

**RCT Impacts of Cash, Food, and Nutrition Behavior Change Communication on Long-Term Child Development in Bangladesh**

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Pre-Analysis Plan

## **Abstract**

Our research aims to conduct a long-term follow-up of social protection interventions on child development outcomes. Poor households from across 500 villages in two Northern districts (Rangpur and Kurigram) and four Southern districts (Patuakhali, Pirojpur, Bhola, Khulna, and Bagerhat) in Bangladesh were randomized across five different treatment arms and we examine impacts on four of the treatment arms surveyed in the 8-year post-program follow-up survey. The treatment arms are: 1) cash only 2) food only 3) cash and nutrition behavior change communication (BCC) 4) food and nutrition BCC and a control group. Our study aims to answer the following research questions: What are the impacts of different early childhood transfer modalities and complementary programming on child development at age 10-12 years old? What are the tradeoffs between cash and food? How does adding complementary nutrition education to transfers affect child development? Findings from this research will inform whether social protection programs can support long-term benefits for child development and a pathway to break the cycle of intergenerational poverty.

## Introduction

Due to extreme poverty and inadequate early nutrition environments, 250 million children under 5 years old in low-and-middle-income countries (LMICs) are at risk of not reaching their developmental potential (M. M. Black et al., 2017). An estimated 55 million of these children have significant cognitive delay (Emerson et al., 2018). Social protection programs can positively impact child development through many pathways, such as increasing income for child investments in health and education, reducing parental stress and depression, and increasing knowledge about cognitively stimulating activities. Previous research demonstrates positive effects of social protection programs on children's health, schooling, and academic outcomes (Baird et al., 2014; de Walque et al., 2017).

However, there are several gaps in the literature. First, there is little evidence on how social protection affects foundational cognitive and noncognitive skills, yet theories of skill formation discuss the importance of these foundational skills to maximize the returns to investments in children's human capital (Cunha et al., 2006).

Measures of foundational cognitive and behavioral skills predict better adult health, academic, and financial outcomes (Gertler et al., 2014; Moffitt et al., 2011; Ozawa et al., 2022). In particular, executive function (EFs) support learning and social skills critical for child development and later-life outcomes (Obradović & Willoughby, 2019). EF skills are higher-order cognitive processes that support engagement in goal-directed learning (Diamond, 2013). EF behaviors are the application of EF skills in everyday contexts to pay attention and stay engaged (McClelland & Cameron, 2012). Certain early childhood interventions impact short-term EFs in LMICs (Jeong et al., 2021; Obradović et al., 2019) and high-income countries (Takacs, 2019). There is limited causal evidence on the *long-term* impacts of early childhood interventions on EFs (Walker et al.,

2022). Targeting social protection programs to low-income households with children can maximize program benefits by addressing immediate needs and alleviating intergenerational poverty. However, we need more evidence on how different early childhood transfer modalities and their complementarities improve child development in the long run.

This study will examine the long-term effects of cash, food, and nutrition behavior change communication (BCC) on measures of child development in middle childhood. The primary analysis will focus on the effect of the different interventions on EF task measures administered to children ages 10-12 years old. We will also analyze the impact of the social protection programs on other child development outcomes and examine the correlations among the different measures. Descriptive path analysis using the longitudinal data will also demonstrate the relations among different factors (e.g., household poverty, parental stress, children's education) that may be positively impacted by the early childhood interventions and in turn promote long-term child development.

## **Background**

Cash transfers can alleviate resource constraints so families can spend more money and time on health care, nutritious foods, and stimulating activities that promote children's development (Macours et al., 2012). Direct in-kind transfers of food and nutritional supplements can also benefit children's development (Walker et al., 2007). There are tradeoffs for cash versus in-kind transfers. In-kind transfers can be better for targeting and providing price insurance, but they are more paternalistic (Gadenne et al., 2021). Unconditional cash transfers improve both psychological wellbeing and economic outcomes more broadly (Haushofer & Shapiro, 2016), but labeling the cash transfer for a specific objective can also direct how it is used (Benhassine et al., 2015). Furthermore, complementary programming combining transfers with knowledge can shift

family preferences toward investing in children's inputs and increase knowledge on how to support children's nutrition and development (Attanasio et al., 2021). We need evidence on the long-term tradeoffs of different transfer programs to design effective social protection programs that improve child development.

Social protection programs that benefit children in the first two years of life during a period of high brain plasticity can be especially advantageous for their long-term development (Thompson & Nelson, 2001). The frontal networks of the brain contribute to the neural basis for EF development and are influenced by biological and environmental factors, such as fulfilling health needs and having a stimulating environment (Britto et al., 2017; Costello et al., 2021). Early investments in child development that improve biological and environmental conditions can promote equitable long-term child outcomes.

### **Biological Mechanisms**

Adequate early childhood health and nutrition supports brain development and children's cognitive outcomes. Stunting, measured by height-for-age Z-scores, is an indicator of inadequate health and nutrition. Children's stunting is associated with negative early childhood cognitive outcomes and later reduced economic productivity and poor school performance (R. E. Black et al., 2013; Perkins et al., 2017). Children need diversified diets rich in iron, folate, vitamins, and other nutrients key for brain and EF development (Costello et al., 2021; Thompson & Nelson, 2001). Nutritional deficiencies can also occur with a high exposure to pathogens and infectious diseases in LMICs, which can hinder food and nutrient uptake (Britto et al., 2017). Resource-constraints prevent families from fulfilling their children's health and nutritional needs, which reduces development of higher order neurological processes that support cognitive skills (Aboud & Yousafzai, 2015).

Cash and food transfers provide resources for families to feed their children more nutrient-rich foods. Cash provides more purchasing power and allows households to invest in income generating assets for sustained investment in children's health and nutrition. Cash transfers significantly decrease children's stunting and increase their dietary diversity and consumption of animal-source foods (Manley et al., 2020). Food transfers also improve children's height and psychomotor development, but the food is divided among all the household members so children do not receive all the additional nutritional benefits (Kristjansson et al., 2015). Overall, social protection programs alleviate resource constraints to promote children's health and nutrition, but there is mixed evidence on the comparative effectiveness of cash versus in-kind food transfers (Olney et al., 2022).

Complementary nutrition BCC provides mothers with knowledge on improved feeding practices and hygiene to target transfers and promote child development. There is mixed evidence on the added effectiveness of complementary nutrition BCC on child development in LMICs. A review of cash transfer programs with added components such as nutrition BCC demonstrated there is no added impact beyond the cash transfers of BCC on child health and cognitive development outcomes (Little et al., 2021). A meta-analysis of food transfers and complementary nutrition education demonstrates small but significant impacts on children's linear growth (Panjwani & Heidkamp, 2017).

Previous follow-up analyses of this study RCT demonstrate that the cash and nutrition BCC intervention reduced children's stunting and improved dietary diversity (Ahmed et al., 2019). Our research will identify whether these early impacts of the intervention on biological mechanisms translate into downstream child development outcomes in middle childhood.

## **Environmental Mechanisms**

In HICs, high levels of chronic and repeated stress from these risk factors hinders development of the prefrontal cortex, stress response physiology, and EF (Blair & Raver, 2012; Zelazo, 2020). Environmental risk factors for child development such as poverty, maternal depression and anxiety, and domestic violence may occur at a higher rate in LMICs compared to HICs (Walker et al., 2011). For example, children in LMICs exposed to corporal punishment are 24% less likely to be on track developmentally (Cuartas, 2021). Social protection programs that alleviate poverty can contribute to improved environmental conditions that can promote child development.

Cash and food transfers alleviate the stress of poverty in low-income households and parents may have more time and bandwidth to interact with children and stimulate them more. Stimulation (linguistic, visual, and sensory, responsiveness (e.g., bonding, secure attachment, sensitive communication), and safety are key environmental conditions to promote child development (Britto et al., 2017). In particular, multisensory stimulation during the sensitive first two years of life promotes brain development (Thompson & Nelson, 2001). Complementary nutrition BCC also encourages mothers to interact more with children through responsive feeding, which is a form of stimulation that can contribute to children's cognitive development.

Women also receive the cash and food transfers, which empowers them and can improve their psychosocial wellbeing. Further, group-based nutrition BCC interventions facilitate social support networks that may improve maternal mental health (Pitchik et al., 2021; Tripathy et al., 2010). Improvements in maternal mental health and wellbeing can enrich nurturing care for children and reduce child stress (Britto et al., 2017). Therefore, social protection programs that reduce household financial stress and help target caregiving resources to childcare can contribute to better environmental conditions that promote child development.

The cash and nutrition BCC intervention in this RCT study improved home stimulation (Ahmed et al., 2021). The same intervention also reduced women's experiences of intimate partner violence (Roy et al., 2019), which suggests children experienced a less stressful home environment. We will evaluate whether the effects of cash and nutrition BCC on environmental mechanisms also translate into long-term effects on child development outcomes.

### **Current Study**

We examine the long-term RCT effects of early childhood cash, food and nutrition behavior change communication (BCC) interventions on foundational child development skills in rural Bangladesh. Our RCT analysis will examine the effects of four different treatment arms 1) cash only 2) food only 3) cash and nutrition BCC and 4) food and nutrition BCC on children's EFs and related behavioral outcomes and fluid intelligence. We will contribute causal evidence on the impact of early childhood interventions on long-term foundational skills, which is an area with limited evidence in LMICs. Our study aims to answer the following research questions: What social protection design using transfer modalities is most effective for long-term child development? Does complementary nutrition education help target transfers to improve child development? This study will advance our understanding of how to design social protection programs that maximize long-term benefits for child development.

## **Methods**

### **Study Design**

Between 2012 and 2014, the International Food Policy Research Institute (IFPRI) and the World Food Programme implemented the Transfer Modality Research Initiative (TMRI)—a cluster-randomized controlled trial that examined which types of social protection programs



improve household and child outcomes among the ultra-poor. TMRI was implemented in two different regions in Bangladesh.

The North encompassed Rangpur and Kurigram districts in the Rangpur division (North). The South encompassed Patuakhali, Pirojpur, and Bhola districts in the Barisal division and Khulna and Bagerhat districts in the Khulna division (South). In 2016, Rangpur (North) had the highest poverty and food insecurity rates in Bangladesh with 31.3 percent of the rural population living in extreme poverty (BBS, 2019). Markets function well in the North because they are connected to each other and accessible with developed road infrastructure and offer a diverse set of consumption goods.

The South has lower rates of poverty and food insecurity than the North with extreme poverty of 14.9 percent and 13.1 percent of the population in Barisal and Khulna, respectively. However, the South is along the coastline and has a flat topography with multiple rivers so it is more prone to flooding and environmental risks such as cyclones and saline water surges. Compared to the North, the physical infrastructure is worse in the South and markets do not function as well. Therefore, each region has unique conditions that led to allocating different transfers by region.

In each region, there were 50 villages randomly selected from each of the five subdistricts for a total of 250 villages. Each village was assigned to the control group or one of four interventions. In both the North and the South, villages were assigned to (1) cash transfers only (Cash), (2) food rations only (Food), or (3) half cash transfers and half food rations (Cash + Food). In the North, the fourth intervention was cash transfers and nutrition BCC (Cash + BCC) and in the South, the fourth intervention was food rations and nutrition BCC (Food + BCC). Ten households that met the following criteria were randomly selected from each of the 250 villages:

(1) the household was poor (defined as their total consumption expenditure being less than the lower poverty line in Bangladesh), (2) the household had at least one child aged 0-24 months in February-March 2012, when a village census was conducted to identify eligible households, and (3) the household was not receiving benefits from other social safety net interventions. Thus 2,500 households in each region were selected for the study for a total of 5,000 households.

The mother of the child was the beneficiary for the transfers and the participant in the BCC activities. Mothers in the Cash arm received a monthly payment of 1,500 Taka (USD 19) per household via a mobile phone cash transfer system. Mothers in the Food arm received a monthly food ration of 30 kilograms (kg) of rice, 2 kg of mosoor pulse (a lentil), and 2 liters of micronutrient-fortified cooking oil. Rations were given out at designated distribution points. The initial value of the food rations was equivalent to the value of the cash transfers. Mothers in the Cash + Food arm received half of each transfer: 750 taka, 15 kg of rice, 1 kg of mosoor pulse, and 1 L of micronutrient-fortified cooking oil.

In the Cash + BCC and Food + BCC arms, mothers received the same transfers as the Cash and Food arms respectively along with intensive nutrition BCC interventions that promoted education and behavior change for the household and community. The BCC intervention involved three activities: (1) weekly group trainings led by a female community nutrition worker (CNW), (2) bimonthly visits by CNWs to beneficiary households, and (3) monthly group meetings between program staff and influential community leaders. About 9-15 beneficiaries were a part of each group. The group trainings took place within 2 km of beneficiaries' homes and lasted about one hour on average. Beneficiaries assigned to the BCC attended on average 48 out of the 52 scheduled sessions each year.

Trainings covered basic nutrition, control and prevention of micronutrient deficiencies, infant and young child feeding, health care, maternal nutrition, and hygiene. Although the training did not include a specific component related to stimulating children for early childhood development, the sessions emphasized responsive feeding. For example, mothers were presented messages to encourage children to eat by singing songs and telling stories rather than forcing them to eat (Ahmed et al., 2021). Therefore, the nutrition BCC may target the transfers to promote biological and environmental conditions beneficial for child development.

### **Previous Data Collection and Findings**

The initial TMRI impact evaluation consisted of three surveys: (1) a baseline survey in March-April 2012 prior to the start of the intervention in May 2012, a midline survey in June 2013, and an endline survey in April 2014. Two additional rounds of surveys were conducted to assess the post-program impacts of the TMRI interventions. The first survey was conducted six to ten months after the intervention ended (between October 2014 and February 2015). The second survey was conducted four years after the intervention ended (between April and May 2018). Multi-topic surveys that were consistent across survey rounds included rich longitudinal data on a range of outcomes including consumption, assets, child nutrition, home environment, child academic outcomes, intimate partner violence and other intrahousehold dynamics, and men's and women's emotional well-being.

Previous analysis showed that all treatment arms improved food security at endline, but the combination of Cash + BCC led to the largest benefits in terms of outcomes at the level of households, women, and children (Ahmed et al., 2016, 2019). In particular, there was an improvement in children's height-for-age z-scores (0.25 SD) and dietary diversity, which may promote neurobiological development of children's foundational skills and behaviors (Ahmed et

al., 2019). Cash + BCC also reduced women's experience of intimate partner violence four years after the program ended (Roy et al., 2019). In the Northern Region, there are also significant improvements in children's home environment (quality and amount of stimulation for children and maternal depression) in the Cash and Cash + BCC arms at both six months and four years after the program (Ahmed et al., 2021). There are also some impacts on children's IQ and academic outcomes from the Cash or Cash + BCC but these effects are concentrated among boys (Ahmed et al., 2021). In the Southern region, there were limited impacts of the Food or Food + BCC arms on home environment or child development (Ahmed et al., 2021). This study will incorporate measures of EF and SR to capture additional foundational constructs important for children's learning and wellbeing.

### **Current Study Data Collection**

In summer of 2022, we conducted another TMRI follow-up survey 8-years post-program to examine the impact of the social protection programs on long-term child development in addition to other household level outcomes. We surveyed the Cash, Food, and Control treatment arms in both the North and the South and the Cash + BCC arm in the North and the Food + BCC arm in the South. Our sampling frame included the 3,683 households who were surveyed in the 2018 survey at 4-years post-program.

### **Measures**

#### ***Hearts and Flowers Task***

The Hearts and Flowers task (H&F; Davidson et al., 2006) is a tablet-based task administered to the index child and measures inhibitory control and cognitive flexibility skills. The task consisted of three blocks of trials. First, there were 12 congruent hearts trials where students pressed the button on the same side as the stimuli (i.e., heart), which establishes a baseline response

time for the trials. Next, there were 12 incongruent flowers trials where students pressed the button on the opposite side of the stimuli (i.e., flower), which measured their inhibitory control to suppress the dominant response to press below the flower. Finally, there were 33 mixed hearts and flowers trials to measure cognitive flexibility of switching between the instructions. The stimuli for all the blocks appeared for 750 ms.

### ***Digit Span***

The Digit Span task is administered to the index child and is a measure of working memory based on children's ability to repeat a sequence of numbers. The Digit Forward block included eight items starting with sequences of two numbers in the first item and increasing sequences by one number for each item to a maximum sequence of nine numbers in the final item. The assessor read out the sequence of numbers and the child was instructed to repeat the sequence back in the same order. The Digits Backward block included seven items starting with sequences of two numbers in the first item and increasing sequences by one number for each item for a maximum of eight numbers in the final item. The assessor read out the sequence of numbers and the child was instructed to repeat the sequence backwards. There were three trials in each item and the block ended when the child was incorrect on two out of three trials for an item. The score for each block is the highest number of digits the child repeated correctly.

### ***Raven's Standard Progressive Matrices***

The Raven's Standard Progressive Matrices (RSPM) is administered to the index child and is a measure of fluid intelligence based on pattern recognition and abstract reasoning. We administered sets A and B, which each consisted of 12 items. The items show different geometrical patterns with missing pieces and ask the child to select the missing piece that matches the pattern

among four multiple choice options. The child's correct responses were summed across the 24 items, which resulted in a score ranging from 0 to 24.

### ***Assessor-Report of Self-Regulation***

The Assessor-Report of Self-Regulation (ARSR) was adapted from the Preschool Self-Regulation Assessment Assessor Report (Smith-Donald et al., 2007) by selecting relevant items and translating the wording to convey the appropriate meaning in Bangla. The ARSR was completed by the assessor who administered the child assessments and reported on children's behavior during the assessment. The assessor rated children using 13 items that measure children's self-regulation of attention, behavior, and emotion with a response scale that indicates behavioral markers. For example, assessors rated children on the item, "Sustains concentration; willing to try repetitive tasks", on the following scale: *1 = Child not able to concentrate or persist/continue on much of the assessment; 2 = Child frequently distracted, requires multiple prompts from the Child Assessor; 3 = Child occasionally distracted but generally persistent, but does not require prompt from the Child Assessor; 4 = Child able to concentrate and persist with the task, even toward the end of tasks and with distractions.* Higher scores indicate more developed self-regulation. Assessors were trained on the ARSR and in the field both the male and female interviewers completed the ARSR with an inter-rater reliability of XX%. The 13 items had an internal consistency of ( $\alpha =$ ) and we created a composite score by taking the average of the ratings across all the items.

### ***Strength and Difficulties Questionnaire***

The Strength and Difficulties Questionnaire (SDQ) is completed by the female caregiver of the index child and includes 25 items that report on the child's behavior over the last six months. Each item describes a behavior of the child (e.g., "Restless, overactive, cannot stay still for long")

and the caregiver responds whether it is  $0 = \text{Not true}$ ,  $1 = \text{Somewhat true}$ ,  $2 = \text{Certainly true}$ . The SDQ consists of five subscales for emotional problems, conduct problems, hyperactivity, peer problems, and prosocial behavior. The caregiver responses are summed across all the items and the total score can range from 0 to 40. A higher SDQ score is indicative of a child with more behavioral difficulties.

### **Analysis Plan**

The RCT design allows us to rigorously identify the effect of cash and food transfers and the effects of nutrition BCC over and above the transfers. The main analysis will assess the impact of TMRI interventions on child development measures. We will conduct intent-to-treat (ITT) analysis. Our results will be disaggregated by region (North and South), child sex, child stunting at baseline, and maternal education. We will also use the rich panel data to analyze the intermediate inputs that promote child development, such as nutrition, home stimulation, and maternal mental health.

### **Primary Outcomes**

We will construct composites of the primary outcomes and assess the robustness of our results to different constructions of the composite.

- Hearts and Flowers task (EF inhibitory control and cognitive flexibility)
- Digit Span task (EF working memory)
- Raven's Progressive matrices (IQ)

### **Secondary Outcomes**

#### *Child Behavioral Outcomes*

- Assessor-report of self-regulation (SR)
- Module T7: Strength and difficulties questionnaire

- Emotional problems scale, conduct problems scale, hyperactivity scale, peer problems scale, prosocial scale

*Education of index child and siblings*

- Module B. Household composition and education

*Nutrition of the index child*

- Module X-2: Intra-Household Food Arrangement and Distribution from last 24 hours

*Home environment/maternal wellbeing*

- Module T8: Discipline of index child (e.g., took away privileges, explained why behavior wrong, physical punishment, verbal punishment)

**Exploratory Outcomes**

*Household socioeconomic status*

- Household consumption module

*Home environment/maternal wellbeing*

- Men (Module CCM) and Women's (Module CCF) psychological well-being
  - Perceived stress scale (how often felt a certain way in the last month), depression
- Module WP: Intimate Partner Violence
  - How partner treats mother
- Module O4: Time allocation
  - Child care for different household members

*Parental aspirations for child/values*

- Module BB2: Women's gender norms and Module BBM2: Men's gender norms
- Module CCM4.3 and Module CCF4.3: Men and Women's Aspirations for education of children in family



### *Maternal knowledge of nutrition*

- Module T2: Maternal nutrition knowledge:
  - Maternal knowledge of infant and young child feeding (IYCF) practices; knowledge, attitudes, practice of IYCF scored as yes/no and as a total score on all questions

### **Power Calculations**

The sample size of the original TMRI study was designed with power calculations that give 80 percent chance of detecting key child development outcomes such as a 16% improvement in the average height-for-age Z-score and an 8% improvement in their average dietary diversity (Ahmed et al., 2016). At the household level, the sample size of the TMRI study was designed with power calculations that give 80 percent chance of detecting a 12% increase in per capital total expenditure per month and a 7% increase in per capita calorie intake per day (Ahmed et al., 2016). We can conduct power calculations for the 2022 follow-up survey using the results from the previous TMRI surveys. The clustered standard errors observed in the short and medium term on the impact of the treatment arms on child IQ, motor scores, early literacy and numeracy, and the SDQ ranged from 0.08 to 0.13 across North and the South (Ahmed et al., 2021). Therefore, I multiply the clustered standard error by 1.96 to obtain the minimum detectable effect size at the 95 percent confidence level that ranges from 0.16 to 0.25 standard deviations for each treatment arm for the primary child outcomes.

### **Empirical Model**

For the North and South separately, we will use standard ordinary least squares (OLS) to estimate the following regression model:

$$Y_{ihv} = \alpha + \beta_1 Cash_v + \beta_2 Food_v + \beta_3 TransferBCC_v + X'_{ihv}\gamma + \epsilon_{ihv} \quad (1)$$

Where  $Y_{ihv}$  indicates the outcome of interest for individual  $i$  in household  $h$  in village  $v$ .  $Cash$  is an indicator equal to 1 if the village was assigned to the Cash treatment arm and  $\beta_1$  is the ITT estimate of being assigned to the cash arm relative to the control group.  $Food$  is an indicator equal to 1 if the village was assigned to the Food treatment arm and  $\beta_2$  is the ITT estimate of being assigned to the food arm relative to the control group.  $TransferBCC$  is an indicator equal to 1 if the village was assigned to the Cash + BCC treatment arm (North) or the Food + BCC arm (South) and  $\beta_3$  is the ITT estimate of being assigned to the transfer and BCC treatment arm relative to the control group.  $X_{ihv}$  is a vector of controls included to improve estimate precision. We will include control variables for child sex (except for analyses disaggregated by sex) and age, mother's age at baseline, mother's and father's education at baseline, a dummy variable to indicate if the child was stunted at baseline (e.g., baseline height-for-age z-score less than 2), a dummy variable to indicate the father was part of the baseline household, household size, and per capital monthly household expenditure. I will replace missing values in these variables with 0 and include a separate indicator variable equal to 1 if the value was missing and replaced with 0. I will cluster standard errors at the village level, which is the unit of the randomization. Equation (1) will be estimated for the full sample in each region and for boys and girls separately within each region. We will also examine heterogeneity across maternal education and children's stunting at baseline.

We will also conduct a pooled analysis with both the North and South. Previous findings indicate divergent findings between the North and the South, however, we would like to examine the overall difference in impacts between the Food and the Cash transfers across both regions. We will use standard OLS to estimate the following regression model for the pooled analysis:

$$Y_{ihv} = \alpha + \beta_1 Cash_v + \beta_2 Food_v + \beta_3 TransferBCC_v + X'_{ihv}\gamma + \delta R_{iv} + \epsilon_{ihv} \quad (2)$$

The variables in Equation (2) are the same as Equation (1) except the indicator for *TransferBCC* is excluded since this treatment arm differed between the North and the South. We also added  $R_{iv}$  as an indicator for the region (North or South).

### **Balance Table on Baseline Characteristics and Attrition**

We will analyze the sample descriptive statistics including baseline characteristics (child age and gender, mother's age and education, average household size, stunting rates). We will also examine attrition across the treatment arms and create a balance table that examines the differences in baseline characteristics across treatment arms to examine whether there are any significant differences.

### **Measurement Analysis**

We will investigate the reliability and validity of the EF measures used in this study. We can look at metrics of internal consistency and measurement invariance by child gender and baseline maternal education. We can also examine concurrent validity by analyzing the association of the EF measures with the other child development outcomes administered. Factor analysis of the assessor-report measure will also demonstrate if the factors match what is expected in this population. Additionally, we can go beyond accuracy scores to examine response time on the tablet-based Hearts and Flowers task to see if response time further differentiates children's EF skills. We will also examine the robustness of our results across different methods of calculating the composite primary outcome measure.

### **Additional Analyses**

Based on the findings, we can also explore descriptive path analyses using the longitudinal data to understand the mechanisms behind the effects of different social protection programs. For example, we can examine if the effect of Cash + BCC on EF outcomes is based on biological

and/or environmental mechanisms by incorporating the relevant variables (e.g., height-for-age Z-score, dietary diversity, maternal psychosocial wellbeing, discipline, and intimate partner violence) into a structural model. The main challenge with this approach will be tracing households over time as there are households that separated since the baseline outcomes. We can use records from previous follow-up surveys to identify how to trace households over time based on where the child resides.

### **Implications**

The 2030 United Nations Sustainable Development Goals prioritized equitable child development and policymakers are determining how to maximize their resources to meet this goal. Our analysis will provide policymakers with information on how to design and target social protection programs to promote child development and insights into complementary interventions to support mechanisms behind the effects. Future research can pilot interventions targeting the relevant foundational child development skills identified in our study to complement social protection programs in LMICs. Understanding how social protection programs impact the long-term malleability of foundational skills will inform future policies for equitable child development.

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