BEYOND POVERTY REDUCTION: EVIDENCE FROM A MULTIFACETED PROGRAM ON POVERTY, NUTRITION AND CHILD DEVELOPMENT

ADRIEN BOUGUEN
Santa Clara University

ANDREW DILLON
Northwestern University

We study the impacts of a multifaceted program implemented in Burkina Faso that targets ultra-poor households with young children or pregnant women. The experimental design includes a cash transfer program, a cash plus animal transfer program and a cash, animal and nutrition-focused transfer program. We find that the program significantly reduced extreme poverty in all treatment branches, but only the third, nutritionally focused program, positively impacted child nutrition and development. We find large impacts on young children's anthropometrics measures, motor development and cognitive development of new born children in the nutritionally focused program branch. Our results suggest that while transfer programs are effective at reducing household poverty, nutritionally focused programs are critical to trigger a cognitive response at the child level.

KEYWORDS: Multifaceted, Nutrition, Cognitive development.

INTRODUCTION

Evidence from multiple studies (e.g., Banerjee et al. 2015; Bandiera et al. 2017; Angelucci et al. 2022) suggests that multifaceted programs targeting ultra-poor households have lasting impacts on poverty reduction, asset ownership, household income, consumption, and business investment and revenues. However, whether such programs can effectively address malnutrition and subsequently enhance child cognitive development remains an open question with antecedents in previous debates about the calorie-income elasticity (Bouis and Haddad, 1992, Deaton and Subramanian, 1996, Colen et al., 2018, Almas et al., 2023), intra-household reallocation (Thomas, 1990) or cash transfers, whose impacts on child nutrition remain limited (Manley et al., 2020), specifically when provided unconditionally, as shown in the full literature review available online (Table OB.1). Can multifaceted programs outperform simple cash transfer initiatives in addressing malnutrition and enhancing cognitive development? This broad question is our main motivation, not only because malnutrition affects more than 148 million children worldwide 24 percent of whom live in West Africa, but also because chronic malnutrition can lead to irreversible cognitive and motor development issues (UNICEF et al., 2023). It is also a relevant question for social protection investment because programs that address immediate poverty without reducing child malnutrition might be unable to durably affect inter-generational poverty given the high negative correlation between malnutrition-related cognitive deficits and future earnings (Alderman et al., 2006, Hoddinott et al., 2008).

We study three models of a multifaceted programs to estimate the relative impacts of cash transfers (T1), cash plus asset (livestock) transfers (T2), or cash, asset and a nutrition-focused program that includes nutrition training and nutrient-rich food transfers (T3). Our assessment spans three follow-up surveys: one conducted approximately one year after the initiation of all transfers (later referred to as the *1-year follow-up*), another at the two-year mark (*2-year*

Adrien Bouguen: abouguen@scu.edu
Andrew Dillon: andrew.dillon@kellogg.northwestern.edu

follow-up), and a final survey at the three-year point (*3-year follow-up*), capturing effects about two years post-program completion. Our randomized controlled trial allocates one of the three program models at the village level, targeting ultra-poor households with young children or pregnant women. The study covers 168 villages across two regions of Burkina Faso (East and Boucle du Mouhoun). Our approach differs from previous studies by integrating nutrition focused transfers and education to a “standard” multi-faceted program. Additionally, our targeting strategy focuses on households with pregnant women and children less than five years old, a particularly vulnerable demographic during early life stages (Black et al., 2017, Hamadani et al., 2014). We hypothesize that multifaceted programs, if targeted to households with young children or pregnant women, could fundamentally transform the early environment of young children, reducing poverty and malnutrition, which would, in turn, improve children’s cognitive skills. To our knowledge, the available literature on nutrition-focused multifaceted ultra-poverty programs has not carefully examined this important causal pathway.

We aim to address four primary research questions: First, is the specific multifaceted program implemented in Burkina Faso, targeted at poor households with pregnant women or young children, effective in reducing poverty, improving food security, enhancing nutrition, and ultimately improving children’s anthropometric outcomes? Second, is there evidence of complementarity between cash transfer, asset transfer and/or nutrition-focused program’s activities? Third, are the program’s activities provided in T1 and T2 sufficient to generate significant investment in human capital through improved nutrition and food security, or does such impact necessitate a specific nutrition-focused transfer program as in T3? Fourth, using the 2- and 3-year follow-up survey data, which intervention bundle is more likely to have a lasting impacts on (inter-generational) poverty reduction via cognitive development improvements? Although not a direct research question, our study also provides evidence about the effectiveness of multifaceted poverty reduction programs implemented during a period of increasing conflict. Since 2016, the presence of terrorist groups in Burkina Faso has generated an increasing number of attacks that became prominent in 2019, the second year of the program interventions.

Despite the challenging security situation in the region, we first report evidence that the program was remarkably well implemented. Almost all eligible households received a cash transfer, with 95% of them receiving an average of 182 USD over two years, about 76% of T2 and T3 benefited from an animal transfer (about 5.5 animals transferred) and about 65% received enriched flour in T3. Compliance was also high among the control group which received almost no transfers. In T3, the household heads evaluated the overall value of the transfers cumulatively over two years to be about 314 USD (based on the mid-May 2018 exchange rate), 41 USD significantly larger than in T2 and 114 USD larger than in T1. T3 transfers correspond to 89% of the national poverty rate (INSD, Janvier 2022) provided over two years. Since the households included in the study are by design below the national poverty threshold, we estimate that, over the two years of implementation, the program transferred about one year of annual consumption. The T3 program is equivalent to a transfer of 836 USD PPP, based on a PPP conversion factor in mid-May 2018. While substantial, its value is lower than comparable multifaceted programs implemented elsewhere, which transferred amounts ranging from 1,131 to 3,091 USD PPP (Banerjee et al., 2015).

Second, we find evidence that the program reduced overall poverty. Using our large baseline survey and the qualitative baseline poverty classification (ultra poor, poor ...), we train a machine learning algorithm (random forest) to predict the probability to have been categorized as ultra-poor at baseline during the HEA. We then use this algorithm to determine whether each household is predicted to be ultra poor in follow-up survey rounds. One year after the beginning of the interventions, the predicted probability of ultra-poverty significantly decreased in all experimental groups, by approximately 3 percentage points (pp) in T1 and 4 pp in T2 and

T3 relative to the control group. This reduction remained significant after two years (about one year after the end of transfers) and after three years, exclusively in the T3 branch. Although the predicted probability to be ultra-poor is probably underestimated (our classification sensibility is only of 83%), taken at face value, these poverty impacts are striking. They imply that, one year after the beginning of the intervention, ultra-poverty is reduced between 50% and 70% depending of the treatment group. After two years, the reduction is significant only in T3 but remains large (-50%) and stays substantial and significant in the 3-year follow-up (-28%) almost two years after the end of all transfers. These substantial poverty reductions stem from significant financial and agricultural investments, with larger and more pronounced effects in T3. Treated households exhibited reduced debt (in the 1-year follow-up), increased savings (in the 1- and 2-year follow-up), expanded land cultivation and ownership (in the 1- and 2-year follow-up), augmented investments in agricultural equipment (in all follow-up surveys), and have higher agricultural revenue (in the 1-year follow-up). These economic impacts come along with positive shifts in aspirations and stress reduction. In summary, the multifaceted program effectively enhanced the economic and social well-being of households, with discernible impacts on adult's aspirations and mental well-being.

Third, these impacts extend to self-reported household food insecurity and food diversity. In the 2-year follow-up survey, the reduction in severe food insecurity ranged from 5 to 8 percentage points across all treatment groups. This represents a significant decrease between 22% to 34% compared with the control average. Moreover, the program affected food diversity, with significant differences observed in the 1-year follow-up and specifically in T3. In a survey targeting breastfeeding mothers and pregnant women, we uncovered noteworthy findings. Women in T3 exhibit significantly better food diversity (+0.31 SD), primarily driven by increased consumption of animal proteins and fruits and vegetables rich in Vitamin A. This result together with our measures of aspirations, which reveals particularly large effect on aspiration with regards to children's education attainment, suggest a shift in household priorities towards education and nutrition in T3.

Fourth, our child-level measurements, focusing on children below five years old, reveal positive impacts on anthropometrics, predominantly concentrated in the T3 cash, livestock and nutrition treatment group. In the 1-year follow-up survey, T3 exhibits strong effects on all anthropometric measures, addressing both short-term (children with severely wasting is down by -1.2 pp from a control average of 2.6% i.e. a 46% decline) and chronic malnutrition (severely stunting is down by 3.3 pp from an average of 12.8 i.e. 26% decline). T3 children also have larger arm circumference (another measure of wasting) and are less likely to be severely underweight (-2.6 pp from a control average of 8.3%, i.e. 31% decline). These impacts remain positive, significant, and mostly amplified in the 2-year follow-up survey. In this survey year, severe stunting is for instance down by 5.4 pp or equivalent to a 33% decline. Two years after the end of the intervention, the impacts remain significant for chronic malnutrition (+0.12 SD), again in the T3 group only.

Last, we find evidence that the program positively impacted the motor skills of already-born children and the cognitive development of newborns who benefited from the program *in utero*. Our measures of cognitive and motor development administered to the children age 3-6 in the 2- and 3-year follow-up i.e., those born before the interventions started, indicates no impact on cognitive ability but significant impacts on motor development, only significant in the 2-year follow-up survey (+0.19 SD). As these results are only significant for T3, we attribute them to the improved nutrition provided to these children. Furthermore, we find evidence that children aged 0-3 years in the 3-year follow-up survey exhibit improved cognitive and motor capacities. None of these children were born at baseline; they were either *in utero* when the program started or received the program in their very early years. These findings suggest that the timing of the intervention is crucial to generate significant impacts on cognitive ability with more pronounced impacts when children are either very young or *in utero*. Our results suggest that better nutrition for young mothers during pregnancy and breastfeeding can have enduring effects on the cognitive abilities of young children.

These results contribute to several strands of the literature on poverty alleviation and nutrition. First, they suggest that multifaceted interventions, such as those highlighted in studies like Bandiera et al. (2017) and Banerjee et al. (2015), which have proven effective at stimulating economic activity, may not be sufficient to reduce malnutrition, when implemented without a specific nutrition program. Our findings, therefore, provide causal evidence supporting the conclusions of the calorie-income elasticity literature, which generally suggests a weak relationship between income and calorie intake. As illustrated in the Panel A of the online appendix Table OB.1, the majority of studies reporting positive impacts on anthropometrics involve cash transfers provided conditionally to health visits (Macours et al., 2012, Kandpal et al., 2016, Evans et al., 2014, Akresh et al., 2016, Galiani and McEwan, 2013). In most cases, unconditional cash transfer programs alone are not sufficient to improve anthropometric measures, with the one exception (McIntosh and Zeitlin, 2018) being significant only for the largest cash transfer amounting to $567, almost three times larger than ours. This suggests that unconditional cash transfer policies may only enhance household investments in early nutrition at a very high cost. Our study also reveals distributional consequences of cash transfer programs on nutrition and diet. We find ultra-poor households in our study use cash transfers for food consumption (68% of cash is used for food) rather than investment. However, this consumption does not seem to benefit the youngest members of the households, as anthropometric measures are not affected in T1 or T2.

Second, our study demonstrates that transfers of nutrient-enriched food, combined with nutrition training and the distribution of garden kits, targeted at very poor households with young or soon-to-be-born children, are highly effective in increasing food security, food diversity, and anthropometric measures. This finding aligns with the nutrition literature that suggest the impacts of nutrient-enriched foods, homestead gardening programs and focused nutrition education to enhancing nutrition outcomes (see online appendix Table OB.1 Panel B for a review of the main findings).

Last, our study provides suggestive evidence that the relationship between anthropometrics and cognition is not as direct as commonly assumed. While improved nutrition may influence motor skills, we do not find evidence that it directly affects cognitive development. Instead, our findings indicate that nutritive supplementation and improved maternal nutrition have positive impacts on the cognitive development only when the program is provided *in utero* to pregnant or lactating women. Although epidemiological studies have demonstrated that better nutrition impacts fetal brain development and cognitive function (Cusick and Georgieff, 2016), there is little evidence that an at-scale nutritional intervention conducted during pregnancy causally affects child cognitive development, as shown in the most recent systematic review available on this subject (Taylor et al., 2017). Our paper brings a valuable contribution to this literature by establishing a clear causal relationship between mother's nutrition, anthropometrics measures and children cognitive development only when the program specifically target pregnant and lactating mothers.

In the rest of the paper, we will first describe the context and content of the intervention (Section 2), the design of the experiment (Section 3) and finally the results (Section 4).

2. CONTEXT AND PROGRAM'S DESCRIPTION

Burkina Faso stands as one of the poorest nations globally, grappling with profound economic and development challenges. With a GDP per capita of only 830 USD in 2022 (equivalent to 2549 USD PPP), it ranks as the 17th poorest country worldwide, nestled between the economic standings of Mali and Togo. Additionally, the UNDP places Burkina Faso among the ten poorest countries, ranking 184th out of 191 nations in terms of the Human Development Index. Moreover, a recent publication by the Minister of Health of Burkina Faso underscores the gravity of the country's nutritional crisis (ENN, 2020). Among children aged 6-59 months, statistics reveal significant levels of malnutrition, with approximately 9% suffering from wasting, 25% experiencing stunted growth, and 18% facing malnourishment. In comparison, within the 168 villages surveyed across the East and Boucle du Mouhoun regions for our study, among the children belonging to eligible households (i.e poor or ultra poor), 13% suffers from wasting, 34% are stunted and 28% are undernourished, indicating that the children included in our main sample are significantly more deprived than the average children of Burkina Faso.

Our study was conducted in a context of instability in the region. Over the period of program implementation, the instability in Libya resulted in a race by international terrorists groups to control drug trafficking routes in Mali and gain control over artisanal mining in Burkina Faso. The instability in Burkina Faso is also an indirect consequence of the 2014 military intervention of the French army in Mali (operation "Barkhane") that progressively pushed some terrorist groups to regroup in nearby countries (Burkina Faso, Niger). Since 2016, the presence of these groups in Burkina Faso has generated an increasing number of attacks all over the country. However, the violence did not affect too much our program's implementation. As depicted in the online appendix (Figure OA.1), in the 15 communes where the experimental villages are located, the onset of violent attacks escalated after the first year of the program's implementation (see Figure A.1). The violence increased throughout 2019, impacting the second year of our program's delivery, and to a lesser extent, our 1-year follow-up survey. The onset of the COVID-19 pandemic briefly quelled the violence, allowing for a respite during our 2-year follow-up survey in 2019. In an analysis not shown here, we verified whether these attacks had any impacts on the program's delivery but could not find any major disturbance probably because violence did not affect the first year of implementation and that our communes were less concerned by attacks than the rest of the country.

The multifaceted program we study, funded by the Emergency Trust Fund of the European Union, aims to enhance the resilience of households vulnerable to food and nutritional insecurity in Burkina Faso. This program incorporates a research dimension with the overarching goal of developing a model for sustainable resilience. The interventions was implemented by two consortia of NGOs: the RÃľsiane consortium operating in the East region of Burkina Faso is coordinated by Action Contre la Faim and the Promirian consortium, coordinated by Terre des Hommes (TdH), operates in the region Boucle du Mouhoun. Both consortia carried out the program simultaneously over a two-year period in 2018 and 2019 (see Figure A.1). Prior to the program's inception, we collaborated with both consortia to design three intervention modalities:

(1) **Unconditional cash transfers ("cash")** were distributed to households at the rate of 36 USD per household and per month during the four months of the lean season (June-September) during the first year of program's implementation and 27 USD the second year (equivalent to 20,000 and 15,000 FCFA per months using mid-May 2018). The objective of these payments was to alleviate the peaks of food insecurity experienced during the lean season. Additionally, beneficiaries received training on the appropriate utilization of these funds.

(2) **Productive assets (poultry, livestock)** aimed to enhance the productive capacities of households through the distribution of animals.[1] It was estimated that a typical household could acquire 11 poultry or three goat or sheep with the vouchers. The animals underwent a two-week observation period to ensure their health status and minimize post-distribution mortality.

(3) **Nutrition interventions (nutrition)** focused on the distribution of enriched flour[2] for children aged 6-23 months and pregnant or lactating women (FEFA). In the East region, each eligible child was eligible to receive 2.5 kg of fortified flour per month for four months. Pregnant or breastfeeding women were eligible to receive 10 sachets of 67g each, corresponding to a monthly supply of fortified flour for four months. In the Boucle du Mouhoun, households with children aged 6-23 months receive 2.5 kg of flour per child for a period of 3 months. Each pregnant or breastfeeding woman in this region benefits from 30 sachets of 70g flour each, amounting to a monthly consumption of 2.1 kg per beneficiary over a 3-month period. Additionally, households receive behavior change communication messages on the nutrition of pregnant women and young children.

In addition to the three main categories of interventions, households in the communes affected by the experiment (control and treatment groups) would also receive community-level interventions.[3]

3. DESIGN, SAMPLING AND METHOD

3.1. *Village Randomization and Targeting*

Our sample is composed of 168 villages, located in two regions and randomly assigned to four treatment groups. The villages were chosen from a list of villages in communes where both consortia were already operating. In cooperation with the implementation partners, we selected the villages that received in the last five years the least amount of interventions. We randomly assigned 42 villages to treatment group 1 (T1) which received monetary transfers; 41 villages to treatment group 2 (T2) which received monetary and asset transfers and 42 villages to treatment group 3 (T3) which received the full set of treatment interventions including cash transfers, asset transfers, and the nutrition intervention. Last, a control group of 43 villages was randomly selected to received no specific treatment except community level interventions that affected all experimental villages.

Before random assignment, we conducted a Household Economic Assessment (HEA) to identify eligible households in each village (see (Figure A.1). The HEA, a quantitative and qualitative participatory targeting approach, involved three phases:

[1]Participants were provided with coupons that could be exchanged for animals at designated fairs. In the East region, households received a voucher worth 80 USD for poultry or 207 USD for small ruminants. In Boucle du Mouhoun, households received a coupon worth 45 USD for poultry or 164 USD for small ruminants.

[2]The flour, called *Farine Misola*, is locally produced and specifically designed to reduce malnutrition among pregnant women and young children. It is based of pearl millet, soy and peanut oil. It contains legumes and is therefore rich in protein. The porridge prepared using this flour is reported to be three times more calorific than the one using millet flour.

[3]These were implemented by the communes in the study zone independently of the village's treatment status. The community-based interventions encompassed awareness campaigns, the management of malnutrition cases in collaboration with the local health system, the establishment of accountability mechanisms, the development of a contingency plan for risk management, the creation of a contingency fund, the establishment of early warning committees, the initiation of a risk-early monitoring system, and community support for planning and developing climate change adaptation activities. Since community interventions are executed at the commune level, villages could not be excluded from them, and both treated and control villages in the same commune could potentially benefit from these interventions.

(1) **A local census**, conducted in January 2018 by our research team that collects basic information on all households in the 168 villages, including asset and household characteristics to create a poverty index.
(2) **the Community-Based Classification (CSE)** where the village community engaged in a discussion during a community meeting to determine a village-specific definition of poverty. The villagers first nominated two selection committees that determined which criteria should be used and how each criteria should be weighted. Both committees then classified, based on the criteria and weights, households into four socioeconomic categories: ultra-poor, poor, average, or wealthy. In case of disagreement, the committees were expected to meet and converge towards a consensus classification. Households also had the opportunity to appeal the decision in front of a complaint committee in case of disagreement.
(3) **The eligibility determination** was conducted by the research team, based on the CSE classification and the quantitative data collected during the census. We selected as eligible the households classified as poor or ultra poor and which had a pregnant women or/and a child under five. Additionally, due to budgetary constraints, only a maximum of 21 households per village could benefit from the program. In villages with more than 21 eligible households, we selected the 21 poorest households using the poverty index from the census. Conversely, in villages with fewer than 21 eligible households, available spots were redistributed to villages with extra-eligible households in the same community. As a result, the number of eligible households varies from community to community.[4]

After identifying the eligible households, we randomized the 168 villages into the four treatment branches, stratified within the commune. Our main specification includes commune fixed effects, and standard errors are clustered at the village level.

3.2. *Data and survey*

After identifying the eligible households and randomizing, we conducted four surveys, all administered between April and June: baseline (2018), one year follow-up (2019), two years follow-up (2020), and 3-year follow-up surveys (2021) (see Figure A.1). Each household survey includes approximately the same modules, covering revenues, spending, investment and assets, saving, shocks, and aspirations. Each year, except in the 1-year follow-up survey[5], we also administered a children's questionnaire that includes usual anthropometrics measures and two cognitive testsâĂŤone for children below 3 (CREDI) and one for children between 3 and 5 (MELQO). Unfortunately, the CREDI test administered in year 2 had a coding error that made the results not usable. In the 2-year follow-up survey, our cognitive metrics, therefore, only include the MELQO (children between 3-5 years old).

The sample is composed of about 3500 eligible households at baseline, approximately 4000 eligible children (i.e., below 5 years old), and 28,700 household members, as shown in the Table B.I.

3.3. *Protocol validation*

In online appendix Table OB.2, we show that our data does not suffer from major differential attrition issues in the one and two-year follow-up surveys. Overall attrition in the treatment

[4]We also identified the 21 poorest households who were non eligible to the program, either because they did not meet the poverty or the household composition criteria. These non-eligible households are included in the surveys but are not covered in this paper.

[5]We did not administer cognitive tests in the one year follow-up because we did not expected that even a large impacts on poverty could have an immediate effect on cognitive development.

groups is never significantly different from the one observed in the control group. The attrition rate is about 10% in the one and 2-year follow-up surveys, mostly driven by household attrition, i.e., households that could not be found in villages we surveyed. In the 3-year follow-up survey, the situation is less favorable, in large part due to the security situation that was then particularly tense. Attrition is up to 22%, driven by village attrition (i.e., attrition due to villages not being surveyed) and household attrition of those who fled the region. For security reasons, we had to organize surveys in neighboring villages and bus eligible households from the experimental village. This has mechanically reduced our ability to survey households. While overall attrition remains not significantly differential, we do find differential village attrition in group T2. This attrition may affect the validity of our results in T2.

We also verify that our sample is balanced using our balancing data. Since we have a long list of baseline outcomes, we present in Table B.II how our main indexes are related to the treatment variables at baseline. We find some weakly significant imbalances. When accounting for multi-hypothesis testing, using the false discovery rate (Benjamini et al., 2006), none of the q-value are significant. Yet, these results indicate that we may occasionally suffer from imbalance. For our main results, we will therefore provide, as a robustness test, a double LASSO estimation using all of the baseline indexes, their square and their cube in the algorithm to control for potential imbalances.

3.4. *Empirical Method*

We provide intention-to-treat (ITT) results, estimated using strata fixed effects (commune fixed effects used for stratification) and clustering at the village level (the level of randomization) for each treatment (*T1, T2, T3*). Given the multifaceted nature of the intervention, Local Average Treatment Effect (LATE) interpretation becomes challenging, particularly in T3, where the intervention consists of several primary components (cash, asset, nutrition) with varying levels of compliance. Given the high compliance observed (see Section B.III), the ITT results closely approximate the potential LATE in any case.

Following our Pre-Analysis Plan (PAP), we present results controlling only for strata fixed effects (commune fixed effects). To account for potential baseline imbalances, we adopt a double LASSO as a robustness test. We include in the double LASSO seven primary indices defined at baseline. To handle missing values in these indices, we impute them with the mean of the respective index, and we introduce an indicator variable assigning imputed observations a value of one. Additionally, we include the second and third-degree polynomials of these variables. In the double LASSO algorithm (Belloni et al., 2013), we use all these variables (22 in total, including the imputation indicators). In addition, we constrain the algorithm to retain the strata fixed effect. When available, we add the corresponding baseline outcome: for instance, when we measure the impact of the program on height-for-age, we add the measure of baseline height-for-age to the list of control variable in the double LASSO algorithm.

In our PAP, we initially planned to conduct heterogeneity analyses based on network proximity and a wealth index. However, we acknowledge the risk of multiple hypothesis testing and the limited sample size within each treatment group. Given the relatively small sample size and the inherent homogeneity of the population of interest—where the Household Economic Assessment (HEA) selected the poorest 21 households in each village—we believe that exploring heterogeneous impacts within sub-divisions of an already economically deprived population may not yield highly informative results. Therefore, in this paper, we prioritize presenting the main impacts on all eligible households.

Finally, all specifications in our analyses include standard errors that account for village clustering. Acknowledging the challenge of multi-hypothesis bias arising from the numerous tests conducted (3 treatments over 4 surveys and across various dimensions of poverty), we adopt a two-fold strategy following Anderson (2008). We first address this issue by reducing the dimensionality of our tests through the creation of aggregated indices and sub-indices. In line with our pre-analysis plan, we predefined a set of indices based on data collected at each survey round. Each index captures a distinct dimension of capital accumulation and is formed by averaging standardized individual items. Specifically, we compute four individual indices of capital accumulation:

(1) The *agricultural equipment* index consolidates measures of agricultural equipment owned by households (e.g., the number of pickaxes owned).
(2) The *livestock* index combines measures of animals owned (e.g., the number of chickens owned)
(3) The *farming* index aggregates various measures related to the agricultural property of the household (e.g., the number of parcels, overall size of agricultural property).
(4) The *saving* index encompasses different measures of net savings (e.g., the number of saving accounts, amount saved).

Using these four indexes, we create an aggregated index of wealth, referred to as the *wealth aggregated index*, consolidating information from all individual indexes. To form these indexes, we standardize each item by survey year using the control group's average and standard deviation and then take their average. Additionally, we create two additional indexes for nutrition:

(1) The *anthropometrics* index aggregates all anthropometric measures (height for age, weight for age, weight for height, and the mid-upper arm measurement). As the anthropometric items are already standardized, we do not re-standardize these individual items when forming the anthropometrics index.
(2) The *food Security* index aggregates all tests measuring food security and diversity.

Analyzing our experiment using indices significantly reduces the dimensionality of our dataset. However, the number of hypothesis tests at each survey round remains substantial and may still be susceptible to multi-hypothesis testing bias. To address this concern, we provide, for the most important analyses, the q-values of the false discovery rate (FDR) as defined by Benjamini et al. (2006).[6] We control for multi-hypothesis testing per year, considering that impacts measured at different points in time are highly correlated and essentially measure the same outcome. We also exclude the aggregated index from the multi-hypothesis testing, as it is simply the average of the sub-indices.

Importantly, we control for multi-hypothesis testing when analyzing our indices and sub-indices but not when delving into the more granular analysis of our impacts, i.e., when analyzing the effect of items composing each index. Given the number of tests conducted, controlling for the FDR rate at the granular level could be cumbersome and lack statistical power. Nevertheless, we believe that presenting more specific results is essential for the analysis. Therefore, in addition to presenting results without controlling for multi-hypothesis testing, we track, by treatment group and survey rounds, the share of significant hypotheses we report. This analysis is presented in Table B.VI. To be conservative, we exclude from this analysis the hypotheses that relate to compliance, as we expect these to be positive and strongly significant, and we focus on hypotheses for which the sign and significance are *a priori* undetermined.

[6]The FDR approach is particularly well suited to our context as we expect our final outcomes to be strongly positively correlated and very unlikely negatively correlated.

4. RESULTS

We present the results based on the hypotheses laid out in the pre-analysis plan (PAP)[7] where we estimate program model impacts from the participation decision, analyzed using several compliance measures (sub-section 4.1), to children's cognitive impacts (sub-section 4.4). Between compliance and cognition, we first analyze how the program impacted household welfare by measuring effects on poverty status, wealth and asset (sub-section 4.2) and then its impact on nutrition, cognition and child development (sub-section 4.3).

4.1. *Compliance*

Table B.III provides the compliance level for the interventions. For our main interventions (cash, asset and nutrition), compliance is high for cash (about 95% in treatment received cash) and slightly less satisfactory for asset (about 75% in T2 and T3 received animals) and nutrition (about 65% of T3 households received enriched flour). The control group received almost no equivalent interventions even when we include interventions provided by other NGOs or government entities. The lower compliance observed in T2 for assets can be attributed largely to the security situation in certain communities. Regarding nutrition, imperfect compliance can be largely attributed, by construction, to the restricted target population for enriched flour distribution, which included children between 6 and 23 months of age and pregnant women while all families with a pregnant woman or a child below 3 years old were eligible. Despite these minor deviations, the interventions were carried out in strict adherence to the experimental protocol.

Beyond our main interventions, Table B.III reveals that cereals transfers were significant higher in the treatment groups and more so in T2 and T3. The larger T3 effects may be attributed to households considering enriched flour as a form of cereal transfer, which could have caused some confusion in reporting accuracy. Furthermore, the increased cereal transfers in T2 and T3 can also be explained by the distribution of cereals in communes where the transfer of animals was not feasible, as mentioned above. Transfer of inputs (i.e. agricultural equipment, fertilizer, pesticide, fungicide, seeds...), larger in T2 and T3, is essentially a consequence of the T2 and T3 interventions which included agricultural inputs. Some of these inputs may also be offered to villages that could not receive animals and, to a lesser extent, to specific interventions such as the lowland management assistance program.[8] Last, T2 and T3 households are much more likely to attend training programs compared to those in C and T1 groups, due to the training associated with the animal distribution in T2 and T3 and to the nutrition programs provided in T3.

In Online Appendix Figure OA.3, we show that about half of the transferred animals died within a year of the transfer. T2 and T3 households reported receiving an average of about six animals each, comprising either three sheep or 11 chickens. However, after one year, the number of surviving animals decreased to less than four on average. This decline is associated with a mortality rate of 29% for sheep and 59% for chickens. In contrast, goats, which were distributed less frequently and have a lower value, exhibited a lower mortality rate of 13% after one year. While this high mortality rate may be attributed to the avian influenza that affected both regions during the intervention period, it could also be influenced by factors such as the lack of experience among households and limited access to veterinarian care. These findings, coupled with the distribution challenges encountered in some communes, underscore

[7]Our PAP was pre-registered at the AEA registry and the pre-registered report was pre-accepted for publication by the Journal of Development Economics.

[8]Lowland management program, part of the commune level interventions, consists in helping villagers to manage irrigation systems in lowlands. This intervention was provided to all treatment villages with access to lowlands.

concerns regarding the effectiveness of animal transfers in regions where access to veterinarian care is severely limited. Addressing these challenges is crucial to ensuring the success and sustainability of similar interventions in the future.

In addition, Table B.IV provide an assessment of the perceived value of each intervention over the two years of implementation, as reported by the respondents. Across all three treatment branches, households reported receiving approximately 212 USD in cash over two years (225 USD for those who received any cash), which fairly aligns with the objective to distribute 252 USD per household. This corresponds to 600 USD PPP in 2018, below the typical cash amounts transferred in comparable multifaceted programs.[9] Animal transfers were valued at around 74 USD (in ITT terms) for T2 and T3 households, or 97 USD for households in these branches reporting receiving at least one animal. Although slightly lower than the expected values of these transfers (estimated around 129 USD by our implementation partners), it is consistent with the program's design.[10] The value of the other interventions appears more marginal: 16 USD for the enriched flour transfer in T3 (24 USD for households who actually received enriched flour), about a 3 USD for cereals or between 4 and 12 USD for the transfer of inputs. Overall, the treatment households estimate the program to be worth about 261 USD over two years, significantly smaller in T1 (200 USD) and significantly larger in T3 (314 USD). Given that the 2018 national poverty line was 284 USD per year (INSD, Janvier 2022) and we expect that most, if not all, households included in our sample would fall below the national poverty line, our intervention is at least equivalent to one poverty line delivered over two years, a little less in T1 and a little more in T3. Compared to other multifaceted program implemented elsewhere, the T3 intervention, which mimics the program that would have been implemented absent the experiment, is equivalent to 836 USD PPP: this is significantly lower than the typical multifaceted programs described in Banerjee et al. (2015) where the cost of the direct transfers are evaluated between 1131 and 3091 USD PPP.

Lastly, we surveyed household heads to understand how they utilized the cash transfers they received during the lean season. In the online Appendix Figure OA.2, we present all treatment groups' cash utilization in the same pie chart, since we could not identify any statistical differences between treatment branches. The responses unequivocally indicate that the majority of the cash was used for food purchases (68%), followed by agricultural investments (equipment, fertilizer, seeds, labor...), health, and education. The category "other spending" encompasses purchases such as clothing and non-agricultural equipment, with cellphones being the most prominent. Additionally, spending related to celebrations (marriage, death, etc.) is included in the "other" category as well. The substantial portion of cash allocated for food (nearly 70%) is unsurprising given that we targeted extremely impoverished households, often struggling to meet basic needs. Considering the cash utilization pattern, we have reasons to anticipate potential impacts of the program on food security and nutrition.

4.2. *Poverty, Wealth and Assets*

Poverty We start our analysis of the program's impacts on household poverty status. Using the qualitative and quantitative categorization established during the HEA and the extensive baseline dataset collected before the beginning of interventions, we predict the probability to be categorized as ultra-poor (instead of simply poor) on each successive surveys. This approach

[9]In the six experiments included in their analysis, Banerjee et al. (2015) indicate that the cash transfers vary between 700 and 2048 USD PPP.

[10]Households may face lower prices than our implementation partners. It is also possible, given the high mortality rate, that households account for lost property when assessing the value of the transferred animals.

offers the benefit of transparency and bases the poverty measure in large part on the qualitative categorization that households themselves defined during the HEA. The predicted probability of being ultra poor is derived from a selected set of baseline variables that possess two properties: firstly, they must have been collected in every surveys and secondly, they need to be possibly affected by the intervention. Property (1) excludes for instance child cognitive tests that were not administered in the first follow-up survey. It excludes also our measures of aspirations that we only collected in the two and 3-year follow-up survey. Property (2) excludes a large number of baseline variables which may strongly predict poverty but which are unlikely to be affected by the intervention. For instance, we do not expect the program to have any impact on adult education or adult literacy level while these are strongly correlated with poverty. The final set of baseline variables included in the algorithm is composed of 84 variables, 50 original ones to which we add their polynomial of degree 2 and 3 and drop those which are multicollinear.[11]

We use the 84 variables to predict the expected poverty categorization among eligible households in the follow-up surveys. As eligible households are all categorized as either ultra-poor or poor, the prediction focuses on identifying the ultra-poor households among them. To make this prediction, we experimented with various algorithms (Logit Lasso, logit elasticity net, and random forest). We divided our sample into *training* and *test* sets and compared the known categorization at baseline with the predicted one. The decision criterion we employed is accuracy, representing the proportion of households correctly categorized at baseline. All parametric methods (LASSO and Elasticity net) exhibited similar and relatively poor performance, regardless of the selection method employed (Cross-validation, plugin, BIC, or adaptive), with an accuracy rate of 61.3%, only marginally above chance. In contrast, the random forest algorithm demonstrated significantly better results with an accuracy rate of 82.6%. Consequently, we adopted the random forest as our primary predictive strategy.

We present our findings in Table B.V. In the 1-year follow-up survey, approximately nine months after the initial transfers (see Figure A.1), the predicted probability of being ultra-poor shows a reduction of 5-7 percentage points across all treatment branches. Considering the predicted probability in the control group, estimated at 10.4% (likely slightly underestimated, given an 84% sensitivity[12] at baseline), these impacts suggest that in the first follow-up survey, between half and 70% of treated households are predicted to be out of ultra-poverty. However, the effects are not long-lasting in the T1 and T2 groups, with insignificant reduction rates after the first follow-up survey. Yet, in the T3 group, nine months after the end of all transfers (2-year follow-up), the impact on predicted poverty remains significant but with lower magnitudes. Still in the 3-year follow-up survey, almost two years after the end of all transfers, ultra-poverty is reduced by 29% in the T3 group.

Given the relatively low cost of enriched flour (+16 USD ITT or 24 USD per household declaring receiving the flour[13]), this result may be surprising. In appendix Figure A.2, we present the top 10 variables used in generating the 1000 trees of the random forest prediction model. Unsurprisingly, the algorithm frequently incorporates various poverty and asset indices, such as wealth, farming, and animal ownership. It also often includes baseline outcomes related to nutrition such as food expenditures, the anthropometrics index and the anthropometrics index cube. This selection of variables sheds light on why this measure of poverty is more affected

[11]We exclude perfectly and imperfectly multicollinear variables (i.e. above 90% correlation) to improve the performance of the algorithm.

[12]The sensitivity or true positive classification rate gives the share of households that were correctly classified as ultra-poor in the test sub-sample i.e. 30% of the baseline sample

[13]This does not include the cost of the nutrition training, which may have had significant impact in our case, nor the enriched flour delivery.

in T3 than in other branches. It reflects the notion that poverty, as defined by households themselves during the HEA, is closely tied to the perceived ability of village members to provide food for themselves and their families.

Wealth indexes In addition to measuring poverty using random forest, we present in Table B.V and Figure A.3 a more traditional approach to assessing poverty, asset accumulation, and investment. Our aggregated index (wealth_index) reveals a relatively substantial treatment effect about one year after the beginning of the transfers (+0.2 SD in T3), which is larger and more long-lasting in T2 and T3. The overall impacts are primarily driven by significant 1-year improvements in agricultural assets (+0.45 SD in T3), livestock (+0.38 SD in T3), and to a lesser extent in farming (+0.15 SD). Two years after, the impacts are reduced but still significant for T3, suggesting that the cash-only program has a short-lived effect—a finding consistent with several other results in the literature (see for instance (Baird et al., 2011)). By the 3-year follow-up, most of these impacts become insignificant in all three groups, with the exception of the agricultural asset index, which remains significant in T3 only. Controlling for multi-hypothesis testing does not fundamentally alter our main results, which remain significant in the first year follow-up survey, less so one year after, and generally not significant in the 3-year follow-up survey.

To validate these main results on poverty, we assess the robustness of our findings using the double LASSO approach outlined in Section 3.4. The results of the double LASSO are presented in the Online Appendix Table OC.1. While the magnitudes of the impacts are generally slightly lower, the significance of our tests improves due to a substantial reduction in standard errors. In the first follow-up survey, the results in Table OC.1 closely align with those presented earlier. In the 2-year follow-up survey, impacts are actually more significant with the double LASSO approach, especially for the farming index, which is significantly larger in T2 and T3 (although only marginally so when accounting for multi-hypothesis testing). In the 3-year follow-up survey, results are generally not significant, except for agricultural equipment in T3. With the double LASSO, we also lose the significance for our poverty prediction in T3 group in the last follow-up survey (p-value=11.2%).

Asset accumulation In more granular results, we can show that the significant impact on the agriculture index is driven by the purchase of tools (e.g., rake, shovel, sickle) during the first two years of the experiment (results not given here). Consistent with the impacts on the index and the experiment's design, these results are significantly larger in T2 and T3 in the first two follow-ups and remain significant in T3 in the 3-year follow-up survey. Additionally, Online Appendix Table OB.3 shows that livestock increases by about 4 additional animals per household in T2 and T3 during the first year of the experiment. As expected, the T1 group is unaffected. However, after two years, livestock is only slightly larger in the treatment groups than in the control. We attribute this lack of persistence to the previously mentioned high level of animal mortality during the first two years of implementation. Table OB.3 also reveals that selling price of animals sold at the one year follow-up, and to a lesser extent at the two years follow-up, declines. This decline, which is sizable after one year (-30%), only affects T2 and T3 group, suggesting that it is a direct consequence of the animal distribution. After two years, the price drop only affects T2 and is lower magnitude (-22%). These price drops during animal distribution raise further concerns regarding animal distribution which may have had the unintended effect of lowering animal price in the local markets.

Lastly, we delve into the effect of the program on the individual items included in the farming index. Table OB.4 reveals that the number of cultivated crops, the number fertilizer plots and the agricultural revenue tends to increase in the one year follow-up. In the 2-year follow-up survey, the number of cultivated plots and the size of the cultivated plots increase. These results are only significant in T3, sometimes barely and are generally not long-lasting. Yet, these impacts are sizable: after two years for instance, the property size of the T3 households is expected to increase by 0.38 hectare, a 14% increase compared to the control group. Similarly, despite the absence of overall impact on the saving index (see Table B.V), we do find isolated impacts on savings, especially after one year as shown in the Online Appendix Table OB.5. Treatment households appear more likely to save, more likely to reimburse outstanding loans, and/or limit taking out new loans in the 1-year follow-up survey. In the 1-year follow-up survey, these impacts affect all treatment groups similarly, suggesting a direct effect of the cash transfers. However, after one year, these impacts are not significant anymore, except possibly in T3, where households declare being more likely to save in the two and three year follow-up survey. Finally, in results not presented here, we find no impacts on the number of shocks affecting the households. Similarly, we do not find impacts on crimes or social cohesion which were collected in a separate survey.

In summary, our measures of wealth and poverty provide a relatively clear picture of the program's impact. Treated households experienced numerous positive effects on their financial well-being: they are less poor, more wealthy, save more, are more likely to reimburse loans, and possess more assets. Specifically, their agricultural property is larger, they own more livestock, and have more agricultural equipment. This clearly indicates that a portion of the transfers was invested in household economic activity. As expected, the economic impacts we found are stronger and more long-lasting in the branches where the transfers were larger. To ascertain that these individuals impacts are not driven by multi-hypothesis testing, we track in Table B.VI the share of hypothesis that are significantly different from 0 at 10% for each treatment branch, each survey and using the two specifications (simple strata control and double LASSO): Table B.VI confirms that the T3 interventions unequivocally affect final outcomes after one year (65% of significant hypothesis), after two years (respectively 44%) and even in the 3-year follow-up survey (21%). For T1 and T2, the share of significant hypothesis is lower but still above 10% in the first and second follow-up survey. Using the double LASSO which should account for any initial imbalance reinforce these results, especially in the last follow-up survey where T1 and T2 are also found to have an overall significant effect on final outcomes.

Other outcomes To gain a more nuanced understanding of how the impacts on poverty and wealth influenced household well-being, we administer an aspiration test in the two and 3-year follow-up survey. In this test, households assess their own socio-economic status and indicate the level they aspired or desired to reach in the future. After two years, treatment households assessed their current situation as more favorable than the control group, particularly in terms of land area and education and they also *desire* or aspire to even better economic situation. In comparison to the control group, T3 households hoped to acquire an additional 0.5 hectares of land and 1.4 more years of education for their children. This suggests that treated households expressed a higher level of optimism regarding their own future. The 3-year results are not significantly different zero for all treatment branches. Using double LASSO (see Online Appendix Table OC.2), the impacts on aspirations are still large and significant after two years and become larger and significant also after three years, once again only in T3. Similarly, we measured, in the 2-year follow-up survey, the stress level expressed by young mother and found that the index is in general pointing towards a reduction in stress, only significantly so in T2 however. Once again, when we estimate the impacts with double LASSO, results are slightly larger and much more significant, indicating that stress has reduced in all treatment branches.

4.3. *Food security, Nutrition and Anthropometrics*

While our results highlight substantial improvements in wealth accumulation, poverty reduction, and aspirations, this paper places a particular emphasis on investigating the potential consequences of these outcomes on food security, the nutrition of young children, and ultimately, children's cognitive development. Given that respondents self-report that 68% of the cash was spent on food consumption, we may reasonably expect that the interventions had significant impacts on nutrition. However in T1, where households only received unconditional cash distribution, there is no guarantee that the additional nutrition intake was specifically targeted to the members who may be expected to benefit the most from it, such as pregnant women, breastfeeding mothers, and children below 3 years old. Similarly, while poverty impacts are larger in T2, there is no guarantee either that the reduction in economic poverty went hand in hand with a better nutrition. In this section, we will delve into how the program influenced nutrition, starting with analyzing nutritional inputs such as food security outcomes and then direct measures of children's nutritional outcomes with anthropometrics.

Nutrition We present the results on food insecurity, food diversity, and the nutrition of pregnant and breastfeeding mothers in Table B.VIII. In the first follow-up survey, we observe a significant impact on food insecurity, with a substantial decrease of -6.2 percentage points from a control group estimated at 20%, only barely significant in T3. We also find impacts on food diversity but this time concentrated in T1 and T2. In the second follow-up, the impact on food security remains significant in T1 and T2 but is not significant anymore in T3 (but close with a p-value equals to 10.5%). The coefficients across treatment branches are however not significantly different from each other. In the third follow-up, impacts vanish except maybe in terms of food diversity (here again larger in T2). Interestingly, in online appendix Table OC.3 results are robust to the double LASSO approach, with much larger significance. For instance, after one year, the impact on severe insecurity is now estimated at -5.4 pp, i.e. slightly lower than with our main specification, but with a strong level of significance. After two years, the impacts become significant for all treatment branches where we find a reduction of 4 pp of the households categorized in severe insecurity (-18% from the control average).

Although these impacts are informative about the household perception on their own food security, they do not precisely indicate whether those improvements affected pregnant or lactating women or specifically improved the nutrition of young children. In the 2-year follow-up survey, we administered a questionnaire module directly asking pregnant/lactating women about their nutrition during the past seven days. This module was better tailored to the population of interest and is less likely to be influenced by response bias.[14] Table B.VIII demonstrates strong impacts of the program on the nutrition practices of pregnant and lactating women using the mother's nutrition module administered during the 2-year follow-up survey, once again concentrated in T3. We attribute this effect to the nutrition training sessions that these women received in T3, covering nutrition during pregnancy and breastfeeding. Notably, in results not shown here, the +0.31 standard deviation impact (+0.32 with double LASSO see Online Appendix Table OC.3) is driven by an increased intake of foods particularly favorable during the pregnancy and breastfeeding period. T3 women reported having consumed more meat and fish, more vitamin A-rich legumes and fruits, more cereals, and more fruits and vegetables in general over the last 7 days. This result indicates that in T3, the nutrition information provided to mothers, together with cash and asset transfers, modified their nutrition practices. We consider this result as a crucial pathway to explaining our impacts on children's anthropometric measures.

[14]Note that we did not administer this test in the 3-year follow-up because the nutritive practices as unlikely to affect anthropometrics measure of children included in our baseline surveys or born shortly after.

Anthropometrics We present our anthropometric measures in Table B.IX, revealing robust, significant, and long-lasting impacts of the T3 intervention on the anthropometrics measures. In T3 after one year, severe wasting is nearly halved, severe underweight reduced by 31%, and severe stunting by 26%. These positive impacts are specific to T3 children, indicating that the nutrition program, including training and enriched flour, had substantial and significant effects on early nutrition and growth. More notably, these positive results remain significant and even strengthen after two years. For instance, severe stunting is reduced by about 33% after two years and by 41% after three years compared to the control group (not provided in Table B.IX). In the 3-year follow-up survey, occurring 1 year and nine months after the end of all transfers (cash, animals, or flour), chronic and acute malnutrition remain significantly affected, although to a lesser and less significant manner. This indicates that the initial transfer of enriched flour had some longer-term effects on children's developmental performance. Interestingly, the fact that the T3 branch specifically affected height-for-age, the most persistent nutrition metrics, suggests that in T3 the nutrition received a better nutrition throughout the intervention period. In contrast, the lack of impacts in T1 and T2 raises doubts about the efficacy of simple poverty alleviation programs in influencing early investments in nutrition and human capital accumulation. In our context, the nutrition intervention emerged as a crucial factor in achieving these impacts. Once again, we provide in the Online Appendix Table OC.4, the double LASSO robustness test for anthropometrics measures. Results are reinforced when controlling for baseline variables: in the 3-year follow-up survey, for instance, while the effect was barely significant for chronic malnutrition in T3 in Table B.IX, the impact is of similar magnitude (+0.11.5 SD) but this time strongly significant.

There are at least three plausible and possibly complementary explanations for the anthropometric impacts observed in T3. The first, and likely the most influential program component, is that the enriched flour, distributed during the pregnancy and during the lean season, was particularly effective at improving children's anthropometrics. The literature on enriched flour does indicate that enriched flour is a valuable strategy to improve nutrition, as shown in the Nutrition panel of the Online Appendix Table OB.1. Yet, the size of the impacts and the fact that they last almost two years after the end of the distribution seem to suggest that in our context, enriched flour by itself may not entirely explain all the results. Another possible explanation is that the nutrition training, in conjunction with the flour distribution, prompted a shift in household behavior regarding nutrition. Households might have adopted improved nutrition practices, which have, together with enriched flour, yield even larger anthropometric outcomes. The impacts we find on the nutrition of pregnant and lactating women confirm that nutrition training had important impacts on nutrition. Lastly, the emphasis on nutrition in T3 interventions may have led households to prioritize pregnant women, breastfeeding mothers, and infants. Whereas T1 and T2 households use the cash and animal transfer to further the household economic development or distributed resources among all household members, it is possible that in T3, the cash and asset transfers were more targeted to these more vulnerable members.

4.4. *Children's cognitive development*

Our cognitive measurement relies on two separate tests that we originally planned to administer in the two (nine months after the end of all transfers) and the 3-year follow-up survey (almost two years after the end of all transfers): the CREDI, administered to caregivers for children aged between 0 and 36 months, and the MELQO, administered directly to children aged above 36 months and up to 6 years old. While we had prior experience with the MELQO test, a coding error in the CREDI rendered our 2-year follow-up results unusable.[15] Consequently, in Table B.X, we chose to omit the CREDI 2-year follow-up results from our analysis.

CREDI Using the 3-year CREDI test, we find moderate-to-small impacts across all dimensions of the tests, except for mental heath. For the aggregated CREDI score and the sub-index language, the impact is significant at less than 5%, once again, exclusively in group T3—the group that demonstrated substantial and long-lasting anthropometric impacts and benefited from the nutrition interventions. Taken at face value, these impacts align with our original theory of change that connects nutrition and cognition. As depicted in the Online Appendix Figure OA.4, the cohort of children whose caregivers took the 3-year follow-up CREDI test (children born between July 2020 and July 2017) primarily consists of children affected by the program partly *in utero* (for children born between June 2020 and October 2017) partly directly (for children born before December 2018). This suggests that the nutrition intervention is particularly effective when implemented very early, during lactation and pregnancy. Interestingly, when the impacts are estimated using the double LASSO approach, the impacts are similar and more significant (see Online Appendix Table OC.5).

However, the fact that the CREDI was administered directly to the caregivers may introduce (upward) bias in our context. Indeed, if mothers who were able to provide more food during infancy tend to be more optimistic about their child's development, they may over-report positive child behavior or developmental steps. While this concern has not been reported as a primary issue in the CREDI test validation (Waldman et al., 2021), in our context, where households report higher levels of aspiration and optimism in T3 (see Table B.VII), we should seriously consider this potential bias. The absence of impacts in T1 and T2 partly alleviates this concern. If the intervention increased mothers' optimism, we might have expected all treatment branches to be affected upward. However, since the aspiration effects found after two years only affect T3 (see Table B.VII), this argument does not entirely alleviate the concern. More convincingly, the fact that the mental health sub-score is entirely unaffected supports the view that caregivers did not overestimate their child's developmental progress. Mental health is an outcome that we would not have expected to be influenced by a nutrition program. If caregivers overestimated their children's developmental steps, they should have done so for all sub-categories of the test. Also, when analyzing the impact of the program in T3 by age group, we find the treatment heterogeneity that we would have expected. For instance, in results not shown here, we find no treatment effect in the 3-year follow-up CREDI test on children below nine months old. This is exactly what we would have expected since these children were too young to have benefited from the program *in utero* or post-natal in the 3-year follow-up survey, as shown in Online OA.4. If the CREDI scores were driven upward, we would have expected all children to show positive score, not only the ones who benefited from the program the most.

MELQO Results on the MELQO test are, for the most part, not significantly different from zero as shown in Table B.XI. However, in the 2-year follow-up survey, we observe one positive impact in motor development, once again in T3 and in a domain (motor skills) that we can reasonable expect to be affected by a nutrition intervention. This effect is however not significant anymore in the 3-year follow-up survey. Interestingly, children who took the MELQO in the 2-year follow-up survey were already between 13 and 35 months old when the transfers started (see Online Figure OA.5). Although these children directly benefited from the interventions during 16 months, they were already too old to benefit from the program during pregnancy or

[15]The coding mistake related to the specific stopping rule used in the CREDI.

even during breastfeeding. The absence of large impacts on these children reinforces the impression that the nutrition intervention was particularly effective when implemented early and ideally during pregnancy.

In the 3-year follow-up survey, results are similarly not significantly different from zero. In comparison to two years test, the children who took the three years tests were younger (between 4 and 26 months old) when the program started but they still did not benefit from the program during their mothers' pregnancy (see Online Figure OA.6). We further investigated whether younger children (typically below 48 months and who benefited from the program early) were more affected but could not identify any treatment variation by age. This further suggests that the *in utero* period may be particularly crucial for the efficacy of the nutrition program.

CONCLUSION

The literature on multifaceted programs have now firmly established the effectiveness of such programs to reduce ultra-poverty. Yet, whether these programs can have lasting impacts on nutrition and child cognitive development remain understudied. In this article, in addition to contributing to the multifaceted literature in a context of civil unrest, we formally test the hypothesis that such program, targeted to ultra poor households, improves young children anthropometric outcomes and cognitive development.

Our study is designed to disentangle the components of the program bundle to estimate the relative effects of cash transfers, animal transfers and nutrition-focused programs. We first find that one year after the start of the intervention, ultra-poverty was reduced by 50 to 70%. This effect slowly diminished over time but remained strong and significant almost two years after the end of all transfers in the nutritionally focused treatment (T3). This poverty reduction is driven by substantial positive impacts on livestock, agricultural equipment, number of parcels cultivated and improve financial situation. Second, we find that only the nutrition-focused group demonstrated strong and long-lasting impacts on children's anthropometric measures. In addition to the direct impacts of the enriched flour on anthropometrics, we provide suggestive evidence that the nutrition intervention may have prompted households to allocate more resources specifically to the nutrition of the most vulnerable groups, such as young children, pregnant women, and breastfeeding women. Last, our analysis of the relationship between nutrition and cognitive development suggests that the nutrition intervention is the only one with positive impacts on child cognition and that these impacts are particularly large when the program is targeted to pregnant women. Children born to mothers who received these interventions are the only ones who showed significant and compelling improvements in cognitive development.

To mitigate the risk of over-claiming significant results when there are multiple outcomes, we first reduced the dimensionality of our tests using summary indices as suggested by Anderson (2008). We then employed the False Discovery Rate (FDR) to control for multiple hypothesis testing when analyzing indices. Moreover, we systematically tracked the number of hypotheses tested and the proportion of significant hypotheses. This approach revealed compelling evidence of significant impacts of the T3 branch across all survey rounds, while T1 and T2 showed significance mainly in the two first follow-up surveys. The T3 group also generated more significant hypotheses than T1 and T2, confirming the possible complementarity between the interventions. Finally, we employed a double LASSO algorithm using baseline indexes and strata fixed effects as potential controls. The double LASSO estimation reinforced our findings, with a significant proportion of hypotheses supported, reaching 43% after one year and remaining above 10% in all follow-up surveys and across all treatment branches.

Our results highlight the potential of ultra-poverty programs that integrate nutritional interventions to impact not only malnutrition, but also the cognitive development of children if properly targeted. While these results confirm those available in the epidemiological literature that demonstrated large cognitive benefits from improved nutrition early on and during pregnancy (Cusick and Georgieff, 2016), our study provides causal evidence of the effectiveness of this approach using a social protection program conducted at scale during a period of increasing conflict in a low-income country. Given the high costs and uncertain effectiveness of formalized early education program (Bouguen et al., 2018, Berkes et al., 2024) in low-income countries, the relative cost effectiveness of nutrition interventions (in our case valued by the household head at USD 24 per household) provide a strong case for targeted nutritional investments.

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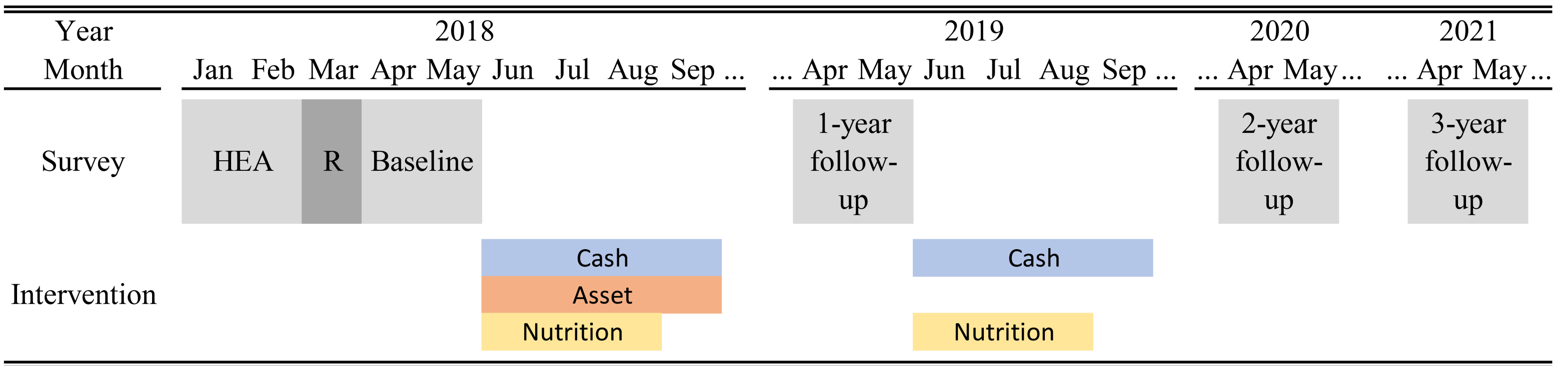
APPENDIX A: FIGURES

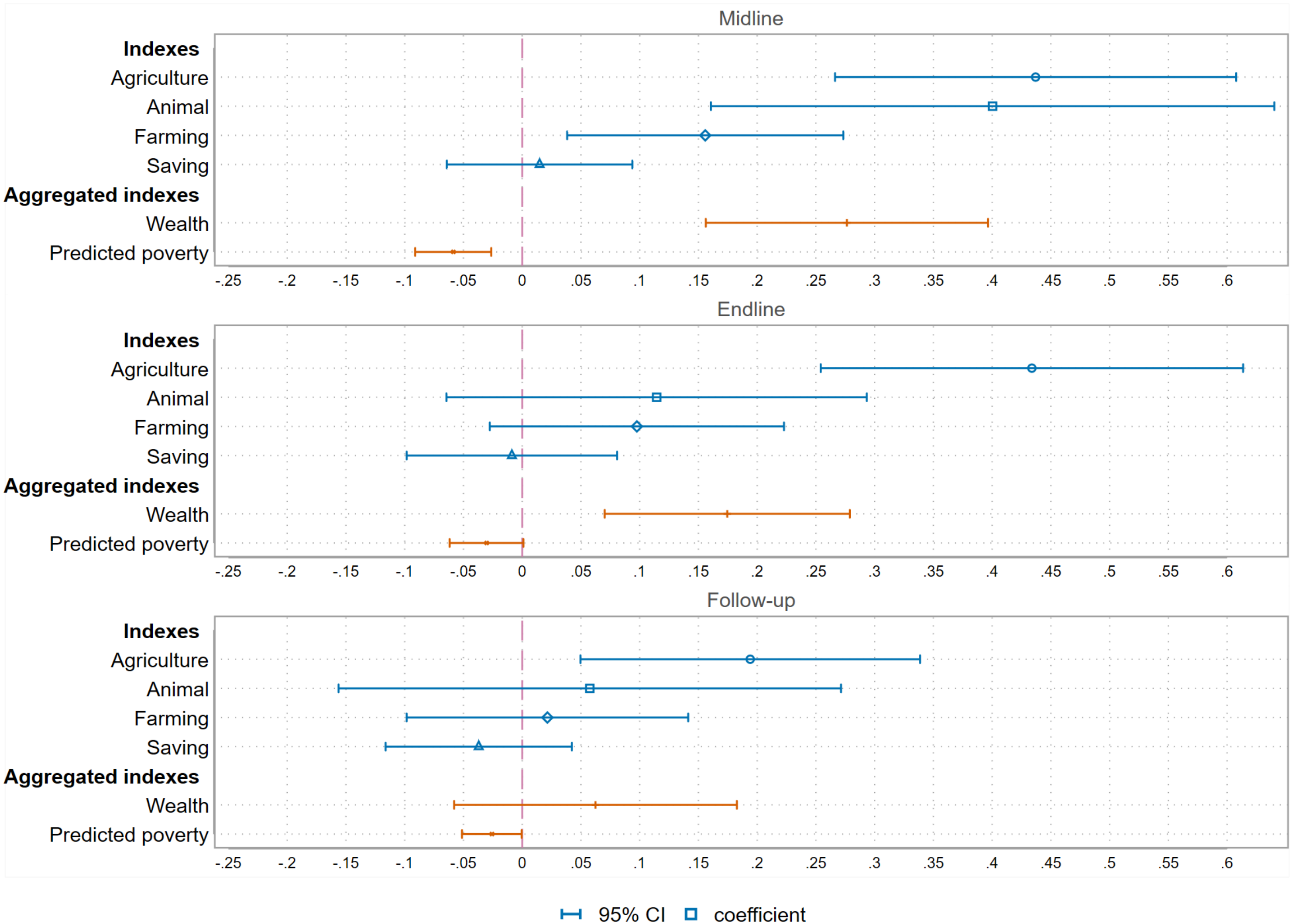
FIGURE A.1.—Timeline - Interventions and Surveys



The graph provides the interventions period as well as the timing of each surveys.

FIGURE A.2.—Top 10 Variables used in Random Forest

FIGURE A.3.—Indexes and Aggregated Indexes - T3 group



APPENDIX B: TABLES

TABLE B.I
SAMPLE SIZES

	Total	C	T1	T2	T3
Household dataset					
Baseline	3,465	1,005	858	806	796
Midline	3,170	908	801	697	764
Endline	3,020	913	737	658	712
Follow-up	2,836	870	696	580	690
Household member dataset					
Baseline	28,699	8,274	7,257	6,628	6,540
Midline	27,073	7,641	6,972	5,836	6,624
Endline	26,288	7,949	6,568	5,626	6,145
Follow-up	30,478	9,374	7,707	6,092	7,305
Anthropometrics dataset, 0-59 months					
Baseline	6,082	1,760	1,567	1,343	1,412
Midline	5,556	1,576	1,457	1,207	1,316
Endline	6,281	1,856	1,629	1,346	1,450
Follow-up	6,686	1,952	1,700	1,336	1,698
CREDI test score, 0-35 months					
Baseline	4,069	1,177	1,017	944	931
Midline	0	0	0	0	0
Endline	0	0	0	0	0
Follow-up	1,979	596	509	411	463
MELQO test score, 36-59 months					
Baseline	0	0	0	0	0
Midline	0	0	0	0	0
Endline	2,200	644	558	488	510
Follow-up	2,352	710	599	456	587

Table B.I provides the sample sizes by experimental group, for each dataset and for each survey round.

TABLE B.II

INDEX BALANCING

	Obs	C	T1-C	T2-C	T3-C
Agriculture	3,465	0.000	0.152***	0.050	0.070
		[1.000]	(0.055)	(0.059)	(0.056)
			[0.151]	[0.647]	[0.510]
Animals	3,465	0.000	0.108	0.134	0.070
		[1.000]	(0.072)	(0.084)	(0.090)
			[0.455]	[0.439]	[0.668]
Farming	3,465	-0.011	0.041	0.158*	0.047
		[0.592]	(0.042)	(0.083)	(0.048)
			[0.599]	[0.380]	[0.599]
Saving	3,465	0.000	-0.022	0.078	-0.018
		[1.000]	(0.041)	(0.083)	(0.041)
			[0.795]	[0.599]	[0.795]
Anthropometrics	3,050	-1.124	-0.003	-0.003	0.052
		[0.880]	(0.055)	(0.052)	(0.052)
			[0.967]	[0.967]	[0.599]
Food security	3,465	0.000	-0.093*	-0.053	-0.064
		[0.776]	(0.050)	(0.052)	(0.051)
			[0.380]	[0.599]	[0.510]
Aggreagated	3,465	-0.003	0.072*	0.100*	0.056
		[0.570]	(0.037)	(0.055)	(0.041)
			[0.380]	[0.380]	[0.510]
Observations	3,465	1,005	858	806	796
Clusters	168	43	42	41	42

Table B.II provides the initial differences between the experimental groups using the wealth indexes. Column *C* gives the average in the control group while the other columns give the difference between the treatment groups and the control group. We control for commune fixed effect and standard errors are robust and clustered at the village level. Below the balancing coefficients, we provide in square parenthesis the FDR q-value that accounts for all the hypothesis tested at baseline for all treatment branches i.e. 21 hypothesis.
*significativitÃl' *** 1%, ** 5%, * 10%*

TABLE B.III

PARTICIPATION IN PROGRAM'S INTERVENTIONS OVER TWO YEARS

	Obs	C	T1-C	T2-C	T3-C	T2-T1	T3-T1	T3-T2
Main program 's interventions								
Cash,	3,219	0.042	0.893***	0.890***	0.916***	-0.002	0.023	0.025
		[0.200]	(0.023)	(0.022)	(0.020)	(0.020)	(0.018)	(0.020)
Animals	3,186	0.001	0.028	0.684***	0.820***	0.656***	0.792***	0.136*
		[0.033]	(0.027)	(0.062)	(0.041)	(0.061)	(0.043)	(0.071)
... #	3,274	0.003	0.093	3.726***	4.581***	3.633***	4.488***	0.855
		[0.097]	(0.212)	(0.501)	(0.489)	(0.503)	(0.490)	(0.681)
Flour	3,196	0.003	0.002	-0.001	0.640***	-0.002	0.639***	0.641***
		[0.057]	(0.011)	(0.012)	(0.029)	(0.011)	(0.029)	(0.029)
Other program's interventions								
Cereals	3,188	0.032	0.117***	0.235***	0.369***	0.118***	0.252***	0.134***
		[0.176]	(0.034)	(0.037)	(0.045)	(0.042)	(0.049)	(0.051)
Inputs	3,188	0.000	0.020	0.239***	0.303***	0.220***	0.283***	0.063
		[0.000]	(0.027)	(0.041)	(0.042)	(0.043)	(0.044)	(0.054)
Training	3,188	0.005	0.017	0.186***	0.210***	0.169***	0.193***	0.024
		[0.074]	(0.018)	(0.038)	(0.034)	(0.039)	(0.035)	(0.049)
Other unrelated interventions						-0.006	0.023	0.029
Other	3,274	0.039	-0.003	-0.009	0.020	0	0	0
		[0.193]	(0.019)	(0.019)	(0.025)	13.42	13.68	0.259

Table B.III provides the participate rates in each components of the program.Column C gives the average in the control group. The other columns give the respective differences between each experimental groups, estimated using strata fixed effect. Below in bracket, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level. *** 1% **5 % * 10% significance level

TABLE B.IV

VALUES OF THE INTERVENTION IN USD EQUIVALENT

	Obs	C	T1-C	T2-C	T3-C	T2-T1	T3-T1	T3-T2
Cash transfer	2,932	13.13	190.7***	202.0***	203.4***	11.37	12.71	1.342
		[86.64]	(11.78)	(11.77)	(11.77)	(8.321)	(8.322)	(8.299)
Animals transfer	2,932	0.157	7.731	65.88***	80.84***	58.15***	73.11***	14.96
		[4.638]	(5.344)	(10.46)	(10.79)	(11.74)	(12.04)	(15.02)
Enriched flower	2,932	0.026	0.172	0.147**	15.71***	-0.025	15.54***	15.56***
		[0.596]	(0.128)	(0.074)	(1.794)	(0.145)	(1.798)	(1.795)
Cereals transfer	2,932	0.506	0.592	1.673**	2.855***	1.082	2.263***	1.181
		[4.510]	(0.408)	(0.695)	(0.483)	(0.776)	(0.594)	(0.818)
Inputs transfer	2,932	0.000	0.803*	3.733***	11.58***	2.930***	10.77***	7.844**
		[0.000]	(0.428)	(0.906)	(3.145)	(1.002)	(3.174)	(3.273)
Total value	2,932	13.82	200.0***	273.5***	314.4***	73.50***	114.4***	40.89**
		[86.79]	(13.14)	(15.52)	(15.78)	(14.36)	(14.64)	(16.80)

Table B.IV provides the compliance rates for each components of the program for eligible households. Column C gives the average in the control group. The other column gives the respective differences between each experimental groups, estimated using strata fixed effect. Below in parenthesis, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level.

*** 1% **5 % * 10% significance level

TABLE B.V

WEALTH INDEXES AND POVERTY IMPACTS

	1-year results			*2-year results*			*3-year results*		
	T1-C	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**
Indices									
Ag. Equipment	0.167**	0.270***	0.445***	0.045	0.155**	0.435***	0.128*	0.092	0.194***
	(0.075)	(0.072)	(0.089)	(0.069)	(0.064)	(0.092)	(0.071)	(0.069)	(0.072)
	[0.037]	[0.001]	[0.001]	[1.000]	[0.102]	[0.001]	[0.703]	[0.893]	[0.106]
Livestock	0.096	0.313***	0.382***	0.003	0.075	0.099	0.059	0.066	0.049
	(0.065)	(0.071)	(0.118)	(0.073)	(0.079)	(0.093)	(0.093)	(0.081)	(0.106)
	[0.139]	[0.001]	[0.004]	[1.000]	[0.980]	[0.940]	[1.000]	[1.000]	[1.000]
Farming	0.066	0.193	0.149**	0.054	0.129	0.090	0.069	0.020	0.026
	(0.062)	(0.167)	(0.062)	(0.080)	(0.119)	(0.066)	(0.054)	(0.054)	(0.060)
	[0.239]	[0.230]	[0.028]	[1.000]	[0.940]	[0.855]	[0.893]	[1.000]	[1.000]
Saving	0.028	0.020	0.020	-0.059	0.030	-0.012	-0.042	-0.007	-0.038
	(0.038)	(0.043)	(0.037)	(0.044)	(0.069)	(0.044)	(0.035)	(0.034)	(0.039)
	[0.323]	[0.365]	[0.365]	[0.855]	[1.000]	[1.000]	[0.893]	[1.000]	[1.000]
Aggregated indices									
Wealth	0.100**	0.229***	0.272***	0.019	0.118	0.167***	0.064	0.046	0.062
	(0.048)	(0.071)	(0.060)	(0.053)	(0.072)	(0.054)	(0.055)	(0.050)	(0.059)
Poverty	-0.060***	-0.068***	-0.054***	-0.007	-0.008	-0.030*	-0.010	-0.012	-0.023*
	(0.015)	(0.017)	(0.016)	(0.016)	(0.014)	(0.016)	(0.017)	(0.016)	(0.013)

Table B.V provides the impacts on indices and aggregated indices for each components of the program for eligible households. The *Poverty* aggregated index is predicted using the Machine Learning approach described in Section 4.2. Column C gives the average in the control group. The other column gives the respective differences between each experimental groups, estimated using strata fixed effect. Below in parenthesis, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level.
*** 1% **5 % * 10% significance level

TABLE B.VI

HYPOTHESIS

	Main specification				Double LASSO			
	T1-C	**T2-C**	**T3-C**	**T-C**	**T1-C**	**T2-C**	**T3-C**	**T-C**
Midline								
# of hypothesis tested	20	20	20	60	20	20	20	60
# of hypothesis with p-value<10%	3	5	13	21	4	9	13	26
% sigificant hypothesis	15.0%	25.0%	65.0%	35.0%	20.00%	45.00%	65.00%	43.33%
Endline								
# of hypothesis tested	34	34	34	102	34	34	34	102
# of hypothesis with p-value<10%	6	6	15	27	9	9	21	39
% significant at 10%	17.6%	17.6%	44.1%	26.5%	26.47%	26.47%	61.76%	38.24%
Follow-up								
# of hypothesis tested	38	38	38	114	38	38	38	114
# of hypothesis with p-value<10%	3	3	8	14	6	9	10	25
% significant at 10%	7.9%	7.9%	21.1%	12.3%	15.79%	23.68%	26.32%	21.93%

Table B.VI tracks by survey rounds and treatment branches the number of hypothesis tested, the number of null hypothesis rejected at 10% and the share of significant at 1-% hypothesis. We exclude from this analysis the hypothesis that relates to compliance(i.e. the one evoked in Section 4.1. We highlight with a graded color scale the share of hypothesis above 10% (in green) and the share of hypothesis below 10% in red.

TABLE B.VII

ASPIRATION AND STRESS MEASURES

	2-year results				3-year results		
	C	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**
Land area (ha)							
own	2.688	0.348*	0.145	0.360*	0.264	0.106	0.204
	[2.514]	(0.203)	(0.173)	(0.212)	(0.162)	(0.150)	(0.170)
desired	4.882	0.500	0.226	0.587*	0.426	0.239	0.403
	[3.468]	(0.346)	(0.258)	(0.336)	(0.359)	(0.297)	(0.381)
Cattle size (#)							
own	6.646	0.468	1.140	0.305	-0.032	0.325	0.047
	[7.784]	(0.653)	(0.846)	(0.658)	(0.630)	(0.624)	(0.692)
desired	25.01	-0.456	-1.553	-1.829	4.255	2.089	-0.338
	[25.42]	(2.224)	(2.635)	(2.358)	(3.100)	(2.031)	(1.901)
Education (years)							
own	2.841	0.181	0.354	0.504**	0.015	0.021	0.448
	[3.340]	(0.275)	(0.299)	(0.255)	(0.302)	(0.315)	(0.273)
desired	10.58	0.457	0.788*	1.373***	0.290	0.356	0.323
	[3.714]	(0.376)	(0.415)	(0.411)	(0.360)	(0.386)	(0.338)
Aspiration index	0.002	0.124	0.104	0.222**	0.175*	0.114	0.090
	[1.000]	(0.098)	(0.100)	(0.100)	(0.097)	(0.087)	(0.090)
	Stress						
Stress index	0.000	-0.083	-0.217**	-0.099	.	.	.
	[1.000]	(0.090)	(0.094)	(0.089)	.	.	.

Table B.VII provides measures of aspiration with regards to land size, cattle size and education. For each category we ask the household heads own level and his desired level. We aggregate the answers by standardizing each dimension using the control group and taking their average. Column C gives the average in the control group. The other columns give the respective differences between each experimental groups, estimated using strata fixed effect. Below in parenthesis, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level. *** 1% **5 % * 10% significance level

TABLE B.VIII

FOOD SECURITY AND FOOD DIVERSITY

	1-year results				*2-year results*			*3-year results*		
	C	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**
Household food insecurity										
insecure	0.557	-0.014	-0.011	0.013	0.015	-0.075*	-0.009	0.037	0.060	-0.005
	[0.497]	(0.038)	(0.040)	(0.042)	(0.042)	(0.043)	(0.043)	(0.041)	(0.043)	(0.043)
Severe insecure	0.305	-0.011	-0.026	-0.062*	-0.053*	-0.075**	-0.048	-0.023	-0.001	-0.003
	[0.461]	(0.036)	(0.033)	(0.037)	(0.028)	(0.033)	(0.029)	(0.033)	(0.039)	(0.036)
Food Diversity										
Poor diversity	0.210	-0.074***	-0.067**	-0.012	-0.003	0.011	-0.021	-0.042	-0.093***	-0.031
	[0.408]	(0.026)	(0.030)	(0.026)	(0.031)	(0.039)	(0.033)	(0.030)	(0.032)	(0.028)
Pregnant/lactating women nutrition										
Index	.	.	.	.	0.036	0.096	0.310***	.	.	.
	.	.	.	.	(0.123)	(0.111)	(0.114)	.	.	.

Table B.VIII provides Column C gives the average in the control group. The other column gives the respective differences between each experimental groups, estimated using strata fixed effect. Below in parenthesis, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level.

*** 1% **5 % * 10% significance level

TABLE B.IX

ANTHROPOMETRICS MEASURES - CHILDREN BETWEEN 0 AND 6 YEARS OLD

	1-year results				*2-year results*			*3-year results*		
	C	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**
Acute malnutrition										
Weight-for-height	-0.800	-0.019	-0.081*	0.044	-0.084	-0.053	0.005	0.077*	0.085*	0.035
	[1.106]	(0.052)	(0.045)	(0.053)	(0.057)	(0.054)	(0.063)	(0.044)	(0.051)	(0.047)
...wasting	0.134	0.007	0.006	-0.024	0.025**	0.026**	0.000	-0.016	-0.013	-0.020
	[0.341]	(0.015)	(0.015)	(0.015)	(0.013)	(0.013)	(0.012)	(0.013)	(0.014)	(0.014)
...severe wasting	0.026	-0.002	-0.002	-0.012*	0.002	-0.005	-0.005	0.001	0.003	-0.003
	[0.160]	(0.006)	(0.007)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
MUAC	14.15	0.007	0.079	0.130**	-0.060	-0.056	0.101	-0.039	-0.164	0.084
	[1.134]	(0.060)	(0.056)	(0.065)	(0.056)	(0.054)	(0.069)	(0.074)	(0.181)	(0.072)
...wasting, MUAC	0.148	-0.004	-0.014	-0.022	0.026*	0.012	0.012	-0.004	-0.004	-0.003
	[0.355]	(0.016)	(0.018)	(0.016)	(0.014)	(0.014)	(0.016)	(0.024)	(0.027)	(0.023)
Chronic malnutrition										
Height-for-age	-1.454	-0.051	0.067	0.147**	-0.034	0.076	0.182**	-0.069	-0.011	0.118*
	[1.433]	(0.063)	(0.074)	(0.067)	(0.068)	(0.070)	(0.070)	(0.070)	(0.062)	(0.063)
...stunting	0.338	0.002	-0.024	-0.044*	0.020	-0.018	-0.054**	0.038	0.023	-0.021
	[0.473]	(0.021)	(0.024)	(0.023)	(0.022)	(0.021)	(0.022)	(0.025)	(0.023)	(0.022)
...severe stunting	0.128	-0.007	-0.011	-0.033**	0.003	0.001	-0.036**	0.012	0.005	-0.011
	[0.334]	(0.015)	(0.016)	(0.016)	(0.018)	(0.016)	(0.016)	(0.012)	(0.012)	(0.011)
Underweight										
Weight-for-age	-1.376	-0.067	-0.036	0.113**	-0.100*	-0.008	0.139**	-0.033	0.022	-0.036
	[1.158]	(0.054)	(0.053)	(0.056)	(0.057)	(0.052)	(0.060)	(0.109)	(0.127)	(0.099)
...underweight	0.281	0.021	0.005	-0.030	0.031	-0.009	-0.041**	0.026	-0.002	-0.030
	[0.450]	(0.021)	(0.022)	(0.020)	(0.019)	(0.020)	(0.019)	(0.023)	(0.026)	(0.021)
...severe underweight	0.083	0.002	-0.019	-0.026**	0.023**	0.010	-0.013	0.010	-0.002	-0.013
	[0.276]	(0.012)	(0.013)	(0.012)	(0.011)	(0.011)	(0.010)	(0.012)	(0.011)	(0.009)
Observations	1,576	1,457	1,207	1,313	1,719	1,377	1,510	1,700	1,331	1,698

Table B.IX provides several anthropometrics measures for eligible 0-5 years children during the first follow-up survey. Column C gives the average in the control group. The other columns give the respective differences between each experimental groups, estimated using strata fixed effect. Below in parenthesis, we provide the standard errors and in square bracket the standard deviation of the control group. Standard errors are robust and clustered at village level.

*** 1% **5 % * 10% significance level

TABLE B.X

CREDI TEST RESULTS - 0-36 MONTHS CHILDREN - 3-YEAR FOLLOW-UP

	T1-C	***T2-C***	**T3-C**
Cognition	0.008	-0.062	0.129*
	(0.072)	(0.076)	(0.071)
Langage	0.017	-0.068	0.150**
	(0.075)	(0.077)	(0.071)
Moteur	0.021	-0.043	0.135*
	(0.069)	(0.076)	(0.070)
Socio-emotional	0.000	-0.047	0.133*
	(0.068)	(0.074)	(0.070)
Mental health	0.040	0.165	0.025
	(0.110)	(0.111)	(0.087)
Score global	0.026	-0.037	0.145**
	(0.069)	(0.075)	(0.070)
Observations	510	411	463

Table B.X provides impacts measures of the CREDI. Column C gives the average in the control group. The other columns give the respective differences between each experimental groups, estimated using strata fixed effect. Below in parenthesis, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level.
*** 1% **5 % * 10% significance level

TABLE B.XI

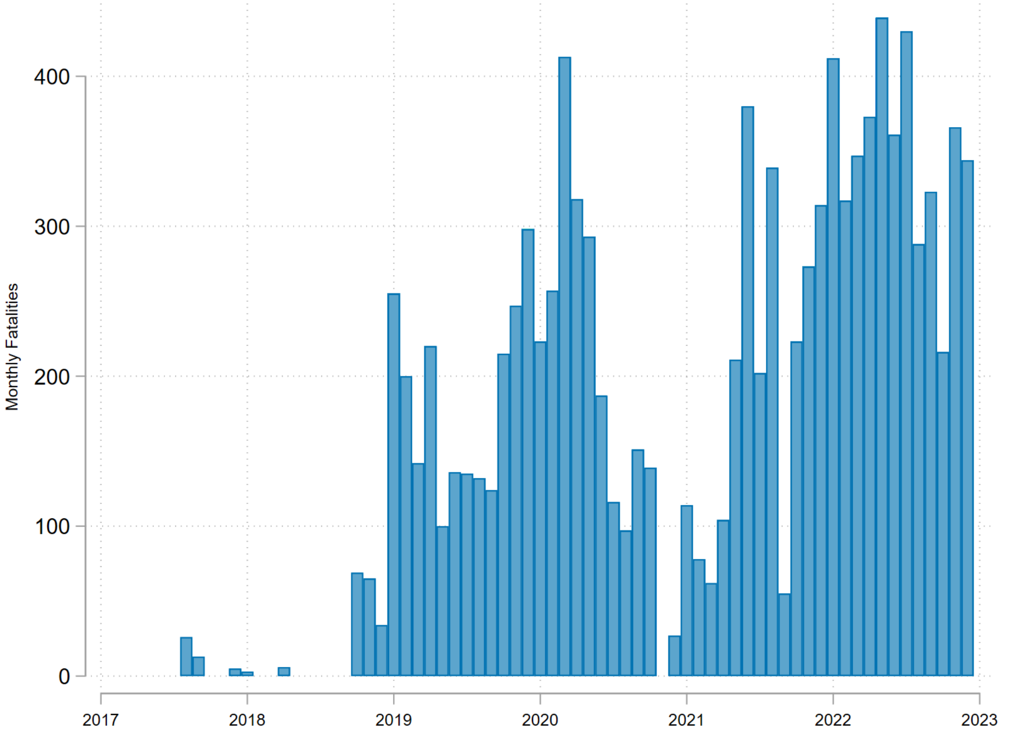
MELQO TEST RESULTS - 36-59 MONTHS CHILDREN

	1-year results			*2-year results*		
	T1-C	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**
Math score	-0.066	0.037	0.109	0.033	-0.091	-0.003
	(0.077)	(0.093)	(0.088)	(0.060)	(0.065)	(0.051)
Cognitive score	-0.045	0.062	0.010	0.082	-0.046	0.053
	(0.061)	(0.077)	(0.078)	(0.066)	(0.073)	(0.063)
Language score	-0.104	-0.063	-0.088	0.049	-0.060	0.009
	(0.087)	(0.100)	(0.088)	(0.061)	(0.064)	(0.055)
Motor Score	0.018	-0.118	0.191**	0.020	-0.178*	0.041
	(0.104)	(0.114)	(0.096)	(0.104)	(0.099)	(0.098)
Overall score	-0.042	0.043	0.001	0.055	-0.065	0.014
	(0.062)	(0.076)	(0.073)	(0.054)	(0.059)	(0.047)
Observations	558	488	510	599	456	587

Table B.XI provides measures of cognitive development(MELQO) in the 2-year follow-up survey. Column C gives the average in the control group. The other columns give the respective differences between each experimental groups, estimated using strata fixed effect. Below in parenthesis, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level.
*** 1% **5 % * 10% significance level

APPENDIX: ONLINE APPENDIX A: SUPPLEMENTARY FIGURES

FIGURE OA1.—Violent Events Fatalities - Experimental Communes



The graph shows the number of monthly fatalities due to terrorist attacks from 2017 (one year before the beginning of the interventions) to 2022 (one year after) in the 15 communes where the experiments was conducted.
source: ACLED

FIGURE OA2.—Cash Utilization

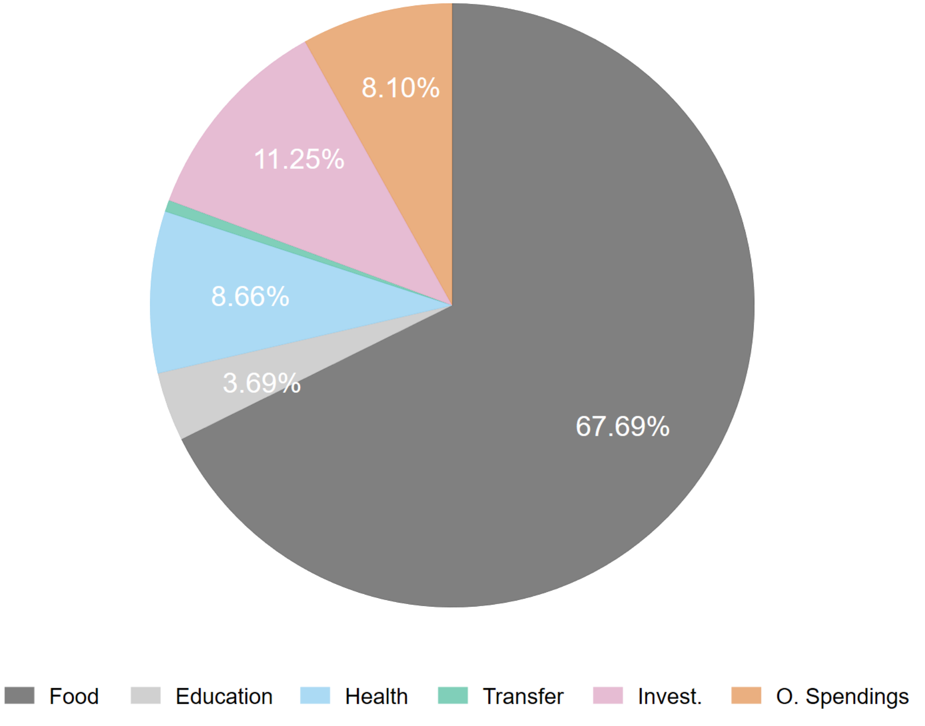
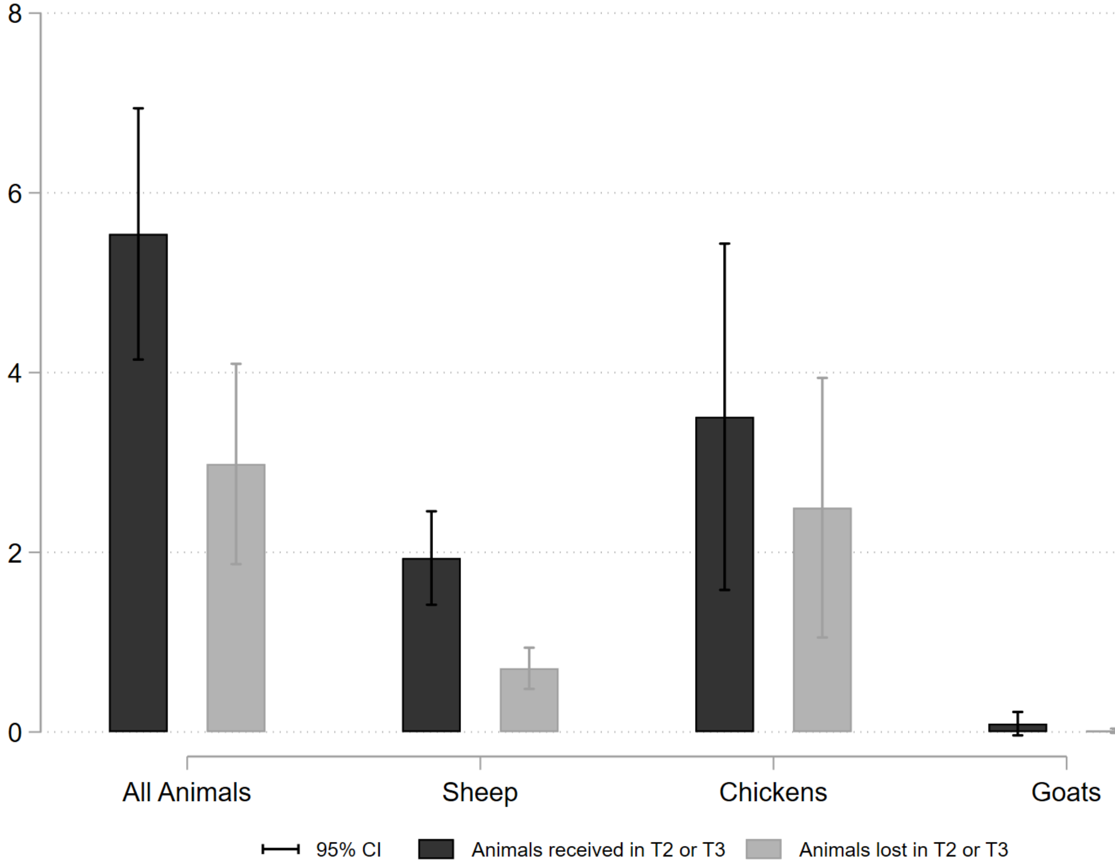


FIGURE OA3.—Animal Transfers - T2 and T3 only and conditional on benefiting from an animal transfer



Number of animals transferred as reported by respondent conditional on being in an asset branch (T2 or T3) and having had at least one transfer. Since households only benefited from one type of animal transfer, the average number for sheep, chickens and goats includes many zeros while the averages for all animals only includes positive numbers.

FIGURE OA4.—Treatment Exposure and Start Date - CREDI cohort - 3-year follow-up

	Month conceived	Birthday	age (months) April 2021	Treatment dosage in-utero	Treatment dosage direct	Treatment start age	Treatment intensity
CREDI	Jul-20	Apr-21	0	0	0	NA	Not directly impacted
	Jun-20	Mar-21	1	0	0	NA	
	May-20	Feb-21	2	0	0	NA	
	Apr-20	Jan-21	3	0	0	NA	
	Mar-20	Dec-20	4	0	0	NA	
	Feb-20	Nov-20	5	0	0	NA	
	Jan-20	Oct-20	6	0	0	NA	
	Dec-19	Sep-20	7	0	0	NA	
	Nov-19	Aug-20	8	0	0	NA	
	Oct-19	Jul-20	9	0	0	NA	
	Sep-19	Jun-20	10	1	0	NA	only in-utero impacted
	Aug-19	May-20	11	2	0	NA	
	Jul-19	Apr-20	12	3	0	NA	
	Jun-19	Mar-20	13	4	0	NA	
	May-19	Feb-20	14	5	0	NA	
	Apr-19	Jan-20	15	6	0	NA	
	Mar-19	Dec-19	16	7	0	NA	
	Feb-19	Nov-19	17	8	0	NA	
	Jan-19	Oct-19	18	9	0	NA	
	Dec-18	Sep-19	19	9	1	1	In-utero \& directly impacted
	Nov-18	Aug-19	20	9	2	1	
	Oct-18	Jul-19	21	9	3	1	
	Sep-18	Jun-19	22	9	4	1	
	Aug-18	May-19	23	9	5	1	
	Jul-18	Apr-19	24	9	6	1	
	Jun-18	Mar-19	25	9	7	1	
	May-18	Feb-19	26	8	8	1	
	Apr-18	Jan-19	27	7	9	1	
	Mar-18	Dec-18	28	6	10	1	
	Feb-18	Nov-18	29	5	11	1	
	Jan-18	Oct-18	30	4	12	1	
	Dec-17	Sep-18	31	3	13	1	
	Nov-17	Aug-18	32	2	14	1	
	Oct-17	Jul-18	33	1	15	1	
	Sep-17	Jun-18	34	0	16	1	directly impacted, not in-utero
	Aug-17	May-18	35	0	16	2	
	Jul-17	Apr-18	36	0	16	3	

The graph shows the treatment intensity and treatment starting age for 0-36 children whose caregiver took the 3-year follow-up CREDI test. The treatment intensity and start age is given by age. Column *Month conceived* gives the approximate month the child was conceived and column *Birthday* the approximate birthday of the child. Columns *Treatment dosage* give the number of months the child benefited from the treatment both *in utero* and post-natal (direct). We consider as the *treatment* the period between June 2018 (dates of the first transfers) until September 2019 (date of the last transfers), see Figure **??** for more details about the timeline of the interventions.

FIGURE OA5.—Treatment Exposure and Start Date - MELQO cohort - 2-year follow-up

Month conceived	**Birthday**	**age (months) April 2020**	**Treatment dosage** in-utero	**Treatment dosage** direct	**Treatment start age**	**Treatment intensity**
Aug-16	May-17	37	0	16	13	
Jul-16	Apr-17	38	0	16	14	
Jun-16	Mar-17	39	0	16	15	
May-16	Feb-17	40	0	16	16	
Apr-16	Jan-17	41	0	16	17	
Mar-16	Dec-16	42	0	16	18	
Feb-16	Nov-16	43	0	16	19	
Jan-16	Oct-16	44	0	16	20	
Dec-15	Sep-16	45	0	16	21	
Nov-15	Aug-16	46	0	16	22	
Oct-15	Jul-16	47	0	16	23	
Sep-15	Jun-16	48	0	16	24	directly impacted not in-utero
Aug-15	May-16	49	0	16	25	
Jul-15	Apr-16	50	0	16	26	
Jun-15	Mar-16	51	0	16	27	
May-15	Feb-16	52	0	16	28	
Apr-15	Jan-16	53	0	16	29	
Mar-15	Dec-15	54	0	16	30	
Feb-15	Nov-15	55	0	16	31	
Jan-15	Oct-15	56	0	16	32	
Dec-14	Sep-15	57	0	16	33	
Nov-14	Aug-15	58	0	16	34	
Oct-14	Jul-15	59	0	16	35	

Same as Figure OA4 but for MELQO in the 2-year follow-up survey i.e. for children aged between 36 and 60 months.

FIGURE OA6.—Treatment Exposure and Start Date - 3-year MELQO test cohort

Month conceived	**Birthday**	**age (months) April 2021**	**Treatment dosage**		**Treatment start age**	**Treatment intensity**
			in-utero	direct		
Jun-17	Mar-18	37	0	16	4	
May-17	Feb-18	38	0	16	5	
Apr-17	Jan-18	39	0	16	6	
Mar-17	Dec-17	40	0	16	7	
Feb-17	Nov-17	41	0	16	8	
Jan-17	Oct-17	42	0	16	9	
Dec-16	Sep-17	43	0	16	10	
Nov-16	Aug-17	44	0	16	11	
Oct-16	Jul-17	45	0	16	12	
Sep-16	Jun-17	46	0	16	13	
Aug-16	May-17	47	0	16	14	
Jul-16	Apr-17	48	0	16	15	directly impacted not in-utero
Jun-16	Mar-17	49	0	16	16	
May-16	Feb-17	50	0	16	17	
Apr-16	Jan-17	51	0	16	18	
Mar-16	Dec-16	52	0	16	19	
Feb-16	Nov-16	53	0	16	20	
Jan-16	Oct-16	54	0	16	21	
Dec-15	Sep-16	55	0	16	22	
Nov-15	Aug-16	56	0	16	23	
Oct-15	Jul-16	57	0	16	24	
Sep-15	Jun-16	58	0	16	25	
Aug-15	May-16	59	0	16	26	

Same as Figure OA4 but for the 3-year MELQO test i.e. for children aged between 36 and 60 months.

TABLE OB1

LITERATURE REVIEW CASH, NUTRITION AND MULTI-FACETED COMPARABLE EXPERIMENTAL STUDIES

Panel A: Conditional and Unconditional Cash litterature

Study	Country	HAZ	WHZ	age	intervention
Premand and Barry (2022)	Niger	0	0	6-59 m	UCT
McIntosh and Zeitlin (2018)	Rwanda	+	NA	0-5 yr	UCT
Baird et al. (2019)	Malawi	0	NA	13-22 yr	UCT
Houngbe et al. (2017)	Burkina Faso	0	0	24-39 m	UCT
Akresh et al. (2016)	Burkina Faso	0	0	0-5 yr	UCT
Paxson and Schady (2010)	Ecuador	0	NA	0-6 yr	UCT
Baird et al. (2019)	Malawi	0	NA	13-22 yr	CCT
Evans et al. (2016)	Philippines	+	NA	6-36 m	CCT
Kandpal et al. (2016)	Tanzania	0	0	0-4 yr	CCT
Akresh et al. (2016)	Burkina Faso	+	+	0-5 yr	CCT
Galiani and McEwan (2013)	Honduras	+	NA	0-6 yr	CCT
Macours et al. (2012)	Nicaragua	+	NA	0-5 yr	CCT
Maluccio and Flores (2005)	Nicaragua	+	0	0-5 yr	CCT

Panel B: Multifaced program litterature

Study	Country	Food security	Asset	Health
Angelucci et al. (2022)	Congo	**NA**	+	0
Soofi et al. (2022)	Pakistan	NA	NA	+
Banerjee et al. (2022)	Ghana	+	+	NA
Banerjee et al. (2021)*	India	+	+	+
Bandiera et al. (2017)	Bangladesh	NA	+	NA
Banerjee et al. (2015)	Multiple	+	+	0

Continued

TABLE OB1

LITERATURE REVIEW - *Continued*

Panel C: Nutrition Program

Study	Country	WHZ	HAZ	Dev. Skills	Program Type
Wegmüller et al. (2022)	Kenya	NA	+	NA	NA
Olney et al. (2019)	Burundi	+	+	+	MMN+Training
Barffour et al. (2019)	Lao PDR	0	0	NA	MMN
Maleta et al. (2015)	Malawi	0	0	NA	LNS
Hess et al. (2015)	Burkina Faso	+	+	NA	LNS
Chang et al. (2013)	China	NA	NA	+	MMN
Aboud and Akhter (2011)	Bangladesh	NA	NA	+	MMN
Sazawal et al. (2010)	India	+	+	NA	MMN
Makrides et al. (2010)	Vietnam	NA	NA	0	Fish Oil
Li et al. (2009)	China	NA	NA	+	MMN
Manger et al. (2008)	Thailand	0	0	0	MMN
Adu-Afarwuah et al. (2008)	Ghana	+	+	NA	MMN
Tofail et al. (2008)	Bangladesh	NA	NA	0	MMN
McGrath et al. (2006)	Tanzania	NA	NA	+	Multivitamin

Table OB1 provides the main impacts of the most prominent experiments on the cash, nutrition and multifaced literature, conducted in the last 20 years. Column *HAZ* gives the Height for age z-score impacts,*WHZ*, the Weight for Height z-score impacts, age gives the age of the child, *Skills*, the effect on developmental skills. For the multifaceted literature, we provide the results on food security, asset and health index. Column intervention gives the type of program implemented: UCT stands for unconditional cash transfer, CCT conditional cash transfer, MMN for MultipleâĂŘmicro-nutrient supplementation, LNS for liquid-based nutrient supplementation

* long-term follow-up of a previously listed experiment. + indicates positive and significant effect, *NA* not reported/collected, *0* no significant effect.

TABLE OB2
ATTRITION

	Obs	C	T1-C	T2-C	T3-C	T-C
Midline						
overall attrition	3,483	0.096	-0.030	0.038	-0.054	-0.015
		[0.295]	(0.045)	(0.064)	(0.041)	(0.042)
... Villages	3,483	0.000	0.000	0.037	0.000	0.012
		[0.000]	(0.000)	(0.036)	(0.000)	(0.012)
... Households	3,483	0.096	-0.030	0.001	-0.054	-0.027
		[0.295]	(0.045)	(0.055)	(0.041)	(0.040)
Endline						
overall attrition	7,109	0.098	0.063	0.084	0.032	0.060
		[0.297]	(0.055)	(0.063)	(0.051)	(0.040)
... Villages	7,109	0.030	0.056	0.094	0.026	0.059
		[0.171]	(0.049)	(0.063)	(0.047)	(0.037)
... Households	7,109	0.068	0.007	-0.010	0.006	0.001
		[0.251]	(0.032)	(0.022)	(0.026)	(0.020)
Follow-up						
overall attrition	7,109	0.224	0.030	0.102	-0.003	0.042
		[0.417]	(0.065)	(0.078)	(0.066)	(0.053)
... Villages	7,109	0.046	0.052	0.159**	0.025	0.078*
		[0.209]	(0.052)	(0.075)	(0.051)	(0.043)
... Households	7,109	0.178	-0.022	-0.057	-0.028	-0.036
		[0.383]	(0.050)	(0.048)	(0.051)	(0.040)
Observations	7,109	1,923	1,777	1,695	1,714	5,186
Clusters	169	44	43	41	42	126

Table OB2 gives attrition rate for the control group (column C) and the differential attrition between the treatment branches and the control group. Column T-C compares all treatment groups with the control group. Regression results are controlled for commune fixed effect. Standard errors are clustered at the village level and robust to heteroskedasticity. *significativitÃľ *** 1%, ** 5%, * 10%*

TABLE OB3
LIVESTOCK

		1-year results			*2-year results*			*3-year results*		
	C	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**
Livestock										
# of animals	10.75	1.041	3.394***	4.140***	0.039	0.921	1.213	0.722	0.804	0.599
	[10.83]	(0.706)	(0.766)	(1.275)	(0.893)	(0.975)	(1.144)	(1.136)	(0.988)	(1.295)
Average price	31.51	1.109	-3.769*	-1.155	1.431	-1.774	-1.111	0.092	-3.919	-1.514
	[34.36]	(2.251)	(2.043)	(2.094)	(2.268)	(2.041)	(2.049)	(2.534)	(2.613)	(2.793)
Total Value	244.7	11.34	2.880	46.24*	1.083	-14.91	4.034	10.85	13.20	-21.92
	[357.5]	(23.28)	(21.43)	(27.43)	(20.97)	(24.59)	(25.68)	(25.86)	(32.49)	(29.84)
Animals sold										
# sold	2.865	0.311	0.214	0.385	0.106	0.089	0.030	-0.005	-0.080	-0.046
	[5.791]	(0.361)	(0.352)	(0.421)	(0.315)	(0.336)	(0.334)	(0.636)	(0.529)	(0.647)
Average price	28.88	-2.527	-10.81***	-6.547*	1.827	-5.546**	0.095	.	.	.
	[50.55]	(3.232)	(2.966)	(3.411)	(3.131)	(2.581)	(2.975)	.	.	.
Value	42.17	-0.165	-10.22*	-4.607	-0.007	-10.40**	-3.320	.	.	.
	[104.4]	(5.555)	(5.334)	(6.558)	(4.882)	(4.491)	(4.741)	.	.	.

Same as Table **??** but with a specification including baseline outcome variables.
*** 1% **5 % * 10% significance level

TABLE OB4

FARM SIZE AND REVENUE

	1-year results			*2-year results*			*3-year results*		
	T1-C	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	***T3-C***
# of plots									
... cultivated	-0.044	0.180	0.177	-0.083	0.052	0.229*	0.171	0.127	0.087
	(0.110)	(0.116)	(0.138)	(0.124)	(0.136)	(0.137)	(0.116)	(0.109)	(0.105)
... owned	-0.071	0.054	0.166	-0.169	-0.054	0.267*	0.110	0.128	0.087
	(0.117)	(0.101)	(0.149)	(0.121)	(0.119)	(0.138)	(0.124)	(0.116)	(0.113)
... fertilized	0.126	0.065	0.164*	0.033	0.072	0.115	0.032	-0.012	0.088
	(0.080)	(0.113)	(0.094)	(0.099)	(0.103)	(0.093)	(0.080)	(0.080)	(0.097)
... irrigated	0.011	0.078	0.007	0.024	0.055	-0.003	0.010	0.003	-0.002
	(0.015)	(0.075)	(0.016)	(0.018)	(0.041)	(0.008)	(0.006)	(0.006)	(0.006)
# of cultivated crops	0.248	0.182	0.345**	0.078	-0.023	0.268	0.148	0.057	-0.013
	(0.166)	(0.176)	(0.171)	(0.159)	(0.183)	(0.181)	(0.147)	(0.148)	(0.162)
Plot size (in ha)	0.278	0.035	0.225	0.317	0.096	0.384*	0.377**	0.216	0.202
	(0.215)	(0.170)	(0.217)	(0.200)	(0.179)	(0.213)	(0.166)	(0.155)	(0.180)
Agricultural revenue	-3.131	-17.14	31.94*	-5.046	-23.09	6.312	-5.830	-10.98	-1.802
	(14.07)	(12.95)	(17.99)	(15.30)	(14.05)	(17.01)	(12.59)	(10.49)	(11.61)
Observation	801	697	764	737	658	712	696	580	690

Same as Table OB4 but with a specification including baseline outcome variables.
*** 1% **5 % * 10% significance level

TABLE OB5
LOANS AND SAVING

	1-year results				*2-year results*			*3-year results*		
	C	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**
Tontine										
Tontine, (yes=1)	0.068	-0.020	-0.013	-0.009	-0.039*	0.005	0.010	0.008	0.023*	0.021
	[0.252]	(0.016)	(0.018)	(0.015)	(0.022)	(0.024)	(0.024)	(0.015)	(0.013)	(0.016)
Tontine, amount	0.167	0.041	0.191	0.026	0.024	0.161	0.016	0.978	-0.085	0.351
	[1.027]	(0.078)	(0.147)	(0.080)	(0.162)	(0.154)	(0.156)	(0.689)	(0.367)	(0.270)
Savings										
saving, (yes=1)	0.281	0.032	0.051	0.070*	0.025	0.052	0.107***	0.046	0.047	0.056*
	[0.450]	(0.039)	(0.038)	(0.039)	(0.037)	(0.037)	(0.039)	(0.034)	(0.030)	(0.031)
saving, amount	5.328	2.122*	2.739**	1.407	0.123	3.102	3.003	1.547	2.417*	1.335
	[129.6]	(4.577)	(5.389)	(4.671)	(1.800)	(2.122)	(1.868)	(1.118)	(1.322)	(1.337)
Loans										
has loan, (yes=1)	0.445	-0.096**	-0.041	-0.023	-0.006	-0.009	0.045	-0.005	0.011	-0.013
	[0.497]	(0.042)	(0.042)	(0.035)	(0.034)	(0.037)	(0.036)	(0.034)	(0.036)	(0.038)
loan, amount	27.69	-9.076***	-8.576**	-6.776*	-0.003	-0.009	0.049	-0.002	0.007	-0.021
	[77.48]	(3.267)	(3.474)	(3.616)	(0.035)	(0.039)	(0.039)	(0.038)	(0.041)	(0.042)
loan, remaining	15.92	-6.350**	-4.100	-4.443*	-1.784	-5.921	-0.385	2.620	-2.210	-0.440
	[65.70]	(2.555)	(3.080)	(2.481)	(4.944)	(3.875)	(4.071)	(4.353)	(3.419)	(4.247)
Observations	908	801	697	764	737	658	712	696	580	690

Same as Table **??** but with a specification including baseline outcome variables.
*** 1% **5 % * 10% significance level

APPENDIX: APPENDIX C: ROBUSTNESS TESTS

TABLE OC1

INDEXES - DOUBLE LASSO CONTROLS

	1-year results			*2-year results*			*3-year results*		
	T1-C	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**
Ag. Equipment	0.092*	0.214***	0.410***	-0.030	0.082**	0.388***	0.037	0.047	0.147***
	(0.047)	(0.039)	(0.039)	(0.041)	(0.040)	(0.049)	(0.048)	(0.047)	(0.048)
	[0.048]	[0.001]	[0.001]	[0.685]	[0.117]	[0.001]	[1.000]	[1.000]	[0.026]
Livestock	0.035	0.233***	0.356***	-0.049	0.018	0.062	0.002	0.005	0.015
	(0.041)	(0.045)	(0.048)	(0.042)	(0.046)	(0.048)	(0.049)	(0.048)	(0.048)
	[0.282]	[0.001]	[0.001]	[0.383]	[0.685]	[0.372]	[1.000]	[1.000]	[1.000]
Farming	0.034	0.136***	0.135***	0.027	0.072**	0.071**	0.049	-0.003	0.012
	(0.033)	(0.045)	(0.029)	(0.037)	(0.036)	(0.030)	(0.031)	(0.032)	(0.030)
	[0.223]	[0.004]	[0.001]	[0.685]	[0.117]	[0.101]	[1.000]	[1.000]	[1.000]
Saving	0.028	0.003	0.023	-0.055	-0.019	-0.009	-0.042	-0.007	-0.038
	(0.037)	(0.051)	(0.036)	(0.041)	(0.047)	(0.038)	(0.038)	(0.036)	(0.041)
	[0.286]	[0.651]	[0.315]	[0.372]	[0.685]	[0.685]	[1.000]	[1.000]	[1.000]
Aggregated index	0.053**	0.164***	0.251***	-0.022	0.048	0.139***	0.016	0.011	0.035
	(0.026)	(0.030)	(0.026)	(0.028)	(0.029)	(0.029)	(0.030)	(0.028)	(0.029)
Poverty Prediction	-0.051***	-0.064***	-0.050***	-0.002	-0.003	-0.027**	-0.006	-0.007	-0.022
	(0.013)	(0.014)	(0.014)	(0.013)	(0.014)	(0.012)	(0.015)	(0.016)	(0.014)

Same as Table **??** but with a specification including baseline outcome variables selected using double LASSO.
*** 1% **5 % * 10% significance level

TABLE OC2

ASPIRATION AND STRESS MEASURES - DOUBLE LASSO

		2-year results			*3-year results*		
	C	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**
Land area (ha)							
own	2.631	0.130**	0.045	0.227***	0.264	0.106	0.204
		(0.059)	(0.058)	(0.068)	(0.162)	(0.150)	(0.170)
desired	5.069	0.109	0.068	0.355***	0.426	0.239	0.403
		(0.099)	(0.091)	(0.103)	(0.359)	(0.297)	(0.381)
Cattle size (#)							
own	6.905	-0.090	0.091	-0.235	-0.032	0.325	0.047
		(0.260)	(0.247)	(0.235)	(0.630)	(0.624)	(0.692)
desired	27.63	0.759	1.199	-1.506	4.255	2.089	-0.338
		(1.021)	(1.274)	(0.953)	(3.100)	(2.031)	(1.901)
Education (years)							
own	2.738	-0.023	0.138	0.301***	0.015	0.021	0.448
		(0.095)	(0.099)	(0.098)	(0.302)	(0.315)	(0.273)
desired	10.54	-0.037	0.298**	0.674***	0.290	0.356	0.323
		(0.112)	(0.122)	(0.112)	(0.360)	(0.386)	(0.338)
index	0.001	0.026	0.055*	0.109***	0.175*	0.114	0.090
		(0.027)	(0.028)	(0.026)	(0.097)	(0.087)	(0.090)
				Stress			
Stress index	0.000	-0.083**	-0.204***	-0.100***	.	.	.
		(0.038)	(0.040)	(0.038)	.	.	.

Table OC2 provides measures of aspiration with regards to land size, cattle size and education. For each category we ask the households head own level and his desired level. We aggregate the answers by standardizing each dimension using the control group and taking their average. Column C gives the average in the control group. The other columns give the respective differences between each experimental groups, estimated using double LASSO. Below in parenthesis, we provide the standard error of the coefficient and in square bracket the standard deviation. Standard errors are robust and clustered at village level.

*** 1% **5 % * 10% significance level

TABLE OC3

FOOD SECURITY AND FOOD DIVERSITY - DOUBLE LASSO

	1-year results				*2-year results*			*3-year results*		
	C	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**	**T1-C**	**T2-C**	**T3-C**
Household food insecurity										
insecure	0.557	0.001	0.007	0.022	0.029	-0.062***	0.000	0.054**	0.071***	0.005
		(0.022)	(0.023)	(0.023)	(0.024)	(0.024)	(0.024)	(0.025)	(0.027)	(0.025)
Severe insecure	0.305	0.002	-0.013	-0.054***	-0.042**	-0.065***	-0.040**	-0.012	0.010	0.005
		(0.021)	(0.022)	(0.021)	(0.019)	(0.020)	(0.019)	(0.021)	(0.024)	(0.022)
Food Diversity										
Poor diversity	0.210	-0.071***	-0.063***	-0.011	-0.003	0.012	-0.021	-0.038*	-0.091***	-0.028
		(0.017)	(0.019)	(0.018)	(0.019)	(0.020)	(0.018)	(0.022)	(0.024)	(0.021)
Pregnant/lactating women nutrition										
Index	.	.	.	.	0.073	0.074	0.323***	.	.	.
	.	.	.	.	(0.101)	(0.094)	(0.096)	.	.	.

Same as Table **??** but with a specification including baseline outcome variables selected using double LASSO.

TABLE OC4

ANTHROPOMETRICS MEASURES - DOUBLE LASSO

	1-year results				*2-year results*			*3-year results*		
	C	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**
Acute malnutrition										
Weight-for-height	-0.800	-0.029	-0.137***	0.018	-0.077*	-0.019	0.001	0.077*	0.085*	0.035
		(0.044)	(0.046)	(0.043)	(0.044)	(0.046)	(0.044)	(0.044)	(0.051)	(0.047)
... wasting	0.134	0.019	0.019	-0.019	0.036***	0.035***	0.008	-0.016	-0.013	-0.020
		(0.014)	(0.015)	(0.013)	(0.012)	(0.013)	(0.012)	(0.013)	(0.014)	(0.014)
... severe wasting	0.026	-0.002	-0.009	-0.007	0.008	0.000	-0.005	0.001	0.003	-0.003
		(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)
MUAC	14.15	-0.006	0.007	0.086**	-0.039	-0.095**	0.096**	-0.039	-0.164	0.084
		(0.037)	(0.039)	(0.038)	(0.037)	(0.039)	(0.040)	(0.074)	(0.181)	(0.072)
... wasting, MUAC	0.148	-0.012	-0.003	-0.009	0.028	0.021	0.020	-0.004	-0.004	-0.003
		(0.015)	(0.017)	(0.016)	(0.019)	(0.020)	(0.019)	(0.024)	(0.027)	(0.023)
Chronic malnutrition										
Height-for-age	-1.454	-0.011	0.089*	0.146***	-0.016	0.060	0.161***	-0.069	-0.011	0.118*
		(0.049)	(0.052)	(0.048)	(0.047)	(0.053)	(0.049)	(0.070)	(0.062)	(0.063)
... stunting	0.338	0.015	-0.025	-0.035*	0.026	-0.016	-0.044**	0.038	0.023	-0.021
		(0.019)	(0.021)	(0.019)	(0.018)	(0.019)	(0.018)	(0.025)	(0.023)	(0.022)
... severe stunting	0.128	-0.018	-0.009	-0.035**	-0.007	-0.005	-0.030**	0.012	0.005	-0.011
		(0.014)	(0.015)	(0.014)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.011)
Underweight										
Weight-for-age	-1.376	-0.036	-0.040	0.109***	-0.088**	-0.007	0.126***	-0.033	0.022	-0.036
		(0.038)	(0.039)	(0.037)	(0.036)	(0.039)	(0.037)	(0.109)	(0.127)	(0.099)
... underweight	0.281	0.019	0.010	-0.040**	0.043**	0.004	-0.032*	0.026	-0.002	-0.030
		(0.018)	(0.019)	(0.018)	(0.017)	(0.018)	(0.016)	(0.023)	(0.026)	(0.021)
... severe underweight	0.083	-0.009	-0.021*	-0.032***	0.020**	0.007	-0.014	0.010	-0.002	-0.013
		(0.012)	(0.012)	(0.011)	(0.010)	(0.010)	(0.009)	(0.012)	(0.011)	(0.009)
Observations	1,576	1,457	1,207	1,313	1,719	1,377	1,510	1,700	1,331	1,698

Same as Table **??** but with a specification including baseline outcome variables.
*** 1% **5 % * 10% significance level

TABLE OC5

CREDI TEST RESULTS - 0-36 MONTHS CHILDREN - 3-YEAR FOLLOW-UP SURVEY - DOUBLE LASSO

	T1-C	***T2-C***	**T3-C**
Cognition	0.008	-0.062	0.129**
	(0.064)	(0.066)	(0.064)
Langage	0.017	-0.068	0.150**
	(0.064)	(0.066)	(0.064)
Moteur	0.021	-0.043	0.135**
	(0.064)	(0.066)	(0.064)
Socio-emotional	0.008	-0.043	0.139**
	(0.064)	(0.066)	(0.064)
Mental health	0.040	0.165***	0.025
	(0.058)	(0.062)	(0.060)
Score global	0.033	-0.033	0.150**
	(0.064)	(0.067)	(0.064)
Observations	510	411	463

Same as Table **??** but with a specification including baseline outcome variables selected using double LASSO.

TABLE OC6

MELQO TEST RESULTS - 36-59 MONTHS CHILDREN - DOUBLE LASSO

	1-year results			*2-year results*		
	T1-C	***T2-C***	**T3-C**	***T1-C***	***T2-C***	**T3-C**
Math score	-0.015	-0.024	0.052*	-0.015	-0.024	0.052*
	(0.030)	(0.035)	(0.031)	(0.030)	(0.035)	(0.031)
Cognitive score	0.023	0.009	0.034	0.023	0.009	0.034
	(0.027)	(0.031)	(0.028)	(0.027)	(0.031)	(0.028)
Language score	-0.026	-0.063*	-0.034	-0.026	-0.063*	-0.034
	(0.029)	(0.033)	(0.029)	(0.029)	(0.033)	(0.029)
Motor Score	0.023	-0.145***	0.108***	0.023	-0.145***	0.108***
	(0.039)	(0.043)	(0.039)	(0.039)	(0.043)	(0.039)
Overall score	0.009	-0.009	0.008	0.009	-0.009	0.008
	(0.024)	(0.028)	(0.025)	(0.024)	(0.028)	(0.025)
Observations	1,157	944	1,097	1,157	944	1,097

Same as Table OC6 but with a specification including baseline outcome variables selected using double LASSO.

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