.

Figure X. Distribution of standardized Cognitive Total z-scores in control group at baseline

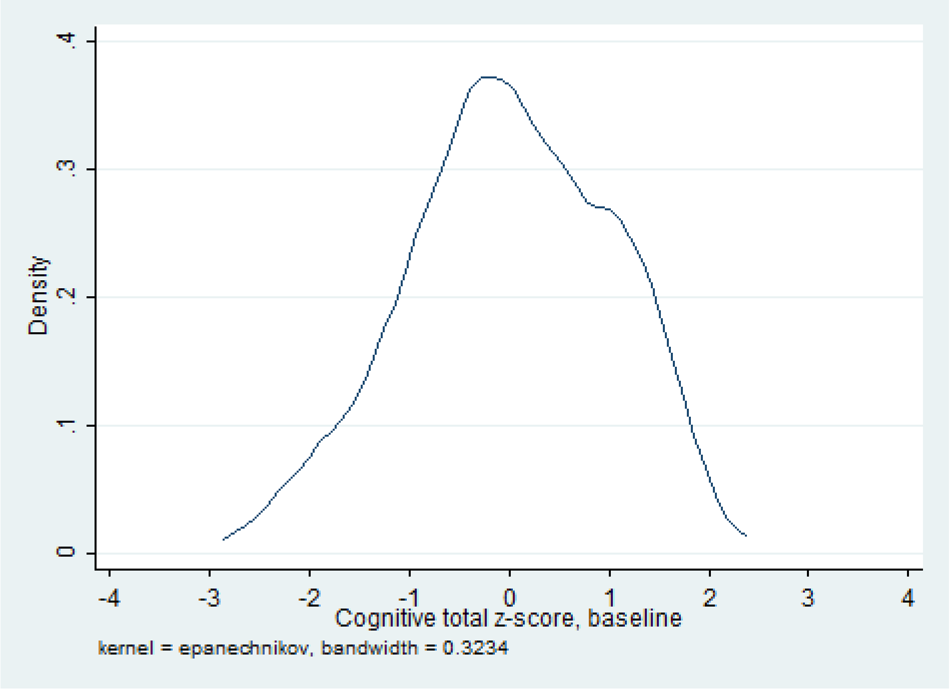
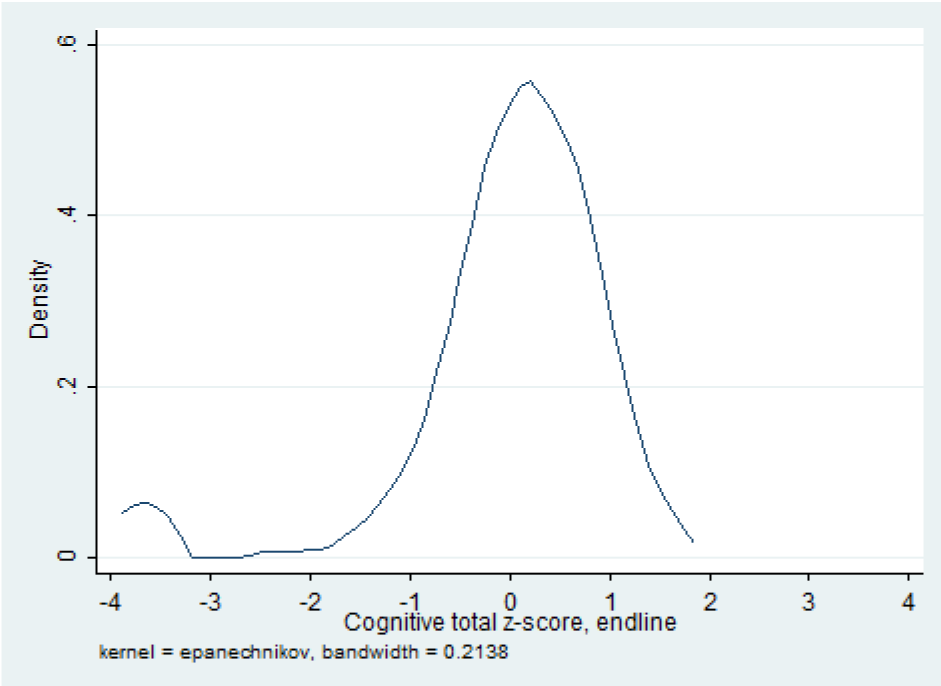


Figure X. Distribution of standardized Cognitive Total z-scores in control group at endline



Density
0
.2
.4
.6
-4
-3
-2
-1
0
1
2
3
4
Cognitive total z-score, endline
kernel = epanechnikov, bandwidth = 0.2138

Appendix B:

Although the attrition rate in our study sample is low, it is necessary to examine whether the attrition was balanced with respect to key characteristics of the sample. We tested whether the probability of attrition was correlated with the treatment assignment. It may be that households receiving food or cash transfers are more likely to remain in their community than the control group households in order to maintain their access to the transfers. If so, this would bias estimated impacts of the transfers on outcomes between treated and control communities. Table B1 presents the results of the models to test for whether attrition was associated with the assignment to the treatment arms. Column 1 shows the results of a linear probability model (OLS) and column 2 presents a probit model. In both models, there is no relationship between assignment to the food, cash or control group and the probability of attrition.

Table B1. Association of attrition with assignment to treatment

Dep. Var.: 1 if household attrited from the sample, 0 otherwise	Linear prob. model	Probit
Food	0.003	0.037
	(0.018)	(0.198)
Cash	-0.004	-0.047
	(0.018)	(0.211)
Constant	0.042***	-1.730***
	(0.013)	(0.143)
Observations	2,561	2,561

Notes: *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

We also examined whether the distribution of key outcome variables or child age differed at baseline in the sample of households that later attrited from the sample of households that remained in the study. Table B2 presents means of several outcome variables and child age across the attrited and non-attrited baseline sample, as well as a test for differences in means across these samples.

Across five raw scores from the tests of child cognitive development, there is no significant difference across samples for four of these outcomes. For the expressive language score, there is a small difference in scores between attrited and remaining households, but the difference is only weakly significant. There are also no differences in food security measures or in child age for the BIC across the attrited sample and the sample that remained in the study.

Table B2. Differences in Baseline Outcome Indicators by Attrition Group

		Full Sample	Remain	Attrited	Difference
Cognitive Development	Mullen	30.154	30.125	30.792	0.667

	[1,735 obs.]	(7.958)	(0.367)	(1.005)	(1.014)
	Visual reception	9.336	9.312	9.894	0.582
	[2,024 obs.]	(3.562)	(0.143)	(0.363)	(0.374)
	Fine motor	5.038	5.044	4.911	-0.133
	[1,845 obs.]	(2.255)	(0.093)	(0.280)	(0.281)
	Receptive language	10.934	10.913	11.417	0.504
	[2,018 obs.]	(3.143)	(0.137)	(0.362)	(0.362)
	Expressive language	4.442	4.431	4.694	0.263*
	[2,072 obs.]	(1.295)	(0.046)	(0.085)	(0.096)
Food Security	DD I	8.239	8.245	8.112	-0.132
	[2,560 obs.]	(3.331)	(0.160)	(0.330)	(0.340)
	HDDS 13	5.307	5.315	5.121	-0.193
	[2,560 obs.]	(1.738)	(0.076)	(0.154)	(0.162)
	HDDS	5.092	5.098	4.953	-0.145
	[2,560 obs.]	(1.608)	(0.074)	(0.152)	(0.158)
	FCS 9	34.168	34.193	33.589	-0.604
	[2,560 obs.]	(15.179)	(0.633)	(1.955)	(1.871)
	FCS	32.863	32.867	32.766	-0.101
	[2,560 obs.]	(14.638)	(0.649)	(2.003)	(1.918)
Demographic	Child age (months)	53.003	52.847	56.579	3.733
	[2,561 obs.]	(17.719)	(0.416)	(1.451)	(1.458)

Notes: *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Appendix C.

For context, we provide additional descriptive statistics on baseline household characteristics, with balancing demonstrated at baseline across treatment arms.

We first compare household demographics across treatment groups, looking at differences in the full age distribution. Table C1 shows that means are very similar in magnitude by treatment group, and there are no significant differences.

Table C1. Differences in household size and age distribution by treatment group, 2010

	Means, 2010			Difference in Means		
	Food	Cash	Control	Food - Control	Cash - Control	Food - Cash
Total number of household members	6.324	6.190	6.311	0.014	-0.121	0.135
	(0.084)	(0.100)	(0.112)	(0.142)	(0.156)	(0.129)
Number of members aged 0-2	0.796	0.797	0.785	0.012	0.013	-0.001
	(0.024)	(0.032)	(0.027)	(0.036)	(0.042)	(0.041)
Number of members aged 3-5	1.360	1.398	1.380	-0.020	0.019	-0.038
	(0.020)	(0.022)	(0.018)	(0.028)	(0.029)	(0.030)
Number of members aged 6-14	1.791	1.705	1.764	0.028	-0.058	0.086
	(0.049)	(0.061)	(0.074)	(0.088)	(0.098)	(0.077)
Number of members aged 15 and up	2.377	2.289	2.383	-0.006	-0.094	0.088
	(0.045)	(0.037)	(0.046)	(0.066)	(0.060)	(0.057)

Notes: Estimates are baseline means with standard deviations in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. N=2560.

We then compare ownership of assets and durables by treatment group. Table C2 shows that proportions of households owning each category of assets or durables is in most cases very similar in magnitude by treatment group, particularly for livestock. There are however significant differences in the ownership of large pots and pans (about 7 percent more households in each of the cash and food groups owns large pots and pans than in the control group), as well as in ownership of mosquito nets (about 8 percent more households in each of the cash and food groups owns mosquito nets than in the control group). There is also very-small-in-magnitude but borderline-significant difference in the proportions of households owning farm implements between the food and control groups.

Table C2. Differences in ownership of assets and durables by treatment group, 2010

	Proportions, 2010			Difference in Proportions		
Proportion of households with…	Food	Cash	Control			Food - Cash

				Food - Control	Cash - Control	
Any cattle	0.125	0.105	0.122	0.002	-0.018	0.020
	(0.021)	(0.025)	(0.025)	(0.033)	(0.035)	(0.032)
Any sheep	0.132	0.107	0.115	0.016	-0.008	0.025
	(0.019)	(0.018)	(0.015)	(0.025)	(0.025)	(0.026)
Any goats	0.192	0.190	0.176	0.016	0.014	0.002
	(0.019)	(0.028)	(0.024)	(0.031)	(0.038)	(0.035)
Any chickens	0.373	0.365	0.394	-0.021	-0.029	0.008
	(0.025)	(0.031)	(0.026)	(0.037)	(0.042)	(0.041)
Any farm implements	0.952	0.944	0.912	0.039*	0.032	0.007
	(0.008)	(0.017)	(0.018)	(0.020)	(0.025)	(0.019)
Any ploughs	0.259	0.232	0.228	0.031	0.004	0.027
	(0.030)	(0.034)	(0.027)	(0.041)	(0.045)	(0.047)
Any seed stores	0.100	0.073	0.082	0.018	-0.008	0.027
	(0.018)	(0.017)	(0.020)	(0.027)	(0.026)	(0.025)
Any chairs	0.423	0.452	0.416	0.007	0.036	-0.029
	(0.035)	(0.041)	(0.045)	(0.057)	(0.062)	(0.054)
A coal or wood stove	0.171	0.201	0.165	0.006	0.035	-0.029
	(0.028)	(0.033)	(0.030)	(0.041)	(0.044)	(0.043)
Any granaries	0.468	0.414	0.367	0.101	0.047	0.054
	(0.048)	(0.051)	(0.046)	(0.066)	(0.069)	(0.070)
Any jewelry	0.831	0.819	0.847	-0.016	-0.028	0.012
	(0.028)	(0.030)	(0.029)	(0.041)	(0.043)	(0.042)
Any large pots/pans	0.410	0.416	0.340	0.071*	0.076*	-0.005
	(0.029)	(0.024)	(0.028)	(0.041)	(0.038)	(0.038)
Any mosquito nets	0.849	0.841	0.759	0.089**	0.081**	0.008
	(0.022)	(0.023)	(0.033)	(0.040)	(0.040)	(0.032)
Any skins/animal hide	0.681	0.665	0.694	-0.013	-0.028	0.015
	(0.032)	(0.039)	(0.031)	(0.045)	(0.050)	(0.052)
Any weapons	0.204	0.171	0.171	0.033	0.001	0.033
	(0.024)	(0.030)	(0.025)	(0.036)	(0.040)	(0.040)

Notes: Estimates are baseline means with standard deviations in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. N=2560.

We next consider whether there are differences at baseline between treatment groups on several measures of food consumption patternsin addition to those shown in Section 4.3. Table C3 shows that, for the food gap and meal frequency during the worst month of food insecurity over the last 12 months, there is no significant difference by treatment group status. For meal frequency during a good month, there is a small, weakly significant difference between meal frequency, with households in the cash group reporting slightly higher meal frequency than those in the control group.

Table C3. Differences in Measures of Food Consumption Patterns by Treatment Group, 2010

		Mean, 2010			Difference in Means		
	N	Food	Cash	Control	Food - Control	Cash - Control	Food - Cash
Number of months of 'food gap' in last 12 months	2,977	6.155 (0.313)	5.926 (0.298)	5.571 (0.312)	0.584 (0.442)	0.355 (0.449)	0.229 (0.431)
Meals per day for adults during worst month in last 12 months	2,930	1.208 (0.031)	1.268 (0.039)	1.221 (0.029)	-0.014 (0.046)	0.046 (0.051)	-0.060 (0.052)
Meals per day for children during worst month in last 12 months	2,929	1.636 (0.040)	1.656 (0.047)	1.622 (0.037)	0.013 (0.057)	0.034 (0.063)	-0.020 (0.063)
Meals per day for adults during a good month in last 12 months	2,929	2.318 (0.049)	2.335 (0.051)	2.206 (0.052)	0.112 (0.073)	0.129* (0.073)	-0.017 (0.072)
Meals per day for children during a good month in last 12 months	2,911	2.645 (0.047)	2.706 (0.050)	2.591 (0.044)	0.054 (0.066)	0.114* (0.067)	-0.061 (0.069)

Notes: The 'food gap' refers to a month in which the household was unable to meet its food needs. Estimates are baseline means with standard deviations in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. N=2560.

We then assess differences in child health behaviors, by looking at child deworming in the past 6 months by treatment group. Table C4 shows that proportions of children age 3-5 receiving deworming are very similar across treatment groups for all categories, and there are no statistically significant differences.

Table C4. Differences in child deworming in the past 6 months by Treatment Group, 2010

	Proportions, 2010			Difference in Proportions		
Proportion of…	Food	Cash	Control	Food - Control	Cash - Control	Food - Cash
Children age 3-5 who received de-worming medicine in the last 6 months	0.904 (0.020)	0.907 (0.017)	0.906 (0.019)	-0.002 (0.028)	0.001 (0.026)	-0.003 (0.026)

Notes: Estimates are baseline means with standard deviations in parentheses. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. N=2560.

Appendix D. Alternate estimates using ANCOVA specification

As a robustness check for each of our each estimates, for all outcomes where we have baseline information, we also use an ANCOVA specification to estimate impacts, which allows for the autocorrelation of outcomes to be positive but low (McKenzie, 2010). [20] We find very similar results in all cases, even with the slightly smaller sample owing to some missing observations at baseline.

Denoting the outcome variable at baseline as Y_{i0}, the outcome at endline as Y_{i1}, and the indicator for the treatment as T_i, the general ANCOVA model takes the form,

$$(1) \quad Y_{i1} = \beta_0 + \beta_1 T_i + \beta_2 Y_{i0} + \varepsilon_i \, .$$

In our estimation, we include two treatment indicators – one for receiving the food treatment and one for receiving the cash treatment. We also include dummy variables for children's age in months, in order to non-parametrically account for patterns in our outcome variables by age, since there is potential for child development to differ considerably by small differences in ages in months at such young ages. The dummies capture variation in outcomes due to the effects of age, improving precision of estimates. The specification is flexible enough to take into account relationships between outcomes and age that are not linear and include discontinuities at particular ages.

We show below the results for impact estimates on cognitive and noncognitive measures using the ANCOVA specification. We find that results are both qualitatively and quantitatively very similar between the ANCOVA specification and the single-difference specification, as would be expected with balanced scores at baseline. The ANCOVA specification simply has slightly fewer observations due to some missing observations at baseline.

[20] For all of the analysis in this paper, we test the autocorrelation in outcomes and find that it is generally quite low (for example, often below 0.2). McKenzie (2010) shows that when autocorrelation is low, there is a substantial gain in statistical power from estimating an ANCOVA specification rather than a difference-in-difference specification.

Table D1. Impacts of food or cash transfers on cognitive and noncognitive measures, ANCOVA

	COGNITIVE Z-SCORES					NON-COGNITIVE SCORE
	Visual reception	Fine motor	Receptive language	Expressive language	Cognitive total	Sticker test
Food	-0.189	-0.085	-0.120	-0.217*	-0.140	-0.044
	(0.117)	(0.136)	(0.139)	(0.119)	(0.138)	(0.083)
Cash	0.310**	0.190	0.348**	0.447***	0.328*	0.076
	(0.138)	(0.176)	(0.156)	(0.148)	(0.190)	(0.086)
Observations	644	556	640	659	519	612
F-Test: Food=Cash	5.18 **	1.09	3.47 *	8.95 ***	2.92 *	0.69
p-value	0.0254	0.2997	0.0661	0.0036	0.0912	0.4086

Notes: Standard errors in parentheses, corrected for stratified design and clustering. * $p < 0.1$ ** $p < 0.05$; *** $p < 0.01$. All estimations include children's age-in-months dummies as covariates.