IMPACTS OF AN UNCONDITIONAL CASH TRANSFER ON HOUSEHOLD FOOD AND NUTRITION SECURITY AND CHILD HEALTH OUTCOMES IN MALAWI

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ABSTRACT

Kristen Nichole Brugh: Impacts of an Unconditional Cash Transfer on Household Food and Nutrition Security and Child Health Outcomes in Malawi
(Under the direction of Gustavo Angeles)

Social cash transfer programs are increasingly employed in sub-Saharan Africa to reduce household vulnerability to extreme poverty, strengthen food and nutrition security, and improve child health. Many of these programs are government-run, and as countries take these programs to scale it is important to understand the range of impacts programs can have as well as how these impacts occur. The main objectives of this dissertation are to determine if the Government of Malawi's Social Cash Transfer Program (SCTP) improves household food and nutrition security (FNS) and young child health, and to understand the mechanisms through which the program achieves these impacts by analyzing critical relationships along the causal chain. This study uses baseline and 17-month follow-up household panel data from a large-scale evaluation of the SCTP. The evaluation is a cluster-randomized control trial that employs both random selection and random assignment to treatment and delayed-entry control groups. The first paper uses the difference-in-differences approach and specifies Generalized Linear Models to estimate average treatment effects of the program on three components of FNS: current economic vulnerability, diet quantity, and diet quality. Results show protective program impacts during the lean season on diet quantity, but beneficiary households experience little improvement in diet quality or current economic vulnerability to food insecurity relative to controls. The second paper applies the health production function framework to trace the impact of the SCTP through household demand for child health inputs to child health outcomes. The empirical strategy combines the difference-in-differences approach with instrumental variables to estimate the derived health input demands and the effects of these inputs on important child health outcomes. We also estimate a fixed-effects specification of the health production function as a robustness check for potential weak instruments. Study results indicate that after approximately one year of exposure the program has strong positive impacts on food expenditures and apparent caloric availability, but not child feeding, and that these impacts do not translate to significant improvements in child health outcomes. Clear policy and program implications emerge related to the purchasing power of the cash transfer and the importance of integrated social protection initiatives.

To my dad, who taught me the Hokie Pokie and what life is all about.

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LIST OF ABBREVIATIONS

2SLS	2-Stage Least Squares
ADMARC	Malawi agricultural Development and Marketing Corporation
AE-L	Adult equivalent assuming light activity levels
AIC	Akaike information criterion
AIDS	Acquired immunodeficiency syndrome
AME	Average marginal effect
ATE	Average treatment effect
BIC	Bayesian information criterion
CCT	Conditional Cash Transfer
CGP	Zambia Child Grant Program
CSSC	Community Social Support Committee
CT-OVC	Kenya Cash Transfer for Orphans and Vulnerable Children
DD	Double-Difference; Difference-in-Differences
ESA	Eastern South Africa
FAO	Food and Agriculture Organization
FE	Fixed-Effects
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
FNS	Food and Nutrition Security
GLM	Generalized Linear Models
GoM	Government of Malawi
HAZ	Height-for-Age
HDDS	Household diet diversity score
HIV	Human immunodeficiency virus
HSCT	Zimbabwe Harmonized Social Cash Transfer
IFPRI	International Food Policy Research Institute

IHS3	Malawi 3rd Integrated Household Survey
IPW	Inverse probability weight
IRB	Institutional Review Board
ITT	Intention to treat
IV	Instrumental Variables
Kcal	Kilocalories
KM	kilometers
MCTG	Zambia Multiple Transfer Category Grant program
MDG	Millennium Development Goals
MWK	Malawian Kwacha
NCST	National Commission For Science And Technology
OLS	Ordinary Least Squares
PC	Per capita
SCTP	Social Cash Transfer Program
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
TA	Traditional Authority
TIP	Targeted Inputs Program
UCT	Unconditional Cash Transfer
UNC	University of North Carolina at Chapel Hill
UNICEF	United Nations Children's Fund
USD	United States dollars
VC	Village Cluster
WAZ	Weight-for-Age
WHO	World Health Organization
WHZ	Weight-for-Height

CHAPTER 1: INTRODUCTION

Considerable gains in poverty reduction and food and nutrition security (FNS) have been made since the inception of the Millennium Development Goals (MDG) era. The share of people living in extreme poverty in developing countries has decreased from 43 percent in 1990 to 17 percent in 2015,[1] and the global prevalence of undernourishment declined by 216 million people (from 19 percent to 11 percent) despite a concurrent 1.9 billion increase in the global population.[2] While progress has been made in reducing poverty and hunger in recent decades, substantial problems persist. Globally, nearly one billion people continue to live in extreme poverty (less than US$1.25 per capita per day), [1] and 11 percent of the global population is undernourished (795.6 million), most of whom are in developing regions (779.9 million, 12.9 percent). Nearly two billion people experience "hidden hunger", or micronutrient deficiency,[3,4] and 749 million are estimated to be calorie deficient.[1] As most of the world's regions have experienced declining poverty and undernutrition rates, sub-Saharan Africa (SSA) has seen little progress. Half of the population in SSA is extremely poor, and just under one in four people is undernourished (220 million). Sub-Saharan Africa has the highest regional prevalence of undernourishment, and the number of undernourished actually increased by 44 million between 1990 and 2015.[2]

The poor are particularly vulnerable to hunger and food insecurity because they often live just above or at subsistence levels, and even small shocks will move them closer towards destitution.[5] When confronted with difficulties in purchasing food, poor households result to coping strategies which can be harmful and further exacerbate the cycle of poverty. These adverse coping strategies often include reducing diet quantity or compromising diet quality by switching towards cheaper calorie sources, or selling productive assets and taking children out of school to afford food.[1]

Children are disproportionately represented among the income-poor.[6] Over one-third of the global extreme poor are children under age 13, and half of all children in low-income countries live in extreme poverty.[7] Children living in poverty are at the highest risk for inadequate nutrition, limited health service access, and poor health outcomes,[8] and socioeconomic-based health inequalities among children are worsening.[9] Poverty and early child malnutrition are of critical concern because of their mutually reinforcing relationship over the life-course. Nutritional status as young as age two has been demonstrated to influence outcomes later in life. Malnourishment in early childhood has been linked with a reduced cognitive capacity,[10,11] lower levels of educational attainment,[8,11,12] and reduced adult economic productivity.[8,13] As poverty is both a cause and an outcome of poor human capital development in children with cumulative and long-term effects, country and development actors are beginning to favor social welfare programs that address the root causes of poverty and poor health outcomes.[7]

Social protection strategies are increasingly being employed to reduce household vulnerability to extreme poverty, strengthen food and nutrition security (FNS), and improve child health. The prominence of social safety net programs in government welfare strategies has grown largely in response to the negatively reinforcing relationship between poverty and low levels of human capital accumulation. Social safety net programs are those "… programs comprising of non-contributory transfers in cash or in-kind, designated to provide regular and predictable support to poor and vulnerable people."[14] As of 2015, every country in the world has at least one social assistance program; 130 countries are currently providing unconditional cash transfers and 63 countries are providing conditional cash transfers that include a focus on promoting FNS.[2]

Conditional cash transfer (CCT) programs are typically targeted towards households with young and school-age children in poor regions. They provide cash and sometimes in-kind transfers, and are usually given directly to the mother or female caregiver. Beneficiary households must commit to undertaking co-responsibilities to continue receiving the transfers, such as sending their children to school, receiving routine health checkups, and attending health and nutrition educational sessions. While cash transfer are demand-oriented interventions, many programs in Latin America concurrently developed the supply environment, helping to ensure that beneficiaries could meet their co-responsibilities and invest transfer money in their children and health by improving education and health service infrastructure.[5] A strong experimental literature exists on the impacts of CCT programs. These evaluations demonstrated short- and long-term positive effects on consumption, poverty reduction, food security and dietary diversity, and many also led to increased use of preventive and curative health care services.[15–17]

Unlike their Latin American counterparts, cash transfers in sub-Saharan Africa tend to be unconditional (some programs have 'soft' conditions), beneficiary targeting is at the community-level, and targeting is usually linked to geographical or vulnerability-based eligibility criteria. Despite the short time in which they have been operating, several SSA unconditional cash transfer (UCT) programs have achieved positive impacts on consumption, food security, and health.[18–21] Beneficiary households typically spend more on food and health from the cash transfer than they spend relative to other increases in income, even when the transfer programs are not directly linked to health or nutrition.[22]

The cash transfer literature provides clear evidence that direct income transfers to poor families can improve consumption and food and nutrition security, however impacts on use of health services, health outcomes, and child anthropometry are mixed. Many social cash transfer programs in SSA are government-run, and as countries take these programs to scale it is important to know the breadth and depth that different targeting schemes and payment mechanisms can achieve. In addition to knowing what these programs can achieve, it is critical to understand how cash transfer programs achieve impacts. Cash transfers are demand-oriented interventions, but there are certain supply-side pre-conditions that are necessary for these programs to achieve impacts, including well-functioning food markets and quality health services.

1.1. Dissertation Objectives

This dissertation focuses on the case of Malawi, a country plagued by persistent poverty, undernutrition, and poor health outcomes for young children. Malawi is one of the poorest countries in the world; in 2013, the Government of Malawi (GoM) reported a per capita Gross National Income of $715 (2011 PPP$), the third lowest out of 187 countries after the Democratic Republic of the Congo and the Central African Republic.[23] Poverty is widespread throughout the country as evidenced by high poverty headcount ratios and poverty gaps. In 2010, 51 percent of Malawians were living below the national poverty line, with a poverty gap of 19 percent. At that time, Malawi ranked ninth out of 187 countries for the highest percentage of the population living below the international benchmark of $1.25 per person per day (62 percent), with an associated gap of 26 percent. The percentage of people living below the national poverty line decreased by two percentage points between 2004 and 2010, but the national poverty gap increased by one percentage point;[24] thus, while relatively fewer people were living in poverty in 2010 compared to 2004, the poor were getting poorer.

The prevalence of undernourishment was halved between 1990 and 2010, but over one in five people in Malawi remained undernourished in 2010.[25] The nutritional status of children remained relatively stable between 2004 and 2010. The percent of children under-five who were stunted decreased from 53 percent to 47 percent, the prevalence of wasting decreased from six to four percent, and the prevalence of underweight fell from 17 to 13 percent.[26] Diet quality among very young children also remained low in 2010, with only 19 percent of children ages six to 23 months receiving a minimum acceptable diet.[7]

The Government of Malawi (GoM), in partnership with UNICEF, began to implement its social cash transfer program as a pilot in Mchinji district in 2006 as an innovation to address these persistent problems of poverty and undernutrition. The Social Cash Transfer Program (SCTP) is an unconditional cash transfer program targeted to ultra-poor labor-constrained households. A short-term impact evaluation of the Mchinji pilot from 2007 – 2008 provided evidence of positive effects of the cash transfer on household food security, curative care seeking, and child education.[27] The SCTP has undergone changes in targeting and operations and has experienced significant expansion since 2009, now reaching 18 out of 28 districts in Malawi. By March 2015 the program was operating at full scale in 10 districts and reached over 100,000 households with plans to enroll over 175,000 households by the end of 2015. Currently, households are eligible for the program if they are ultra-poor and labor-constrained. A household is considered to be ultra-poor if it is unable to meet the most basic urgent needs of members, including procuring food and essential non-food items (e.g., soap and clothing). A labor-constrained household has no 'fit to work' members or the ratio of 'unfit' to 'fit' is greater than three; household members are 'unfit' if they are younger than 18, older than 64, or have a chronic illness, disability, or are otherwise unable to work.[20]

The overall objectives of this dissertation are to determine if the Government of Malawi's Social Cash Transfer Program improves household food and nutrition security and young child health and to trace the mechanisms through which the program achieves these impacts by analyzing critical relationships along the causal chain. This research adds to the emerging evidence base of the welfare impacts of unconditional cash transfer programs in SSA using experimental data from a large-scale impact evaluation of a national social cash transfer program.

The first paper analyzes the impact of the program on three critical components of food and nutrition security: current economic vulnerability, diet quantity, and diet quality. The second paper seeks to understand how a social cash transfer – with no conditionalities on how households must spend their resources or time – can influence household health behavior and child health outcomes. This study analyzes the impact of the SCTP on household demand for child health inputs and the effect of these inputs on child health. There are few studies that investigate the mechanisms through which a positive exogenous income shock influences health, and this study attempts to fill that gap.

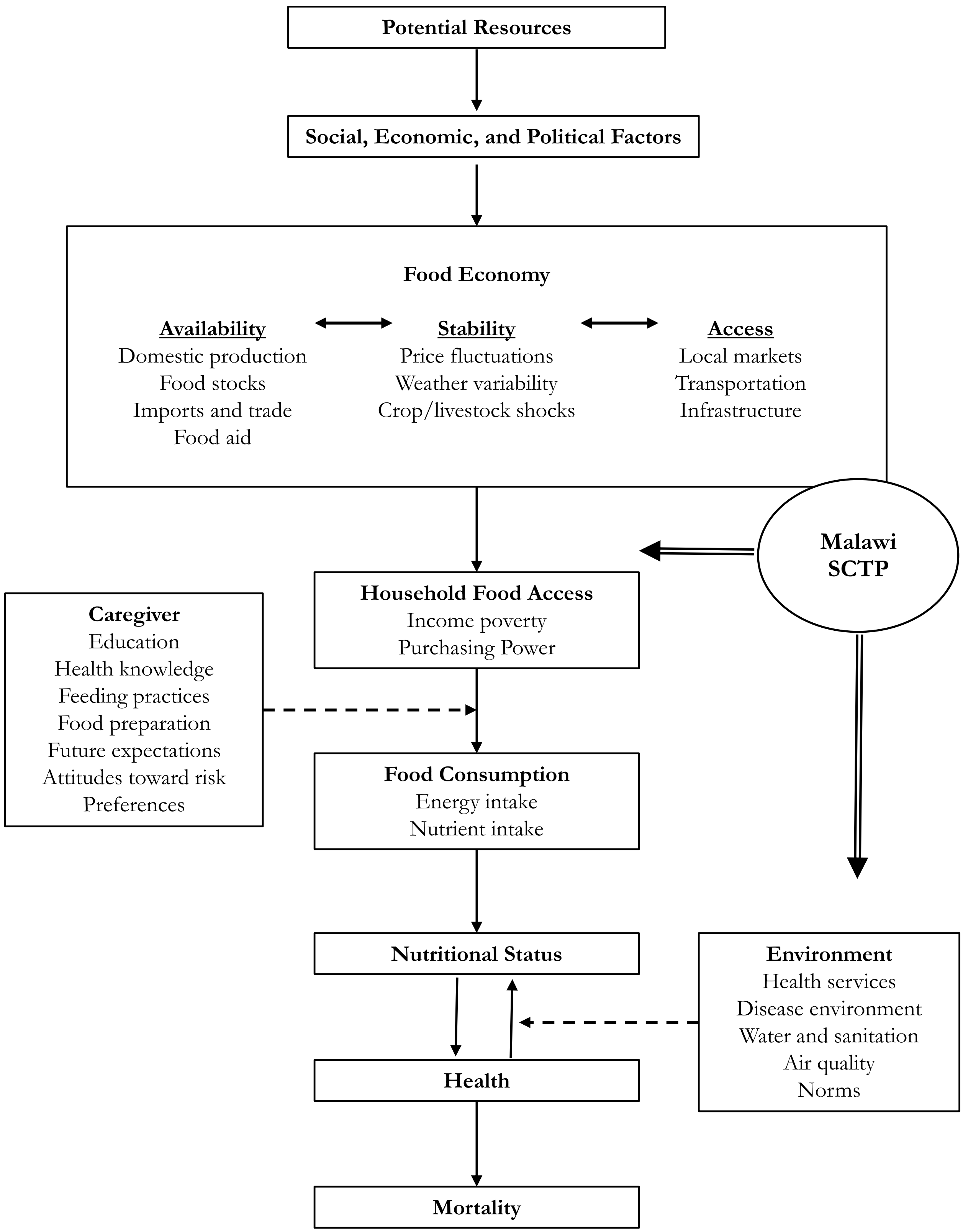
1.2. Conceptual Framework

Figure 1.1 depicts a conceptual framework that encompasses the research questions and hypotheses of both dissertation papers. The conceptual model expands Mosley and Chen's framework[28] to include Black et al.'s 2008 framework[29] of the relationships among poverty, food insecurity, and other distal and proximate causes of maternal and child nutrition.[29] This is mapped onto a simplified version of the FAO's FIVIMS (Food Insecurity and Vulnerability Information and Mapping Systems)[30] to better understand how the local food economy influences SCTP beneficiaries' ability to use the cash transfer to improve household FNS.

The conceptual framework is read from top to bottom. The food economy operates at both a local and national scale. In the case of Malawi, domestic production and food stocks of maize have been critical components of other social welfare program. Price fluctuations are known to have dramatic swings between the post-harvest and lean seasons, but can become more unstable due to droughts or flooding that damages staple crops. In order to use the cash transfer to improve FNS, a beneficiary must be able to access a market, which could include a small local market or employ transportation to travel to a larger market. In addition to the presence of markets, the ability of external producers to reach local markets is important because of potential implications for food selection and diet diversity.

The SCTP enters at the levels of household food and health service access by increasing the household's purchasing power. Households make decisions about the types of foods to buy, with implications for both quantity (energy intake) and quality (nutrient intake) components of food consumption. FNS only influences child health through the individual's nutritional status. The child's health status also influences nutritional status in that the child must be able to absorb nutrients from food, which may be compromised during diarrheal episodes. Caregiver characteristics can moderate the effect of the program on food consumption, and the local environment can influence the relationship between nutrition status and health.

Figure 1.0.1. Conceptual Framework



CHAPTER 2: IMPACTS OF AN UNCONDITIONAL CASH TRANSFER ON HOUSEHOLD FOOD AND NUTRITION SECURITY IN MALAWI

2.1. Introduction

Last year marked the conclusion of the Millennium Development Goals (MDGs) timeline and the launch of the 2015-2030 Sustainable Development Goals (SDGs). The SDGs include 17 goals and 169 targets; the first goal is to "end poverty in all its forms everywhere", and the second goal aims to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture." [31] While progress has been made in reducing poverty and hunger in recent decades, substantial problems persist. Globally, nearly one billion people continue to live in extreme poverty (less than US$1.25 per capita per day), [1] and 795.6 million are undernourished.[2]

Social protection systems play a vital role in promoting household welfare and food security and will be instrumental in the global community's efforts to achieve the SDGs. The goal of this study is understand whether and how a social cash transfer can have an impact on household food and nutrition security. This study adds to the emerging evidence base of the welfare impacts of cash transfer programs in sub-Saharan Africa (SSA) using experimental data from a large-scale evaluation of a national social cash transfer program. We analyze the impact of the Government of Malawi's (GoM) Social Cash Transfer Program (SCTP) on household food and nutrition security (FNS) among ultra-poor and vulnerable households. We contribute to the knowledge about the breadth and depth social transfers can have by investigating protective effects of the program on three critical components of FNS – current economic vulnerability, diet quantity, and diet quality. Key design features of the Malawi SCTP are similar to programs in other sub-Saharan African countries, suggesting a high degree of external validity.

2.2. Background

Considerable gains in poverty reduction and FNS have been made since the inception of the MDG era. The share of people living in extreme poverty in developing countries has decreased from 43 percent in 1990 to 17 percent in 2015,[1] and the global prevalence of undernourishment declined by 216 million people (from 19 percent to 11 percent) despite a concurrent 1.9 billion increase in the global population.[2] Yet almost one billion people still live below US$1.25 per day. Most of the extreme poor live in rural areas, and the rural poor are more likely than other rural households to rely on agriculture for livelihoods.[1] Currently, 11 percent of the global population is undernourished (795.6 million), and the majority of the undernourished live in developing regions (779.9 million, 12.9 percent). Nearly two billion people experience "hidden hunger", or micronutrient deficiency,[3,4] and 749 million are estimated to be calorie deficient.[1] As most of the world's regions have experienced declining poverty and undernutrition rates, sub-Saharan Africa has seen little progress. Half of the population in sub-Saharan Africa is extremely poor, and just under one in four people is undernourished (220 million). Sub-Saharan Africa has the highest regional prevalence of undernourishment, and the number of undernourished actually increased by 44 million between 1990 and 2015.[2]

2.2.1. Operationalizing Food and Nutrition Security

The food security terminology currently in use was adopted from the 1996 World Food Summit to highlight the multiple facets of food security and to establish the four pillars of food security: availability, accessibility, utilization, and stability.[32] The Food and Agriculture Organization (FAO) of the United Nations defined food security as existing when "… all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." [33] Since that time, the concept has evolved from the recognition that nutrition is an intrinsic component of food security. Frakenberger, Oshaug, and

Smith defined nutrition security as "… a nutritionally adequate diet and the food consumed is biologically utilized such that adequate performance is maintained in growth, resisting or recovering from disease, pregnancy, lactation, and physical work."[34] The combined term "food and nutrition security" (FNS) is now the common language used by prominent international agencies, including the United Nations High Level Task Force on Global Food Security, FAO, UNICEF, and the International Food Policy Research Institute (IFPRI).[32]

Given the complexity and multidimensionality of the concept, a range of indicators are typically employed to characterize FNS.[32,35,36] Food security indicators reflect diet quantity, whereas nutrition security indicators tend to describe diet quality. Examples of diet quantity indicators include the number of meals eaten per day and household daily food energy available per capita. Diet quality, in addition to quantity, is increasingly recognized as a major constraint for the poor. Quality metrics include household diet diversity of the major food groups and the percent of household food energy derived from staple foods. The percent of total household expenditures on food represents a measure of current economic vulnerability to food insecurity. [2,35,37,38]

2.2.2. Poverty and Food and Nutrition Security

The poor are particularly vulnerable to hunger and food insecurity because they often live just above or at subsistence levels, and even small shocks will move them closer towards destitution.[5] The majority of the poor and hungry live in rural areas and tend to rely on smallholder agriculture, particularly in sub-Saharan Africa where seasonality is a major contributor to food and nutrition insecurity.[1] Food prices follow a predictable seasonal pattern, starting low after the April-May harvest and peaking during the "hungry season" months of January-March.[39] Strong seasonal variation in food prices have been found to be a major determinant of child malnutrition in Malawi and Niger.[40] Poor rural smallholder households are also vulnerable to shocks including spikes in prices for agricultural inputs, declining prices of agricultural production, and adverse weather events such as floods or droughts that can cause harvest failure.[41] Vulnerability can increase over time if these households face repeated or multiple shocks. Inflation, high food prices, and price volatility are also significant threats to FNS.

When confronted with difficulties in purchasing food, poor households result to coping strategies which can be harmful and further exacerbate the cycle of poverty. These adverse coping strategies often include reducing diet quantity or compromising diet quality by switching towards cheaper calorie sources, or selling productive assets and taking children out of school to buy food.[1] A key function of social safety nets is to prevent poor households from resorting to these detrimental coping mechanisms.

2.2.3. The Cash Transfer Response

Social protection strategies are increasingly being employed to reduce household vulnerability to extreme poverty and improve FNS. The prominence of social safety net programs in government welfare strategies grew largely in response to the negatively reinforcing relationship between poverty and low levels of human capital accumulation. Social safety net programs are those "… programs comprising of non-contributory transfers in cash or in-kind, designated to provide regular and predictable support to poor and vulnerable people."[14] As of 2015, every country in the world has at least one social assistance program; 130 countries are currently providing unconditional cash transfers and 63 countries are providing conditional cash transfers that include a focus in promoting FNS.[2]

2.2.3.1. Cash Transfers in Latin America and the Caribbean

In late 1997, the government of Mexico launched PROGRESA (formerly *Oportunidades,* now *Prospera*), a conditional cash transfer (CCT) to alleviate immediate and short-term consumption poverty, encourage human capital development among children, and to break the intergenerational transmission of poverty. Soon after, other countries in Latin America and the Caribbean – and then around the world – began implementing national CCTs to improve poverty, food insecurity, and help households protect themselves against risks and shocks. CCTs are typically targeted towards households with young and school-age children in poor regions. They provide cash and sometimes in-kind transfers. Transfers are usually given directly to the mother or caretaker, and beneficiary households must commit to undertaking co-responsibilities to receive the transfers (e.g., keeping their children in school, attending preventive care visits, etc.).[5] While cash transfers are demand-oriented interventions, many programs in Latin America concurrently developed the supply environment, helping to ensure that beneficiaries could meet their co-responsibilities and invest transfer money in their children and health by improving education and health service infrastructure.

The positive impacts of the CCT schemes in Latin America and the Caribbean are well-documented in large part because many of the programs were accompanied by experimental impact evaluations. These first generation evaluations demonstrated short- and long-term positive effects on consumption, poverty reduction, food security and dietary diversity, and many also led to increased use of preventive and curative health care services.[15]

PROGRESA was found to have a positive impact on consumption and food expenditures; on average, CCT households spent 60 to 70 percent of the transfer on food and consumed 7.1 percent more calories compared to control households.[11,42,43] Households receiving Nicaragua's *Red de Protección Social* increased annual per capita food expenditures and diet diversity, and during a food crisis the program prevented worsened food security among beneficiaries.[11,44] *Familias en Acción* in Colombia, *Bolsa Família* in Brazil, and the Family Allowance Program in Honduras were also shown to improve diet diversity.[11] Cash transfer beneficiary households in Colombia, Ecuador, Mexico, and Nicaragua were found to spend more on food and health out of the transfer income than from general household income sources, even when the transfer programs were not directly linked to nutrition and health.[45]

2.2.3.2. Cash Transfer Programs in Africa

Social protection programs, particularly cash transfers, are rapidly becoming a cornerstone of African development programs and government policies. The African Union adopted the Social Policy Framework for Africa in 2008, which promotes the codification of social protection coverage into national development agendas.[5] In 2010, unconditional cash transfer programs were operating in about half of the countries on the African continent. As of 2015, 40 out of 48 African countries are implementing some form of unconditional cash transfer (UCT) as a component of social safety net programming.[14] Unlike their Latin American counterparts, cash transfers in sub-Saharan Africa tend to be unconditional (some programs have 'soft' conditions), beneficiary targeting is at the community-level, and targeting is usually linked to geographical or vulnerability-based eligibility criteria.

Despite the short time in which they have been operating, several SSA UCT programs have achieved positive impacts on consumption, food security, and health. A 24-month impact evaluation of Zambia's Child Grant Program (CGP) – which is one of the largest governmental social protection programs in the country – attributed improved household consumption, food security, and diet diversity to the program. The study found that three-fourths of the increase in consumption among beneficiary households was for food, and households were substituting away from inferior foods towards protein.[46] Similar results were found in a 24-month evaluation of the Zambia Multiple Transfer Category Grant program (MCTG), which also found program positive impacts on a household diet diversity score.[47] The Kenya Cash Transfer for Orphans and Vulnerable Children (CT-OVC) Evaluation Team found that, as a results of the cash transfer program, beneficiary households had higher expenditures for food, health, and clothing, and allocated more of their food budget on meat, fish, and dairy.[48,49] A recent evaluation of Zimbabwe's Harmonized Social Cash Transfer (HSCT) discovered on year impacts on a diet diversity score and increased per capita food expenditures, although food expenditure impacts were not significant after controlling for fixed-effects.[50]

2.3. The Malawi Context

Poverty and undernutrition are widespread throughout Malawi as evidenced by high poverty headcount ratios, wide poverty gaps, and a large prevalence of undernutrition. In 2010, 62 percent lived below the international benchmark of $1.25 per day, with an associated gap of 26 percent. The percentage of people living below the national poverty line decreased between 2004 and 2010, but the national poverty gap increased; [24] thus, while relatively fewer people are living in poverty, the poor are getting poorer. From 1990-1992, 33 percent of the population was undernourished (4.3 million people), compared to 21 percent (3.6 million) in 2014-2015.[2]

Food security problems among the poor in Malawi can largely be attributed to high lean season food prices, especially for maize, which is a dominant food staple. [51] Most Malawians earn their livelihood via agriculture; over 85 percent of the population resides in a rural area, and 89 percent of the labor force works on smallholder farms or commercial estates.[39] The HIV/AIDS epidemic in Malawi has also been a key driver of poverty and associated food insecurity. A high prevalence of HIV/AIDS increased household vulnerability and reduced coping capacities, particularly after the death of a household head or main income earner. Although Malawi still has a generalized HIV epidemic, the prevalence is declining. Among people 15-49 years of age, the prevalence has decreased from 16 percent in 1999 to 11 percent in 2010.[52]

2.3.1. Previous Social Protection Programs

Several social protection programs have been implemented in Malawi since the late 1990s to improve food and nutrition security. Earlier projects tended to focus on agricultural production under the rationale that it is more cost effective and sustainable to subsidize food production than food consumption; more recent projects tend to give cash and in-kind transfers.[39] In 1998, the GoM launched the Starter Pack program, which gave 2.8 million farmers a package containing fertilizer and maize and legume seeds. The program was found to significantly reduce the food gap.[53] The Starter Pack program was scaled down and rebranded as the Targeted Inputs Program (TIP) in 2000. Later, in 2005, the GoM launched the Farm Input Subsidy Program, which helped vulnerable smallholders to access improved fertilizer and hybrid seeds with the aim of improving household food security.[5]

Several small-scale cash transfer programs were introduced in 2005/2006. Oxfam implemented an unconditional cash transfer of US$26/month to 6,000 households in one district for five months as a complimentary intervention to humanitarian food aid following extreme weather events that reduced the national maize harvest by 25 percent. Households receiving the program were reported to have spent 80-85 percent of the transfer on food.[54] The Dowa Emergency Cash Transfer Project adjusted cash transfer payments monthly based on local food prices to allow households to maintain purchasing power during a localized drought in 2006.[55] In 2005-2006, Concern Worldwide provided a "food plus cash" package, basing transfer amounts on household size and adjusting the cash component monthly in accordance with changes in local prices. An evaluation of the program found that, in addition to food, the cash was also used to meet other non-food needs, including the purchase of productive assets. Lastly, the Malawi Cash and Food for Livelihoods Pilot provided a mixed food and cash transfer program to 11,000 households in southern Malawi from October 2008 to May 2009. Households were randomly assigned to receive cash, food, or a mixed cash/food transfer in exchange for working in the construction of community assets. The evaluation found that households receiving cash had improved food consumption and diversity.[51]

2.3.2. The Malawi Social Cash Transfer Program

The Government of Malawi's Social Cash Transfer Program (SCTP) is an unconditional cash transfer program targeted to ultra-poor, labor-constrained households. Key objectives of the program include reducing poverty and hunger and increasing school enrollment rates. The program is administered by the Malawi Ministry of Gender, Children, and Social Welfare with additional oversight provided by the Ministry of Economic Planning and Development and technical support from UNICEF Malawi.[20]

The program was first implemented in 2006 as a pilot in Mchinji district. The 2007-2008 impact evaluation of the Malawi SCT Pilot Scheme provided evidence of positive results of the pilot project on household food security, curative care seeking, and education.[20,27] A 2008 prospective, longitudinal qualitative study found that – prior to the implementation of the Mchinji SCT pilot program – respondents reported lacking food and basic necessities and being destitute and frequently sick. The majority of respondents reported improved nutrition and food security and being able to provide adequate food for children after receiving the cash transfer.[56] Results from the quantitative impact evaluation demonstrated that beneficiary households consumed twice as many food groups and were more likely to eat higher quality foods compared to control households.[57]

The SCTP has undergone changes in targeting and operations and has experienced significant expansion since 2009, now reaching 18 out of 28 districts in Malawi. By March 2015 the SCTP was operating at full scale in 10 districts and reached over 100,000 households, with plans to enroll over 175,000 households by the end of 2015.[20] Households are eligible for the program if they are ultra-poor and labor-constrained. A household is considered to be ultra-poor if it is unable to meet the most basic urgent needs, including food and essential non-food items (e.g., soap and clothing). A labor-constrained household has no 'fit to work' members or the ratio of 'unfit' to 'fit' is greater than three; household members are 'unfit' if they are younger than 18 or older than 64, or if they are age 18 to 64 but have a chronic illness, disability, or are otherwise unable to work.

A community-based approach is used to select beneficiary households. Community members are appointed to Community Social Support Committees (CSSC). Each CSSC compiles a list of households that meet the eligibility criteria, and after further screening the list is condensed to include a target coverage rate of the poorest 10 percent of households in each village cluster (VC). Oversight is provided by the District Commissioner's Office and the District Social Welfare Office, which implements a proxy means test to impose the ultra-poor eligibility condition.[20]

The cash transfer amount varies by household size and the number of household members enrolled in primary and secondary school. Prior to May 2015, a single-person household received a monthly cash benefit of Mk 1,000, a two-person household received Mk 1,500, a three-member household received Mk 1,950, and households with four or more members received Mk 2,400. The household receives an additional Mk 300 for each member age 21 years and younger enrolled in primary school and Mk 600 for members age 30 and younger enrolled in secondary school. Transfer amounts were increased starting in May 2015, after midline data collection was complete.[20]

2.4. Program Theory of Change

The theoretical framework for how the Malawi SCTP can affect household FNS is guided by the basic economic theory of household demand, including insights from Engel, Bennett, and Deaton. Because they lack the resources to meet even their most basic needs on a daily basis, poor households are vulnerable to hunger and chronic poverty-related food insecurity.[5] Poor households spend a larger share of their total expenditures on food and have a higher income elasticity of demand for food.[58] In addition to analyzing income expenditure on food, it is also helpful to study household demand of different food groups such as cereals and tubers compared to meats and dairy products. Results from a study of food consumption patterns in Mozambique found that rural households in the poorest quintile actually showed expenditure elasticities for staples foods such as cereals, maize, and cassava of greater than unity.[59] Because poor households have higher expenditure elasticity for food and a higher marginal utility for calories, they are predicted to choose a diet which maximizes caloric content given their budget constraints. As staple foods are the least expensive source of calories, poor households tend to spend most of their food budget on cereals and tubers. When a poor household's budget is increased, after meeting a critical caloric quantity threshold, purchases can be expected to shift towards more expensive foods with improved caloric quality such as fruit, vegetables, and mean.[35]

Unconditional cash transfer programs can promote food and nutrition security by expanding the household's budget to improve both the quantity and quality of calories consumed.[5] The regularity and predictability of the cash transfer payment can help families to meet immediate consumption needs, and then begin investing in their children's human capital development, access credit, and save. The exogenous inflow of cash can also bridge household consumption shortages and protect household assets from being liquidated at distress prices in order to prevent hunger, which is particularly important as poor households have difficulty replacing assets lost during a food crisis.[60]

The Malawi SCTP enters the household demand function through its income effect on the household budget constraint; as a result of the transfer, beneficiary households will have more disposable income. Any potential impact of the transfer program on household food and nutrition security must work through the household's spending decisions. Accordingly, the household must use transfer resources to improve levels and quality of consumption to improve FNS. Beneficiary households' marginal propensity to consume food is a key factor in predicting the transfer's relative effectiveness on FNS outcomes.[14] Beneficiary households are so poor that their marginal propensity to consume is likely to be close to 100 percent, meaning that they are expected to spend all of the transfer rather than save it or use it to pay down debt. Therefore, the first round of SCTP impacts is expected to be on household consumption, particularly for basic items such as food.[61] Over time, once households have been able to meet their basic needs, additional monthly transfers can induce households to switch to higher quality foods.

Household demand for food follows Engel's Law, according to which as income (consumption expenditure) increases, the household decreases its budget share of food. Household demand for staple foods follows Bennett's Law, which reflects the average household's desire for diet diversity. As income increases, the households reduces the budget share of starchy staple foods, substituting away first from low quality towards finer grains, and then away from grains/carbohydrates toward fruits, vegetables, dairy, and especially meat.[36] From these two theories, we expect the SCTP to induce households to increase consumption, but reduce their food share, and for households to decrease the proportion of food expenditures directed toward starchy staples and increase the proportion spent on other food groups such as fruits, vegetables, and meat. These hypotheses can be tested using indicators for household expenditures on food, the household's food share, food group shares, a diet diversity indicator, caloric quantity, and the proportion of calories the household obtains from staple foods.

We might expect the ultra- poor (those consuming below the food poverty line) to spend almost all income on food, because food is the "first necessity". However, this is not always the case, even when households are consuming below subsistence levels Households make trade-offs between food and other non-food essential items, health, and education. Also, while we may expect food expenditures to increase, we may not necessarily see an improvement in caloric quality because households also care about non-nutrient characteristics of food, including taste and variety.[62]

2.4.1. Potential Effect Modification and Heterogeneous Program Impacts

Given that certain community, household, and caregiver characteristics have been shown to exert differential effects on household consumption and FNS, there are multiple reasons why we can expect heterogeneous impacts of the Malawi SCTP. The local supply environment is essential to the success of cash transfers in promoting food and nutrition security. If the poor cannot access markets or if they face volatile prices and high inflation, direct food and other in-kind transfers may be more effective than cash programs.[1] Hoddinott and Skoufias found that PROGRESA's impact on increased food expenditures reflected increased diet quality instead of increased caloric consumption, and attributed this to the nutrition education component of the programs conditions.[63]

The impacts of the SCTP on household welfare may differ by the transfer level itself. A recent World Bank review of global cash transfer programs reported that the relatively low levels of transfers provided by social safety nets are generally insufficient to allow the poor to escape poverty. On average, the transfers are 23 percent of poor households' consumption level, but the Bank estimates that the average level of consumption among poor households globally is 34.8 percent below the international $1.24/day poverty line.[14] Because the direct and indirect impacts of the SCTP depend upon the purchasing power of the transfer, and given that the Malawi program is not indexed with inflation (i.e., the real value of the transfer is decreasing over time), it is important to assess the level of program impacts that can be expected from current transfer levels.

2.4.2. Study Goals and Contribution

The goal of this study is understand whether and how a social cash transfer can have an impact on household food and nutrition security. This study adds to the emerging evidence base of the welfare impacts of cash transfer programs in SSA using experimental data from a large-scale evaluation of a national social cash transfer program. The Malawi SCTP has undergone expansions and benefit revisions since the Mchinji pilot and currently has common targeting and benefit designs similar to other cash transfer programs in SSA, which is important for the external validity of our results. We examine program impacts on three critical FNS components – current economic vulnerability, diet quantity, and diet quality. While previous studies have demonstrated impacts on consumption expenditures, diet diversity scores, and household self-assessment of hunger, information on impacts on caloric availability is lacking in the SSA context. Thus, this study fills an important gap by examining program impacts on both expenditures and apparent caloric availability among study households.

2.5. Methods

2.5.1. Study Design and Data Collection

This study uses baseline and midline follow-up data from the Impact Evaluation of the Malawi SCTP in Mangochi and Salima districts, which is being conducted on a larger scale than the 2007-2008 Mchinji Pilot Scheme. Some of the key evaluation questions are whether the SCTP improves consumption, reduces food insecurity, and increases diet diversity among beneficiary households.

The impact evaluation uses a mixed methods, longitudinal, experimental study design. The quantitative component is based on a difference-in-differences experimental design and uses both random selection of study locations (at the traditional authority and village cluster levels) and random assignment of village clusters into treatment and control groups.

The Malawian Ministry of Gender, Children, and Social Welfare decided to integrate an impact evaluation into the planned expansion of the SCTP into Mangochi and Salima districts, which were scheduled for scale-up in early 2013. Two traditional authorities (TAs) were randomly selected from each. Village clusters (VCs) were then randomly selected from each TA; 14 VCs were selected in Mangochi and 15 in Salima, for a total of 29 study VCs. The process for selecting households to be interviewed at baseline was slightly different between the two districts. Mangochi VCs typically had large numbers of selected households, so eligible households were randomly selected for interview. Salima VCs had smaller numbers of selected eligible households, and so all eligible households were interviewed. A total of 1,756 households were interviewed in Mangochi and 1,775 households were interviewed in Salima, for a total baseline sample size of 3,531 SCTP-eligible households. Baseline interviews were conducted between late June and early September 2013. All study households are in rural areas.

Random assignment was conducted at the VC level after the baseline survey was completed. Half of the VCs in each TA were randomly assigned to the treatment group, which was to receive the program immediately, and the other half to a delayed-entry control group. A total of 14 VCs were in the treatment group (1,678 households) and the remaining 15 VCs were in the control group (1,853 households). Randomization was determined to have successfully created equivalent groups at baseline: treatment and control group mean characteristics across a range of program impacts were balanced. Sampling weights were calculated and adjusted to reproduce the total number of eligible households at the TA level, as well as the total number of households at the district level.

The midline follow-up survey was originally scheduled for 12 months after baseline. The first payments, however, were not administered until March and April 2014, so the decision was made to implement midline data collection in November 2014 at 17 months in order to have an adequate number of payments and time to detect early program impacts. Midline data was collected between the end of November 2014 and late January 2015, at which time treatment households had received five to six cash transfer payments every two months; as such, beneficiary households had been receiving treatment for one year as of midline data collection, so midline results should be interpreted as one year impact results. Approximately 95 percent of baseline households were re-interviewed at midline, yielding a panel of 3,369 study households (1,761 control and 1,608 treatment households). No evidence of differential or overall attrition was detected among panel households at the midline follow-up, indicating that balance was preserved between treatment and control groups and sample representativeness was maintained.[20]

2.5.1.1. Ethics Approval

Study protocols, survey instruments, and consent procedures were approved by the University of North Carolina at Chapel Hill Internal Review Board (UNC IRB Study No. 14-1933) and Malawi's National Commission for Science and Technology, National Committee for Research in Social Sciences and Humanities (Malawi NCST Study No. RTT/2/20).

2.5.2. Derivation of the Analytical Sample and Attrition Analysis

Figure 2.1 depicts the derivation of the analytical sample used for this study. Of the 3,369 panel households interviewed, 79 were excluded from analysis due to missing data on outcome variables. The occurrence of missing data did not systematically differ between treatment and control households. The final sample included in this study includes 1,561 households from treatment communities and 1,729 household from control communities for a total of 6,580 observations across baseline and midline waves. Approximately 98 percent of panel households (3,290 households) and 93 percent of baseline households were retained for analysis in this study.

There are two main sources of missing data in panel studies: sample attrition and item non-response. The critical problem created by sample attrition and item non-response in this study is that the missing data may erode the benefits of the original random selection of participants into the study and random assignment of village clusters to treatment and control groups, thus threatening both the internal and external validity of the impact evaluation. The sample selectivity arising from households attriting from the study or declining to answer questions due to reasons that also affect their potential outcomes may create bias in our estimates of program impact. Program impact estimates will also be less efficient simply due to the reduction in sample size. The external validity of the study may be compromised due to sample selection bias if participants non-randomly leave the study, thus reducing the original representativeness of the sample.

We examined differential attrition by comparing the average baseline characteristics of treatment and control households remaining in the analytical sample, and general attrition was examined by comparing the baseline characteristics of the analytical sample with households that attrited. We determined that differential attrition was not a problem in our sample, but did find some evidence of general attrition which could threaten the generalizability of the impact estimates. We checked to see if Inverse Probability Weights (IPW) could be a solution but ultimately decided that, given the absence of both differential and general attrition in the full household panel,[64] the low rate of missing data (2.3 percent), and the risk of misspecification of the IPW model, we would assume that general attrition in the analytical sample was negligible and thus did not make any adjustments to the baseline sampling weights. Appendix 1 provides an in-depth explanation of the attrition analysis.

2.5.3. Measures

2.5.3.1. Outcomes of Interest

The outcomes of interest are at the household-level and are grouped by FNS component. Appendix 2 provides details for key study variables.

Indicators for *current economic vulnerability to food and nutrition insecurity* include a binary indicator equal to one if households reported worrying that there would not be enough food in the past seven days, the household's annualized real per capita expenditures on food, and the household's food share (the proportion of total household expenditures devoted to food). The evaluation survey instrument included the full Malawi Third Integrated Household Survey (IHS3) consumption expenditure module, so food expenditures and the household consumption aggregate were constructed using IHS3 program files and following guidelines the World Bank's methodology for poverty analysis in Malawi 2010-2013.[65] Baseline nominal consumption was adjusted for spatial price differences, and midline nominal consumption was adjusted for both spatial and temporal cost-of-living differences using the Malawi National Statistical Office's rural consumer price index to deflate midline prices and the spatial price index to reweight local prices to the national level. As such, all prices are reported in real August 2013 Malawian kwacha (MWK); the exchange rate in August 2013 was US$ 1 to MWK 330.[20]

We include four measures of *diet quantity*. The first is an indicator of whether the household consumed more than one meal on a typical day during the past week. The remaining diet quantity outcomes are related to the food energy available to the household assuming light activity levels. The household's total daily energy acquisition in kilocalories (Kcal) is calculated using data from the survey consumption module. Per capita daily energy acquisition (p.c. Kcal) is calculated by dividing the household's total daily Kcal amount by the household size. The third measure of diet quantity is a binary indicator equal to one if the household is food energy-deficient; households are considered to be food energy-deficient if the household total daily Kcal amount is less than the household's total energy requirement for light activity levels (adjusted for age and sex composition of the household).[66] The final diet quantity indicator is a measure of the household's depth of hunger, or the intensity of the household's food inadequacy. This outcome is only defined for those households that are food energy-deficient in at least one wave, and is calculated as the difference between the household's dietary energy intake and its minimum dietary energy requirement. The hunger depth measure is analogous to the concept of the poverty gap in that it indicates how far below the minimum energy requirement a household's food consumption falls, with larger values indicating more severe energy deficits. We report the household's hunger depth at the daily per capita level.[38,67,68]

The final FNS component we investigate is *diet quality*. We report the household's diet diversity score (HDDS), the proportion of household daily food energy derived from staples (cereals, grains, roots, tubers, and plantains), real annualized per capita expenditures on food groups, and household food group shares. We use the 12 food groupings recommended by the FAO [68] to derive the HDDS, and include foods produced at home, received as gifts, and purchased but consumed at home. The HDDS ranges from one to 12, and the 12 groups include: (1) cereals, (2) white tubers and roots, (3) vegetables, including Vitamin A rich orange tubers, (4) fruits, (5) meat, (6) eggs, (7) fish and other seafood, (8) legumes, nuts, and seeds, (9) milk and milk products, (10) oils and fats, (11) sweets, and (12) spices, condiments, and beverages, including alcohol. When reporting food group expenditures and shares, we combined HDDS groups with average shares of less than five percent in either wave. This resulted in five groups: the first combines HDDS groups (1) and (2), the second combines groups (3) and (4), the third group combines groups (5-7) and (9), the fourth groups is group (8), and the fifth group combines HDDS groups (10-12).

2.5.3.2. Intervention

The exposure of interest is whether the household receives the Malawi SCTP and is represented as a binary indicator equal to one for beneficiary households and zero for delayed-entry control households.

We also investigate whether there is a 'dose' response to the cash payment by examining the transfer share, which is defined as the annual per capita value of the transfer as a percent of baseline annual per capita household expenditure. We simulate values for each household's expected transfer level for both treatment and control households based on program assignment and transfer level rules (in real August 2013 MWK). We examine three variations of the transfer share: a continuous value expressed as a percentage; a binary indicator of whether the household is expected to receive a high (greater than or equal to 20 percent) or low (less than 20 percent) transfer share; and as a categorical variable equal to one if the transfer share is greater than 30 percent, equal to two if the share is between 20 and 30 percent, equal to three if the share is between 15-20 percent, and equal to four if the share is less than or equal to 15 percent.

We conduct an intention to treat (ITT) impact analysis as we use predicted transfer levels rather than actual transfer amounts from program data; because all eligible households offered treatment took it up, the ITT can be considered equal to the average treatment effect (ATE).

2.5.3.3. Moderators

We examine the presence of heterogeneous program impacts on household FNS based on baseline household consumption, whether the household had more than four members at baseline (the cap for additional non-schooling per-person cash transfer increases), distance from the nearest food market, and the caregiver's health knowledge. The first impact effect moderator is a binary indicator equal to one if the household was among the poorest 50 percent of beneficiary households at baseline. The second moderator is a binary indictor equal to one if the household had four or fewer members at baseline. The third moderator equals 1 if the household is within 1.5km of a food market, the median reported distance of households from the nearest food market. The last moderator is a binary indicator equal to one if the household scored in the top third of the health knowledge score (refer to Appendix 2 for details). We include health knowledge as a potential treatment effect moderator because households that have knowledge about nutritious foods may be motivated to use the cash transfer differently than households that do not; for example, households with high health knowledge may be more likely to purchase smaller quantities of diverse foods compared to households that may use the transfer to increase cereal quantities.

2.5.3.4. Controls

All regression models control for a vector of contemporaneous cluster-level prices, whether the household experienced a crop shock, including droughts, floods, high levels of crop and livestock pests/disease, and unusually high costs of agricultural inputs, and whether the household experienced unusually high prices for food. The models also control for baseline values of the four moderator variables, as well as household baseline characteristics, including the natural log of household size, the number of household members in five age groups (0-5, 6-11, 12-17, 18-64, and 65 and older), the household dependency ratio, whether there were any single or double child orphans residing in the household, and characteristics of the household head including sex, age, marital status, schooling, chronic illness, and disability. Lastly, we also control for whether the household had accessed credit in the 12 months prior to the baseline survey, whether they had received cash, food, labor, or agricultural inputs from friends, family, or neighbors, and whether they had participated in food or cash programs or maternal and child nutrition programs in the 12 months before the baseline interview.

Although community-level prices for some items decreased between baseline and the midline follow-up, there is no evidence that the differences in prices over time is attributable to the SCTP, and there is no significant differential price inflation across treatment and control locations.[20]

2.5.4. Empirical Approach

Calculation of descriptive statistics and bivariate analyses were undertaken to check that the balance between treatment and comparison groups was maintained in the analytical sample for the variables of interest. We report t-tests for continuous outcomes and Pearson design-based F statistics for categorical variables. Means and significance tests control for clustering at the VC level[69] and use baseline sample weights.

2.5.4.1. Main Impact Analysis

Our empirical strategy employs the difference-in-differences (DD) approach to examine the overall mean impact of the Malawi SCTP on household FNS outcomes. The DD estimator compares changes in FNS outcomes between baseline and follow-up for the treatment group with changes over the same time period in the control group. The DD approach removes any time-invariant unobserved heterogeneity from both the treatment and control groups, and thus is able to account for both observed and time-invariant unobserved differences between treatment and control groups at baseline and for general time trends. The two key assumptions of the DD approach are the 'parallel trends assumption' – that the outcomes of the treatment group would follow the same trajectory as those actually experienced by the control group in the absence of the SCTP, and that there is no systematic time-varying unobserved difference between treatment and control groups. Although pre-baseline data are not available, the balance observed between treatment and control groups on a wide variety of household and individual factors provides convincing evidence that no pre-treatment systematic differences existed between beneficiary and delayed-entry households.

We pool the balanced household panel, and use the generalized linear model (GLM) framework to estimate the program impact; the basic estimating equation is given in Equation (1):

$$Y_{jkt} = g\big(\beta_0 + \beta_1 TREAT_k + \beta_2 TIME_t + \beta_3 (TREAT_k * TIME_t) + \beta_4 X_{jkt}\big) + \varepsilon_{jkt} \qquad (1)$$

In this framework, the inverse function of g(·) is the linearizing link function. Y_{jkt} is the FNS outcome of interest for household *j* in VC *k* at time *t*. Baseline differences between treatment and control groups are given by β_1 and the change in the outcome over time among the control group is given by β_2 (general time trends in the outcome). The DD estimator of program impact is given by β_3, and X_{jkt} is a vector of contemporaneous and time-invariant control variables. The control vector includes baseline characteristics to account for any pre-treatment differences between treatment and control groups and to add stability to the results and improve the precision of the estimates.

We use the GLM framework rather than ordinary least squares or basic maximum likelihood estimation because of the ease with which we can switch between models, as well as to avoid having to log-transform expenditure and Kcal outcome variables and then solve the subsequent re-transformation problem. The GLM family and link functions selected to model each outcome are listed in Table 2.1. Family and link decisions were made based on which models had the lowest deviance, AIC, and BIC values (Appendix 3). Two-part models are used for continuous outcomes with substantial bunching at zero in order to calculate the overall average differential effect of the SCTP, rather than the program impact conditional on positive values of the dependent variable. A binary choice model is used in the first part to estimate the probability that the outcome will be greater than zero, and in the second part we specify a continuous GLM to model the distribution of the dependent variable conditional on positive outcome values. The user-written Stata program TWOPM [70] was used to estimate the models and calculate average marginal effects; the program automatically adjusts standard errors to account for both the first and second parts of the model. We calculate and report average marginal effects (AMEs) for each model for ease of interpretation and to facilitate making comparisons across models.[71,72] The relative impact and effect size are also calculated for the main models of interest; the relative impact represents the program impact as a percentage of the mean baseline value among controls, and the standardized effect size is equal to the program impact divided by the standard deviation of the control group's baseline values.

All models use baseline sample weights and standard errors are adjusted for clustering at the level of randomization – the VC. Stata 14 was used for all analyses.

2.5.4.2. Heterogeneous Impacts

We then examine whether there are differential program impacts for the poorest 50 percent of households, households with four or fewer members at baseline, households within 1.5 km of a food market, and households where the caregiver scored in the top third of the health knowledge index. Equation (1) is extended to include a triple-difference estimator that gives the differential program impact for those households that have non-zero values for the moderating variable of interest. The heterogeneous impact model is specified as:

$$Y_{jkt} = g\begin{pmatrix}\beta_0 + \beta_1 TREAT_k + \beta_2 TIME_t + \beta_3(TREAT_k * TIME_t) + \beta_4 X_{jkt} + \ \beta_5 MOD_{jk} \\ + \beta_6(TREAT_k * MOD_{jk}) + \ \beta_7(TIME_t * MOD_{jk}) + \ \beta_8(TREAT_k * TIME_t * MOD_{jk})\end{pmatrix} + \ \varepsilon_{jkt} \quad (2)$$

MOD_{jk} represents the effect modifier, and β_8 gives the differential impact of the program by moderator status.

2.5.4.3. Transfer Share

A final fundamental issue is the value of the transfer, which is critically important for the extent of program impacts that can be expected. The cash transfer must constitute a large enough portion of the target population's pre-program consumption in order to generate impacts. Experience from cash transfer programs around the world, including several major African programs, suggests that transfers should deliver at least 20 percent of pre-program consumption as a 'rule of thumb'.[14,20]

We model the transfer share each household in the evaluation sample is likely to receive in three different ways. First, we model the transfer share as a continuous percentage of the household's annual consumption. Equation (1) is modified by adding the continuous treatment share variable *TXSHR*$_k$.

$$Y_{jkt} = g\begin{pmatrix}\alpha_0 + \alpha_1 TREAT_k + \alpha_2 TIME_t + \alpha_3 TXSHR_{jk} + \alpha_4(TREAT_k * TIME_t) + \ \alpha_5(TREAT_k * TXSHR_{jk}) \\ + \alpha_6(TIME_t * TXSHR_{jk}) + \alpha_7(TREAT_k * TIME_t * TXSHR_{jk}) + \alpha_8 X_{jkt}\end{pmatrix} + \varepsilon_{jkt} \quad (3)$$

In Equation (3), α_7 gives the marginal program impact of an increase in the transfer share among beneficiary households; the average program impact among beneficiary households is equal to $\alpha_4 + \alpha_7$.

We then model the transfer share as a dichotomous indicator of whether the share is greater than or equal to 20 percent of baseline consumption. In order to better compare treatment households with control households having similar expected transfer shares, we replace the treatment dummy and the transfer share variable in Equation (3) with three program indicators: $TTXSHRH_{jk}$ is equal to one for beneficiary households with an expected transfer share greater than or equal to 20 percent and is equal to zero otherwise; $TTXSHRL_{jk}$ is equal to one for beneficiary households with expected transfer levels below 20 percent; and $CTXSHRH_{jk}$ is equal to one for control households with high expected transfer shares and equal to zero otherwise. The impact of the SCTP among beneficiary households receiving a high transfer share, relative to control households with expected high shares, is given in Equation (3) by $\alpha_5 - \alpha_7$, and the program impact on beneficiary households receiving low transfer shares relative to comparison households with expected low shares is given by α_6.

$$Y_{jkt} = g\begin{pmatrix} \alpha_0 + \alpha_1 TIME_t + \alpha_2 TTXSHRH_{jk} + \alpha_3 TTXSHRL_{jk} + \alpha_4 CTXSHRH_{jk} + \alpha_5(TIME_t * TTXSHRH_{jk}) \\ + \alpha_6(TIME_t * TTXSHRL_{jk}) + \alpha_7(TIME_t * CTXSHRH_{jk}) + \varepsilon_{jkt} \end{pmatrix} \tag{4}$$

Lastly, equation (4) is extended to model the transfer share as a categorical variable. There are now seven program dummies: $TTXSHR1_{jk}$, $TTXSHR2_{jk}$, $TTXSHR3_{jk}$, and $TTXSHR4_{jk}$ correspond to beneficiary households with transfer shares greater than 30 percent, between 20 and 30 percent, between 15 and 20 percent, and less than 15 percent of baseline consumption, respectively. $CTXSHR1_{jk}$, $CTXSHR2_{jk}$, and $CTXSHR3_{jk}$ correspond to control households with transfer shares greater than 30 percent, between 20 and 30 percent, between 15 and 20 percent. Equation (4) presents this specification; the impact of the program among beneficiary households with the highest shares, relative to similar control households, is given by $\alpha_9 - \alpha_{13}$, the impact among beneficiary households with shares between (20,30] percent compared to control households with expected shares between (20,30] is equal to $\alpha_{10} - \alpha_{14}$, the impact for treatment households with shares between (15,20] percent compared to similar control households is $\alpha_{11} - \alpha_{15}$, and α_{12} is the impact of the SCTP among beneficiary households with low transfer shares compared to control households with low expected shares.

$$Y_{jkt} = g\begin{pmatrix} \alpha_0 + \alpha_1 TIME_t + \alpha_2 TTXSHR1_{jk} + \alpha_3 TTXSHR2_{jk} + \alpha_4 TTXSHR3_{jk} + \alpha_5 TTXSHR4_{jk} + \alpha_6 CTXSHR1_{jk} \\ +\alpha_7 CTXSHR2_{jk} + \alpha_8 CTXSHR3_{jk} + \alpha_9 (TIME_t * TTXSHR1_{jk}) + \alpha_{10}(TIME_t * TTXSHR2_{jk}) \\ +\alpha_{11}(TIME_t * TTXSHR3_{jk}) + \alpha_{12}(TIME_t * TTXSHR4_{jk}) + \alpha_{13}(TIME_t * CTXSHR1_{jk}) \\ +\alpha_{14}(TIME_t * CTXSHR2_{jk}) + \alpha_{15}(TIME_t * CTXSHR3_{jk}) + \varepsilon_{jkt} \end{pmatrix} \quad (5)$$

It is important to note that the transfer share equations are defined for all study households, not just beneficiaries. The significance of linear combinations of coefficients was calculated using the LINCOM post-estimation command in Stata 14.

2.6. Results

2.6.1. Descriptive Statistics

Analytical sample means for study outcomes, moderators, and controls by treatment status and wave are presented in Table 2.2. Randomization was maintained in the analytical sample as there were no significant differences in sample means between treatment and control households at baseline. Just under half of study households received the SCTP. Among beneficiaries, the predicted real per capita annual value of the transfer was 7,346.10 MWK (US$ 22), with an average transfer share of 22 percent of pre-program consumption.

Of the 3,290 households that met the sample criteria, over 80 percent reported worrying that they would not have enough food during the past week at baseline; at the midline follow-up the percentage of control households worrying about food increased by four percentage points, comparted to an eight percentage point decrease among program households. Approximately 80 percent of study households were consuming more than one meal per day at baseline, and at midline this percentage increased to 88 percent of control households and 94 percent among treatment households. Due to seasonality, daily per capita apparent calorie availability declined over time for all households, coinciding with a general increase in the proportion of households that were food-energy deficient. Control households experienced an increase in hunger depth, while the average calorie gap decreased among treatment households. The mean HDDS remained stable over time, with households consuming between five to six different food groups on average. Total consumption and food consumption declined between baseline and follow-up. On average, households decreased spending on cereals, roots, and tubers, as well as 'other' food groups such as oils, fats, spices, etc., while increasing consumption of fruits and vegetables and meat, eggs, fish, and dairy products. Households devoted 77 percent of their total expenditures to food at baseline, the majority of which went to staple foods.

Most study households were located in Mangochi district and were within 1.5 km of a food market. The percentage of households reporting crop/livestock shocks or food price shocks declined from around 80 percent at baseline to 57 percent reporting agricultural shocks and 69 percent reporting food shocks at midline. Caregivers from control households tended to have higher health knowledge scores on average than those from treatment households, although the difference was not significant. The average household size at baseline was between four and five members; half of all households had more than four members, the majority of whom were children ages six to 11 and adults 18 to 64. The mean dependency ratio was 2.77, indicating that each working-age household member was supporting nearly three children or elderly members, and nearly 40 percent of all households were caring for at least one orphan. Heads of households tended to be older illiterate women with no schooling, many of whom were widowed and chronically ill. Most households were not using credit at baseline, but did report receiving cash, food, and other consumables from non-household members, and fewer than 20 percent of households were participating in food or cash social safety net programs.

2.6.2. Main Impact Results

At the time of midline data collection households had received between five and six bi-monthly payments and so had been in the program for approximately one year; as such, results should be interpreted as one year impacts.

Table 2.3 presents the main program impact results estimated from Equation (1). The first three columns present marginal effect from an unadjusted model controlling only for time, treatment, and the difference-in-differences dummy variables. The remaining columns are estimated from models that adjust for the full vector of control variables in addition to the DD specification.

We did not find strong impacts of the SCTP on households' current economic vulnerability to food insecurity. Beneficiary households reduced their food share by two percentage points ($p = 0.10$), and while not statistically significant, program impacts on the probability of worrying about having enough to eat and on total food spending were in the expected direction.

The program had strong protective effects against the generally negative trends among the diet quantity indicators. On average, program households were 11 percentage points more likely to consume more than one meal per day ($p = 0.001$). Members of treatment households increased their apparent calorie consumption by 267.49 Kcal per person per day ($p = 0.05$) relative to control households, which represents 14 percent of baseline household caloric availability. The program impact on the probability that a household was food energy deficient was -0.10 ($p = 0.05$), and the mean caloric deficit was 111.11 Kcal lower among the treatment group compared to the mean hunger gap in control households ($p = 0.05$).

There is weak evidence that the program had an impact on diet quality. The DD estimate is positive but not significant for the household diet diversity score. The program significantly increased spending on three food groups: cereals, meat, and other, although program impacts on meat expenditures and the meat food share were only marginally significant ($p = 0.10$).

Full results for the adjusted models are presented in Appendix 4. Although all study households are poor, households from the bottom half of the baseline consumption distribution fared worse than those from the top on every FNS outcome. The poorest households were five percentage points more likely to worry about not having enough food ($p = 0.01$), were 10 percentage points less likely to eat multiple meals per day ($p = 0.001$), and were 24 percentage points more likely to be food energy deficient ($p = 0.001$). The poorest households also had lower total food expenditures, reduced caloric availability, and a larger hunger gap, and consumed on an average of one fewer food groups. Households experiencing unusually high prices for food also fared worse than those households that did not suffer food shocks. They spent less on food, had lower apparent caloric consumption, and were more likely to be food-energy deficient with a larger depth of hunger. Households experiencing a food shock at midline were 15 percentage points more likely to worry about not having enough food ($p = 0.001$).

2.6.3. Heterogeneous Impacts

Marginal effects from the heterogeneous impact models are presented in Tables 2.4 – 2.7. We find little evidence that program impacts differ in meaningful ways by poverty level, household size, distance to the nearest food market, or the caregiver's health knowledge score. The only differential program impact among the poorest households relative to beneficiary households in the top half of the baseline consumption distribution is an increase of 775.60 MWK spent on consumption items in the 'other' category ($p = 0.10$). Program recipients from the poorest households spent on average 2,599.64 MWK per capita annually less on cereals and 749.86 MWK less on 'other' foods compared to beneficiary households at the top of the consumption distribution ($p = 0.05$). Lastly, there was a positive differential program impact of 0.03 ($p = 0.05$) on the food share between households where the caregiver scored in the top third of the health knowledge score distribution and households with scores in the bottom two-thirds.

2.6.4. Transfer Share

We also examined whether program impacts varied by the level of the household's transfer share (Table 2.8). When modeled as a continuous percentage, a one percentage point increase in the value of the transfer share was associated, on average, with a 13 percentage point increase in the likelihood that a household consumed more than one meal on a typical day during the past week among beneficiary households ($p = 0.01$).

Next, we considered the effects of the SCTP based on a binary indicator of whether the predicted transfer share was greater than or equal to 20 percent of the household's pre-program consumption. We found no significant program impacts on indicators of current economic vulnerability, weak evidence of protective program impacts on diet quantity, and no impacts on diet quality other than a three percentage point decrease in the legume food expenditure share ($p = 0.05$) among treatment households with low predicted transfer shares relative to control households with low predicted transfer shares. There are, however, very strong program impacts on household food and nutrition security indicators among households with transfer shares of at least 20 percent. For example, relative to control households with high predicted transfer shares, program households with high transfer shares spend, on average, MWK 5,527.92 ($p = 0.001$) more on food – including MWK 2,850.27 ($p = 0.001$) on cereals, MWK 1,533.91 ($p = 0.01$) on meat, and MWK 1,597.13 ($p = 0.001$) on 'other' foods – and consume more apparent calories. Results from Wald tests of the equality of program impacts between high and low share beneficiary households reveal that the differential impacts are significant for total food expenditures (*p = 0.05*), HDDS (*p = 0.05*), and expenditures on the 'other' group (*p = 0.01*).

Program impacts based on a categorical representation of the transfer share are presented in the last four columns of Table 2.8. Beneficiary households with expected transfer shares greater than 20 percent but less than or equal to 30 percent experienced the strongest program impacts, especially among indicators of caloric availability, the hunger gap, and HDDS (no other transfer share group experienced significant impacts on HDDS at the five percent significance level or better). We conclude from Wald tests that none of the impacts on current economic vulnerability, diet quantity, or diet quality differed significantly between beneficiary households in the two highest share categories. Program impacts on HDDS and per capita expenditures on meat are larger for households with shares between 20 and 30 percent compared to shares between 15 and 20 percent *(p = 0.10)*, and impacts on expenditures for the other food group are larger among households with shares between 15 and 20 percent compared to households with shares less than or equal to 15 percent *(p = 0.05)*.

<u>2.6.5. Extensions</u>

2.6.5.1. Households with Children

We repeat the main impact analyses for households that have one or more children ages 0-17 years at baseline and/or midline follow-up, and for households with children ages 0-5 (Table 2.9). Approximately 89 percent (2,941) of households have at least one child ages 0-17, and 50 percent (1,657) have a child under five. The proportion of households with children does not differ significantly between treatment and control groups. Households with children are a subpopulation of importance as children are especially susceptible to the insalubrious consequences of poor food and nutrition, particularly during early growth and development.

Unlike in the full study sample, we find marginally significant protective program impacts on the likelihood of caregivers worrying over having enough food during the past week (a seven percentage point decrease among households with young children and an eight percentage point decrease among households with any children), as well as increased food expenditures among households with children ages 0 to 17. Program indicators of diet quantity are consistent with those estimated among all households. The treatment effect on HDDS is significant among households with children, and beneficiary households with children ages 0 to 17 spend an average of 909.91 MWK ($p = 0.05$) more on foods from the meat group than control households with children.

2.6.5.2. Energy Requirement for Moderate Activity Levels

A frequent criticism of measures of caloric deficiency is that these indicators tend to underestimate undernutrition because they are based on a caloric threshold that assumes a light level of physical activity, or a mostly sedentary lifestyle. In the case of measuring the incidence of household energy deficiency, the moderate activity threshold necessarily includes those individuals who would also be considered deficient under the light activity threshold, but individuals consuming between the light and moderate activity thresholds who engage in agricultural chores or perform *ganyu* labor would not be counted using lower caloric thresholds (the recommended minimum daily caloric intake for the reference population of men ages 30 to 60 is 2,500 Kcal, compared to 3,000 Kcal under moderate activity guidelines). The hunger deficit is also susceptible to under-reporting, particularly among the rural poor, who often operate at higher activity levels.[2] These issues are important for our study given that, at the time of the baseline survey, 96 percent of households reported owning or cultivating land during the 12 months before the survey and nearly all of these households were smallholder subsistence farms with landholdings of less than one hectare.[64]

Given the prominence of smallholder farming in our sample, we assess the sensitivity of our estimates of program impact on the incidence of food-energy deficiency and the hunger gap using moderate activity caloric thresholds.[66] At baseline, 61 percent of study households were considered to be food-energy deficient using guidelines for light activity, compared to an incidence of 70 percent using moderate activity thresholds. The average depth of hunger among study households at baseline was 420.75 Kcal per capita daily under light requirements and 649.24 Kcal under moderate requirements. The program impact on incidence of calorie deficiency using light activity levels was -0.10 ($p = 0.05$), with an average impact on the hunger gap of -111.11 Kcal ($p = 0.05$). Using the moderate activity threshold, the program reduced the incidence of food-energy deficiency by 12 percentage points ($p = 0.01$) and was associated with a 146.23 Kcal decrease in the hunger depth ($p = 0.01$) among SCTP households compared to control households.

2.6.5.3. Apparent Caloric Availability and Calorie Shares by Food Group

Finally, we undertook two extensions focused on food group calories and cereal group items to better understand how there could be significant program impacts on diet quantity but not on food expenditures.

Program impacts on group-specific apparent caloric availability and calories shares are presented in Table 2.10. The effects of the SCTP on caloric availability among the different food groups are consistent with impacts on food group expenditures. Compared to control households, beneficiary households increased apparent per capita daily calories available from cereals by 225.41 Kcal ($p = 0.05$), 21.08 Kcal from meat ($p = 0.001$), and from other foods by 46.12 Kcal ($p = 0.10$). Program impacts on food group calories represented larger shares of mean baseline control group values than did impacts on food group expenditures; relative impacts on apparent caloric availability from cereals, meats, and the other food groups are 14.47 percent, 69.46 percent, and 43.57 percent of baseline mean values among control households compared to relative program impacts on group expenditures.

2.6.5.4. Cereals, Roots, and Tubers

As program impacts on expenditures and apparent caloric availability were largest for the cereals groups, we decomposed the cereals, roots, and tubers food group into six sub-groups. We estimated program impacts on food expenditures and caloric availability among staple foods to test whether households were substituting away from inferior cereals such as millet towards finer grains such as rice, pasta, and wheat. The maize category includes maize flour, maize grain, green maize, and cooked maize from vendors; the millet category consists of finger millet, pearl millet, and sorghum, bread includes wheat flour and pasta, and the tuber category includes cassava tubers, cassava flour, white sweet potatoes (orange sweet potatoes are classified as vegetables), Irish potatoes, potato crisps, plantains, and cocoyam.

Maize dominated household cereal group expenditure and Kcal shares at baseline (86.07 percent of expenditures and 90.96 percent caloric availability for study households) and at midline (92.96 percent of expenditures and 95.48 percent of Kcal). Figure 2.2 displays the average program impacts on per capita annual expenditures and daily per capita apparent calorie availability: Panel A gives the impact estimates and Panel B presents the impact estimates as standardized effect sizes in order to facilitate direct comparison of program impacts across food groups and by indicator within food groups. We find that beneficiary households are substituting away from millet as evidenced by a program impacts of MWK – 337.52 *($p = 0.05$)* and -11.95 Kcal *($p = 0.05$)*. We also find evidence of the program inducing decreases in cereal expenditure shares and calorie shares by one percentage point *($p = 0.05$)*. The SCTP has a positive significant impact on expenditures on bread, rice, and tubers, with corresponding positive significant impacts on caloric availability from rice and tubers. While we do not find significant program impacts on maize expenditures, we do find that the program is associated with an increase of 122.36 Kcal from maize *($p = 0.05$)*. As illustrated in Panel B, we find more significant impacts on cereal group caloric availability than we do on expenditures.

The standardized effect sizes on daily per capita Kcal is similar for maize, rice, and tubers, and effect sizes on caloric availability and on expenditures are similar for rice and millet.

2.7. Discussion

This study uses longitudinal experimental data to investigate the impact of the Government of Malawi's Social Cash Transfer Program on food and nutrition security among ultra-poor, labor-constrained households. Our findings demonstrate that after approximately one year of program exposure, beneficiary households were achieving increased diet quantity but had relatively few improvements in economic vulnerability to food insecurity or diet quality relative to control households. The program was protective against worsening caloric insecurity during the lean season, but the limited impacts on diet quality suggests that the program had a limited ability to alleviate micronutrient undernutrition. Based on findings from other cash transfer programs, we also assessed heterogeneous impacts by the household's baseline poverty level, household size, distance from the nearest food market, caregiver health knowledge, and the transfer amount.

This study builds on previous research by providing evidence of protective program impacts of a social cash transfer on food insecurity during the lean season. An important contribution of this study is its use of multi-dimensional FNS indicators across three key areas of interest – current economic vulnerability, diet quantity, and diet quality. This study is unique in that it tests program impacts on total and food group-specific apparent caloric availability, which is lacking in the literature on cash transfer programs in SSA.

We find strong, positive impacts on apparent caloric availability, which appears to have translated into an increased probability that beneficiary households consumed multiple meals per day, a reduction in the likelihood of being food-energy deficient, and a reduction in the average hunger gap. The SCTP was associated with an 11 percentage point increase in the probability of eating two or more meals per day, and this finding was robust to different specifications of the transfer share. These findings are very similar to 24 month impacts of the Zambia MCTG program, which also found a significant program impact of 11 percentage points with a mean transfer share of 25 percent,[47,73] and the 24 month impact evaluation of the Zambia CGP, which found an eight percentage point increase from an average transfer share of 26 percent.[46,73] The six- and 12-month impact evaluations of the Mchinji pilot program in Malawi found much larger program impacts on the probability of consuming multiple meals per day (38 percentage points at six months and 42 percentage points at 12 months).[57] Our results may differ from those found in the Mchinji pilot in part because the pilot transfer share averaged around 30 percent of pre-program consumption. The impacts of cash transfer programs on caloric availability measures is very limited in sub-Saharan Africa, which is an important contribution of the present study.

We find weak evidence of program impact on household current economic vulnerability to food and nutrition insecurity. At midline, beneficiary households were beginning to decrease food shares and shift consumption resources to other households needs relative to the control group. Although the estimate of program impact on the prevalence of households feeling food-insecure is not statistically significant, it is in the expected direction. Per capita food expenditures declined on average for control and treatment households, but the average decline among program households was only two-thirds that of the decline among control households; again, while the impact on food spending was not significant, it is in the expected direction.

Lack of significant program impacts on households' feelings of food insecurity were consistent across all tested levels of the transfer share, but we did find strong program impacts on food expenditures among beneficiary households with transfer shares greater than 20 percent of pre-program consumption. The lack of SCTP impact on per capita food expenditures diverges from findings of other recent social transfer evaluations in SSA. The Mchinji pilot found significant impacts on food expenditures and the food share after six months (midline data were collected post-harvest) and after 12 months (during the hunger season).[57] The 24-months evaluations of the Kenya CT-OVC, Zambia MCTG, and Zambia CGP determined that the cash transfers led to significant increases in food expenditures,[17–19] and the 12 month evaluation of Zimbabwe's HSCT also found significant program impacts on food expenditures, although these impacts were no longer significant in fixed-effects models.[50]

Our findings of no significant program effects on households feeling food insecure during the past week or on food expenditures are somewhat surprising in light of the strong positive impacts on apparent caloric availability. It could be the case that treatment households substitute toward less expensive starchy staples during the lean season, which may lead to increased caloric availability without a corresponding increase in food expenditures. The lack of SCTP impact on overall food expenditures, coupled with strong significant program impacts on expenditures and calories available from foods in the cereal group, provides evidence in support of this theory.

Program impacts on diet quality are limited. The SCTP did not improve diet quality as measured by the HDDS on average, although we do see evidence of significant increases in the HDDS among beneficiary households with transfer shares greater than 20 percent of baseline consumption. Results from the Mchinji pilot, the Zambia CGP, and the Zimbabwe HSCT all show positive impacts on household diversity scores,[46,50,57] and the Kenya CT-OVC impact evaluation found that program households were more likely to have consumed meat during the past week.[48] As program impacts in our study occurred mostly on diet quantity during the lean season, it may be the case that the transfer amount was not sufficient to help households reach their caloric quantity threshold in order to begin substituting away from inferior foods. The transfer amount was increased after midline data collection was completed to compensate for general inflation between the baseline and midline surveys, so we might expect to see stronger protective impacts on current economic vulnerability and diet quality at endline.

The program had significant positive effects on cereal group expenditures and caloric availability, as well as increased spending and a larger food expenditure share among items in the 'other' category. Further investigation of program effects within the cereals, roots, and tubers food group revealed that beneficiary households were increasing consumption of higher quality staple foods while decreasing expenditures and calories from millet, which is generally considered to be a low-quality carbohydrate. Treatment households had increased caloric availability from meat, fish, and dairy compared to the control group, and while program impacts on meat expenditures were only marginally significant on average, they were strong and significant among beneficiary households with high transfer shares. We did not detect significant effects on expenditures or calories from fruits and vegetables or the legume groups. Our findings are consistent with those from the Zambia MCTG and CGP evaluations, which found significant positive program impacts on cereal and meat expenditures but did not find impacts on fruit and vegetable spending.[46,47] In general, program impacts on diet quality indicators appear to be more consistent with evidence of program-induced improvements in diet quantity rather than gains in diet quality, which appears to be limited to a small increase in consumption from the meat group.

2.7.1. Implications for Policy and Practice

While the SCTP confers protective impacts to beneficiary households during the lean season, the FNS status of beneficiary households remains bleak at midline: two-thirds of program households remain food-energy deficient and three-fourths continue to worry that they would not have enough to eat. The purchasing power of the cash transfer has important implications for the types of impacts the SCTP can have on household FNS. The limited effect of the intervention on diet quality may be due, in large part, to the erosion of the SCTP's purchasing power between the post-harvest and lean seasons. Food markets in Malawi tend to be thin and are characterized by highly volatile prices.[75] As evidenced by the high percentage of study households reporting food price shocks at baseline and midline, and the negative trends in FNS outcomes among all study households, high fluctuations in seasonal food prices are detrimental to FNS among poor households. Potential policy solutions could include indexing the value of the cash transfer to food prices, or simply increasing the transfer amount during the lean season to better help households smooth food consumption. In practice, however, this is not always a straight-forward decision to make as program planners are charged with balancing the amount of the transfer such that it is sufficient to improve household welfare, particularly in response to known seasonal food and price shocks, but not enough to encourage moral hazard (e.g., reducing labor among fit adults). Social policymakers in Malawi must also face the tradeoff between increasing the transfer amount among current beneficiary households in order to see improved program impacts versus the risk of crowding out other eligible households given limited program resources. The SCTP transfer amount was increased after midline data collection was completed to compensate for general inflation between the baseline and midline surveys, so it will be important for future research to investigate whether SCTP impacts have expanded beyond protection from caloric deficits and allowed households to feel more food secure and consume a more diverse diet.

The persistence of low FNS among beneficiary households also suggests that the cash transfer alone is insufficient to overcome both the demand- and supply-side constraints households face when attempting to acquire more and better food. Household diets are dominated by maize consumption and are heavily dependent upon staple foods to meet caloric quantity requirements. As the effects of climate change become more pronounced and damage to local food systems is exacerbated, the ultra-poor – particularly smallholder subsistence farming households like those in our study – are at risk of falling further into poverty and chronic undernutrition. Seasonal fluctuations in food availability and prices may become more extreme, and poor households may be priced out of local food markets more frequently throughout the year. The SCTP could work with other safety net programs that aim to boost smallholder resilience to crop failures that provide in-kind transfers when local markets fail, or that set price ceilings on staple foods. Program linkages could also boost the SCTP's effect on diet quality. As the percentage of beneficiary households consuming meals with adequate total calories increases, incidence of undernutrition likely remains high as few households routinely consume diets rich in protein and micronutrients. Program administrators could also facilitate linkages between beneficiaries and other social services designed to improve nutrition, such as access to micronutrient supplements and fortified foods, or prices subsidies to stimulate demand for a more diverse and nutrient-rich diet. Integration of cash transfer schemes and other social service interventions is an emerging area of research (Social Protection PLUS) aimed at understanding how to achieve more comprehensive improvements in the welfare of poor populations.

2.7.2. Limitations

There are several limitations to this study that merit discussion. First, the majority of our outcomes are based on household recall of quantities of all foods consumed in the home during the past week, which means that we do not directly measure spending or food consumption. The use of a consumption aggregate as a summary welfare measure is the gold standard in household surveys that seek to measure population poverty dynamics. Consumption recall is preferred to income reporting because there is a great deal of fluctuation in income over time, particularly among agricultural households, relative to smoother seasonal variations in consumption.[76] Gold standards among nutritionist include food diaries, 24-hour recall, and an observed-weighed food method. These surveys are time consuming, expensive, often conducted in small non-representative samples and are not routinely implemented. Household economic surveys, on the other hand, are more feasible and affordable and therefore have become part of routine data collection in many low- and middle-income countries. [77–79]

There are important assumptions and sources of measurement error associated with using household economic surveys that could influence the sensitivity of study expenditure and diet quantity measures. Two implicit assumptions are that food wastage is minimal and that the consumption of food stocks during the reference period averages out with food acquired during but consumed after the reference period.[79,80] We also have to make the assumption that food consumption is equally distributed among household members (per capita measures) or is distributed proportional to age- and sex-specific requirements (adult equivalent measures) because household consumption data is not captured at the individual level. Potential sources of reporting error could include recall error where households misreport true consumption due to the length of the recall period (some studies have documented that longer recall periods are associated with lower consumption averages) and telescoping, where households report consumption activity that occurred over a longer period of time than the recall window.[78] While we don't expect reporting error to systematically differ between the treatment and control groups, there could be instances of social desirability bias in which households under-report consumption if they think their responses will influence their program eligibility. Any social desirability bias was likely equal between groups at the pre-treatment baseline, but beneficiary households may over-report consumption to appear thankful for the transfer or control households may under-report if they believe it affects their future eligibility; in such a case we would overestimate the program's impact on consumption.

Secondly, higher levels of per capita food expenditures do not necessarily translate into improved diet quantity because more expensive foods do not always contain more calories. Likewise, increased apparent caloric consumption does not necessarily imply better nutrition if there is not sufficient variety and micronutrient content in the diet. Future research into the impacts of the SCTP on households FNS could use indicators more sensitive to diet quality, such as a micronutrient-sensitive version of the HDDS, per capita access to iron, and per capita consumption of foods rich in vitamin A.[81]

The final limitations of this study relate to the timing of midline data collection. The amount of time between the baseline and midline surveys may have been too short for beneficiary households to overcome food quantity requirements, leaving less opportunity for diet diversification. As discussed throughout this paper, a limitation of this study is that baseline data were collected shortly after the harvest season whereas midline were collected near the end of the lean season. During the lean season households begin to extinguish their food stores and food markets have lower diversity and lower quantities, which in turns drives up the cost of purchased foods. Households struggle more to meet their diet quantity needs, and given high prices and low availability during the lean season may not be able to overcome these quantity constraints to begin improving diet quality. The additional challenges faced during the lean season do not differentially affect the treatment and control groups in our study and so we do not expect that seasonality biases our estimates of program impact. The focus of our study is not on changes in FNS outcomes over time, but rather on the differential changes in outcomes between treatment and control households that can be attributed to the SCTP. Because treatment is randomly assigned we are able to attribute the protective effects of increased income (i.e., the cash payments) to the program and draw causal inferences about the program's ability to prevent households from falling deeper into hunger during the lean season.

2.8. Conclusions

Results from this study indicate that after one year of intervention exposure, beneficiary households were attempting to achieve a higher diet quantity more so than an improved diet quality. The program was protective against worsened calorie insecurity, but did little to ameliorate current economic vulnerability or lack of diet diversity. Key design features of the Malawi SCTP – such as its lack of conditionalities and targeting to ultra-poor and labor-constrained households – that are similar to programs in other sub-Saharan African countries, suggesting a high degree of external validity. Clear policy and program implications emerge related to the purchasing power of the cash transfer, particularly during the lean season, and the importance of the supply-side environment and linkages to other social services in the efficient maximization of program impacts.

2.9. Tables and Figures

Table 2.1. Generalized Linear Model Specifications

Outcome	Family	Link
Worried not enough food	Binomial	Logit
PC real annual food expenditure	Gamma	Log
Food share	Gaussian	Identity
More than 1 meal/day	Binomial	Logit
Kcal per capita	Gamma	Log
Food energy deficient	Binomial	Logit
Depth of hunger *	Gamma	Log
HDDS	Zero-Truncated Poisson	
Per capita real annual expenditures		
Cereals, roots, and tubers	Gamma	Log
Fruits and vegetables *	Gaussian	Identity
Meat, eggs, fish, and milk *	Gaussian	Identity
Legumes, nuts, and seeds *	Gaussian	Identity
Other *	Gaussian	Identity
Share of total food expenditure		
Cereals, roots, and tubers	Gaussian	Identity
Fruits and vegetables *	Gamma	Log
Meat, eggs, fish, and milk *	Gamma	Log
Legumes, nuts, and seeds *	Gamma	Log
Other *	Gamma	Log

Notes: * Equations are specified using a two part model; all two-part models use logits for the first part and the family and link specifications for the second part of the model are specified in the table.

Table 2.2. Descriptive Statistics by Wave and Treatment Status (N = 6,580)

	Baseline					Midline				
	Control		Treatment			Control		Treatment		
	Mean	(SD)	Mean	(SD)	*p-value*	Mean	(SD)	Mean	(SD)	*p-value*
Intervention										
Treatment	0.51		0.49							
Simulated PC real annual transfer	7,367.63	(2,179.59)	7,346.10	(2,124.84)	*0.93*					
Simulated share	22.95	(14.26)	22.03	(12.65)	*0.58*					
Proportion high share	0.49	(0.51)	0.45	(0.49)	*0.38*					
Categorical shares										
> 30%	0.20	(0.41)	0.20	(0.39)	*0.99*					
20 – 30%	0.29	(0.46)	0.25	(0.43)	*0.07*					
15 – 20%	0.21	(0.41)	0.21	(0.40)	*0.89*					
≤ 15%	0.30	(0.47)	0.34	(0.47)	*0.31*					
Outcomes of Interest										
Worried not enough food	0.83	(0.38)	0.84	(0.36)	*0.75*	0.87	(0.34)	0.76	(0.42)	*0.00*
PC real annual food expenditure	33,409.08	(23,177.41)	35,169.03	(24,711.64)	*0.52*	26,244.69	(17,023.85)	30,382.36	(17,768.55)	*0.02*
Food share	0.77	(0.11)	0.77	(0.11)	*0.92*	0.72	(0.11)	0.70	(0.11)	*0.09*
More than 1 meal/day	0.82	(0.39)	0.79	(0.40)	*0.59*	0.88	(0.34)	0.94	(0.24)	*0.01*
Kcal per capita	1,894.32	(1,240.05)	1,831.03	(1,220.90)	*0.69*	1,558.20	(981.62)	1,767.27	(973.66)	*0.01*
Food energy deficient	0.60	(0.50)	0.62	(0.48)	*0.68*	0.74	(0.45)	0.65	(0.47)	*0.01*
Depth of hunger	420.75	(490.88)	464.10	(491.02)	*0.52*	559.82	(504.54)	438.12	(456.40)	*0.00*
HDDS	5.64	(1.87)	5.63	(1.78)	*0.95*	5.34	(1.44)	5.85	(1.54)	*0.00*
Proportion with positive expenditures										
Cereals, roots, and tubers	1.00	(0.06)	1.00	(0.06)	0.66	0.99	(0.12)	1.00	(0.06)	0.04
Fruits and vegetables	0.99	(0.11)	0.99	(0.09)	0.31	0.99	(0.08)	1.00	(0.05)	0.39
Meat, eggs, fish, and milk	0.38	(0.49)	0.36	(0.47)	0.71	0.73	(0.45)	0.81	(0.39)	0.04
Legumes, nuts, and seeds	0.77	(0.43)	0.77	(0.41)	0.94	0.43	(0.50)	0.55	(0.49)	0.04
Other	0.99	(0.08)	0.99	(0.10)	0.41	0.99	(0.10)	1.00	(0.06)	0.08
Per capita real annual expenditures										
Cereals, roots, and tubers	18,580.20	(13,296.52)	19,422.40	(14,245.27)	*0.54*	12,550.89	(9,091.41)	13,757.87	(8,068.88)	*0.14*
Fruits and vegetables	5,371.99	(5,446.37)	5,760.48	(5,861.04)	*0.40*	6,895.68	(6,477.88)	7,737.02	(6,557.23)	*0.23*
Meat, eggs, fish, and milk	2,347.29	(5,863.05)	2,534.22	(6,624.37)	*0.79*	3,211.28	(5,216.23)	3,947.33	(5,605.66)	*0.10*
Legumes, nuts, and seeds	3,855.45	(5,479.20)	4,412.70	(6,305.27)	*0.38*	1,841.90	(3,837.09)	2,572.44	(4,111.30)	*0.06*
Other	3,254.16	(5,597.03)	3,039.23	(4,484.39)	*0.69*	1,744.94	(3,169.90)	2,367.70	(3,533.26)	*0.02*
Share of total food expenditure										
Cereals, roots, and tubers	0.58	(0.17)	0.57	(0.17)	*0.67*	0.50	(0.17)	0.48	(0.15)	*0.24*
Fruits and vegetables	0.18	(0.13)	0.19	(0.13)	*0.70*	0.27	(0.16)	0.26	(0.14)	*0.56*
Meat, eggs, fish, and milk	0.05	(0.10)	0.05	(0.09)	*0.83*	0.11	(0.12)	0.12	(0.11)	*0.54*
Legumes, nuts, and seeds	0.11	(0.11)	0.12	(0.11)	*0.49*	0.06	(0.10)	0.07	(0.09)	*0.13*

Other	0.09	(0.09)	0.08	(0.08)	*0.38*	0.06	(0.07)	0.07	(0.07)	*0.15*
Household Characteristics										
Crop shock	0.77	(0.43)	0.78	(0.41)	*0.92*	0.56	(0.50)	0.59	(0.48)	*0.65*
Food shock	0.82	(0.39)	0.84	(0.36)	*0.73*	0.67	(0.48)	0.71	(0.45)	*0.61*
Reside in Salima district	0.41	(0.50)	0.36	(0.47)	*0.77*					
4 or fewer members	0.50	(0.51)	0.50	(0.49)	*0.96*					
Poorest 50%	0.50	(0.51)	0.49	(0.49)	*0.77*					
Market within 1.5km	0.53	(0.51)	0.63	(0.48)	*0.28*					
Top third health knowledge score	0.37	(0.49)	0.32	(0.46)	*0.28*					
Household size	4.58	(2.28)	4.59	(2.20)	*0.96*					
Number members in age group										
0 to 5	0.68	(0.90)	0.68	(0.91)	*0.96*					
6 to 11	1.23	(1.12)	1.17	(1.04)	*0.44*					
12 to 17	0.93	(0.97)	0.94	(0.95)	*0.85*					
18 to 64	1.18	(1.02)	1.17	(1.02)	*0.93*					
65 and older	0.56	(0.65)	0.63	(0.64)	*0.23*					
Dependency ratio	2.77	(1.71)	2.77	(1.63)	*0.98*					
Any child orphans	0.37	(0.49)	0.41	(0.48)	*0.26*					
Household head										
Female	0.85	(0.36)	0.83	(0.37)	*0.34*					
Age	56.86	(19.68)	58.80	(19.45)	*0.38*					
Chronically ill	0.41	(0.50)	0.47	(0.49)	*0.15*					
Severe disability	0.10	(0.31)	0.11	(0.31)	*0.82*					
Any school	0.30	(0.46)	0.29	(0.45)	*0.92*					
Literate	0.19	(0.40)	0.17	(0.37)	*0.61*					
Widow	0.42	(0.50)	0.44	(0.49)	*0.65*					
Any credit	0.44	(0.50)	0.43	(0.49)	*0.75*					
Transfers received from non-household members										
Cash	0.71	(0.46)	0.66	(0.46)	*0.32*					
Food/other consumables	0.94	(0.24)	0.90	(0.29)	*0.14*					
Labor or time	0.55	(0.51)	0.49	(0.49)	*0.20*					
Agricultural inputs	0.34	(0.48)	0.31	(0.45)	*0.41*					
Participation in other social programs										
Food/cash program	0.20	(0.41)	0.15	(0.35)	*0.39*					
Mother/child feeding program	0.16	(0.37)	0.15	(0.35)	*0.89*					

Notes: There are 1,729 control households and 1,561 treatment households per wave. Sample means, standard deviations, and p-values are adjusted for complex survey design, and p-values are calculated from simple weighted linear regression controlling for clustering at the Village Cluster level.

Table 2.3. Program Impacts on Household FNS, Marginal Effects (N = 6,580)

	Unadjusted			Adjusted				
	Treat	Time	DD	Treat	Time	DD	Relative Impact	Effect Size
Current Economic Vulnerability to Food Insecurity								
Worried not enough food	0.01	0.05	-0.13*	-0.05	-1.18***	-0.06	0.00	0.00
	(0.04)	(0.04)	(0.05)	(0.04)	(0.28)	(0.05)		
PC real annual food expenditure	1605.66	-7548.92***	2973.12	633.79	21704.93+	3,212.44	0.00	0.00
	(2481.29)	(1482.78)	(2884.16)	(1,598.95)	(11,534.81)	(2,278.45)		
Food share	0.00	-0.06***	-0.01	0.00	0.04	-0.02+	-2.60	-0.18
	(0.01)	(0.01)	(0.01)	(0.01)	(0.08)	(0.01)		
Diet Quantity								
More than 1 meal/day	-0.02	0.05*	0.11***	-0.02	0.32+	0.11***	13.41	0.28
	(0.03)	-0.02	(0.03)	(0.02)	(0.19)	(0.03)		
Kcal per capita	-59.88	-344.18***	281.73+	-24.34	342.03	267.49*	14.12	0.22
	(146.33)	-101.66	(146.71)	(114.64)	(535.63)	(122.60)		
Food energy deficient	0.02	0.14***	-0.11*	0.00	0.04	-0.10*	-16.67	-0.20
	(0.05)	-0.04	(0.05)	(0.04)	(0.21)	(0.04)		
Depth of hunger	44.19	138.44***	-166.95**	-2.36	-177.58	-111.11*	-26.41	-0.23
	(50.17)	-35.16	(52.35)	(33.94)	(221.32)	(44.08)		
Diet Quality								
HDDS	-0.02	-0.32	0.54	0.14	4.22**	0.23	0.00	0.00
	(0.25)	(0.22)	(0.33)	(0.22)	(1.54)	(0.32)		
Per capita real annual expenditures								
Cereals, roots, and tubers	712.35	-6303.98***	763.1	-663.76	6,394.07	1759.26*	9.47	0.13
	(1134.08)	(660.76)	(982.79)	(875.22)	(4,850.53)	(830.24)		
Fruits and vegetables	441.72	1597.21*	309.04	719.99+	911.19	345.12	0.00	0.00
	(522.83)	(625.26)	(898.28)	(408.57)	(4,192.92)	(643.55)		
Meat, eggs, fish, and milk	283.92	719.23*	556.11	-424.50	2,938.47	884.88+	37.70	0.15
	(613.04)	(285.42)	(707.25)	(392.55)	(3,524.65)	(474.43)		
Legumes, nuts, and seeds	432.72	-2026.33***	355.21	1309.08***	5328.66+	-480.41	0.00	0.00
	(445.28)	(317.53)	(483.49)	(339.31)	(3,191.07)	(541.79)		
Other	-176.77	-1617.50***	971.23	-371.35	5846.89*	990.84*	30.45	0.18
	(440.92)	(412.08)	(596.13)	(366.38)	(2,829.07)	(459.68)		
Share of total food expenditure								
Cereals, roots, and tubers	-0.01	-0.08***	-0.01	-0.03***	-0.17	0.01	0.00	0.00
	(0.01)	(0.01)	(0.02)	(0.01)	(0.12)	(0.02)		
Fruits and vegetables	0.01	0.09***	-0.02	0.02+	-0.12	-0.01	0.00	0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.12)	(0.02)		
Meat, eggs, fish, and milk	0.00	0.05***	0.01	-0.02*	0.02	0.02+	40.00	0.20

	(0.01)	(0.01)	(0.01)	(0.01)	(0.08)	(0.01)		
Legumes, nuts, and seeds	0.01	-0.04***	0.00	0.04***	0.08	-0.03*	-27.27	-0.27
	(0.01)	(0.01)	(0.01)	(0.01)	(0.07)	(0.01)		
Other	-0.01	-0.03***	0.02	-0.02*	0.09	0.02*	22.22	0.22
	(0.01)	(0.01)	(0.01)	(0.01)	(0.06)	(0.01)		

*Notes: Survey-weighted marginal effects are estimated using difference-in-difference modeling in the GLM framework among panel households. Unadjusted models do not include control variables. All adjusted models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. Relative impacts and standardized effect scores are equal to zero for non-significant program impacts. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 2.4. Heterogeneous Program Impacts by Baseline Poverty Level, Marginal Effects (N = 6,580)

	Treat	Time	DD	Poorest	DD*Poorest
Worried about food	-0.04	-1.18***	-0.07	0.05*	0.02
	(0.04)	(0.28)	(0.06)	(0.02)	(0.04)
PC Food Exp.	1494.71	11317.84	1966.52	-25118.13***	2588.99
	(1207.18)	(9452.36)	(1940.25)	(1049.37)	(1790.17)
Food Share	-0.00	0.01	-0.01	-0.04***	-0.01
	(0.01)	(0.07)	(0.01)	(0.01)	(0.01)
More than 1 meal/day	-0.04+	0.25	0.14***	-0.14***	-0.05
	(0.02)	(0.19)	(0.03)	(0.01)	(0.03)
PC Kcal.	18.59	-75.86	227.65+	-1008.71***	96.36
	(105.51)	(504.82)	(117.55)	(68.52)	(93.26)
Energy Deficient	0.00	0.23	-0.09+	0.40***	-0.01
	(0.05)	(0.23)	(0.05)	(0.02)	(0.06)
Hunger Depth	0.00	0.23	-0.09+	0.40***	-0.01
	(0.05)	(0.23)	(0.05)	(0.02)	(0.06)
HDDS	2.99	175.64	-95.17	510.00***	-29.43
	(47.66)	(221.53)	(62.91)	(34.42)	(56.10)
Per Capita Expenditures					
Cereals, roots, and tubers	-209.29	1936.17	1369.62	-10940.06***	973.21
	(764.20)	(4700.93)	(942.92)	(542.30)	(1063.51)
Fruits and vegetables	511.84	-1152.77	680.25	-3881.79***	-523.54
	(441.71)	(4120.78)	(640.06)	(235.71)	(545.54)
Meat, eggs, fish, and milk	-291.97	531.18	553.94	-4836.07***	937.38
	(444.40)	(3020.22)	(486.31)	(427.15)	(721.81)
Legumes, nuts, and seeds	1478.76***	3629.94	-798.49	-2860.63***	685.80
	(354.15)	(2802.78)	(533.69)	(285.66)	(608.31)
Other	-301.26	4557.29+	587.93	-3082.45***	775.60+
	(344.53)	(2594.97)	(452.26)	(223.17)	(426.94)
Food Expenditure Shares					
Cereals, roots, and tubers	-0.03*	-0.14	0.02	0.05***	-0.01
	(0.02)	(0.12)	(0.02)	(0.01)	(0.02)
Fruits and vegetables	0.01	-0.12	-0.00	0.04***	-0.02
	(0.01)	(0.12)	(0.02)	(0.01)	(0.02)
Meat, eggs, fish, and milk	-0.01	-0.01	0.01	-0.06***	0.01
	(0.01)	(0.07)	(0.01)	(0.01)	(0.01)
Legumes, nuts, and seeds	0.04***	0.08	-0.03*	-0.02*	0.00
	(0.01)	(0.07)	(0.01)	(0.01)	(0.02)
Other	-0.02+	0.08	0.02	-0.03***	0.01
	(0.01)	(0.06)	(0.01)	(0.00)	(0.01)

*Notes: Survey-weighted marginal effects are estimated using difference-in-difference modeling in the GLM framework among panel households. All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. Relative impacts and standardized effect scores are equal to zero for non-significant program impacts. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 2.5. Heterogeneous Program Impacts by Baseline Household Size, Marginal Effects (N = 6,580)

	Treat	Time	DD	HH Size	DD*HH Size
Worried about food	-0.05	-1.16***	-0.07	0.01	0.01
	(0.04)	(0.28)	(0.04)	(0.03)	(0.04)
PC Food Exp.	214.65	24560.32*	3089.54	2649.89**	524.72
	(1623.62)	(11409.14)	(2068.30)	(848.00)	(1725.21)
Food Share	-0.00	0.05	-0.02*	0.01	0.02
	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)
More than 1 meal/day	-0.02	0.34+	0.10**	0.00	0.01
	(0.02)	(0.19)	(0.03)	(0.02)	(0.04)
PC Kcal.	-49.54	498.32	288.91*	157.52**	-32.44
	(119.55)	(511.68)	(123.47)	(49.15)	(78.56)
Energy Deficient	0.00	0.00	-0.07	-0.02	-0.05
	(0.04)	(0.20)	(0.05)	(0.03)	(0.05)
Hunger Depth	-0.66	-222.52	-103.02*	-77.57*	-10.95
	(37.53)	(220.62)	(46.26)	(30.60)	(47.46)
HDDS	0.14	4.19**	0.24	-0.09	-0.03
	(0.24)	(1.55)	(0.35)	(0.09)	(0.16)
Per Capita Expenditures					
Cereals, roots, and tubers	-749.45	7887.47+	1730.13+	1023.54*	172.27
	(913.72)	(4636.32)	(1000.54)	(402.18)	(1022.24)
Fruits and vegetables	588.20	1472.53	162.16	623.03+	393.58
	(454.10)	(4254.33)	(735.86)	(370.37)	(562.91)
Meat, eggs, fish, and milk	-556.54	3199.44	1160.24*	363.04	-518.58
	(380.05)	(3477.50)	(463.03)	(320.21)	(418.02)
Legumes, nuts, and seeds	1237.19***	5469.27+	-384.91	181.14	-179.82
	(361.96)	(3193.67)	(582.97)	(217.66)	(431.05)
Other	-320.13	6074.27*	953.09*	411.60*	76.79
	(377.38)	(2824.50)	(452.31)	(203.45)	(373.34)
Food Expenditure Shares					
Cereals, roots, and tubers	-0.03**	-0.18	0.02	-0.01	-0.00
	(0.01)	(0.12)	(0.02)	(0.01)	(0.01)
Fruits and vegetables	0.02	-0.13	-0.02	0.01	0.01
	(0.01)	(0.12)	(0.02)	(0.01)	(0.01)
Meat, eggs, fish, and milk	-0.02*	0.02	0.02*	-0.01	-0.01
	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)
Legumes, nuts, and seeds	0.04***	0.08	-0.03*	0.00	-0.00
	(0.01)	(0.07)	(0.01)	(0.01)	(0.01)
Other	-0.01+	0.10	0.02+	0.01+	0.00
	(0.01)	(0.06)	(0.01)	(0.00)	(0.01)

*Notes: Survey-weighted marginal effects are estimated using difference-in-difference modeling in the GLM framework among panel households. All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. Relative impacts and standardized effect scores are equal to zero for non-significant program impacts. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 2.6. Heterogeneous Program Impacts by Distance to Food Market, Marginal Effects (N - 6,580)

	Treat	Time	DD	Distance	DD*Distance
Worried about food	-0.06	-1.18***	-0.04	-0.02	-0.05
	(0.04)	(0.28)	(0.06)	(0.02)	(0.05)
PC Food Exp.	406.96	19782.80+	5015.79*	1452.50	-2476.21
	(1865.23)	(11523.00)	(2487.15)	(1033.84)	(1666.64)
Food Share	0.00	0.04	-0.02	-0.00	-0.00
	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)
More than 1 meal/day	0.01	0.30	0.08+	0.05**	0.06
	(0.02)	(0.19)	(0.04)	(0.02)	(0.05)
PC Kcal.	74.81	209.80	274.97+	127.14*	-1.05
	(129.13)	(533.40)	(155.26)	(62.82)	(124.50)
Energy Deficient	-0.03	0.10	-0.12*	-0.04	0.03
	(0.04)	(0.21)	(0.06)	(0.02)	(0.05)
Hunger Depth	-42.73	-89.56	-139.88**	-65.34**	38.25
	(42.99)	(235.32)	(51.88)	(21.73)	(49.62)
HDDS	0.15	3.94**	0.32	0.33*	-0.00
	(0.26)	(1.47)	(0.37)	(0.16)	(0.24)
Per Capita Expenditures					
Cereals, roots, and tubers	-897.25	5084.46	3393.68**	739.94	-2599.64*
	(1092.57)	(4776.75)	(1043.90)	(508.48)	(1103.13)
Fruits and vegetables	678.37	1221.41	12.97	494.69**	673.37
	(479.57)	(4157.64)	(802.33)	(170.12)	(649.78)
Meat, eggs, fish, and milk	-580.35	2764.53	1247.23*	-100.57	-598.08
	(559.55)	(3579.36)	(626.88)	(318.19)	(617.42)
Legumes, nuts, and seeds	1604.91***	4792.85	-356.28	140.34	-133.74
	(379.07)	(3115.34)	(639.34)	(215.32)	(476.60)
Other	-487.60	5396.93+	1475.15**	2.48	-749.86*
	(431.21)	(2850.59)	(558.27)	(170.94)	(378.75)
Food Expenditure Shares					
Cereals, roots, and tubers	-0.03**	-0.18	0.03	0.00	-0.02
	(0.01)	(0.12)	(0.03)	(0.01)	(0.03)
Fruits and vegetables	0.01	-0.10	-0.03	-0.00	0.02
	(0.01)	(0.12)	(0.02)	(0.01)	(0.02)
Meat, eggs, fish, and milk	-0.02	0.02	0.02	-0.00	-0.00
	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)
Legumes, nuts, and seeds	0.05***	0.08	-0.03*	-0.00	0.01
	(0.01)	(0.07)	(0.02)	(0.01)	(0.01)
Other	-0.02*	0.09	0.03*	-0.00	-0.01
	(0.01)	(0.06)	(0.01)	(0.00)	(0.01)

*Notes: Survey-weighted marginal effects are estimated using difference-in-difference modeling in the GLM framework among panel households. All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. Relative impacts and standardized effect scores are equal to zero for non-significant program impacts. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 2.7. Heterogeneous Program Impacts by Caregiver Health Knowledge, Marginal Effects (N = 6,580)

	Treat	Time	DD	HK Score	DD*HK Score
Worried about food	-0.05	-1.18***	-0.05	0.02	-0.03
	(0.03)	(0.28)	(0.05)	(0.01)	(0.04)
PC Food Exp.	552.60	21878.40+	3120.59	233.68	145.85
	(1566.76)	(11482.70)	(2256.23)	(943.59)	(1822.49)
Food Share	0.00	0.05	-0.03**	0.01***	0.03*
	(0.01)	(0.08)	(0.01)	(0.00)	(0.01)
More than 1 meal/day	-0.02	0.34+	0.10**	-0.00	0.00
	(0.02)	(0.19)	(0.03)	(0.02)	(0.04)
PC Kcal.	-14.51	343.90	257.33*	25.35	32.92
	(114.76)	(536.50)	(122.54)	(53.31)	(84.57)
Energy Deficient	0.01	0.05	-0.10*	-0.01	0.01
	(0.04)	(0.21)	(0.04)	(0.01)	(0.04)
Hunger Depth	9.56	-168.20	-128.84*	46.44*	59.24
	(36.13)	(221.70)	(51.33)	(22.93)	(45.37)
HDDS	0.15	4.23**	0.23	-0.04	-0.00
	(0.23)	(1.54)	(0.34)	(0.10)	(0.21)
Per Capita Expenditures					
Cereals, roots, and tubers	-559.24	6468.14	1483.40	132.93	838.40
	(893.38)	(4854.48)	(955.60)	(433.93)	(861.86)
Fruits and vegetables	631.90	950.05	532.02	-22.21	-655.29
	(405.41)	(4202.01)	(693.86)	(365.55)	(700.57)
Meat, eggs, fish, and milk	-400.21	2974.71	737.58+	447.44	449.38
	(334.33)	(3484.97)	(444.66)	(420.18)	(631.08)
Legumes, nuts, and seeds	1210.15***	5263.11+	-385.97	-191.99	-315.26
	(343.98)	(3178.20)	(568.23)	(169.81)	(377.68)
Other	-383.62	5918.39*	995.07+	22.04	-27.31
	(368.88)	(2796.32)	(509.51)	(222.12)	(482.45)
Food Expenditure Shares					
Cereals, roots, and tubers	-0.03**	-0.17	0.01	0.00	0.02
	(0.01)	(0.12)	(0.02)	(0.01)	(0.02)
Fruits and vegetables	0.02	-0.12	-0.01	0.00	-0.03
	(0.01)	(0.12)	(0.02)	(0.01)	(0.02)
Meat, eggs, fish, and milk	-0.02*	0.02	0.02+	0.00	-0.00
	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)
Legumes, nuts, and seeds	0.04***	0.08	-0.02+	-0.01	-0.01
	(0.01)	(0.07)	(0.01)	(0.00)	(0.01)
Other	-0.02*	0.09	0.02+	0.00	0.01
	(0.01)	(0.06)	(0.01)	(0.00)	(0.01)

*Notes: Survey-weighted marginal effects are estimated using difference-in-difference modeling in the GLM framework among panel households. All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. Relative impacts and standardized effect scores are equal to zero for non-significant program impacts. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 2.8. Heterogeneous Impacts by Transfer Share Level (N = 6,580)

	Continuous Share	Binary Share		Categorical Share			
		High	Low	> 30%	20-30%	15% - 20%	≤15%
Current Economic Vulnerability to Food Insecurity							
Worried not enough food	-0.10	-0.05	-0.07	-0.01	-0.07	-0.05	-0.07
	(0.08)	(0.04)	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)
Per capita real annual food expenditures	-134.70	5527.92***	2167.92	4545.10*	4752.48**	3141.22	1948.34
	(2645.22)	(1640.01)	(1930.91)	(2066.54)	(1771.71)	(1921.76)	(2046.87)
Food share	-0.00	-0.02*	-0.01	-0.03*	-0.02	-0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Diet Quantity							
More than 1 meal/day	0.13**	0.10**	0.12***	0.07+	0.13**	0.17**	0.08*
	(0.04)	(0.04)	(0.03)	(0.04)	(0.05)	(0.06)	(0.04)
Kcal per capita	228.15	362.53**	245.03+	281.30+	355.41**	245.21+	269.09+
	(171.34)	(116.63)	(136.12)	(146.49)	(117.66)	(143.70)	(154.23)
Food energy deficient	-0.08	-0.14**	-0.08	-0.10+	-0.12+	-0.08	-0.08
	(0.08)	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)
Depth of hunger	-100.56	-149.41**	-99.61+	-109.31+	-157.41**	-104.90	-92.66
	(76.78)	(47.90)	(59.56)	(58.28)	(54.29)	(66.17)	(80.54)
Diet Quality							
HDDS	0.10	0.50***	0.11	0.26	0.59***	0.17	0.11
	(0.17)	(0.13)	(0.12)	(0.18)	(0.16)	(0.18)	(0.15)
Cereals, roots, and tubers							
Per capita real annual expenditures	663.79	2850.27***	1463.03	3452.54***	1917.96*	1842.47*	1512.29
	(1101.95)	(710.74)	(944.06)	(1027.84)	(859.50)	(895.64)	(1053.09)
Share of food expenditures	0.03	0.01	0.01	0.03	-0.00	0.00	0.02
	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)
Kcal per capita	235.56+	275.51**	231.11+	222.46+	266.89**	230.49+	251.02+
	(138.09)	(90.07)	(122.79)	(128.76)	(90.73)	(124.24)	(143.37)
Share of total calories	0.03	0.02	0.02	0.03	0.01	0.01	0.03
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Fruits and vegetables							
Per capita real annual expenditures	354.23	113.80	766.11	-221.37	199.34	679.60	818.11
	(830.39)	(628.20)	(645.57)	(811.75)	(660.00)	(555.92)	(741.21)
Share of food expenditures	-0.01	-0.03	-0.00	-0.03	-0.03	-0.00	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Kcal per capita	-8.62	-5.81	-6.40	-13.27	-1.90	-11.58	-1.31

	(15.01)	(9.79)	(11.21)	(10.40)	(9.69)	(11.24)	(11.39)
Share of total calories	-0.02	-0.02*	-0.01+	-0.02*	-0.01+	-0.02*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Meat, eggs, fish, and milk							
Per capita real annual expenditures	-65.49	1533.91**	601.00	1265.39+	1625.55**	454.52	583.03
	(745.41)	(561.89)	(491.63)	(666.08)	(601.05)	(607.88)	(538.30)
Share of food expenditures	0.00	0.03*	0.01	0.02	0.03*	0.01	0.01
	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Kcal per capita	14.83*	23.79**	19.43***	23.46*	25.66**	17.40*	18.89**
	(7.02)	(8.91)	(5.83)	(10.61)	(9.44)	(8.75)	(6.14)
Share of total calories	0.00	0.01*	0.01+	0.01+	0.01+	0.01	0.01
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)
Legumes, nuts, and pulses							
Per capita real annual expenditures	-848.98	7.03	-806.12	-248.94	90.45	-605.13	-723.81
	(663.50)	(513.15)	(509.15)	(596.72)	(523.44)	(645.56)	(476.90)
Share of food expenditures	-0.03+	-0.03+	-0.03*	-0.03+	-0.02+	-0.02	-0.03*
	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Kcal per capita	-7.37	3.15	-12.79	-1.45	4.73	-12.68	-6.42
	(26.10)	(26.49)	(21.24)	(31.68)	(26.47)	(25.43)	(21.19)
Share of total calories	-0.02	-0.03*	-0.02+	-0.03+	-0.02+	-0.01	-0.02*
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Other							
Per capita real annual expenditures	223.42	1597.13***	577.14	1439.44***	1457.24***	1186.27*	275.80
	(510.22)	(349.93)	(450.30)	(431.03)	(361.95)	(521.93)	(424.15)
Share of food expenditures	0.01	0.03**	0.01	0.03**	0.03**	0.02*	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Kcal per capita	7.89	89.12***	26.98	78.43*	80.73**	35.21	18.94
	(30.18)	(26.93)	(20.93)	(31.79)	(27.70)	(25.03)	(20.90)
Share of total calories	0.00	0.03**	0.01	0.02	0.03**	0.02	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

*Notes: Survey-weighted impact estimates are calculated from average marginal using a modified difference-in-differences approach in the GLM framework among panel households. The continuous share impact is equal to sum of a_4 and a_7 from Equation (2); binary high share is the difference between a_5 and a_7 from Equation (3); impact on >30% category is the difference in a_9 - a_{13}, impact on 20-30% category is difference in a_{10} - a_{14}, and impact on 15-30% category is difference in a_{11} - a_{15} from Equation (4). All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 2.9. Main impact results among households with children, Marginal Effects

	Households with children ages 0 to 5 (N = 3314)				Households with children ages 0 to 17 (N = 5882)			
	Treat	Time	DD	Poorest	Treat	Time	DD	Poorest
Worried about food	-0.03	-0.55*	-0.07+	0.06***	-0.03	-1.10***	-0.08+	0.05**
	(0.03)	(0.26)	(0.04)	(0.02)	(0.03)	(0.26)	(0.04)	(0.02)
PC Food Exp.	-87.37	12671.84	2671.86	-12028.37***	22.90	19275.36+	3658.99+	-13845.72***
	(1116.83)	(9624.97)	(1718.14)	(462.76)	(1431.21)	(10184.47)	(2008.12)	(561.42)
Food Share	-0.00	0.08	-0.02*	-0.01*	-0.00	0.06	-0.02+	-0.02***
	(0.01)	(0.07)	(0.01)	(0.00)	(0.01)	(0.08)	(0.01)	(0.00)
More than 1 meal/day	-0.01	0.28	0.07*	-0.11***	-0.02	0.34	0.09**	-0.10***
	(0.03)	(0.31)	(0.03)	(0.02)	(0.02)	(0.21)	(0.03)	(0.01)
PC Kcal.	-53.30	234.21	278.04**	-490.89***	-42.66	391.84	286.61**	-563.00***
	(73.10)	(434.14)	(87.72)	(33.95)	(96.29)	(496.97)	(108.47)	(32.13)
Energy Deficient	0.02	0.24	-0.13***	0.22***	0.00	-0.03	-0.12**	0.24***
	(0.03)	(0.30)	(0.04)	(0.02)	(0.03)	(0.24)	(0.04)	(0.01)
Hunger Depth	6.61	-348.28	-111.25*	283.53***	-7.65	-265.87	-119.61**	286.58***
	(31.02)	(284.85)	(43.81)	(21.13)	(33.91)	(242.19)	(45.31)	(13.10)
HDDS	0.04	4.35***	0.32*	-0.98***	0.10	4.12***	0.26*	-0.98***
	(0.11)	(0.97)	(0.14)	(0.07)	(0.08)	(0.72)	(0.11)	(0.05)
Per Capita Expenditures								
Cereal	-833.55	3485.62	1299.86*	-5503.84***	-841.26	7302.15+	1752.56*	-6179.38***
	(611.33)	(4136.50)	(632.82)	(331.95)	(740.80)	(4351.77)	(689.79)	(286.09)
Fruit	263.28	-2331.45	537.03	-1521.88***	525.73	-1266.19	463.91	-1746.06***
	(296.98)	(4413.30)	(522.90)	(163.27)	(376.36)	(4044.45)	(605.91)	(160.59)
Meat	-298.07	1496.65	664.46+	-1802.79***	-421.32	2885.86	909.91*	-2036.49***
	(321.16)	(2873.88)	(393.11)	(160.35)	(328.58)	(2968.82)	(412.67)	(175.15)
Legumes	1042.35***	5418.10*	-370.78	-1346.26***	1086.53***	5490.43+	-288.53	-1763.57***
	(274.58)	(2420.28)	(424.27)	(120.48)	(311.71)	(2913.43)	(492.18)	(123.94)
Other	-301.53	4532.17+	832.17*	-1585.91***	-422.70	4635.60	1076.32*	-1844.98***
	(255.54)	(2569.89)	(342.42)	(180.47)	(344.10)	(2851.21)	(427.43)	(169.63)
Food Expenditure Shares								
Cereal	-0.03**	-0.03	0.01	0.03**	-0.03***	-0.09	0.01	0.03***
	(0.01)	(0.14)	(0.02)	(0.01)	(0.01)	(0.11)	(0.02)	(0.01)
Fruit	0.01	-0.26+	-0.00	0.03***	0.02	-0.22+	-0.01	0.04***
	(0.01)	(0.15)	(0.02)	(0.01)	(0.01)	(0.13)	(0.02)	(0.00)
Meat	-0.01	-0.03	0.02	-0.04***	-0.02*	0.03	0.02+	-0.04***
	(0.01)	(0.08)	(0.01)	(0.00)	(0.01)	(0.07)	(0.01)	(0.00)
Legumes	0.04***	0.11	-0.02+	-0.01	0.04***	0.10	-0.02*	-0.01**
	(0.01)	(0.07)	(0.01)	(0.00)	(0.01)	(0.07)	(0.01)	(0.00)

Other	-0.01+	0.11+	0.01+	-0.02***	-0.02*	0.08	0.02*	-0.02***
	(0.01)	(0.07)	(0.01)	(0.00)	(0.01)	(0.07)	(0.01)	(0.00)

*Notes: Survey-weighted marginal effects are estimated using difference-in-difference modeling in the GLM framework among panel households. All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. Relative impacts and standardized effect scores are equal to zero for non-significant program impacts. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 2.10. Program Impacts on Group-Specific Apparent Caloric Availability and Shares, Marginal Effects (N = 6,580)

	Treat	Time	DD
Kcal per capita			
Cereals, roots, and tubers	-62.72	-250.03	225.41*
	(96.13)	(442.22)	(97.55)
Fruits and vegetables	18.45**	124.49	-8.59
	(6.07)	(76.18)	(11.43)
Meat, eggs, fish, and milk	-20.33***	-14.83	21.08***
	(5.16)	(46.53)	(5.67)
Legumes, nuts, and seeds	29.31+	216.43	-5.22
	(15.13)	(151.80)	(22.97)
Other	2.91	383.93*	46.12+
	(19.74)	(170.36)	(23.66)
Share of total Kcals			
Cereals, roots, and tubers	-0.02+	-0.36***	0.02
	(0.01)	(0.10)	(0.02)
Fruits and vegetables	0.01**	0.10+	-0.01*
	0.00	(0.06)	(0.01)
Meat, eggs, fish, and milk	-0.02**	-0.03	0.01*
	(0.01)	(0.04)	0.00
Legumes, nuts, and seeds	0.02**	0.10	-0.02*
	(0.01)	(0.06)	(0.01)
Other	0.00	0.15*	0.02+
	(0.01)	(0.07)	(0.01)

*Notes: Survey-weighted marginal effects are estimated using difference-in-difference modeling in the GLM framework among panel households. All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Figure 2.0.1. Participant Flow Diagram

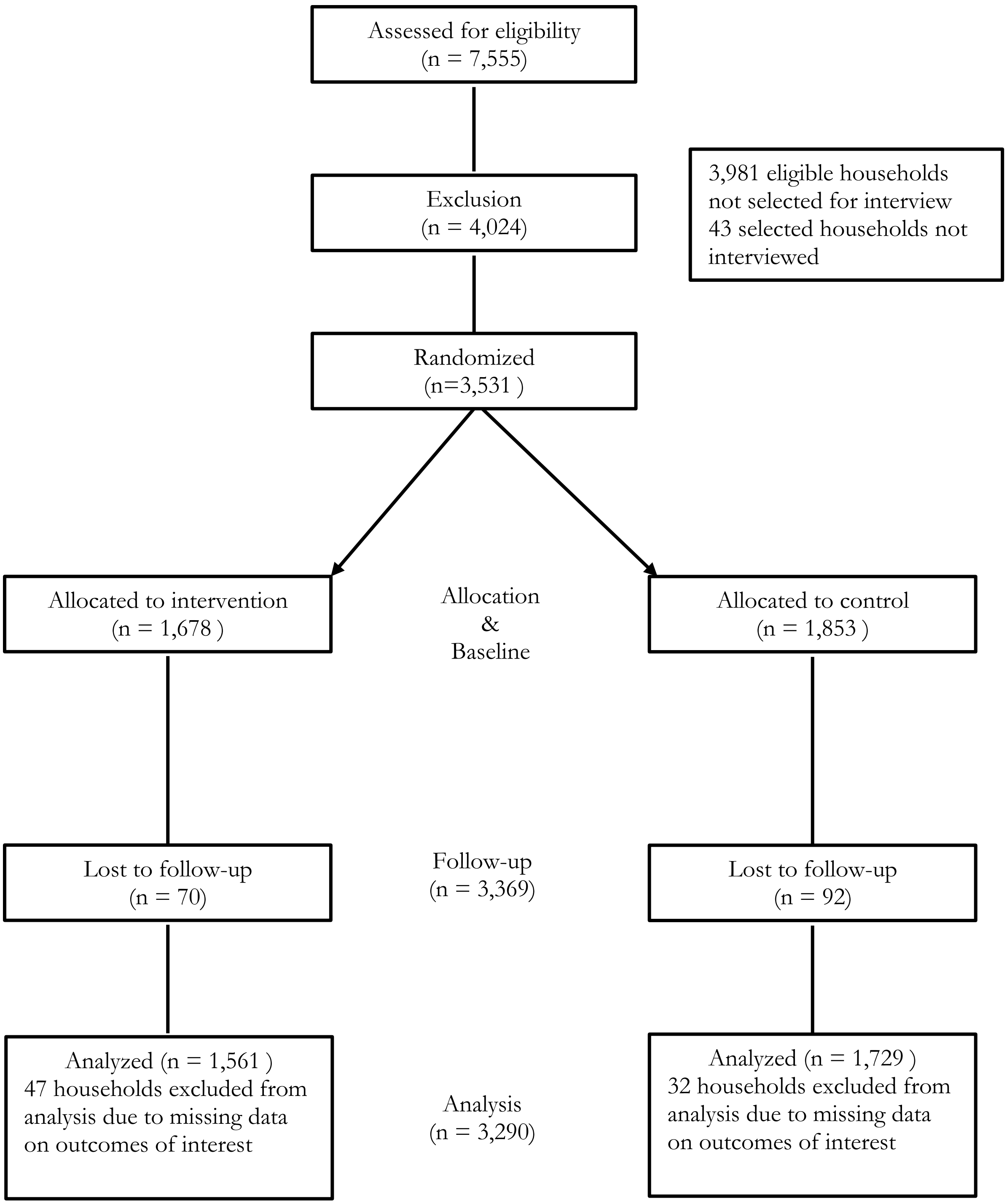


Figure 2.0.2. Program Impacts on Calories from Cereals, Roots, and Tubers (N = 6,580)

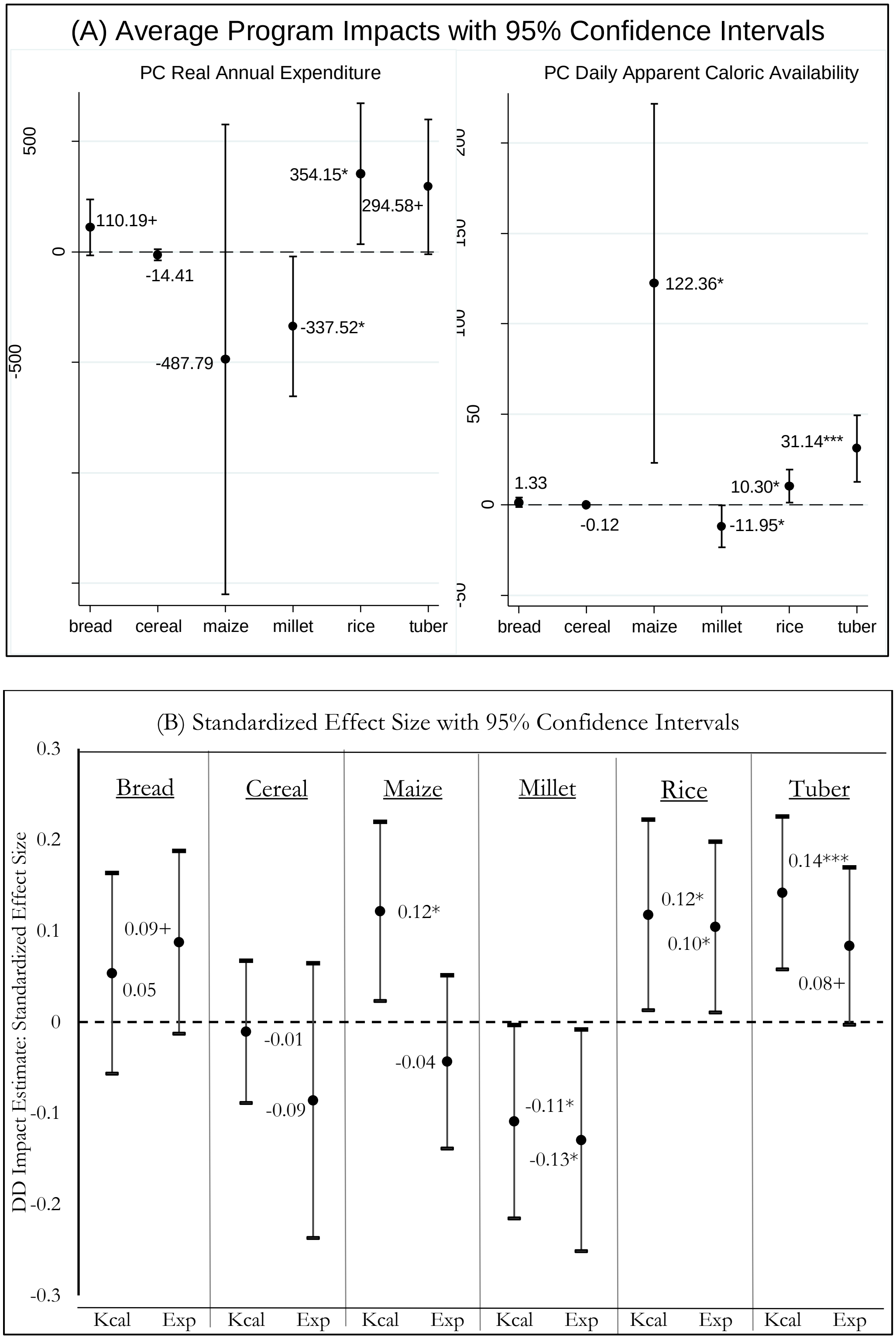


Figure 2.2 Notes:
*Survey-weighted marginal effects are estimated using difference-in-difference modeling in a multivariate regression model among panel households. All models control for a vector of baseline household characteristics, contemporaneous indicators of whether the household experienced an agricultural or food shock within the past year, and a vector of contemporaneous cluster-level prices. Robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

CHAPTER 3: IMPACTS OF AN UNCONDITIONAL CASH TRANSFER ON CHILD HEALTH: A PRODUCTION FUNCTION APPROACH

3.1. Introduction

2015 marked the 25th anniversary of the Convention on the Rights of the Child[82,83] and the conclusion of the Millennium Development Goals (MDG) timeline[84]. Despite gains in all dimensions of child well-being, problems persist. Millions of children die from preventable causes, lack access to essential services, and live in extreme poverty. As the global development community looks to the future with the 2030 Agenda for Sustainable Development, new opportunities exist to reach the most disadvantaged populations through integrated social and public health systems.

Social protection systems will continue to play a vital role in our ability to meet Sustainable Development Goals[85] related to eliminating poverty, hunger, and achieving good health and well-being for all. The goal of this study is to further understanding of how an unconditional cash transfer program can affect young child health outcomes. This study adds to the emerging evidence base of the welfare impacts of cash transfer programs in sub-Saharan Africa (SSA) using experimental data from a large-scale evaluation of a national social cash transfer program. We analyze the impact of the Government of Malawi's Social Cash Transfer Program (SCTP) on household demand for child health inputs and the effect of these inputs on child health outcomes among ultra-poor and labor-constrained households. Evidence of the effect of cash transfer programs on child nutritional outcomes has been inconclusive,[86] and few studies investigate the mechanisms through which a positive exogenous income shock acts to influence health. This study fills an important gap by investigating how a social cash transfer – with no conditionalities on how households must spend their resources or time – can influence household health behavior and child health outcomes.

3.2. Background

Considerable gains in poverty reduction, food and nutrition security, and young child health have been made since the inception of the MDG era. The share of people living in extreme poverty in developing countries has decreased from 43 percent in 1990 to 17 percent in 2015,[1] and the global prevalence of undernourishment declined by 216 million people (from 19 percent to 11 percent) despite a concurrent 1.9 billion increase in the global population.[2]

Yet almost one billion people still live below US$1.25 per day, 795.6 million people are undernourished, two billion experience "hidden hunger" or micronutrient deficiency,[3,4] and 749 are estimated to be calorie deficient.[2] Children comprise a sizable share of the global impoverished. Over one-third of the global extreme poor are children under age 13, and half of all children in low-income countries live in extreme poverty.[7] Children living in poverty are at the highest risk for inadequate nutrition, limited health service access, and poor health outcomes,[8] and socioeconomic-based health inequalities among children are worsening.[9]

Children are disproportionately represented among the income-poor,[6] and children living in poverty are at the highest risk for limited health service access, adequate nutrition, and poor health outcomes.[8] Child health outcomes tend to be worse in low-income countries and within poor countries, and socioeconomic-based health inequalities are worsening.[9] As poverty is both a cause and an outcome of poor human capital development in children with cumulative and long-term effects, country and development actors are beginning to favor social welfare programs that address the root causes of poverty and poor health outcomes.

Limited use of preventive and curative health care is a fundamental driver of poor health among low-income children. Between 2009 and 2013 in Eastern and Southern Africa (ESA) only half of children with pneumonia symptoms sought care, less than one-third received antibiotic treatment, and less than 40 percent of children with diarrhea were treated with oral rehydration salts.[7] Poor nutrition is also a key determinant of child morbidity and mortality. An estimated 6.3 million children under-five died in 2013, with 1.1 million of these deaths concentrated in ESA. Nearly half of young child mortality can be linked to malnutrition, which is associated with an increased likelihood of death from common childhood ailments such as diarrhea, malaria, and pneumonia.[7,87] Inadequate nutrition leaves children more susceptible to frequent illness and exacerbates the severity of common childhood diseases to the point of permanent damage to child growth and development.[88] Poor growth indicators are a consequence of poor nutrition, repeated infections, and diarrhea. Worldwide, an estimated 162 million children under-five are stunted, 100 million are underweight, and 51 million are wasted.[89,90]

Poverty and early child malnutrition are of critical concern because of their mutually reinforcing relationship over the life-course. Nutritional status as young as age two has been demonstrated to influence outcomes later in life. Malnourishment in early childhood has been linked with a reduced cognitive capacity,[10,11] lower levels of educational attainment,[8,11,12] and reduced adult economic productivity.[8,13] As poverty is both a cause and an outcome of poor human capital development in children with cumulative and long-term effects, country and development actors are beginning to favor social welfare programs that address the root causes of poverty and poor health outcomes.[7]

3.2.1 Cash Transfer Programs and Child Health

The prominence of social safety net programs in government welfare strategies grew largely in response to the negatively reinforcing relationship between poverty and low levels of human capital accumulation. Social safety net programs are those "… programs comprising of non-contributory transfers in cash or in-kind, designed to provide regular and predictable support to poor and vulnerable people." [91] Cash transfers – both conditional (CCT) and unconditional (UCT) – have improved many facets of household welfare, including increased consumption, improved food security and diet diversity, and utilization of preventive and curative care. The impacts of cash transfer programs on child health outcomes, however, have been inconsistent. A recent review article conducted a meta-analysis on pooled data from conditional and unconditional cash transfers from around the world and concluded that although the average impact of cash transfers on height-for-age among children under-five is positive (an important summary measure of nutritional status), the mean effect size is small and not statistically significant. The authors noted, however, that nearly all of the previous research on cash transfers and child nutrition focused on conditional programs.[86]

3.2.1.1. Conditional Cash Transfer Programs in Latin America and the Caribbean

Conditional cash transfer programs are typically targeted towards households with young and school-age children in poor regions. They provide cash and sometimes in-kind transfers, and are usually given directly to the mother or female caregiver. Beneficiary households must commit to undertaking co-responsibilities to continue receiving the transfers, such as sending their children to school, receiving routine health checkups, and attending health and nutrition educational sessions. While cash transfer are demand-oriented interventions, many programs in Latin America concurrently developed the supply environment, helping to ensure that beneficiaries could meet their co-responsibilities and invest transfer money in their children and health by improving education and health service infrastructure.[5]

A strong experimental literature exists on the impacts of CCT programs. These evaluations demonstrated short- and long-term positive effects on consumption, poverty reduction, food security and dietary diversity, and many also led to increased use of preventive and curative health care services.[15–17] Mexico's PROGRESA program was found to have a positive impact on consumption and food expenditures; on average, beneficiary households spent 60 to 70 percent of the transfer on food and consumed 7.1 percent more calories compared to control households.[42] Households receiving Nicaragua's *Red de Protección* Social increased annual per capita food expenditures and diet diversity, and during a food crisis the program prevented worsened food security. F*amilias en Acción* in Colombia, *Bolsa Família* in Brazil, and the Family Allowance Program in Honduras were also shown to improve diet diversity.[11]

CCT programs in Latin America were also shown to improve child health and anthropometric outcomes. Children in PROGRESA households demonstrated a lower prevalence of illness and a reduced probability of stunting.[42,92] In Columbia the incidence of diarrhea declined by 11 percentage points among children under-five in rural beneficiary households,[93] and both the Colombian and Nicaraguan programs reduced the probability of stunting in young children.[11] An evaluation of the Family Allowance Program in Honduras found that the program was associated with a 15 to 21 percentage point increase in children's health check-ups and a 17 to 22 percentage point increase in participation in growth monitoring programs.[94] These studies did not, however, find impacts on child health outcomes, which the authors attribute to the small size of the transfers. In general, only a few CCT studies have detected impacts on anthropometry, and typically only in the youngest or poorest children or in households that have been receiving the program for a long time.[86,95,96]

3.2.1.2. Social Cash Transfer Programs in Africa

Social protection programs have rapidly become a cornerstone of African development programs and government policies. The African Union adopted the Social Policy Framework for Africa in 2008, which promotes the codification of social protection coverage into national development agendas.[5] In 2010, unconditional cash transfer programs were operating in about half of the countries on the African continent. As of 2013, 37 African countries are implementing some form of unconditional cash transfer (UCT) as a component of social safety net programming.[91]

Unlike their Latin American counterparts, cash transfers in sub-Saharan Africa tend to be unconditional (some programs have 'soft' conditions which are not enforced), beneficiary targeting is at the community-level, and targeting is usually linked to geographical or vulnerability-based eligibility criteria.

Despite the short time in which they have been in operation, positive impacts on consumption, food security, and health outcomes have been documented for several sub-Saharan UCT programs. Beneficiary households typically spend more on food and health from the cash transfer than they spend relative to other increases in income, even when the transfer programs are not directly linked to health or nutrition.[22] A 24-month impact evaluation of Zambia's Child Grant Program – one of the largest governmental social protection programs in the country – attributed improved household consumption, food security, and diet diversity to the program.[46] The study found that three-fourths of the increase in consumption among beneficiary households was for food, and households were substituting away from inferior foods towards protein. After 48 months, the Child Grant Program was associated with an 11 percentage point increase in the percentage of children who received protein-rich foods during the previous day.[18] A 2008 prospective, longitudinal qualitative study found that prior to the implementation of the Mchinji Social Cash Transfer pilot scheme in Malawi, respondents reported lacking food and basic necessities, being destitute and frequently sick, and receiving little support or aid from friends or family members. After receiving the transfer, the majority of beneficiaries reported improved nutrition and food security, being able to provide adequate food for children, and experiencing improvements in health.[56] Results from the quantitative evaluation demonstrated that beneficiary households consumed twice as many food groups and were more likely to eat higher quality foods compared to control households.[57] Kenya's Cash Transfer for Orphans and Vulnerable Children was shown to have positive two-year impacts on food consumption expenditures and diet diversity, particularly for meat, fish, and dairy.[19,48,49]

More recently, however, a 12 month impact evaluation of Zimbabwe's Harmonized Social Cash Transfer did not find program impacts on food expenditures or on the Household Food Insecurity Access Scale, but did detect a significant increase in diet diversity among beneficiary households.[97]

These same programs have demonstrated mixed impacts on child health service use, health outcomes, and anthropometry. The Zambia Child Grant Program was also found to have reduced the prevalence of diarrhea in the past two weeks by 4.9 percentage points after 24 months of exposure, but this positive impact did not persist at either the 36 or 48 month follow-up evaluations. Researchers did not detect program effects on use of preventive care, curative care, or child nutritional status after 48 months.[18] The evaluation of the Mchinji Social Cash Transfer pilot scheme found a nine percentage point decrease in the prevalence of stunting, a two percentage point decrease in the prevalence of wasting, and an 11 percentage point decrease in the prevalence of underweight among children under-five that could be attributed to the program. After one year in the pilot scheme, the percentage of children in program households who reported being ill in the past month was 13 percentage points lower than children in the control group.[98] Among older children and adolescents ages 6 to 17, beneficiary children had a 37 percent lower odds of illness and higher odds of using health services for a serious illness than children in control households.[21] A two-year impact evaluation of the Kenyan Cash Transfer for Orphans and Vulnerable Children did not detect impacts on curative care seeking, receipt of Vitamin A supplements, possession of a health card, or on stunting, underweight, or wasting.[19] The one year impact evaluation of the Zimbabwe Harmonized Social Cash Transfer program was actually found to be associated with a 15 percentage point increase in the incidence of diarrhea, fever, or cough and an 18 percentage point reduction in the percentage of sick children who sought curative care.[97]

It is unclear if the lack of strong overall evidence that cash transfers can increase use of health services and improve child health outcomes is due to different study populations and sample sizes, different program targeting and implementation practices, or analytic strategies. It is important to bear in mind that, as cash transfers are demand-side interventions, certain supply-side pre-conditions are necessary for the program to achieve impacts, including well-functioning local markets and access to quality health services. The level of improvement in consumption, nutrition, and health outcomes is also dependent upon the initial conditions of households and individuals. And while the results from some of these studies suggest positive effects on child health outcomes, they do not provide evidence of the causal pathways through which the programs affected health outcomes. More research is needed about program effects on intermediate processes and outcomes. Continuing to build this evidence base can help program planners and policy makers better understand how to most effectively implement these programs and illuminate pathways to integrate cash transfers with other social services to achieve synergistic benefits.

3.2.2. Understanding How Unconditional Transfers can Affect Health Outcomes

The basic idea behind how a cash transfer can improve child welfare is that the transfer money is used to improve consumption – more food, better food, preventive health care, etc. – and thereby health and nutritional status. The cash transfer does not directly affect child health outcomes, but rather the income effect of the cash transfer leads to a series of household behavioral responses – which we see through changes in consumption patterns – and it is these behaviors that directly influence child outcomes. For instance, clean water and proper sanitation, sufficient caloric quantity and micronutrient content in the diet, and the use of health services may all be associated with wasting in young children. In order for a cash transfer program to affect wasting, it must first change the household's food consumption and use of child health services. Conditional cash transfers direct changes in household behaviors that are thought to influence health outcomes, but unconditional programs do not require the use of health services or nutritional education to receive benefits, and so rely only on the income effect of the transfer to induce behavioral change.

Because changes in health outcomes are not a direct result of receiving cash transfer benefits, we do not glean actionable evidence on how the program works by estimating this direct relationship. Simply estimating the association between a health outcome and important behavioral inputs such as improved diet diversity or uptake of child health services is also problematic because the health inputs are choice variables and therefore endogenous in the health outcome equation.

This paper's main contribution to the literature is in its approach to modeling the causal pathway between an exogenous positive income shock and a change in child health outcomes. We use the health production function[99–101] approach to trace the impact of an unconditional cash transfer through household demand for child health inputs to child health outcomes. We use this approach in an attempt to understand what types of health inputs (e.g., diet quantity, diet quality, use of health services) the program directly affects, and if the changes in those inputs translate into improved health outcomes for children under-five. Knowledge of these processes can illuminate pathways to integrate cash transfer programs with other social services to bolster the types of impacts the programs can achieve, and can also shed light on potential constraints on the program's ability to achieve desired impacts.

3.3. Theoretical Framework

Our research is guided by the combination of two seminal frameworks from economics and public health. Becker[102] and Grossman's[103] theories of the household and of health production are mapped onto Mosley and Chen's[28] analytical framework for the study of child survival in developing countries. The frameworks are then adapted to a conceptual model of the theory of change that relates the Malawi SCTP to child health outcomes.

Mosley and Chen's 1984 framework organizes the distal and intermediate factors that influence child health and survival. The framework is based on the recognition that child morbidities and mortality represent the culmination of a series of detrimental effects, and that distal socioeconomic factors must operate through proximate determinants that directly influence child health outcomes. Individual, household, and community characteristics make up the socioeconomic determinants, and the proximate determinants include maternal factors, environmental contamination, nutrient deficiency, injury, and personal illness control.[28]

The economic theory of the household's demand for child health, child health inputs, and production of child health is taken from Becker's 1965 theory on the allocation of time and Grossman's 1972 theory on the demand for health and human capital.[102,103] Becker's key contribution to human capital theory was the recognition that households make decisions and allocate resources in a process in which they are both consumers and producers of goods. The household produces commodities that directly enter their utility function through the application of purchased inputs and time. The household decides the quantity of inputs to consume by maximizing their preferences subject to income, time, and other resource constraints that they face. These inputs and time are then combined through the production function to produce the commodity of interest. Grossman's main contribution to human capital theory was the application of Becker's framework to model the demand for the commodity of "good health".

A simple model for the demand for child health inputs and the production function for child health can be derived using these theories of choice. As proposed by Mosley and Chen and elucidated through the economic model of household production, socioeconomic determinants such as household income, wealth, and caregiver skills work through the proximate determinants – the demanded child health inputs – to produce child health. Thus, demand analysis characterizes the relationship between distal and proximate determinants and production analysis describes the relationships between proximate determinants and child health outcomes given socioeconomic determinants. Three critical assumptions of the model are that the household makes decisions as if it were an individual (unitary model), that households are rational actors, and that caregivers know how to produce healthy children.[99,100,104]

Caregivers make the key health decisions for children in the household. Household welfare depends upon consumption *C*, leisure *L*, and the stock of child health *H* as defined by the household's utility function *U*.

$$(1) \quad U = U(C, L, H)$$

The household maximizes its utility subject to a budget constraint (eq. 2) and a time constraint (eq. 3), where X is a vector of inputs into child health, P_x is a vector of the prices of child health inputs, P_c represents the prices of consumption goods, I is household income (typically proxied by household expenditures), and V is a measure of household wealth (an asset index).

$$(2) \quad X \cdot P_x + C \cdot P_c \leq I + V$$

The time constraint is defined by the total time of the caregiver T, time spent working for earned income K, leisure, time spent on child health care t, and time spent on domestic work d.

$$(3) \quad T = K + L + t + d$$

Household income is comprised by the amount of time spent working, the adult's wage rate W, household wealth, and other resource inflows S such as remittances and other social protection programs.

$$(4) \quad I = K \cdot W + V + S$$

The full constraint faced by the household is derived by combining equations 2, 3, and 4.

$$(5) \quad I = W[T - L - t - d] + V + S$$

$$(6) \quad T \cdot W + V + S = X \cdot P_x + C \cdot P_C + W[L + t + d]$$

Equation 7 represents the health production function, which is interpreted as the mechanism through which inputs are converted into health given technological and biological constraints. The technology (i.e., efficiency with which the household converts inputs and behaviors into health outcomes) may differ by sociodemographic and environmental factors – the distal determinants of child health described by Mosley and Chen. It is important to note that the production function is only a function of those things which directly contribute to the production of the child health outcome. The production function is also shaped by the child's health endowment α and caregiver preferences, skills, and characteristics ρ.

$$(7) \quad H = f(X, t;\ \alpha, \rho)$$

The household's choice variables are all taken to be endogenous, while prices (including the opportunity cost of time), the wage rate, income, wealth, and other income sources are taken as given in the short-run.

Endogenous: C, L, H, X, K, t, d

Exogenous: $P_x, P_c, W, V, S, I;\ \alpha, \rho$

The household maximizes its utility subject to the full constraint given by equation 6. The resulting first-order conditions from the household's decision problem are the derived demands. Each of the demand equations has the same form and is dependent on the same set of exogenous factors. Health H appears in both the demand and production equations because it is jointly valued as both a consumer and producer good.

$C^* = C(P_x, P_c, V, S, I, W;\ \alpha, \rho)$

$L^* = L(P_x, P_c, V, S, I, W;\ \alpha, \rho)$

$H^* = H(P_x, P_c, V, S, I, W;\ \alpha, \rho)$

$X^* = X(P_x, P_c, V, S, I, W;\ \alpha, \rho)$

$K^* = K(P_x, P_c, V, S, I, W;\ \alpha, \rho)$

$t^* = t(P_x, P_c, V, S, I, W;\ \alpha, \rho)$

$d^* = d(P_x, P_c, V, S, I, W;\ \alpha, \rho)$

The economic theory provides a framework with which to analyze both the determinants of household demands for commodity and behavioral health inputs and the effect of these inputs on the final outcome of interest – child health. The proposed research employs the unitary model of the household, under which the household is assumed to make decisions as if it were an individual or as if there were a 'benevolent' dictator in charge of decision-making. Household resources are allocated to benefit all household members. This is in contrast to collective household models in which the preferences and negotiating power of individual household members is used to weight the household production function.

The Malawi SCTP enters the household demand and production functions through its income effect on the household budget constraint; as a result of the transfer, beneficiary households will have more disposable income. Any potential impact of the transfer program on child health outcomes must work through the household's spending and time allocation decisions. Accordingly, the household must use transfer resources to increase demand for child health inputs such as nutritious foods and preventive and curative health services to improve child health outcomes. Any impacts of the SCTP on child health will be second round impacts because they are not influenced directly by the transfer, but rather first require the direct effect of the transfer on household consumption and time allocation.

3.4. Methods

3.4.1. Study Design and Data Collection

This study uses baseline and midline follow-up data from the Impact Evaluation of the Malawi SCTP in Mangochi and Salima districts, which is being conducted on a larger scale than the 2007-2008 Mchinji Pilot Scheme. Some of the key evaluation questions are whether the SCTP improves food security and health outcomes among children under-five.

The impact evaluation uses a mixed methods, longitudinal, experimental study design. The quantitative component is based on a difference-in-differences experimental design and uses both random selection of study locations (at the traditional authority and village cluster levels) and random assignment of village clusters into treatment and control groups.

The Malawian Ministry of Gender, Children, and Social Welfare decided to integrate an impact evaluation into the planned expansion of the SCTP into Mangochi and Salima districts, which were scheduled for scale-up in early 2013. Two traditional authorities (TAs) were randomly selected from each. Village clusters (VCs) were then randomly selected from each TA; 14 VCs were selected in Mangochi and 15 in Salima, for a total of 29 study VCs. The process for selecting households to be interviewed at baseline was slightly different between the two districts. Mangochi VCs typically had large numbers of selected households, so eligible households were randomly selected for interview. Salima VCs had smaller numbers of selected eligible households, and so all eligible households were interviewed. A total of 1,756 households were interviewed in Mangochi and 1,775 households were interviewed in Salima, for a total baseline sample size of 3,531 SCTP-eligible households. Baseline interviews were conducted between late June and early September 2013. All study households are in rural areas.

Random assignment was conducted at the VC level after the baseline survey was completed. Half of the VCs in each TA were randomly assigned to the treatment group, which was to receive the program immediately, and the other half to a delayed-entry control group. A total of 14 VCs were in the treatment group (1,678 households) and the remaining 15 VCs were in the control group (1,853 households). Randomization was determined to have successfully created equivalent groups at baseline: treatment and control group mean characteristics across a range of program impacts were balanced. Sampling weights were calculated and adjusted to reproduce the total number of eligible households at the TA level, as well as the total number of households at the district level.

The midline follow-up survey was originally scheduled for 12 months after baseline. The first payments, however, were not administered until March and April 2014, so the decision was made to implement midline data collection in November 2014 at 17 months in order to have an adequate number of payments and time to detect early program impacts. Midline data was collected between the end of November 2014 and late January 2015, at which time treatment households had received five to six cash transfer payments every two months; as such, beneficiary households had been receiving treatment for one year as of midline data collection, so midline results should be interpreted as one year impact results. Approximately 95 percent of baseline households were re-interviewed at midline, yielding a panel of 3,369 study households (1,761 control and 1,608 treatment households). No evidence of differential or overall attrition was detected at the midline follow-up, indicating that balance was preserved between treatment and control groups and sample representativeness was maintained.[20,64]

3. 4.1.1. Ethics Approval

Study protocols, survey instruments, and consent procedures were approved by the University of North Carolina at Chapel Hill Internal Review Board (UNC IRB Study No. 14-1933) and Malawi's National Commission for Science and Technology, National Committee for Research in Social Sciences and Humanities (Malawi NCST Study No. RTT/2/20).

3.4.2. Measures

Because we take a structural approach to test hypotheses about the impact of the SCTP on household demand for child health inputs and the subsequent effects of health inputs on child health outcomes, study variables can be separated into distinct groups. These groups include outcome variables for the derived health input demands, child health outcomes, instrumental variables, potential effect moderators, and a vector of control variables. Appendix 2 provides a comprehensive list of key study variables.

3.4.2.1. Outcomes of Interest – Endogenous Health Inputs

The endogenous intermediate child health input variables are the dependent variables in the derived input demand equations. These inputs include measures of child health service use and household food and nutrition security. We use an indicator of whether the child has a Health Passport and an indicator of whether the child received under-five services or a well-baby checkup in the past six months as measures of child-specific health service use. In Malawi, Health Passports provide records of immunizations, anthropometrics, clinic visits, and other health information.[105]

While this indicator does not consider what is documented in the Health Passport, we assume that possession of the booklet signals interaction between the child and health workers. We also use an indicator of whether the household incurred any expenditures during the past for weeks for non-prescription medicines or medical care not related to an illness (e.g., Panadol, cough syrup, preventative care, check-ups).

Indicators for child feeding practices include whether the child is currently fed solid foods more than once per day (e.g., porridge, n'sima, rice, cerelac, etc.), whether the child consumed foods rich in Vitamin A during the previous day, and whether the child participates in a nutrition program. Unfortunately, we do not have breastfeeding data to include as a measure of infant and young child feeding.

Food security measures include two continuous variables: per adult equivalent annual food expenditures and the household's food share, which is defined as the proportion of total household expenditures devoted to food. Nutrition security indicators, which we use to better understand diet diversity, include the child's per adult equivalent daily energy acquisition assuming light activity levels (AE-L)[66] for five food groups and the share of total food expenditures devoted to each of the five food groups. The five groups include: (1) cereals and tubers; (2) fruits and vegetables; (3) meat, eggs, fish, and dairy products; (4) legumes, nuts, and pulses; and (5) oils, sweets, condiments, and beverages.

We use adult equivalent rather than per capita measures because the focus of this study is on household resources devoted to children and how those resources result in child health outcomes. Because the Malawi SCTP is targeted to ultra-poor and labor-constrained households, most individuals are older adults past child-bearing age or adolescents; young children under-five do not constitute a large portion of the study sample. We believe it is more reasonable to assume that children receive household resources in proportion to their age, sex, and need, and thus use adult equivalent measures as they directly account for these factors; although we have to make this assumption because we do not have information on intrahousehold distribution of resources, we believe the adult equivalent scale is more reasonable than making the assumption that a three year old would receive the same household resources as a young adult.

3.4.2.2. Child Health Outcomes of Interest

We investigate three outcome categories of the young child health production process: general health status, incidence of illness, and anthropometric indicators.

The first two outcomes are indicators of subjective measures of how the caregiver feels the child's health is in general (equal to one if the caregiver reported the child to be in good, very good, or excellent health and equal to zero if poor or very poor) and whether the caregiver feels the child's health is improved relative to the previous year.

The variables selected to represent morbidity incidence include indicators of whether the child had diarrhea, a fever, or a cough during the previous two weeks; we also include a summary indicator of whether the child had one or more of these illnesses.

Lastly, we include continuous and binary measures of anthropometric status including height in centimeters, z-scores, and indicators of stunting, wasting, and underweight. The anthropometric indicators were calculated using the 2006 WHO[106] guidelines and include standardized z-scores (height-for-age, weight-for-height, and weight-for-age) as well as binary indicators of stunting (short for age), wasting (thin for age), or underweight (thin for height). Height-for-age is an indicator of cumulative growth retardation and reflects long-run growth deficits. Children are considered stunted (short for age) when their height-for-age z-score (HAZ) is less than minus two standard deviations below the median of the WHO reference population. Weight-for-height is a measure of current nutritional status and acute malnutrition, and children are considered wasted (thin) when their weight-for-height z-score (WHZ) is below minus two standard deviations from the reference cohort.

Lastly, weight-for-age is a composite indicator of both stunting and wasting, reflecting both current and chronic malnutrition. Children with a weight-for-age z-score (WAZ) less than minus two standard deviations from the reference median are classified as underweight. Appendix 2 details the process undertaken to clean anthropometric panel data.

3.4.2.3. Instrumental Variables

The health production function framework (the theoretical model) provides guidance for the types of variables needed as instruments for the endogenous derived health input demands in order to consistently estimate the health production function. The theoretical model also indicates that *all* of the derived demands are functions of the same exogenous variables. The (excluded) instrumental variables for the child health inputs include baseline and contemporaneous household and community characteristics that are believed to influence household behaviors related to child health inputs but that do not directly influence child health outcomes.

The time-variant instruments include a vector contemporaneous cluster-level prices, wage rates for men's salaried work, women's salaried work, and men's casual, part-time (*ganyu)* labor, an indicator of whether households had experienced a spike in food prices over the past year, and an indicator of whether the household had experienced agricultural spikes during the past year such as high input prices, drought, or crop/livestock pests or disease. Time-invariant instrumental variables include measures of rurality such as the distance to the nearest tar/asphalt road (km), whether the community has a weekly market, whether there is a permanent ADMARC (Agricultural Development and Marketing Corporation) market in the community, whether the household is located within 1.5km of the nearest food market. Lastly, we include time-invariant instruments that represent the health service supply environment, including indicators for the presence of a local community clinic, distance to the closest community clinic (km), whether community members regard the clinic as being of bad/very bad quality, if there is a larger clinic at the village level, and the distance to the nearest health facility with a medical doctor or clinical officer (km).

Although community-level prices for some items decreased between baseline and midline, there is no evidence that the differences in prices over time is attributable to the SCTP, and there is no significant differential price inflation across treatment and control locations.[20]

3.4.2.4. Intervention

The exposure of interest is whether the household receives the Malawi SCTP and is represented as a binary indicator equal to one for beneficiary households and zero for delayed-entry control households.

We also investigate whether there is a 'dose' response to the treatment level by looking at the transfer share, which is equal to the annual household value of the transfer as a percent of baseline annual household expenditure. We simulate values for each household's expected transfer level – for both treatment and control households – based on program assignment and transfer level rules (in real August 2013 MWK). We examine the continuous transfer share as a percentage of pre-program household expenditures and a binary indicator of whether a household is expected to receive a high share (greater than or equal to 20 percent of baseline consumption) or a low share (the expected transfer represents less than 20 percent of baseline consumption).

We conduct an intention to treat (ITT) impact analysis as we use predicted transfer levels rather than actual transfer amounts from program data; because all eligible households offered treatment took it up, the ITT can be considered equal to the average treatment effect (ATE).

3.4.2.5. Potential Effect Moderators

Because certain household characteristics can shift household demand for inputs or modify the way those inputs are used to produce child health outcomes, we examine the presence of heterogeneous program impacts based on poverty level, household size, and caregiver health knowledge. The poverty modifier is an indicator equal to one if the household was in the bottom half of the baseline sample's pre-program consumption distribution. The household size modifier is an indicator equal to one if the household had four or fewer members at baseline (to represent the payment cap for non-schooling per-person cash transfer payment increases). Lastly, the health knowledge indicator is equal to one if the main caregiver scored in the top third of a composite health knowledge distribution. The health knowledge score is based on questions posed about nutritious foods, child feeding, and disease; Appendix 2 provides more details on how this variable was constructed. We include health knowledge as a modifier because caregivers who have better information about child nutrition and disease prevention may be more likely to invest in health inputs and be more efficient at converting those health inputs to health outcomes.

3.4.2.6. Control Variables

Both the health input and the health outcome regression models control for child-specific characteristics including sex, age in months, whether the child is a grandchild of the household head, and orphan status. Models also control for baseline household characteristics, including the natural log of household size, the number of household members in five age groups (0-5, 6-11, 12-17, 18-64, and 65 and older), the household dependency ratio, whether there were any single or double child orphans residing in the household, and characteristics of the household head including sex, age, marital status, schooling, chronic illness, and disability. Dwelling characteristics include improved sanitation, an improved drinking water source, whether the house has a room used exclusively for cooking, whether the house has an improved cookstove, clean fuel, or improved ventilation, and whether any household member sleeps under a bed net to prevent malaria. Lastly, we also control for whether the household had accessed credit in the 12 months prior to the baseline survey, whether they had received cash, food, labor, or agricultural inputs from friends, family, or neighbors, and whether they had participated in food or cash programs or maternal and child nutrition programs in the 12 months before the baseline interview.

3.4.3. Analytical Sample

Figures 3.1.A and 3.1.B present the derivation of the two analytical samples used in this study. Our first sub-sample of interest is a panel of children and the second sub-sample of interest includes all children ages 6-59 months residing panel households at baseline or midline.

3.4.3.1. Panel of Children

In order to be eligible for inclusion in the child panel, children had to be within the valid anthropometric age range (six to 59 months) at both survey waves. This means that children over 42 months of age were excluded at baseline because they would have aged out of the sample after 17 months, and children younger than 23 months at midline were excluded because they would have been younger than six months of age at baseline. This left 1,295 children ages six to 42 months eligible in the baseline sample (603 children in treatment households and 692 children in control households). Approximately 18 percent of eligible children interviewed and measured at baseline were lost to follow-up at midline either because they were no longer in the household or because they were not interviewed or measured at midline. This left 1,057 eligible children in the panel. A further 194 panel children were excluded from analysis due to missing data on outcomes of interest or implausible changes in height between survey waves. The final child panel consists of 407 children from treatment households and 456 children from control households, for a total panel of 863 children under-five.

We examined the panel of children for evidence of differential and general attrition. Appendix 5 details our attrition analysis. We conclude that differential attrition is not a problem for the analysis of panel children and the internal validity of the study is maintained. Because fewer than 10 percent of the characteristics examined in the general attrition check were significant, we assume that general attrition is negligible and do not make any adjustments to baseline sampling weights for panel children.

3.4.3.2. Children from Panel Households

The final sample included in analysis for the household panel consisted of 1,470 children interviewed at baseline and 1,413 children interviewed at midline. Approximately 38 percent of households had a child ages 6-59 months at baseline, yielding a total of 1,858 eligible children. Of these 1,858 children, 388 (21 percent) were excluded because they did not have a height or weight measure or because they were missing data for an outcome of interest. Of the 1,470 children retained from the baseline sample, 47 percent resided in treatment households and 53 percent in control households. At midline, 1,171 of the 3,369 panel households (35 percent) had a child age 6-59 months. Of the 1,542 children eligible for study inclusion at midline, 139 were excluded (nine percent) due to missing data for weight, height, or another outcome of interest. Over 90 percent of eligible children were retained for analysis at midline; 49 percent of the 1,413 children were from treatment households and 51 percent from control households. Attrition analysis for panel households has been reported elsewhere; there was no evidence of overall or differential attrition between baseline and midline, indicating that balance was preserved between treatment and control groups and sample representativeness was maintained.[20,64]

3.4.4. Estimation Strategy

3.4.4.1. Main Impact Analysis

Calculation of descriptive statistics and bivariate analyses is undertaken to check that the balance between treatment and comparison groups was maintained in the analytical sample for the variables of interest. We report t-tests for continuous outcomes and Pearson design-based F statistics for categorical variables. Means and significance tests control for clustering at the village cluster level and use sample weights.

The empirical strategy combines the difference-in-differences (DD) methodology with the linear instrumental variables (IV) approach to estimate the health demand and production equations, to examine the overall mean impact of the SCTP on household input demands, and to explore whether receipt of the intervention alters the household's production functions.

The DD estimator compares changes in outcomes between baseline and follow-up for the treatment group with changes over the same time period in the control group. The two key assumptions of the DD approach are the 'parallel trends assumption' – that the outcomes of the treatment group would follow the same trajectory as those actually experienced by the control group in the absence of the SCTP, and that there is no systematic time-varying unobserved difference between treatment and control groups. Although pre-baseline data are not available, the balance observed between treatment and control groups on a wide variety of household and individual factors provides convincing evidence that no pre-treatment systematic differences existed between beneficiary and delayed-entry households.

We pool observations across waves for the panel children and we also pool observations from children in panel households and then implement the two-stage least squares (2SLS) variant of the IV estimator to estimate the program impact on demand, production, and the influence of household input behaviors on child health outcomes. The basic estimating equations are given in Equations (8) and (9):

$$H_{ijkt} = \alpha_0 + \alpha_1 TREAT_k + \alpha_2 TIME_t + \alpha_3 (TREAT_k * TIME_t) + \alpha_4 X_{ijkt} + \alpha_5 R_{ijkt} + \varepsilon_{8ijkt} \tag{8}$$

$$X_{ijkt} = \beta_0 + \beta_1 TREAT_k + \beta_2 TIME_t + \beta_3 (TREAT_k * TIME_t) + \beta_4 Z_{jkt} + \beta_5 R_{ijkt} + \varepsilon_{9ijkt} \tag{9}$$

In this framework, H_{ijkt} is the health outcome of interest for child *i* in household *j* located in cluster *k* at time *t*. X_{ijkt} is the vector of child health inputs, $Z_{jkt}$is the vector of household- and community-level instrumental variables, and R_{ijkt} is the vector of control variables common to both the demand and production processes. Equation (9) – the demand equation – only needs to be estimated once per health input, and the production equation (8) is estimated once for each child health outcome. We use the linear instrumental variable framework for its simplicity, thus linear probability models are estimated for binary inputs and health outcomes. Although we theorize that there will not be a direct impact of the program on the health outcome, we include it in the health production function to facilitate comparison with other studies; the presence of a significant program impact in the health production function could signal that there are other important intervening factors which should be considered or that the act of receiving the treatment itself somehow shifts the 'production technology' by which the household 'converts' health inputs into child health outcomes.

All analyses include a district-level indicator, employ sample weights to reproduce the total number of SCTP-eligible households at the TA-level and the total number of households at the District level, and standard errors are corrected for clustering at the village cluster level. Stata version 14 was used for all analyses, **ivregress** (2SLS) was used for estimation.

3.4.4.1.A. Instrumental Variable Diagnostics. We conducted tests to check for the endogeneity of the input demands, instrument validity, and instrument strength. Tests statistics for are presented and discussed in Appendix 6. We conclude that the health inputs are correctly treated as endogenous and that all of the instrumental variables are valid. However, after accounting for variance coming from control variables common to both the health input and health outcome equations we find evidence that suggests our instruments – in the context of the full structural model including all exogenous control variables – may be weak for many of the endogenous inputs.

3.4.4.1.B. Fixed-Effects as Robustness Check. We use the instrumental variables approach in this study to control for the endogeneity of the health input variables in the child health equations. This allows us to consistently estimate the parameters of the child health equations and to learn about factors that influence household demand behaviors. As there is some evidence of weak instruments we also use fixed-effects models to overcome the problem of endogenous health inputs and to serve as a robustness check for the main 2SLS results.

We run fixed-effects models on the health production function specified in equation (8). The health input variables are directly modeled in the equation because we make the assumption that the endogeneity problem stems from a time-invariant component of the error term (i.e., the fixed-effects), and once these fixed effects are removed the endogeneity problem with the health inputs is solved. We also run pooled ordinary-least-squares (OLS) as a check against the fixed-effects models as OLS is efficient but inconsistent in the presence of endogeneity, while fixed-effects are consistent but inefficient. For consistency we exclude the treatment dummy from the OLS equations as is it only varies at the cluster level and thus is swept-out by both individual- and household-level fixed effects in the fixed-effects model.

Among the panel of children we run pooled OLS, then add fixed-effects at the individual child level, and then re-specify the model using household-level fixed-effects. Among children from panel households we run pooled OLS and then add household-level fixed effects. All OLS and fixed-effects models use sample weights and control for clustering at the village cluster level. We correct the standard errors in the fixed-effects models for clustering to clean up the time-variant correlation in the error term at the cluster level.

We cannot calculate Hausman tests to check for significant differences in the parameter estimates from Pooled OLS and FE models because we account for complex-survey design in our models. Since we are unable to statistically test coefficients between the two models, we present Pooled OLS results as a reference and focus the robustness checks on the FE models.

3.4.4.2. Heterogeneous Impacts

We also examine whether program impacts differ by the household's baseline poverty level, whether there are more than four household members at baseline, and whether the caregiver scored in the top third of the health knowledge distribution. Equations (8) and (9) have been modified to include a triple-difference parameter that gives the differential program impact among beneficiary children who have a positive value for the effect modifier of interest. It is important to note that each of the modifiers is included in the vector of control variables common to both the demand and production processes.

$$H_{ijkt}= \alpha_0+\alpha_1 \mathrm{TREAT_k}+\alpha_2 TIME_t+\alpha_3 \mathrm{M_{ijk}}+\alpha_4(\mathrm{TREAT_k}*TIME_t)+ \alpha_5(\mathrm{TREAT_k}*\mathrm{M}_{ijk}) + \alpha_6(TIME_t*\mathrm{M_{ijk}})+\alpha_7(\mathrm{TREAT_k}*TIME_t*\mathrm{M_{ijk}})+\alpha_9 \mathrm{X_{ijkt}} + \alpha_9 \mathrm{R_{ijkt}}+ \varepsilon_{10ijkt} \tag{10}$$

$$\mathrm{X_{ijkt}}= \beta_0+\beta_1 \mathrm{TREAT_k}+\beta_2 TIME_t+\beta_3 \mathrm{M_{ijk}}+\beta_4(\mathrm{TREAT_k}*TIME_t)+ \beta_5(\mathrm{TREAT_k}*\mathrm{M_{ijk}}) + \beta_6(TIME_t*\mathrm{M_{ijk}})+\beta_7(\mathrm{TREAT_k}*TIME_t*\mathrm{M_{ijk}})+\beta_9 \mathrm{Z_{jkt}}+ \beta_9 \mathrm{R_{ijkt}}+ \varepsilon_{11ijkt} \tag{11}$$

3.4.5. Transfer Share

The value of the transfer is critically important for the extent of program impacts that can be expected. The cash transfer must constitute a large enough portion of the target population's pre-program consumption in order to generate impacts. Experience from cash transfer programs around the world, including several major African programs, suggests that transfers should deliver at least 20 percent of pre-program consumption as a 'rule of thumb'.[73,107]

We model the transfer share first as a percentage of the household's annual consumption. Equations (8) and (9) are modified by adding the continuous treatment share (note that this is a percentage) variable $TXSHR_{jk}$. In Equation (12), α_7 gives the marginal program impact of an increase in the transfer share on the health outcome among beneficiary children; the average program impact on the health outcome among beneficiary children is equal to $\alpha_4 + \alpha_7$. Likewise, in Equation (13), β_7 gives the marginal program impact of an increase in the transfer share on the input demand among beneficiary children; the average program impact on the input demand among beneficiary children is equal to $\beta_4 + \beta_7$.

$$\begin{aligned} H_{ijkt} = {} & \alpha_0 + \alpha_1 TREAT_k + \alpha_2 TIME_t + \alpha_3 TXSHR_{jk} + \alpha_4 (TREAT_k * TIME_t) + \alpha_5 (TREAT_k * TXSHR_{jk}) \\ & + \alpha_6 (TIME_t * TXSHR_{jk}) + \alpha_7 (TREAT_k * TIME_t * TXSHR_{jk}) + \alpha_9 X_{ijkt} + \alpha_9 R_{ijkt} + \varepsilon_{12ijkt} \end{aligned} \tag{12}$$

$$\begin{aligned} X_{ijkt} = {} & \beta_0 + \beta_1 TREAT_k + \beta_2 TIME_t + \beta_3 TXSHR_{jk} + \beta_4 (TREAT_k * TIME_t) + \beta_5 (TREAT_k * TXSHR_{jk}) \\ & + \beta_6 (TIME_t * TXSHR_{jk}) + \beta_7 (TREAT_k * TIME_t * TXSHR_{jk}) + \beta_9 Z_{jkt} + \beta_9 R_{ijkt} + \varepsilon_{13ijkt} \end{aligned} \tag{13}$$

Lastly, we model the transfer share as a dichotomous indicator of whether the share is greater than or equal to 20 percent of baseline consumption. In order to better compare treatment households with control households having similar expected transfer shares, we replace the treatment dummy and the transfer share variable in Equations (12) and (13) with three program indicators: $TTXSHRH_{jk}$ is equal to one for beneficiary households with an expected transfer share greater than or equal to 20 percent and is equal to zero otherwise; $TTXSHRL_{jk}$ is equal to one for beneficiary households with expected transfer levels below 20 percent; and $CTXSHRH_{jk}$ is equal to one for control households with high expected transfer shares and equal to zero otherwise. The impact of the SCTP on health outcomes among beneficiary children receiving a high transfer share, relative to control children from households with expected high shares, is given in Equation (14) by $\alpha_5 - \alpha_7$, and the program impact on beneficiary children receiving low transfer shares relative to comparison children with expected low shares is given by α_6. The corresponding coefficients in Equation (15) follow the same interpretation for input demands. Wald tests are used to determine if the program impact on high transfer share children is significantly different from zero and to determine if the program impact on high share beneficiary children is significantly different from the program impact on low share beneficiary children.

$$H_{ijkt} = \alpha_0 + \alpha_1 TIME_t + \alpha_2 T\text{TXSHRH}_{jk} + \alpha_3 T\text{TXSHRL}_{jk} + \alpha_4 C\text{TXSHRH}_{jk} + \alpha_5 (TIME_t * \text{TTXSHRH}_{jk}) + \alpha_6 (TIME_t * \text{TTXSHRL}_{jk}) + \alpha_7 (TIME_t * \text{CTXSHRH}_{jk}) + \alpha_8 Xi_{jkt} + \alpha_9 R_{ijkt} + \varepsilon_{14ijkt} \quad (14)$$

$$X_{ijkt} = \beta_0 + \beta_1 TIME_t + \beta_2 T\text{TXSHRH}_{jk} + \beta_3 T\text{TXSHRL}_{jk} + \beta_4 C\text{TXSHRH}_{jk} + \beta_5 (TIME_t * \text{TTXSHRH}_{jk}) + \beta_6 (TIME_t * \text{TTXSHRL}_{jk}) + \beta_7 (TIME_t * \text{CTXSHRH}_{jk}) + \beta_8 Z_{jkt} + \beta_9 R_{ijkt} + \varepsilon_{15ijkt} \quad (15)$$

It is important to note that the transfer share equations are defined for all study children, not just beneficiaries.

3.5. Results

The first part of this section outlines descriptive statistics for the two study samples. We next describe results from our analyses of impacts of the SCTP on household demand behaviors for child health inputs; this section is organized by input type (health services, feeding, etc.). We then review results of the health production function models and order this discussion by health output type. The fourth section presents the results of our robustness checks using fixed-effects models. The results section concludes with two extensions using children from panel households to see if results differ between children under age two and children ages two to 5, and then to see if estimates from the panel of households are sensitive to the exclusion of children who joined the sample at midline. As households had received between five and six bi-monthly payments at midline, results can be interpreted as one year impacts.

3.5.1. Descriptive statistics, balance at baseline

Tables 3.1.A and 3.1.B present analytical sample means for health inputs, health outcomes, instrumental variables, and controls by treatment status and wave for both the panel of children and children from panel households. Panel children in treatment households tended to have fewer adolescent members than control households ($p = 0.05$); otherwise, all variables were balanced between the study arms at baseline in the panel of children. For the sample of children from panel households, treatment households had higher average caloric availability from fruits and vegetables at baseline ($p = 0.05$) and had more household members ages 65 and older ($p = 0.05$); all other variables were balanced at baseline.

Approximately half of the panel children were female and half were male. At baseline the average age of panel children was approximately two years, one in five children was the grandchild of the household head, and 15 percent of children were orphans. The average age of children in the household panel was higher at 33 months and nearly a quarter of these children were the head's grandchild and 20 percent were orphans.

Household characteristics were similar between the two samples. Household heads tend to be illiterate Muslim women in their early 40s, a quarter of which were suffering from a chronic disease at baseline. Most households had just over six members at baseline, the majority of whom were under-five. Over 70 percent of children lived in households consuming in the bottom half of the evaluation sample's baseline expenditure distribution (compared to half of the full sample of households), and the average dependency ratio was close to 3.5, indicating that each working-age household member was supporting an additional 3.5 household members. Nearly all children lived in households with an improved source of drinking water (mostly boreholes), but less than half were from households with improved sanitation. Half of children from the child panel were from households with a dedicated room for cooking, and over 70 percent were using cooking methods with improved ventilation or an improved cooking fuel. Most children were not receiving other social assistance programs at baseline, but their households were receiving food and other consumable transfers from non-household members. The majority of children resided in Mangochi and three-fourths lived in communities that had experienced an epidemic within a year before the baseline survey.

Half of children in both samples were residing in SCTP households, with an average simulated real annual AE-L transfer of MWK 8,202 for beneficiary children in the child panel and MWK 8,338 for beneficiary children from the household panel (approximately $25 USD August 2013 prices per AE-L). Half of children in both samples lived in households with an expected share greater than 20 percent of baseline consumption.

Descriptive statistics for instrumental variables are very similar among the two study groups. Although none of the instrumental variables were significantly different between treatment and control groups (on average) at baseline, there are some interesting differences to note. Three-fourths of children in treatment households reported having a weekly market in their community compared to less than half of children in control households. Children in the treatment group were nearly twice as likely to have a community clinic as the control group, although over 90 percent of the treatment group felt their community clinic was of poor quality. Children in treatment households were less likely than those in control households to have a larger village health clinic and lived approximately 15km farther away from the nearest clinic with a medical doctor or clinical officer.

3.5.2. Impacts on health inputs

Results for program impacts on child health inputs are detailed in Table 3.2, and results for heterogeneous impacts on child health inputs are presented in Table 3.4.A for the child panel and Table 3.4.B for the household panel.

3.5.2.1. Child health services

Child health service inputs of interest include whether the child has a health passport, whether the child attended an under-five clinic or a well-baby checkup in the past six months, and whether there were any non-illness or non-prescription health expenditures for the child in the past month.

Approximately 90 percent of children in treatment and control households had a health passport in both survey rounds and in both samples (Tables 3.1.A and 3.1.B). We do not detect an overall program impact on the probability that a child has a health passport in either sample (Table 3.2), but we do find weak evidence of a negative differential impact of -0.14 ($p = 0.10$, Table 3.4.A) among beneficiaries in the child panel living in households with four or fewer members at baseline. In the household panel, beneficiary children with low expected transfer shares were seven percentage points more likely to have a health passport compared to control children with low expected transfer shares ($p = 0.05$, Table 3.4.B).

At baseline 86 percent of children in the child panel had received an under-five/well-baby checkup or visited an under-five clinic in the past six months, but this number decreased at midline to 65 percent among control children and 59 percent among treatment children (Table 3.1.A). Compared to children in the control group, beneficiary children were nine percentage points less likely ($p = 0.05$, Table 3.2) to have used under-five services; beneficiary children in households with low expected transfer shares were 13 percentage points ($p = 0.05$, Table 3.4.A) less likely to have accessed services compared to control children in low share households. The percentage of children accessing under-five services also decreased more among treatment children than control children in the household panel (Table 3.4.B), but we do not detect any significant program impacts among this sample.

Results for the percentage of children with any preventive health expenditures during the past month are the same in both samples. Less than 20 percent of children had expenditures at baseline, and this decreased to 12 percent for children in control households and approximately 15 percent for children in treatment households at midline (Tables 3.1.A and 3.1.B). We do not detect any overall or heterogeneous program impacts on the probability of health expenditures.

3.5.2.2. Child feeding

Inputs related to child feeding include whether the child is currently fed solid foods more than once per day, whether the child participates in a nutrition program, and whether the child consumed foods rich in Vitamin A in the past day.

The percentage of children who were currently fed solid foods at least twice a day significantly increased over time in both samples (Table 3.2) from 82 percent to 93 percent among control children in the child panel compared to 85 percent to 97 percent of treatment children (10 percentage point increase over time, $p = 0.05$, Table 3.2). The results are nearly identical among children in the household panel. We do not find evidence of program impacts or differential impacts on the probability of consuming solid foods multiple times per day in either sample.

Very few of the children in our study samples participated in child nutrition programs at baseline or midline. The percentage of control children participating in nutrition programs increased from three percent to six percent among the child panel and increased to seven percent in the household panel, while the percentage of treatment children decreased slightly from four to three percent in the child panel and stayed at three percent during both waves in the household panel (Tables 3.1.A and 3.1.B). The difference-in-difference estimates of program impact on participation in nutrition programs was negative in both samples, but not significant, and we do not see evidence of heterogeneous impacts.

Children in both samples and in both study groups were more likely to have consumed foods rich in Vitamin A at midline than baseline. In the child panel, the percentage of control children consuming Vitamin A-rich foods increased by 24 percentage points (from 64 to 88 percent), compared to a 25 percentage point increase among children in the treatment group (70 to 95 percent) (Table 3.1.A). Increases over time were similar in the household panel (65 to 87 percent increase control children and 72 to 93 percent increase among treatment children) (Table 3.1.B). These changes were significant over time (15 percentage points ($p = 0.01$) among the child panel and 22 percentage points ($p = 0.001$) among the household panel) (Table 3.2), but we do not detect significant program impacts on the likelihood of consuming foods with Vitamin A. We do see a marginally significant differential impact in the child panel among beneficiary children in small households relative to beneficiary children in large households of 0.16 percentage points ($p = 0.10$, Table 3.4.A).

3.5.2.2. Food and Nutrition Security

Additional inputs related to food and nutrition security include the annual per-adult equivalent total food expenditures, the food share, food group expenditure shares, and food group apparent caloric availability.

Average food expenditures decreased among children in both samples and in both study groups, however the decrease was much lower among treatment children relative to control children. In the child panel mean food expenditures decreased by 22 percent over time in the control group, compared to an eight percent decrease among the treatment group (Tables 3.1.A and 3.2). We find a strong and positive overall program impact of MWK 9,090 ($p = 0.001$, Table 3.2), which represents 26 percent of mean pre-program food expenditures in the control group; we also detect significant impacts among high share households and low share households, but results from Wald tests indicate that the impacts are not significantly different from each other (Table 3.4.A). Results for the household panel are very similar. Compared to children in the control group, beneficiary children's food expenditures were MWK 6,966 higher on average ($p = 0.01$, Table 3.2) and the significant impacts among high and low share households were not significantly different from each other (Table 3.4.B).

At baseline the mean food share was 78 percent of total household consumption expenditures among all study children, and most food expenditures were on cereals and tubers, followed by fruits and vegetables (Tables 3.1.A and 3.1.B). In both study groups the average food share decreased by eight percentage points over time ($p = 0.001$, Table 3.2) and we detect a program impact of -0.02 ($p = 0.05$). The program impact in the child panel appears to be driven by children with simulated transfer shares greater than 20 percent of baseline consumption (-0.05, $p = 0.01$, Table 3.4.A). In the household panel beneficiary children in the poorest households decreased their food shares by five percentage points more than beneficiary children in the upper consumption distribution ($p = 0.05$), while beneficiary children in small households had a seven percentage point increase in mean food share relative to beneficiary children in large households ($p = 0.01$, Table 3.4.B).

As descriptive statistics for food group expenditure shares among the two study samples are nearly identical we only report those for the child panel. The share of total food expenditures devoted to cereals, roots, and tubers decreased significantly by five percentage points ($p = 0.05$, Table 3.2) over time, while fruit and mean shares significantly increased and the share devoted to legumes remained relatively stable. We detected a significant positive program impact of 0.02 on the expenditure share for meat, fish, eggs, and dairy ($p = 0.05$ for child panel, $p = 0.10$ for household panel). In the household panel we found a significant decrease in the cereal expenditure share of six percentage points ($p = 0.05$) among beneficiary children with high expected transfer shares relative to low expected shares.

Lastly, we examined per-adult equivalent daily apparent caloric availability from five food groups. At baseline nearly all caloric content came from staple foods (cereals and tubers); calories available from cereals and tubers decreased among control households over time but increased slightly among children in treatment households. The program impact on caloric availability from cereals was 313.08 Kcal/AE-L ($p = 0.05$) in the child panel and 395.29 Kcal/AE-L ($p = 0.01$) in the household panel (Table 3.2); these impacts represented 18 percent of baseline calories from cereal in the child panel and 23 percent in the household panel. We find heterogeneous impacts by transfer share in both samples (Tables 3.4.A and 3.4.B), and we find a marginally significant positive differential impact for children in small households of 639 Kcal/AE-L ($p = 0.10$) relative to beneficiary children in households with more than four members at baseline.

Caloric availability from fruits and vegetables significantly increased over time, but we do not find overall program impacts in either sample (Table 3.2). In the child panel the program impact among households with high expected transfer shares is 30 Kcal/AE-L ($p = 0.05$, Table 3.4.A), and 26 Kcal/AE-L in the household panel ($p = 0.10$, Table 3.4.B). Program impacts on calories available from meat, fish, eggs, and dairy group are approximately the same in both samples. In the child panel there is a positive program impact of 24 Kcal/AE-L ($p = 0.001$); the impact is somewhat higher among households with low expected shares compared to high expected shares, but the difference in these impacts is not significant. Caloric availability from the legume group decreased by 124 Kcal/AE-L ($p = 0.001$) in the child panel and 126 Kcal/AE-L ($p = 0.001$) in the household panel. There is no significant program impact on calories from legumes in either sample, but we do detect an impact of 101 Kcal/AE-L ($p = 0.05$) among beneficiary children from small households relative to beneficiary children from larger households in the household panel. Lastly, we find strong positive impacts on calories available from oils, spices, sweets, and beverages in both samples. In the child panel the overall impact is 140 Kcal/AE-L ($p = 0.001$) and is slightly higher among children in households with high expected transfer shares (179 Kcal/AE-L, $p = 0.001$) than children in households with low expected shares (126 Kcal/AE-L, $p = 0.05$), but the difference in the impacts is not significant. In the household panel children in beneficiary households have 127 Kcal/AE-L more than control children ($p = 0.001$), and this impact appears to be driven by children in high beneficiary share groups (140 Kcal/AE-L, $p = 0.001$). There is a negative heterogeneous impact among beneficiary children from the poorest households in the household panel, who consume on average 117 Kcal/AE-L less than beneficiary children from the top half of the baseline consumption distribution, but this differential impact is only marginally significant ($p = 0.10$).

3.5.3. Child health outcomes

In this section we report the results for the health production functions modelled using instrumented health inputs. Descriptive statistics are found in Tables 3.1.A and 3.1.B, 2SLS results of the primary health production function models are presented in Tables 3.3.A and 3.3.B, and 2SLS results for heterogeneous program impacts on health outcomes are presented in Tables 3.5.A and 3.5.B.

We also present results from the Fixed-Effects robustness checks that were run due to evidence of weak instrumental variables. Because we cannot run Hausman tests to test for significant differences between parameters in the FE models and Pooled OLS models, we present Pooled OLS results only as a reference and focus our attention on FE results. If the results for FE and IV models are the same then we can conclude that the IV approach addressed the endogeneity problem for that particular health production process, but if they are different we will prefer the FE results due to evidence of weak instruments. We also present FE models with fixed-effects at the individual and at the household level for the panel of children; our preferred models are those with individual fixed-effects and we present the household fixed-effects as a comparison. Results for Pooled OLS and FE models are presented by health outcome in Tables 3.6.A – 3.6.M.

3.5.3.1. General Health Status

Measures of general health status include an indicator of whether the caregiver reported the child to be in good, very good, or excellent health and an indicator of whether the caregiver thought the child's health had improved relative to the past year.

Nearly 90 percent of study children were reported by their caregiver to be in good, very good, or excellent health at baseline and midline in both study samples (Tables 3.1.A and 3.1.B). The results for the health production function of good health do not show any significant effects of the instrumented health inputs on the likelihood of being in good health in either study sample (Tables 3.3.A and 3.3.B). Results from FE models (Table 3.6.A), however, indicate that children who were fed solid foods more than once per day were 13 percentage points more likely to be in good health ($p = 0.05$) in the child panel and nine percentage points more likely to be in good health ($p = 0.05$) in the household panel compared to children who were fed solid foods less than twice per day.

The percentage of children whose health was reported to have improved over the past year increased over time in both samples from approximately 25 percent at baseline to 36 percent among control children and 32 percent among treatment children (Tables 3.1.A and 3.1.B). Again, we do not find any significant effects of the health inputs on the outcome of improved health status in the instrumental variables model for either sample (Tables 3.3.A and 3.3.B). Among children in the child panel FE results (Table 3.6.B) show that having a health passport was associated with a 17 percentage point increase in the likelihood of improved health ($p = 0.10$) and higher food shares were associated with a lower likelihood of being reported to have improved health ($p = 0.10$).

3.5.3.2. Incidence of Morbidity

The incidence of diarrhea, fever, cough, or any illness during the past two weeks decreased between baseline and midline for all study groups. The instrumental variables models did not detect any significant effects of health inputs on illness incidence among children in either sample, however there was a marginally significant effect of consuming Vitamin A during the past day on incidence of having a cough among the child panel (-0.37, $p = 0.10$, Table 3.3.B).

The fixed-effects models detected positive and significant effects of having any health expenditures during the past month on diarrhea incidence in the household panel (0.13, $p = 0.01$, Table 3.6.D)), fever incidence in the child panel (0.32, $p = 0.001$) and household panel (0.27, $p = 0.001$) (Table 3.6.E), cough incidence in both the child (0.22, $p = 0.01$) and household panels (0.21, $p = 0.01$) (Table 3.6.F), and any incidence of illness in both samples (0.42, $p = 0.001$ in the child panel and 0.43, $p = 0.001$ in the household panel, Table 3.6.C).

Marginally significant effects of consuming solid foods more than once per day were detected in fixed-effects models for incidence of diarrhea (-0.10, $p = 0.10$, Table 3.6.D) and incidence of any illness (-0.12, $p =0.10$, Table 3.6.C) among children in the child panel. Use of under-five services was associated with a nine percentage point increase in the likelihood of having a fever ($p = 0.10$, Table 3.6.E) in the child panel, and consumption of foods containing Vitamin A was associated with an eight percentage point decrease in the probability of cough ($p = 0.10$, Table 3.6.F) in the household panel.

3.5.3.3. Anthropometrics

The mean height of the child panel increased by approximately 11 cm between baseline and midline, which can be expected due to cohort aging (Table 3.1.A). The mean height in the household panel was stable between survey rounds (Table 3.1.B). Results from the IV model indicate that an increase of one Kcal/AE-L from the meat group was associated with a 0.08 cm increase in height among children in the child panel (*$p = 0.10$,* Table 3.3.A). A similar result (0.1, $p = 0.05$) was detected in the Pooled OLS model, but after controlling for fixed-effects results were no longer marginally significant (Table 3.6.G). While there were no significant effects of health inputs on child height in the household panel IV model (Table 3.3.B), results from the FE model indicate that Vitamin A consumption is associated with an average increase in height of 0.93 cm ($p = 0.05$, Table 3.6.G).

We find a significant direct impact of the SCTP on height in the panel of children. Using FE at the household level the program is associated with a height increase of 0.74 cm (*0.05*), but the direct effect of the SCTP was no longer significant after controlling for individual-level FE (Table 3.6.G).

The average height-for-age z-score (HAZ) decreased among children in the control group and increased slightly for children in the treatment group over time in the panel of children (Table 3.1.A), but decreased over time for all children in the household panel (Table 3.1.B). Prevalence of stunting in the child panel increased from 39 percent to 45 percent in the control group but decreased by two percentage points in the treatment group (from 48 to 46 percent, Table 3.1.A). No significant effects of health inputs were detected for the HAZ in either sample using IV methods (Tables 3.3.A and 3.3.B), but increased caloric availability from foods in the meat group were weakly associated with decreased probability of stunting in the child panel (-0.01, $p = 0.10$). No significant effects of calories from meat, fish, eggs, and dairy were detected for HAZ or stunting in the FE models (Tables 3.6.I and 3.6.K).

In the household panel FE models use of under-five health services is associated with a 0.26 standard deviation decrease in the mean HAZ ($p = 0.05$, Table 3.6.I), but no effect is detected on stunting (Table 3.6.K). Among children in the child panel having any health expenditures is weakly associated with a seven percentage point decreased probability of stunting ($p = 0.10$), and an increase in food expenditure shares devoted to fruits and vegetables is also associated with a significant decrease in the probability of stunting ($p = 0.05$, Table 3.6.K). The significant program impact detected in the household-FE model on increased HAZ in the child panel is not significant after accounting for individual-level fixed-effects.

Among children in the child panel, the mean weight-for-height z-score (WHZ) increased from 0.01 to 0.02 for the control group but decreased from 0.16 to 0.08 in the treatment group (Table 3.1.A). The WHZ decreased for both study groups in the household panel (Table 3.1.B). The IV model for WHZ in the household panel detected a 2.20 SD decrease in mean WHZ among children with a health passport ($p = 0.10$, Table 3.3.B), but this relationship was not significant in the FE models (Table 3.6.J). The prevalence of wasting was very low in both survey rounds and decreased from four to two percent in the child panel and stayed around 3 percent in the household panel (Tables 3.1.A and 3.1.B). The household panel IV model showed a 15 percentage point increase in the probability of wasting among children who used under-five health services ($p = 0.10$, Table 3.3.B), but this relationship was not significant in the FE model (Table 3.6.L). No significant effects of health inputs were detected for the continuous WHZ health outcome (Table 3.6.J) or the incidence of wasting (Table 3.6.L) in any of the FE models.

Lastly we examine the effects of health inputs on the weight-for-age z-score (WAZ) and the prevalence of underweight children. The mean WAZ decreased for children in both study samples; the prevalence of underweight increased from 16 percent to 18 percent in the child panel control group and decreased from 16 to 15 percent in the treatment group (Table 3.1.A). Prevalence of underweight increased slightly in the household panel (Table 3.1.B). No significant effects were found in any of the IV models for WAZ or underweight (Tables 3.3.A and 3.3.B). Results from the household panel FE model showed a 14 SD decrease in the mean WAZ ($p = 0.10$, Table 3.6.H) among children who used under-five services, and child panel FE results show a 14 percentage point increase in the likelihood of being underweight among children who participated in a nutrition program ($p = 0.10$, Table 3.6.M).

3.5.5.4. Heterogeneous Impacts of the SCTP on Health Outcomes

We do not detect any significant direct program impacts on health outcomes in the IV models or after controlling for individual-level fixed-effects in the child panel. 2SLS results for heterogeneous program impacts on health outcomes are shown in Table 3.5.A and 3.5.B. In the child panel, beneficiary children with low expected transfer shares were 19 percentage points ($p = 0.05$) less likely to have had diarrhea than control children with low expected transfer shares; while there was no significant impact found among beneficiaries with high transfer shares, results from Wald tests indicate that the impacts among the low share beneficiaries are significantly different from the high share beneficiaries. There was no evidence of significant impact heterogeneity on diarrheal incidence in the household panel. We also detected marginally significant differential impacts in the child panel between beneficiary children whose caregivers had high health knowledge scores relative to those with low scores (-0.27, $p = 0.10$), an increase of 0.92 SD ($p = 0.10$) in the HAZ among beneficiary children with high transfer shares, and a 33 percentage point decrease ($p = 0.10$) in incidence of stunting among beneficiary children with high transfer shares. We detected similar results for the HAZ among children in panel households.

<u>3.5.4. Extensions – Household Panel</u>

3.5.4.1. Comparisons between children 6-23 months and 24-59 months

We split the household panel sample into children ages 6-23 months and ages 24-59 months to assess whether program impacts on health inputs and health input effects on health outcomes differed by the child's age (Appendix 7).

Results differ somewhat from our main analyses in that several program impacts on health input demands seem to be driven by one age group. The overall program impact of -0.02 ($p = 0.05$)

on the food share appears to be largely attributable to children under two where the program impact was -0.05 (*$p = 0.01$*) as there is no significant impact on the food share among children ages three to five. The overall program impacts on annual food expenditures (MWK 6966, *$p = 0.01$*), calories available from the cereal group (395 Kcal/AE-L daily, *$p = 0.01$*), and calories available from the meat group (25 Kcal/AE-L daily, *$p = 0.001$)* are largely driven by program impacts among older children.

Results from instrumental variables models show no significant effects of health inputs on any health outcome for children age three to five. Among children ages six to 23 months we find a significant impact on incidence of fever (-0.39, *$p = 0.05$*) and a marginally significant impact on incidence of cough (0.28, *$p = 0.10$*). There is a weak positive association between participation in a nutrition program and incidence of cough. There are several significant effects of food group shares on incidence of fever and the WAZ. Increased food shares for the cereal group, fruit and vegetable group, and legume group were associated with decreased likelihood of having a fever. Cereal and legume expenditure shares were also associated with higher WAZ scores.

From these results it appears that the program is having the largest impact on health inputs among older children, whereas the positive effects of health inputs on child health outcomes are occurring among the youngest children.

3.5.4.2. Sensitivity Analysis – Exclusion of new household members

Finally, we test whether estimates from the panel of households are sensitive to the exclusion of children who joined the sample at midline (Appendix 7).

Over 25 percent of the 1,413 children ages 6-59 months retained for analysis from the panel of households at midline were new household members (378 children). Over half of these children had been born since baseline and 20 percent were reported to have been missed during the baseline survey. Nearly a quarter of these new children joined the household to live with relatives, and the remaining children joined the household due to the death of a member in their former household (1.59 percent), the death of a person living in the current household (0.53 percent), the family set up a new household (0.26 percent), breakup of the former household (2.38 percent), and one child joined a study household to recover from illness.

While there is no significant difference in the percentage of new children from treatment and control households (49 percent of new children are in control households and 51 percent are from treatment households), it is possible that the types of children joining treatment and control households are different. If, for example, children who have worse health outcomes are more likely to join treatment households because of the additional resources, estimates of program impact on child health outcomes among children in panel households could be biased downward.

To check whether our estimates of program impact among children in panel households was robust to the inclusion of children who joined the program after the baseline survey, we first examined whether the health outcomes of interest at midline significantly differed among the new children by treatment status. We then repeated our main impact analysis excluding these new children. Compared to children who joined control households between the baseline and midline surveys, children who joined treatment households had weight-for-age z-score that were 0.23 standard deviation units lower on average ($p = 0.037$), were 12 percentage points more likely to be severely stunted ($p = 0.007$), 12 percentage points more likely to be underweight ($p = 0.000$), and were four percentage points more likely to be severely underweight ($p = 0.006$).

Results from the analysis of program impacts on child health input demands and child health outcomes among children in panel households, excluding children who were new members at midline, are given in Appendix 7. Program impacts on food expenditures are higher than those detected among the sample including new household members; the increased meat share is significant at the five percent level, and there is no longer a significant impact of the program on the overall food share. In the health production analysis the protective effect of Vitamin A consumption on decreased incidence of coughing illness becomes statistically significant, and we begin to see more marginally significant effects of health inputs on health outcomes.

There are no significant changes among program impacts in either the input or health outcome models, and so we conclude that while new children may be worse off than those children already in panel households at midline, there is no evidence that worse-off children are selectively migrating into treatment households and attenuating program impacts.

3.6. Discussion

The main objective of this study was to improve understanding of how an unconditional cash transfer program can improve child health. Seminal theories from public health and economics demonstrate that money does not directly change health outcomes, but rather is used to access intermediate goods that do have direct effects on child health. This study sought to understand the mechanisms through which the Malawi Social Cash Transfer Program can influence health by examining how the program changes household demand for child health inputs and works through them to ultimately improve child health outcomes. Because the health inputs are themselves household decisions (and therefore endogenous to the child health outcome), we used the economic theory of the health production function to identify exogenous factors that would change inputs but not directly alter health outcomes; these factors were used as instrumental variable in our empirical strategy.

We find that after approximately one year of exposure the program has a positive impact on diet quantity, but not health service use or child feeding, and that the impacts on diet do not translate to significant improvements in child health outcomes. We do not detect any significant direct program impacts on child health outcomes. This finding is consistent with our hypothesis that the transfer does not directly influence health, but rather affects inputs necessary for good health.

Our findings are also consistent with the program theory of change which predicts that first round impacts will occur for consumption, particularly food consumption. Our results are also very different from those of the one-year evaluation of the Mchinji pilot program, which found a nine percentage point decrease in stunting, two percentage point decrease in wasting, 11 percentage point decrease in underweight, and a 13 percentage point decrease in incidence of any illness.[98] This could be due to differences in the size of the transfer share, which was approximately 30 percent on average among beneficiary households in the Mchinji pilot sample.

3.6.1. Health Service Inputs and Child Health

We proposed that one key mechanism through which the SCTP could improve child health was through increased use of health services. We did not find significant program impacts on possession of a health passport or on incidence of health expenditures for preventative care or non-prescription medicines. This is consistent with results from the two-year evaluation of the Kenya Cash Transfer for Orphans and Vulnerable Children, which found no program impact on the likelihood of having a health card.[19] It may have been difficult to detect a program impact on the likelihood that a child has a health passport using a linear probability model because approximately 90 percent of study children had a health passport at baseline, which could cause a ceiling effect. We did detect a negative program impact on the probability that the child had participated in an under-five clinic or an under-five/well-baby checkup in the past six months, and that under-five service use was associated with an increased likelihood of fever and decreased weight-for-age and height-for-age z-scores. This is in contrast with findings from the Zambia Child Grant Program which found no change in use of preventive care services after 24 months.[46]

The negative program impact on use of under-five services was surprising. It is conceivable that the negative effect occurs because caregivers of beneficiary children believe the child is better off and therefore does not need to access services. This type of behavior would be consistent with the subsequent negative relationships we observe between under-five service use and higher incidence of fever and lower anthropometric z-scores. This could also explain the relationship between health expenditures and a higher probability of illness; non-medical and non-prescription medicines include over-the-counter drugs like Panadol and cough syrup, so the expenditures could have been in response to the illness rather than on a preventive service.

3.6.2. Child Feeding and Health

Another way the SCTP could improve child health is through improving child feeding and nutrition. However, we did not find evidence that the program led to changes in the likelihood that the child was fed solid food at least twice per day, participated in a nutrition program, or consumed foods rich in Vitamin A during the previous day. Results from fixed-effects models show that children who are fed solid foods multiple times per day were more likely to be reported in good health and have a lower incidence of illness. We also found that consumption of foods rich in Vitamin A was associated with a decreased incidence of having a cough and a nearly one centimeter height increase. Participation in a nutrition program was associated with an increased probability of being underweight, which could either reflect purposive targeting of nutrition programs to underweight children or compensating parental behaviors.

3.6.3. Food Security and Child Health

A final component of child feeding and nutrition is food security. Aside from the negative impact on use of under-five health services, all of the significant program impacts we detected were among food security indicators. We find strong program impacts on increased food expenditures and decreased food shares. Overall consumption decreased between baseline and midline due to seasonality, so these results indicate protective program impacts. Taken together these findings indicate that beneficiary households were reducing their economic vulnerability to food insecurity because they were able to simultaneously increase food expenditures while allocating a smaller portion of the household budget to food. Our findings are consistent with those from impact evaluations of other cash transfer programs in sub-Saharan Africa. The Zambia Child Grant Program and the Kenya Cash Transfer for Orphans and Vulnerable Children were both associated with increased food expenditures.[46,48]

The SCTP was also found to have increased apparent caloric availability of foods from the cereal, meat, and 'other' groups. The increase in calories from the cereal group – which consists mostly of starchy staple foods – is indicative of protective program impacts on diet quantity during the lean season. An increase in available calories and food expenditure share for meat, fish, eggs, and dairy products could also signal early stages of improvements in diet quality, especially regarding access to calcium and animal protein. The Zambian and Kenyan evaluations found positive program impacts on availability of protein-rich foods like meat, fish, and dairy after two years,[46,49] so the Malawi SCTP may be on track to achieve similar outcomes.

Positive program impacts on food expenditures, calories from cereal, and food expenditures allocated to foods from the meat group do not appear to have translated into improvements in child health outcomes. This is likely because after only one year of program exposure there has not been enough time for food consumption improvements to significantly change child health outcomes. Results from 2SLS models show weak associations between increased calories from meat and increases in linear height and reduced incidence of stunting. While the program impact on meat is strong, the evidence of increased access to foods from the meat group resulting in improved child health is weak and the effect magnitudes are not large enough to be of policy relevance. However, the relationships among the program, caloric availability and increased food shares for meat, and child growth are in the expected direction.

3.6.4. Heterogeneous Program Impacts

We do not find strong evidence of heterogeneous program impacts on demand for health inputs in the child panel. In the household panel, however, the program has stronger impacts on caloric availability of cereals and legumes among beneficiary children residing in households with four or fewer members at baseline and a stronger impact on food share reduction among children in larger households. We also find that children from the poorest beneficiary households experience a reduction in the food share that is five percentage points greater than beneficiary children in the top half of the baseline consumption distribution. This is an important finding because, relative to the full SCTP impact evaluation sample, children ages 6 – 59 months in this study are more likely to be the "poorest of the poor" as evidenced by 70 percent of study children living in the poorest households.

While we see strong program impacts among the different transfer share groups for several health inputs, the impacts for high share beneficiaries relative to high expected share control children are not significantly different from those impacts among low share children.

Heterogeneous program impacts on health outcomes are somewhat puzzling to explain. There is weak evidence that beneficiary children whose caregivers have higher health knowledge scores are less likely to have had a fever during the previous two weeks compared to beneficiary children whose caregivers have lower health knowledge scores in both the child and household panels. This finding could suggest that increased health knowledge shifts the health production function of caregivers such that they are better able to achieve improved child health outcomes using the same resources as treatment households with low health knowledge.

3.6.5. Implications for Policy and Practice

The purchasing power of the cash transfer has significant implications for households' ability to consume a diverse diet while maintaining necessary calorie levels. The strongest and largest program impacts are on increased food expenditures and calories from cereals, roots, and tubers. This indicates that while the SCTP is protective of diet quantity during the lean season, beneficiaries are not able to overcome diet quantity constraints to begin diversifying and improving their diet quality. While an adequate amount of calories is necessary for child health, diet quality must also improve in order to increase availability of micronutrients.

Program planners could consider increasing the value of the transfer or offering supplemental food vouchers during the lean season. If markets are thin and households are constrained by a lack of diverse foods available for purchase at markets, program planners may instead want to consider in-kind transfers of nutritious foods or micronutrient supplements. As participation in nutrition programs is very low among all study children, there may be additional benefits of linking beneficiary children with other social services or implementing complimentary nutrition programs in conjunction with the cash transfer payments.

3.6.6. Study Limitations

There are four important study limitations that warrant discussion. The first is the timing of the baseline and midline surveys, which ended up being implemented 17 months apart due to field delays in disbursing payments. General consumption and caloric availability decreased between post-harvest baseline and the lean season midline surveys due to seasonal fluctuations. We do not expect seasonality to occur differently in treatment and control areas, so seasonality does not bias our estimates of protective program impacts on food acquisition. However, seasonality could influence our second-stage results in that the disease environments of baseline and midline may differ such that input effects on health during post-harvest would be different than the effects of those same inputs at the end of the lean season. Additionally, inputs require time to change health outcomes, and so there may not have been enough time for program impacts to work their way through inputs to improve health, particularly during the lean season. For this reason it may be useful in future studies using endline data to model current health outcomes as functions of lagged health inputs.

A second limitation of this study is that we do not directly measure several of the health inputs. Food expenditures and caloric availability were calculated using data from the household consumption module, which asks respondents to recall everything consumed during the course of the past week. We collect quantity information and ask about consumption from purchase, gifts, and own-production, which allows for a more comprehensive understanding of members' consumption and calculation of caloric availability, but this approach likely results in more measurement error relative to the gold standards of food diaries, observed-weighed food method, and 24-hour recall. Also, consumption data is collected at the household level, and this lack of information on intra-household allocation means that we have to make the assumption that food consumption is distributed proportional to age- and sex-specific requirements captured through adult-equivalence scales. Potential sources of reporting error from the household consumption module include recall error where households misreport true consumption due to the length of the recall period and telescoping, where households report consumption activity that occurred over a longer period of time than the recall window.[78] While we don't expect reporting error to systematically differ between the treatment and control groups, there could be instances of social desirability bias in which households under-report consumption if they think their responses will influence their program eligibility. Any social desirability bias was likely equal between groups at the pre-treatment baseline, but beneficiary households may over-report consumption to appear thankful for the transfer or control households may under-report if they believe it affects their future eligibility; in such a case we would overestimate the program's impact on consumption and caloric availability.

A study limitation that is particularly relevant to study children ages 6-23 months is that we did not collect information related to breastfeeding. The decision to not collect this information was due in part to the nature of the target population, which is ultra-poor and labor-constrained, resulting in a population with a majority of members between ages five and 18 and more elderly women than middle-aged men or women. The implication of lacking information on breastfeeding is that we cannot adjust caloric measures for children who are still breastfeeding relative to those who are not, but this affects the treatment and control groups equally and so does not bias our estimates of program impact on caloric availability.

The last limitation of this study has to do with the estimation strategy we use to solve the endogeneity problem of health inputs in the health outcome equation. We use the 2SLS approach to specify the health input and health production structural equations in order to address the endogeneity of inputs and test hypotheses about program impacts on important inputs and subsequent changes in child health outcomes. Evidence of weak instruments caused us to suspect that the lack of effects of inputs on health outcomes could be due to attenuation of effects because of weak instruments. We employed fixed-effects models as an alternative approach to addressing the endogeneity problem and did find significant relationships between health inputs and outcomes. However, the fixed-effect approach does not allow us to estimate program impacts on health inputs. Future iterations of this study will reduce the number of endogenous health inputs and use the randomly assigned treatment indicator as an instrument. We will also be able to use a third wave of data to create lagged variables as a source of potential instruments. An alternative approach to tracing the effects of the program could be to conduct a path analysis or use structural equation modelling.

3.7. Conclusion

Results from this study indicate that the Malawi SCTP can protect the food consumption of children living in ultra-poor and vulnerable households during the lean season, but after one year of program exposure these protective impacts have not translated to improved health status, reduced morbidity, or improvements in anthropometric outcomes among children under-five. Results also indicate that while inputs such as increased solid food feeding frequency and consumption of foods containing Vitamin A are associated with health improvements, the inputs themselves are not responsive to the cash transfer payments. More research is needed on the relationships between food availability at local markets, the health service and nutrition programming infrastructure, and unconditional cash transfer payments. It is also important to understand how these dynamics can change when households are not struggling to meet their basic consumption needs at the end of the lean season.

3.8 Tables and Figures

Table 3.1. A. Descriptive Statistics by Wave and Treatment Status - Panel of Children

	Baseline (N =863)			Midline (N = 863)		
	Control	Treatment	*p-value*	Control	Treatment	*p-value*
Input Demands						
Health passport	0.91	0.89	*0.67*	0.91	0.87	*0.12*
Under-5 service	0.86	0.86	*0.81*	0.65	0.59	*0.22*
Any health expenditures	0.16	0.20	*0.28*	0.12	0.14	*0.54*
Solid food >1/day	0.82	0.85	*0.56*	0.93	0.97	*0.15*
Nutrition program	0.03	0.04	*0.83*	0.06	0.03	*0.13*
Vitamin A past day	0.64	0.70	*0.29*	0.88	0.95	*0.02*
AE-L annual food exp.	35,123.09	36,796.55	*0.63*	27,494.61	33,876.52	*0.01*
Food share	0.78	0.78	*0.95*	0.73	0.70	*0.03*
Food expenditure shares						
Cereals and tubers	0.59	0.59	*0.93*	0.51	0.49	*0.19*
Fruits and Vegetables	0.19	0.19	*0.70*	0.27	0.26	*0.74*
Meats, etc.	0.04	0.04	*0.54*	0.10	0.11	*0.46*
Legumes, etc.	0.09	0.10	*0.75*	0.06	0.07	*0.22*
Oils, etc.	0.09	0.08	*0.66*	0.06	0.07	*0.12*
Food group AE-L Kcal/day						
Cereals and tubers	1,707.01	1,645.75	*0.63*	1,434.68	1,678.56	*0.00*
Fruits and Vegetables	35.73	44.76	*0.08*	72.09	91.78	*0.26*
Meats, etc.	29.80	19.59	*0.18*	43.77	54.11	*0.16*
Legumes, etc.	169.28	164.43	*0.91*	65.72	91.97	*0.10*
Oils, etc.	98.92	102.69	*0.90*	78.99	189.37	*0.00*
Child Health Outcomes						
Health status	0.88	0.88	*0.99*	0.88	0.90	*0.64*
Health improvement	0.24	0.25	*0.74*	0.36	0.31	*0.23*
Diarrhea	0.21	0.19	*0.72*	0.09	0.10	*0.51*
Fever	0.33	0.28	*0.33*	0.23	0.19	*0.40*
Cough	0.27	0.28	*0.83*	0.12	0.09	*0.37*
Any illness	0.49	0.48	*0.84*	0.34	0.28	*0.17*
Height	80.83	80.41	*0.57*	91.16	91.24	*0.91*
HAZ	-1.59	-1.88	*0.10*	-1.89	-1.87	*0.87*
Stunted	0.39	0.48	*0.07*	0.45	0.46	*0.92*
WHZ	0.01	0.16	*0.11*	0.02	0.08	*0.54*
Wasted	0.04	0.04	*0.62*	0.02	0.02	*0.64*
WAZ	-0.87	-0.91	*0.66*	-1.08	-1.03	*0.47*
Underweight	0.16	0.16	*0.95*	0.18	0.15	*0.30*
Intervention						
SCTP household	0.51	0.49				
AE-L Annual transfer	8,337.95	8,202.43	*0.45*			
Transfer share	0.24	0.23	*0.37*			
Transfer share ≥ 20%	0.55	0.47	*0.28*			
Moderators						
Poorest 50%	0.72	0.71	*0.78*			
4 or fewer household members	0.13	0.15	*0.29*			
Top 3rd Health Knowledge score	0.29	0.27	*0.58*			
Controls						

Child						
Female	0.51	0.50	*0.86*			
Age (months)	24.80	25.07	*0.71*	41.35	41.14	*0.75*
Grandchild of head	0.18	0.22	*0.32*	0.17	0.22	*0.21*
Orphan	0.17	0.14	*0.50*	0.16	0.19	*0.53*
Household Head						
Female	0.86	0.89	*0.26*			
Age (months)	41.72	42.01	*0.87*			
Any school	0.46	0.43	*0.56*			
Literate	0.28	0.22	*0.11*			
Widow	0.23	0.24	*0.87*			
Muslim	0.82	0.78	*0.73*			
Chronic illness	0.24	0.26	*0.76*			
Disability	0.05	0.05	*0.77*			
Household size	6.40	6.42	*0.88*			
Total number of members						
0 to 5	1.85	1.91	*0.49*			
6 to 11	1.64	1.66	*0.86*			
12 to 17	1.11	0.94	*0.04*			
18 to 64	1.61	1.64	*0.72*			
65 and older	0.19	0.27	*0.06*			
Dependency ratio	3.50	3.37	*0.46*			
Any orphan	0.35	0.39	*0.45*			
AE-L annual consumption	44,430.34	46,823.62	*0.55*			
Improved drinking water	0.90	0.88	*0.70*			
Improved sanitation	0.45	0.45	*0.97*			
Room exclusively for cooking	0.51	0.50	*0.95*			
Improved cooking fuel	0.72	0.70	*0.76*			
Sleeps under mosquito net	0.60	0.59	*0.94*			
Other programs						
Food or cash	0.19	0.13	*0.33*			
Maternal and child nutrition	0.21	0.21	*0.97*			
Any credit	0.53	0.53	*0.96*			
Transfers received from non-household members						
Cash	0.56	0.53	*0.68*			
Food/other consumables	0.92	0.85	*0.10*			
Labor or time	0.40	0.32	*0.25*			
Agricultural inputs	0.34	0.26	*0.20*			
Salima	0.44	0.41	*0.78*			
Community epidemic in the past year	0.71	0.76	*0.46*	0.51	0.77	*0.18*
Instruments						
Distance nearest tar road (km)	6.40	6.22	*0.95*			
Weekly market	0.47	0.76	*0.12*			
Permanent ADMARC	0.17	0.16	*0.91*			
Within 1.5km food market	0.51	0.65	*0.19*			
Community clinic	0.13	0.24	*0.47*			
Distance to community clinic (km)	5.80	3.56	*0.16*			
Community clinic poor quality	0.77	0.92	*0.26*			
Village health clinic	0.59	0.40	*0.36*			
Distance to MD/CO* clinic (km)	37.75	19.33	*0.13*			
Labor wage - men	509.68	679.80	*0.08*	544.41	661.15	*0.36*

Labor wage - women	443.20	478.46	*0.61*	454.06	478.91	*0.84*
Ganyu wage - men	601.38	567.82	*0.71*	551.39	711.74	*0.22*
Prices						
Maize grain per kilo	174.98	166.91	*0.87*	142.71	145.30	*0.96*
Rice per kilo	338.36	326.06	*0.56*	397.74	369.90	*0.16*
Beans per kilo	435.15	453.84	*0.60*	666.92	659.75	*0.94*
Tomatoes per heap	44.09	60.71	*0.16*	48.80	58.20	*0.15*
Beef per kilo	1,091.01	1,249.70	*0.17*	1,480.72	1,515.80	*0.70*
Salt per sachet/tube	31.74	24.94	*0.27*	34.80	37.68	*0.73*
Sugar per kilo	354.32	422.28	*0.13*	504.04	500.37	*0.95*
Cooking oil per sachet/tube	48.26	43.38	*0.59*	48.33	44.78	*0.30*
Bar soap per piece	77.31	69.51	*0.45*	71.40	73.05	*0.70*
Panadol per piece	16.05	18.51	*0.27*	17.31	16.89	*0.86*
Food shock	0.87	0.86	*0.85*	0.69	0.71	*0.77*
Crop shock	0.83	0.81	*0.86*	0.60	0.64	*0.64*

*Notes: Sample means and p-values are adjusted for complex survey design and p-values are calculated from simple weighted linear regression controlling for clustering at the Village Cluster level. * MD = medical doctor, CO = clinical officer. May not sum to 100% because survey weights are applied.*

Table 3.1. B. Descriptive Statistics by Wave and Treatment Status - Children in Panel Households

	Baseline (N = 1,470)			Midline (N = 1,413)		
	Control	Treatment	*p-value*	Control	Treatment	*p-value*
Input Demands						
Health passport	0.88	0.85	*0.14*	0.92	0.89	*0.26*
Under-5 service	0.75	0.73	*0.65*	0.70	0.67	*0.46*
Any health expenditures	0.16	0.19	*0.42*	0.12	0.15	*0.32*
Solid food > 1/day	0.82	0.86	*0.47*	0.92	0.96	*0.14*
Nutrition program	0.03	0.03	*0.90*	0.07	0.03	*0.16*
Vitamin A past day	0.65	0.72	*0.24*	0.87	0.93	*0.07*
AE-L annual food exp.	35,548.56	36,909.99	*0.67*	28,337.03	33,333.72	*0.02*
Food share	0.78	0.78	*0.92*	0.73	0.70	*0.02*
Food expenditure shares						
Cereals and tubers	0.59	0.58	*0.74*	0.51	0.49	*0.17*
Fruits and Vegetables	0.19	0.20	*0.67*	0.27	0.27	*0.73*
Meats, etc.	0.05	0.04	*0.34*	0.10	0.11	*0.42*
Legumes, etc.	0.09	0.11	*0.37*	0.06	0.07	*0.14*
Oils, etc.	0.08	0.08	*0.36*	0.06	0.07	*0.13*
Food group AL-L Kcal/day						
Cereals and tubers	1,725.86	1,656.72	*0.56*	1,690.80	1,960.12	*0.03*
Fruits and Vegetables	35.55	47.20	*0.04*	84.82	107.43	*0.27*
Meats, etc.	31.96	19.56	*0.09*	52.73	60.01	*0.38*
Legumes, etc.	166.67	167.04	*0.99*	70.13	105.43	*0.05*
Oils, etc.	103.93	103.21	*0.98*	105.80	202.05	*0.00*
Child Health Outcomes						
Health status	0.87	0.89	*0.67*	0.88	0.88	*0.85*
Health improvement	0.24	0.26	*0.65*	0.36	0.32	*0.29*
Diarrhea	0.17	0.15	*0.47*	0.11	0.13	*0.31*
Fever	0.29	0.24	*0.29*	0.22	0.19	*0.45*
Cough	0.26	0.28	*0.75*	0.11	0.12	*0.76*
Any illness	0.45	0.42	*0.57*	0.34	0.32	*0.54*
Height	85.64	85.81	*0.80*	86.88	87.01	*0.88*
HAZ	-1.65	-1.80	*0.30*	-1.78	-1.82	*0.76*
Stunted	0.41	0.46	*0.24*	0.43	0.45	*0.62*
WHZ	0.09	0.20	*0.21*	0.00	0.00	*0.99*
Wasted	0.03	0.04	*0.81*	0.04	0.03	*0.84*
WAZ	-0.88	-0.88	*0.98*	-1.02	-1.04	*0.78*
Underweight	0.15	0.15	*0.93*	0.16	0.17	*0.42*
Intervention						
SCTP household	0.51	0.49		0.50	0.50	
AE-L Annual transfer	8,427.60	8,243.99	*0.42*	8,470.94	8,361.47	*0.72*
Transfer share	0.24	0.23	*0.39*	0.24	0.22	*0.35*
Transfer share ≥ 20%	0.55	0.48	*0.27*	0.53	0.45	*0.22*
Moderators						
Poorest 50%	0.73	0.70	*0.61*	0.67	0.64	*0.57*
4 or fewer household members	0.15	0.15	*0.90*	0.21	0.23	*0.49*
Top 3rd Health Knowledge score	0.29	0.25	*0.29*	0.27	0.25	*0.52*
Controls						

Child						
Female	0.50	0.52	*0.49*	0.51	0.48	*0.29*
Age (months)	32.61	33.24	*0.45*	34.99	35.12	*0.88*
Grandchild of head	0.20	0.28	*0.10*	0.23	0.26	*0.39*
Orphan	0.18	0.20	*0.49*	0.13	0.17	*0.20*
Household Head						
Female	0.87	0.86	*0.68*	0.85	0.89	*0.22*
Age (months)	42.36	44.38	*0.23*	44.19	45.42	*0.56*
Any school	0.44	0.42	*0.78*	0.45	0.41	*0.48*
Literate	0.27	0.23	*0.24*	0.27	0.22	*0.17*
Widow	0.22	0.26	*0.35*	0.26	0.31	*0.23*
Muslim	0.81	0.76	*0.61*	0.83	0.78	*0.63*
Chronic illness	0.24	0.28	*0.47*	0.28	0.32	*0.46*
Disability	0.05	0.05	*0.86*	0.07	0.07	*0.71*
Household size	6.34	6.43	*0.61*	6.04	5.99	*0.78*
Total number of members						
0 to 5	1.84	1.89	*0.51*	1.59	1.60	*0.90*
6 to 11	1.64	1.61	*0.74*	1.56	1.51	*0.56*
12 to 17	1.06	1.02	*0.60*	1.04	1.02	*0.74*
18 to 64	1.59	1.62	*0.80*	1.57	1.54	*0.74*
65 and older	0.21	0.29	*0.04*	0.28	0.33	*0.27*
Dependency ratio	3.48	3.42	*0.70*	3.21	3.21	*0.98*
Any orphan	0.35	0.42	*0.19*	0.34	0.40	*0.17*
AE-L annual consumption	44,897.36	46,968.21	*0.57*	44,403.14	47,157.38	*0.39*
Improved drinking water	0.90	0.89	*0.79*	0.88	0.89	*0.83*
Improved sanitation	0.45	0.47	*0.78*	0.47	0.47	*0.94*
Room exclusively for cooking	0.52	0.53	*0.83*	0.52	0.49	*0.54*
Improved cooking fuel	0.70	0.71	*0.95*	0.70	0.73	*0.67*
Sleeps under mosquito net	0.61	0.61	*0.95*	0.61	0.58	*0.55*
Other programs						
Food or cash	0.19	0.14	*0.37*	0.18	0.14	*0.50*
Maternal and child nutrition	0.21	0.21	*1.00*	0.20	0.19	*0.88*
Any credit	0.53	0.53	*0.98*	0.52	0.52	*0.97*
Transfers received from non-household members						
Cash	0.57	0.53	*0.51*	0.58	0.56	*0.75*
Food/other consumables	0.93	0.85	*0.12*	0.90	0.87	*0.41*
Labor or time	0.41	0.34	*0.25*	0.40	0.35	*0.33*
Agricultural inputs	0.33	0.26	*0.21*	0.32	0.27	*0.32*
Salima	0.48	0.40	*0.68*	0.43	0.40	*0.88*
Community epidemic in the past year	0.71	0.82	*0.55*	0.50	0.77	*0.17*
Instruments						
Distance nearest tar road (km)	6.27	6.55	*0.92*	4.67	4.32	*0.84*
Weekly market	0.48	0.75	*0.16*	0.48	0.76	*0.14*
Permanent ADMARC	0.17	0.14	*0.82*	0.18	0.15	*0.83*
Within 1.5km food market	0.50	0.63	*0.20*	0.51	0.64	*0.16*
Community clinic	0.12	0.22	*0.50*	0.09	0.18	*0.45*
Distance to community clinic (km)	6.05	3.71	*0.16*	4.19	2.49	*0.13*
Community clinic poor quality	0.77	0.94	*0.17*	0.77	0.93	*0.25*
Village health clinic	0.60	0.42	*0.40*	0.62	0.43	*0.37*

Distance to MD/CO* clinic (km)	36.82	20.50	*0.16*	27.63	13.67	*0.12*
Labor wage - men	509.47	709.49	*0.06*	547.04	659.99	*0.34*
Labor wage - women	442.28	484.19	*0.54*	452.17	483.33	*0.78*
Ganyu wage - men	609.91	573.82	*0.70*	553.40	698.85	*0.21*
Prices						
Maize grain per kilo	172.68	169.12	*0.94*	152.38	149.63	*0.96*
Rice per kilo	338.55	327.85	*0.61*	397.43	370.42	*0.17*
Beans per kilo	438.34	452.45	*0.70*	662.63	663.02	*1.00*
Tomatoes per heap	44.96	62.54	*0.16*	49.22	58.09	*0.19*
Beef per kilo	1,090.13	1,227.51	*0.17*	1,500.99	1,517.55	*0.86*
Salt per sachet/tube	31.56	25.43	*0.33*	34.96	37.55	*0.74*
Sugar per kilo	355.87	419.83	*0.14*	500.09	503.79	*0.95*
Cooking oil per sachet/tube	48.55	43.33	*0.57*	47.88	44.57	*0.33*
Bar soap per piece	76.36	69.92	*0.50*	71.37	73.50	*0.61*
Panadol per piece	16.11	18.85	*0.25*	17.14	16.95	*0.94*
Food shock	0.86	0.87	*0.94*	0.70	0.71	*0.92*
Crop shock	0.82	0.82	*0.93*	0.59	0.62	*0.72*

*Notes: Sample means and p-values are adjusted for complex survey design and p-values are calculated from simple weighted linear regression controlling for clustering at the Village Cluster level. * MD = medical doctor, CO = clinical officer. May not sum to 100% because survey weights are applied.*

Table 3. 2. Household Demand for Child Health Inputs (1st Stage 2SLS Results)

	Panel of Children (N = 1,726)			Children in Panel Households (N =2,883)		
	Time	Treat	DD	Time	Treat	DD
Health passport	0.09**	-0.03	0.01	0.08***	-0.02	0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Under-5 Services	0.06	0.03	-0.09*	0.03	0.02	-0.04
	(0.05)	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)
Any health expenditures	0.03	-0.02	0.01	0.01	-0.01	0.02
	(0.05)	(0.03)	(0.04)	(0.03)	(0.02)	(0.03)
Solid food > 1/day	0.10**	0.09**	-0.03	0.09*	0.07*	-0.01
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)
Nutrition program	0.06+	-0.02	-0.02	0.06*	-0.01	-0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Vitamin A past day	0.15**	0.05	-0.00	0.22***	0.03	-0.01
	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)
AE-L annual food	-12,770.60***	-2,070.36	9,090.49***	-12,102.89***	-2,197.76	6,965.52**
expenditures	(2,658.49)	(1,450.62)	(2,372.74)	(2,390.33)	(1,444.74)	(2,233.34)
Food share	-0.08***	0.01	-0.02*	-0.08***	0.00	-0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Food group AE-L Kcal/day						
Cereals and tubers	-401.67*	-52.04	313.08*	-517.77**	-144.89	395.29**
	(165.95)	(101.04)	(119.27)	(146.75)	(99.27)	(128.28)
Fruits and vegetables	43.87**	-0.54	15.54	48.31**	3.44	14.87
	(15.62)	(9.67)	(15.32)	(15.64)	(10.40)	(15.68)
Meats, etc.	0.67	-6.69	24.30***	-4.64	-9.22+	25.31***
	(7.89)	(5.86)	(5.59)	(5.34)	(4.61)	(4.61)
Legumes, etc.	-123.80**	11.26	42.69	-126.13***	6.46	45.02
	(36.90)	(27.70)	(27.80)	(31.57)	(25.54)	(27.81)
Oils, etc.	-44.06	-17.25	139.57***	-32.45	-29.70	126.84***
	(36.50)	(23.81)	(29.65)	(35.01)	(21.36)	(29.14)
Food expenditure shares						
Cereals and tubers	-0.05*	0.00	-0.04	-0.06*	0.00	-0.04
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
Fruits and vegetables	0.08**	-0.02	-0.01	0.08***	-0.02	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Meats, etc.	0.04***	0.01	0.02*	0.04***	0.00	0.02+
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Legumes, etc.	-0.00	0.01	-0.00	-0.01	0.02*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

*Notes: All models control for a vector of baseline household characteristics and contemporaneous child characteristics. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.3. A. Household Production of Child Health (2nd Stage 2SLS Results) - Panel of Children (N = 1,726)

	Health Status	Health Improvement	Any illness	Diarrhea	Fever	Cough	Height	WAZ	HAZ	WHZ	Stunted	Wasted	Underweight
Time	-0.16	0.51+	0.01	0.04	-0.11	-0.12	0.58	0.02	0.35	-0.20	-0.24	0.06	0.14
	(0.13)	(0.28)	(0.16)	(0.13)	(0.13)	(0.22)	(1.40)	(0.31)	(0.42)	(0.37)	(0.20)	(0.08)	(0.20)
Treat	0.02	0.02	0.00	0.02	-0.03	0.08	0.53	0.23	0.04	0.27	-0.07	0.00	-0.16
	(0.06)	(0.12)	(0.09)	(0.05)	(0.08)	(0.12)	(0.71)	(0.21)	(0.23)	(0.23)	(0.10)	(0.03)	(0.13)
DD	-0.02	-0.07	-0.05	-0.04	0.02	0.01	1.16	-0.01	0.38	-0.30	-0.05	0.04	0.15
	(0.09)	(0.22)	(0.14)	(0.08)	(0.11)	(0.23)	(1.15)	(0.39)	(0.33)	(0.41)	(0.12)	(0.04)	(0.22)
Health passport	-0.13	-0.46	-0.02	-0.14	-0.04	0.04	-1.84	-1.50	-0.90	-1.60	0.62	0.24	0.75
	(0.42)	(0.70)	(0.54)	(0.35)	(0.44)	(0.58)	(3.75)	(1.30)	(1.19)	(1.37)	(0.47)	(0.19)	(0.67)
Under-5 Services	0.00	-0.09	-0.22	-0.22	-0.16	-0.27	-2.39	-0.20	-0.88	0.50	0.66	-0.05	0.53
	(0.31)	(0.45)	(0.41)	(0.31)	(0.36)	(0.63)	(3.81)	(1.14)	(1.14)	(1.04)	(0.44)	(0.13)	(0.64)
Any health expenditures	0.14	0.19	0.76	0.31	0.64	0.73	5.93	1.94	1.63	1.53	-0.62	-0.10	-1.15
	(0.35)	(0.70)	(0.70)	(0.44)	(0.54)	(0.68)	(3.62)	(1.23)	(1.28)	(1.27)	(0.64)	(0.13)	(0.73)
Solid food > 1/day	-0.21	-0.40	-0.38	-0.17	-0.50	-0.56	-5.89	-1.71	-2.16	-0.81	0.66	0.07	0.85
	(0.39)	(0.56)	(0.51)	(0.39)	(0.42)	(0.72)	(4.42)	(1.24)	(1.38)	(1.21)	(0.54)	(0.14)	(0.68)
Nutrition program	-0.23	-1.25	-0.03	0.04	-0.29	0.73	10.51	2.44	2.98	1.14	-1.18	0.11	-1.08
	(0.77)	(1.11)	(0.79)	(0.53)	(0.71)	(1.33)	(7.60)	(2.46)	(2.29)	(2.17)	(0.87)	(0.26)	(1.29)
Vitamin A past day	0.01	0.29	-0.26	0.11	-0.30	-0.59	-0.91	-0.39	-0.29	-0.36	0.25	0.02	0.23
	(0.25)	(0.36)	(0.39)	(0.23)	(0.31)	(0.49)	(2.57)	(0.70)	(0.69)	(0.59)	(0.29)	(0.08)	(0.46)
AE-L annual food expenditures	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	1.50	1.17	1.97	-0.61	1.64	4.39	29.58	5.77	7.96	2.53	-1.91	-0.24	-2.82
	(2.86)	(4.36)	(3.33)	(2.17)	(2.90)	(4.82)	(29.82)	(8.30)	(8.81)	(7.19)	(3.44)	(0.76)	(4.37)
Food group AE-L Kcal/day													
Cereals and tubers	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00*	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and vegetables	-0.00	0.00	0.00	0.00	0.00	-0.00	-0.01	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00	0.01	0.00	0.00	0.00	0.00	0.08+	0.02	0.03	0.01	-0.01+	0.00	-0.01
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.05)	(0.02)	(0.02)	(0.02)	(0.01)	(0.00)	(0.01)
Legumes, etc.	0.00	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00	-0.00	0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food expenditure shares													
Cereals and tubers	0.62	-0.04	1.84	-0.62	1.54	3.52	-7.17	-4.63	-2.61	-4.14	0.49	0.79	1.16
	(2.00)	(3.23)	(2.28)	(1.29)	(2.23)	(3.64)	(19.48)	(5.39)	(6.00)	(5.42)	(2.09)	(0.72)	(2.78)

Fruits and vegetables	2.05	-1.12	2.90	-0.66	3.10	5.83	7.51	1.30	0.98	1.79	0.43	0.29	-1.44
	(3.18)	(4.16)	(3.62)	(1.75)	(3.26)	(5.14)	(28.38)	(8.65)	(8.74)	(8.08)	(3.10)	(0.91)	(4.44)
Meats, etc.	1.14	-2.51	1.02	-0.69	1.96	2.44	-18.11	-4.80	-7.15	-1.66	3.43	-0.02	0.57
	(2.13)	(3.84)	(2.50)	(1.40)	(2.69)	(3.70)	(18.49)	(6.36)	(4.95)	(7.14)	(2.27)	(1.03)	(3.27)
Legumes, etc.	0.79	1.59	3.24	2.01	2.60	3.27	22.42	1.01	6.24	-3.85	-2.58	1.00	-1.37
	(1.67)	(3.71)	(2.54)	(1.80)	(1.89)	(3.75)	(23.46)	(5.89)	(7.41)	(6.06)	(2.65)	(0.86)	(2.98)

*Notes: All models control for a vector of baseline household characteristics and contemporaneous child characteristics. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.3. B. Household Production of Child Health (2nd stage 2SLS Results) - Children in Panel Households (N = 2,883)

	Health Status	Health Improved	Any Illness	Diarrhea	Fever	Cough	Height	WAZ	HAZ	WHZ	Stunted	Wasted	Underweight
Time	-0.16	-0.06	-0.04	0.03	-0.07	-0.15	-1.08	0.13	-0.24	0.41	0.17	-0.03	0.12
	(0.16)	(0.28)	(0.10)	(0.09)	(0.11)	(0.14)	(1.44)	(0.39)	(0.38)	(0.34)	(0.13)	(0.05)	(0.10)
Treat	0.03	-0.03	-0.06	-0.04	-0.07	0.00	0.12	0.00	-0.10	0.06	0.05	-0.00	0.01
	(0.05)	(0.08)	(0.04)	(0.03)	(0.06)	(0.04)	(0.54)	(0.16)	(0.14)	(0.14)	(0.04)	(0.01)	(0.04)
DD	0.03	-0.05	-0.02	0.02	-0.06	-0.03	0.90	0.20	0.42	-0.02	-0.05	-0.02	0.08
	(0.09)	(0.15)	(0.08)	(0.07)	(0.08)	(0.08)	(1.25)	(0.24)	(0.33)	(0.23)	(0.11)	(0.04)	(0.06)
Health passport	-0.15	0.69	0.15	-0.21	-0.23	0.43	-2.22	-1.97	-0.81	-2.20+	0.20	0.16	0.34
	(0.52)	(0.79)	(0.45)	(0.31)	(0.45)	(0.43)	(6.62)	(1.49)	(1.81)	(1.24)	(0.50)	(0.14)	(0.44)
Under-5 Services	-0.38	-0.13	-0.00	-0.17	-0.17	0.15	-2.18	-0.81	-0.95	-0.38	0.26	0.15+	0.37
	(0.36)	(0.53)	(0.18)	(0.23)	(0.16)	(0.20)	(3.90)	(1.28)	(0.88)	(1.22)	(0.25)	(0.09)	(0.24)
Any health expenditures	0.45	0.08	0.51	0.29	0.78	0.08	5.95	2.53	1.49	2.38	-0.22	-0.24	-0.71
	(0.60)	(0.77)	(0.40)	(0.34)	(0.52)	(0.43)	(6.27)	(1.93)	(1.54)	(1.85)	(0.49)	(0.15)	(0.53)
Solid food > 1/day	0.05	-0.06	-0.00	-0.04	-0.07	0.05	-3.51	-0.70	-1.13	-0.03	0.13	-0.03	-0.04
	(0.28)	(0.51)	(0.24)	(0.15)	(0.20)	(0.26)	(3.64)	(0.91)	(0.99)	(0.89)	(0.30)	(0.10)	(0.22)
Nutrition program	0.40	-1.12	-0.35	0.05	-0.60	-0.37	3.33	1.11	1.22	0.65	-0.10	-0.26	0.08
	(0.70)	(1.23)	(0.55)	(0.47)	(0.50)	(0.48)	(7.69)	(2.32)	(1.91)	(2.17)	(0.67)	(0.17)	(0.63)
Vitamin A past day	-0.07	0.31	-0.17	0.01	-0.18	-0.37+	-3.61	-1.08	-0.93	-0.71	0.09	0.11	0.26
	(0.29)	(0.40)	(0.18)	(0.16)	(0.24)	(0.21)	(2.64)	(0.91)	(0.68)	(0.92)	(0.25)	(0.09)	(0.27)
AE-L annual food exp.	-0.00	0.00	0.00	0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	2.22	-3.48	-1.30	-0.48	-0.93	-1.22	22.79	7.79	5.47	7.12	1.03	-0.77	0.63
	(2.68)	(2.89)	(1.87)	(1.48)	(1.51)	(1.84)	(28.21)	(6.42)	(7.09)	(5.91)	(2.19)	(0.71)	(1.85)
Food group AE-L Kcal/day													
Cereals and tubers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and vegetables	-0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00	-0.00	-0.00	0.00	-0.00	-0.00	0.01	0.01	0.00	0.01	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00	-0.00+	-0.00	-0.00	-0.00	0.00	0.00	0.00	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Food expenditure shares													
Cereals and tubers	-0.39	-0.77	0.97	-0.35	-0.41	1.51	8.99	3.79	2.59	3.15	-0.28	0.40	1.18
	(2.63)	(3.72)	(2.03)	(1.54)	(2.46)	(2.41)	(33.54)	(7.74)	(9.23)	(6.45)	(2.90)	(1.00)	(2.43)
Fruits and vegetables	0.72	-3.05	0.67	-1.27	-0.40	2.09	23.70	6.08	4.76	4.62	-0.19	0.51	1.33
	(3.74)	(5.19)	(2.40)	(1.74)	(2.71)	(3.10)	(40.45)	(9.85)	(11.09)	(8.53)	(3.36)	(1.16)	(2.90)
Meats, etc.	-0.50	2.65	0.77	-0.44	0.04	1.59	23.35	4.80	7.29	0.26	-2.44	0.69	-1.13
	(3.28)	(4.57)	(2.52)	(2.05)	(3.05)	(2.90)	(40.25)	(9.82)	(11.00)	(7.32)	(3.18)	(0.92)	(2.81)
Legumes, etc.	1.10	0.92	1.07	1.51	-0.51	0.37	27.62	8.25	9.44	3.88	-1.63	0.13	-0.06
	(2.49)	(3.48)	(2.31)	(1.76)	(2.09)	(2.22)	(33.63)	(7.68)	(9.43)	(6.75)	(2.93)	(1.02)	(2.03)

*Notes: All models control for a vector of baseline household characteristics and contemporaneous child characteristics. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. + $p<0.10$ * $p<0.05$ ** $p<0.01$ *** $p<0.001$*

Table 3.4. A. Heterogeneous Impacts on Health Demand - Panel of Children (N = 1,726)

	DD* Poorest	DD* Small HH	DD* HK	DD* Continuous Share	High Share Impact	Low Share Impact
Health passport	0.03	-0.14+	0.01	-0.00+	-0.04	0.05
	(0.06)	(0.08)	(0.08)	(0.00)	(0.04)	(0.04)
Under-5 services	0.13	-0.11	-0.02	0.00	-0.04	-0.13*
	(0.10)	(0.09)	(0.08)	(0.00)	(0.07)	(0.05)
Any health expenditures	-0.11	0.10	-0.06	0.00	0.04	0.03
	(0.11)	(0.12)	(0.07)	(0.00)	(0.04)	(0.08)
Solid food > 1/day	0.06	-0.08	0.01	0.00	-0.03	-0.04
	(0.07)	(0.09)	(0.06)	(0.00)	(0.05)	(0.05)
Nutrition program	0.01	-0.00	-0.05	-0.00	0.01	-0.03
	(0.04)	(0.06)	(0.04)	(0.00)	(0.03)	(0.03)
Vitamin A past day	-0.04	0.16+	0.01	0.00	-0.04	0.02
	(0.10)	(0.09)	(0.08)	(0.00)	(0.07)	(0.06)
AE-L annual	-682.28	3,308.41	-7,015.22	117.99	1,1691.40***	9,998.96**
food expenditures	(5,171.31)	(7,539.44)	(5,634.67)	(235.79)	(1,511.86)	(3,332.62)
Food share	-0.02	0.05	0.04	-0.00+	-0.05**	-0.02
	(0.02)	(0.04)	(0.03)	(0.00)	(0.01)	(0.02)
Food group AE-L Kcal/day						
Cereals and tubers	-8.56	282.37	-15.88	-3.95	285.98*	334.91+
	(277.22)	(298.25)	(231.91)	(6.49)	(134.66)	(181.88)
Fruit and vegetables	-22.14	32.20	-11.87	0.45	30.06*	6.81
	(19.00)	(20.53)	(14.60)	(0.59)	(14.47)	(19.90)
Meat, etc.	-6.38	-15.14	2.15	-0.31	21.10*	26.82*
	(15.31)	(23.83)	(13.52)	(0.49)	(8.08)	(11.71)
Legumes, etc.	-39.24	63.75	-31.30	-1.65	46.07+	55.29
	(54.88)	(70.69)	(54.79)	(1.49)	(25.24)	(45.84)
Oils, etc.	-102.32	121.66	-47.18	0.31	179.02***	125.92*
	(87.05)	(95.37)	(77.69)	(2.80)	(33.85)	(51.60)
Food expenditure shares						
Cereals and tubers	-0.01	-0.03	0.03	0.00	-0.04	-0.05
	(0.05)	(0.05)	(0.04)	(0.00)	(0.03)	(0.05)
Fruit and vegetables	-0.00	0.03	-0.03	0.00	-0.01	-0.00
	(0.04)	(0.04)	(0.03)	(0.00)	(0.03)	(0.03)
Meat, etc.	0.03	-0.04	0.02	0.00	0.02	0.01
	(0.03)	(0.03)	(0.02)	(0.00)	(0.01)	(0.02)
Legumes, etc.	-0.01	0.03	-0.01	-0.00	-0.00	0.01
	(0.03)	(0.04)	(0.03)	(0.00)	(0.01)	(0.02)

Notes: All models control for a vector of baseline household characteristics and contemporaneous child characteristics. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses.
*+ p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.4. B. Heterogeneous Impacts on Health Demand - Panel of Households (N = 2,883)

	DD* Poorest	DD* Small HH	DD* HK	DD* Continuous Share	High Share Impact	Low Share Impact
Health passport	-0.04	-0.03	-0.02	-0.00***	-0.01	0.07*
	(0.04)	(0.06)	(0.07)	(0.00)	(0.04)	(0.03)
Under-5 services	0.05	0.03	-0.05	-0.00	-0.00	-0.04
	(0.07)	(0.07)	(0.08)	(0.00)	(0.05)	(0.07)
Any health expenditures	-0.14	0.10	-0.01	0.00	0.01	0.05
	(0.08)	(0.09)	(0.06)	(0.00)	(0.05)	(0.05)
Solid food > 1/day	0.03	0.00	-0.03	0.00+	-0.01	0.01
	(0.04)	(0.06)	(0.06)	(0.00)	(0.04)	(0.04)
Nutrition program	0.01	0.02	-0.04	0.00	0.01	-0.03
	(0.04)	(0.05)	(0.03)	(0.00)	(0.02)	(0.03)
Vitamin A past day	0.07	0.04	0.06	0.00+	-0.01	-0.03
	(0.07)	(0.08)	(0.08)	(0.005)	(0.07)	(0.06)
AE-L annual	-1839.35	2988.56	-6702.48	444.48*	9138.66***	8548.07**
food expenditures	(3692.87)	(4329.90)	(4435.00)	(178.09)	(1593.54)	(2889.61)
Food share	-0.05*	0.07**	-0.00	0.00	-0.04***	0.00
	(0.02)	(0.03)	(0.02)	(0.008)	(0.01)	(0.01)
Food group AE-L Kcal/day						
Cereals and tubers	-384.77	639.46+	129.44	18.31**	257.55+	470.63**
	(227.87)	(356.96)	(211.38)	(6.11)	(125.95)	(167.22)
Fruit and vegetables	-14.87	28.13	-17.76	0.85	26.23+	10.11
	(17.34)	(17.62)	(16.11)	(0.56)	(14.28)	(19.98)
Meat, etc.	-16.25	-9.62	6.60	0.03	21.82**	27.06**
	(12.27)	(21.49)	(13.44)	(0.36)	(7.57)	(9.15)
Legumes, etc.	-58.15	100.64*	-46.37	1.20	42.18	72.47+
	(36.66)	(46.66)	(47.92)	(1.00)	(29.62)	(37.13)
Oils, etc.	-116.55+	53.79	-39.34	-0.72	140.36***	131.33*
	(65.72)	(49.24)	(61.35)	(2.60)	(31.33)	(54.11)
Food expenditure shares						
Cereals and tubers	-0.03	-0.02	0.05	0.00	-0.06*	-0.04
	(0.04)	(0.04)	(0.03)	(0.00)	(0.02)	(0.04)
Fruit and vegetables	0.01	0.02	-0.03	-0.00	0.00	-0.01
	(0.03)	(0.04)	(0.03)	(0.00)	(0.03)	(0.03)
Meat, etc.	0.01	-0.02	0.02	0.00	0.02	0.01
	(0.02)	(0.02)	(0.02)	(0.00)	(0.01)	(0.02)
Legumes, etc.	0.01	0.02	-0.03	0.00	-0.00	0.00
	(0.02)	(0.02)	(0.03)	(0.00)	(0.02)	(0.02)

*Notes: All models control for a vector of baseline household characteristics and contemporaneous child characteristics. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.5. A. Heterogeneous Impacts on Health Production - Panel of Children (N = 1,726)

	Health Status	Health Improved	Any Illness	Diarrhea	Fever	Cough	Height	WAZ	HAZ	WHZ	Stunted	Wasted	Underweigh t
DD*Poorest	-0.00	-0.52	0.44	0.4	0.36	0.13	-4.13	0.30	-0.21	0.87	-0.23	-0.30	-0.35
	(0.35)	(1.29)	(0.83)	(0.48)	(0.66)	(0.49)	(6.11)	(1.30)	(1.15)	(1.84)	(0.60)	(0.42)	(0.74)
DD*Small HH	-0.52	-0.19	-0.06	0.05	-0.03	-0.46	-2.68	-0.71	-0.91	-0.43	0.11	0.05	0.33
	(0.33)	(0.47)	(0.33)	(0.28)	(0.25)	(0.41)	(3.23)	(1.00)	(1.03)	(0.95)	(0.37)	(0.11)	(0.45)
DD*HK	-0.15	0.12	-0.24	0.00	-0.27+	-0.16	-0.52	0.08	0.13	0.01	-0.11	0.03	0.06
	(0.16)	(0.26)	(0.21)	(0.17)	(0.15)	(0.26)	(1.77)	(0.63)	(0.64)	(0.51)	(0.28)	(0.05)	(0.32)
DD* Cont. Share	0.01	0.01	0.01	0.01	0.01	0.02	0.12	0.03	0.04	0.02	-0.01	-0.00	-0.02
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.11)	(0.03)	(0.04)	(0.03)	(0.01)	(0.00)	(0.02)
High Share Impact	0.17	0.12	0.13	0.24	0.09	0.15	2.66	0.75	0.92+	0.34	-0.33+	0.00	-0.31
	(0.24)	(0.25)	(0.24)	(0.16)	(0.22)	(0.35)	(1.77)	(0.49)	(0.53)	(0.58)	(0.20)	(0.07)	(0.32)
Low Share Impact	-0.03	-0.15	-0.11	-0.19*	0.00	-0.04	-0.23	-0.46	-0.08	-0.56	0.11	0.03	0.30
	(0.19)	(0.23)	(0.22)	(0.09)	(0.18)	(0.29)	(1.52)	(0.44)	(0.47)	(0.51)	(0.17)	(0.07)	(0.30)

*Notes: Program impacts among high share children were significantly different from impacts among low share children for diarrhea (p = 0.06) and HAZ (p = 0.02). All models control for a vector of baseline household characteristics and contemporaneous child characteristics. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.5. B. Heterogeneous Impacts on Health Production - Children in Panel Households (N = 2,883)

	Health Status	Health Improved	Any Illness	Diarrhea	Fever	Cough	Height	WAZ	HAZ	WHZ	Stunted	Wasted	Underweight
DD*Poorest	-0.03	-0.46	-0.01	0.02	0.13	-0.08	0.76	0.61	0.12	0.78+	0.12	-0.15	0.04
	(0.21)	(0.38)	(0.22)	(0.14)	(0.24)	(0.29)	(2.59)	(0.57)	(0.81)	(0.46)	(0.27)	(0.09)	(0.28)
DD*Small HH	-0.26	0.46	0.16	0.05	-0.00	0.04	-3.35	-1.04	-0.90	-0.81	-0.09	0.03	0.04
	(0.34)	(0.46)	(0.25)	(0.18)	(0.20)	(0.22)	(3.14)	(0.86)	(0.86)	(0.83)	(0.25)	(0.09)	(0.23)
DD*HK	-0.10	0.05	-0.14	-0.05	-0.27+	0.07	-0.84	-0.06	-0.05	-0.03	0.02	-0.01	0.08
	(0.18)	(0.23)	(0.11)	(0.09)	(0.16)	(0.11)	(1.60)	(0.59)	(0.47)	(0.59)	(0.17)	(0.05)	(0.17)
DD* Cont. Share	0.73	-1.52	-0.55	-0.14	-0.39	-0.14	11.44	2.80	2.27	2.02	0.15	-0.46	0.16
	(0.96)	(1.52)	(0.64)	(0.46)	(0.78)	(0.81)	(9.26)	(2.18)	(2.69)	(1.83)	(0.94)	(0.37)	(0.75)
High Share Impact	0.10	-0.17	0.01	0.05	-0.08	-0.01	2.30	0.59+	0.81+	0.21	-0.10	-0.06	0.06
	(0.13)	(0.27)	(0.13)	(0.11)	(0.15)	(0.14)	(1.63)	(0.30)	(0.48)	(0.32)	(0.17)	(0.07)	(0.12)
Low Share Impact	0.02	0.01	-0.07	-0.03	-0.06	-0.09	-0.36	-0.19	0.07	-0.31	-0.01	0.01	0.13
	(0.08)	(0.19)	(0.10)	(0.06)	(0.09)	(0.10)	(0.93)	(0.19)	(0.29)	(0.20)	(0.12)	(0.04)	(0.08)

Notes: Program impacts among high share children were significantly different from impacts among low share children for diarrhea (p = 0.06) and height (p = 0.10). All models control for a vector of baseline household characteristics and contemporaneous child characteristics. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. + $p<0.10$ * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 3.6. A. Fixed-Effects Estimation - Effects of Health Inputs on Reported Health Status

	Child Panel			Household Panel	
	Pooled OLS	FE-Child	FE-Household	Pooled OLS	FE - Household
Time	0.01	-0.06	-0.01	-0.01	0.00
	(0.04)	(0.15)	(0.06)	(0.04)	(0.07)
DD	0.01	0.01	0.01	-0.01	-0.02
	(0.03)	(0.06)	(0.06)	(0.03)	(0.06)
Health passport	0.01	-0.03	-0.02	0.03	-0.00
	(0.02)	(0.06)	(0.05)	(0.02)	(0.04)
Under-5 Services	-0.01	-0.00	0.00	-0.02	-0.01
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
Any health	-0.05	-0.02	-0.03	-0.06*	-0.04
expenditures	(0.03)	(0.05)	(0.05)	(0.02)	(0.04)
Solid food >1/day	0.06+	0.13*	0.13*	0.06+	0.09*
	(0.03)	(0.05)	(0.05)	(0.03)	(0.04)
Nutrition program	-0.19*	-0.20	-0.21	-0.22**	-0.21
	(0.08)	(0.14)	(0.12)	(0.07)	(0.13)
Vitamin A past day	0.02	0.01	0.00	0.03	0.01
	(0.02)	(0.05)	(0.05)	(0.02)	(0.04)
AE-L annual	0.00	-0.00	-0.00	0.00	-0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.15+	-0.05	-0.05	-0.10	-0.04
	(0.09)	(0.21)	(0.20)	(0.06)	(0.19)
Food group AE-L Kcal/day					
Cereals and Tubers	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food expenditure shares					
Cereals and Tubers	-0.00	0.17	0.16	-0.01	0.08
	(0.11)	(0.21)	(0.19)	(0.10)	(0.19)
Fruits and Vegetables	-0.18	-0.08	-0.08	-0.12	-0.06
	(0.12)	(0.21)	(0.20)	(0.09)	(0.17)
Meats, etc.	0.19+	0.28	0.28	0.21*	0.25
	(0.11)	(0.29)	(0.27)	(0.10)	(0.26)
Legumes, etc.	0.04	0.03	0.02	-0.06	-0.08
	(0.10)	(0.22)	(0.21)	(0.12)	(0.18)
N	1726	1726	1726	2883	2883
Adjusted R2	0.027	0.015	0.094	0.037	0.149

Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses.
*+ p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. B. Fixed-Effects Estimation - Effects of Health Inputs on Health Improvement

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - household	Pooled OLS	FE - household
Time	0.15**	0.38+	0.21*	0.13**	0.15*
	(0.05)	(0.20)	(0.08)	(0.04)	(0.07)
DD	-0.07	-0.09	-0.08	-0.06	-0.05
	(0.05)	(0.10)	(0.09)	(0.04)	(0.08)
Health passport	0.06	0.17+	0.16*	0.01	0.08
	(0.04)	(0.09)	(0.08)	(0.04)	(0.06)
Under-5 Services	0.03	0.03	0.02	0.03	0.02
	(0.03)	(0.06)	(0.05)	(0.03)	(0.05)
Any health	-0.02	-0.01	-0.00	0.02	0.05
expenditures	(0.03)	(0.08)	(0.06)	(0.03)	(0.06)
Solid food >1/day	-0.02	-0.02	-0.02	-0.01	-0.01
	(0.04)	(0.09)	(0.08)	(0.03)	(0.06)
Nutrition program	-0.08+	-0.07	-0.07	-0.06+	-0.04
	(0.04)	(0.09)	(0.08)	(0.03)	(0.08)
Vitamin A past day	-0.02	0.03	0.03	-0.01	0.05
	(0.03)	(0.07)	(0.06)	(0.02)	(0.05)
AE-L annual	0.00*	0.00**	0.00**	0.00	0.00**
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.27*	-0.46+	-0.47*	-0.23*	-0.31
	(0.11)	(0.23)	(0.22)	(0.09)	(0.23)
Food group AE-L Kcal/day					
Cereals and Tubers	-0.00+	-0.00*	-0.00*	-0.00	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00	-0.00	0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	0.04	0.25	0.24	-0.00	0.23
	(0.22)	(0.43)	(0.41)	(0.16)	(0.35)
Fruits and Vegetables	-0.02	0.04	0.04	-0.06	-0.01
	(0.28)	(0.55)	(0.51)	(0.19)	(0.46)
Meats, etc.	-0.29	-0.28	-0.29	-0.14	-0.07
	(0.27)	(0.56)	(0.54)	(0.16)	(0.45)
Legumes, etc.	0.23	0.24	0.26	0.10	0.08
	(0.27)	(0.54)	(0.50)	(0.19)	(0.47)
N	1726	1726	1726	2883	2883
Adjusted R2	0.027	0.015	0.094	0.037	0.149

Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses.
*+ p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. C. Fixed-Effects Estimation - Effects of Health Inputs on Incidence of Illness

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	-0.01	-0.15	0.02	-0.04	-0.04
	(0.04)	(0.24)	(0.07)	(0.03)	(0.06)
DD	-0.06	-0.02	-0.02	-0.03	0.00
	(0.03)	(0.07)	(0.07)	(0.04)	(0.06)
Health passport	0.03	-0.03	-0.03	0.01	-0.02
	(0.04)	(0.07)	(0.06)	(0.03)	(0.05)
Under-5 Services	0.05	0.09+	0.08+	0.06*	0.07+
	(0.03)	(0.05)	(0.04)	(0.03)	(0.04)
Any health	0.44***	0.42***	0.42***	0.43***	0.43***
expenditures	(0.03)	(0.07)	(0.07)	(0.02)	(0.06)
Solid food >1/day	-0.12**	-0.12+	-0.13*	-0.10**	-0.09
	(0.03)	(0.07)	(0.06)	(0.03)	(0.05)
Nutrition program	0.08	0.12	0.12+	0.08	0.07
	(0.07)	(0.08)	(0.07)	(0.05)	(0.07)
Vitamin A past day	-0.08*	-0.06	-0.07	-0.08**	-0.06
	(0.03)	(0.06)	(0.05)	(0.03)	(0.05)
AE-L annual	0.00	0.00	0.00	0.00	0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.32**	-0.17	-0.17	-0.34**	-0.18
	(0.11)	(0.22)	(0.21)	(0.11)	(0.19)
Food group AE-L Kcal/day					
Cereals and Tubers	-0.00*	-0.00*	-0.00*	-0.00+	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00**	0.00	0.00	0.00+	0.00+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00*	0.00	0.00	0.00+	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	0.00	0.13	0.12	-0.13	0.14
	(0.16)	(0.27)	(0.27)	(0.14)	(0.27)
Fruits and Vegetables	0.09	0.14	0.13	-0.03	0.10
	(0.19)	(0.31)	(0.30)	(0.18)	(0.33)
Meats, etc.	-0.59**	-0.37	-0.37	-0.44*	-0.41
	(0.18)	(0.37)	(0.35)	(0.17)	(0.34)
Legumes, etc.	-0.28	-0.15	-0.17	-0.23	-0.20
	(0.18)	(0.24)	(0.23)	(0.23)	(0.28)
N	1726	1726	1726	2883	2883
Adjusted R2	0.196	0.278	0.295	0.174	0.283

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. D. Fixed-Effects Estimation - Effects of Health Inputs on Incidence of Diarrhea

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	0.02	-0.01	0.03	-0.02	-0.01
	(0.02)	(0.15)	(0.05)	(0.01)	(0.03)
DD	0.02	0.04	0.04	0.02	0.05+
	(0.02)	(0.04)	(0.04)	(0.02)	(0.03)
Health passport	-0.01	0.05	0.03	0.00	0.02
	(0.02)	(0.04)	(0.04)	(0.02)	(0.04)
Under-5 Services	0.02	0.00	0.00	0.01	-0.01
	(0.02)	(0.03)	(0.03)	(0.01)	(0.03)
Any health	0.13**	0.08	0.10	0.13***	0.13**
expenditures	(0.04)	(0.07)	(0.06)	(0.03)	(0.05)
Solid food >1/day	-0.11***	-0.10+	-0.11+	-0.07***	-0.06
	(0.03)	(0.06)	(0.05)	(0.02)	(0.04)
Nutrition program	-0.01	0.04	0.04	0.04	0.02
	(0.04)	(0.08)	(0.07)	(0.04)	(0.07)
Vitamin A past day	-0.04*	-0.02	-0.02	-0.04**	-0.02
	(0.02)	(0.04)	(0.03)	(0.01)	(0.04)
AE-L annual	0.00	-0.00	-0.00	0.00	-0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.12	0.07	0.08	-0.15+	0.07
	(0.10)	(0.16)	(0.15)	(0.08)	(0.14)
Food group AE-L Kcal/day					
Cereals and Tubers	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	0.00	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00	-0.00	-0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	0.09	0.12	0.13	0.11	0.22
	(0.13)	(0.20)	(0.19)	(0.09)	(0.18)
Fruits and Vegetables	0.10	-0.00	-0.00	0.10	0.10
	(0.14)	(0.22)	(0.20)	(0.10)	(0.20)
Meats, etc.	0.08	0.04	0.06	0.09	-0.01
	(0.16)	(0.31)	(0.29)	(0.11)	(0.24)
Legumes, etc.	-0.11	-0.12	-0.11	0.10	-0.01
	(0.16)	(0.27)	(0.26)	(0.12)	(0.21)
N	1726	1726	1726	2883	2883
Adjusted R2	0.096	0.162	0.174	0.089	0.157

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. E. Fixed-Effects Estimation - Effects of Health Inputs on Incidence of Fever

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	-0.02	-0.02	-0.01	-0.02	-0.04
	(0.04)	(0.20)	(0.06)	(0.02)	(0.05)
DD	-0.03	0.02	0.02	-0.03	0.02
	(0.03)	(0.06)	(0.06)	(0.03)	(0.05)
Health passport	0.02	-0.04	-0.03	0.02	-0.00
	(0.04)	(0.07)	(0.06)	(0.03)	(0.05)
Under-5 Services	0.06+	0.09+	0.09*	0.05	0.06
	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)
Any health	0.29***	0.32***	0.31***	0.26***	0.27***
expenditures	(0.03)	(0.07)	(0.06)	(0.03)	(0.05)
Solid food >1/day	-0.10*	-0.10	-0.11	-0.08*	-0.05
	(0.04)	(0.08)	(0.07)	(0.04)	(0.06)
Nutrition program	-0.02	-0.06	-0.05	-0.05	-0.06
	(0.05)	(0.11)	(0.09)	(0.05)	(0.08)
Vitamin A past day	-0.06+	-0.04	-0.04	-0.05+	-0.03
	(0.04)	(0.07)	(0.06)	(0.03)	(0.05)
AE-L annual	-0.00	0.00	0.00	0.00	0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.31**	-0.22	-0.22	-0.24**	-0.23
	(0.11)	(0.26)	(0.24)	(0.08)	(0.23)
Food group AE-L Kcal/day					
Cereals and Tubers	0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00*	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00+	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00+	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	-0.23	-0.33	-0.34	-0.26*	-0.30
	(0.15)	(0.25)	(0.23)	(0.12)	(0.25)
Fruits and Vegetables	-0.08	-0.25	-0.26	-0.14	-0.25
	(0.17)	(0.26)	(0.25)	(0.16)	(0.29)
Meats, etc.	-0.55**	-0.47	-0.48	-0.35*	-0.51
	(0.18)	(0.35)	(0.33)	(0.14)	(0.33)
Legumes, etc.	-0.33+	-0.36	-0.36	-0.34*	-0.40
	(0.18)	(0.35)	(0.32)	(0.16)	(0.28)
N	1726	1726	1726	2883	2883
Adjusted R2	0.102	0.146	0.186	0.080	0.178

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. F. Fixed-Effects Estimation - Effects of Health Inputs on Incidence of Cough

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	-0.10**	-0.18	-0.10	-0.12***	-0.13**
	(0.03)	(0.18)	(0.06)	(0.03)	(0.04)
DD	-0.02	-0.02	-0.02	-0.00	-0.01
	(0.03)	(0.06)	(0.06)	(0.03)	(0.05)
Health passport	0.03	-0.03	-0.03	0.01	-0.02
	(0.02)	(0.06)	(0.05)	(0.02)	(0.04)
Under-5 Services	-0.01	-0.02	-0.01	0.02	0.02
	(0.02)	(0.05)	(0.04)	(0.02)	(0.03)
Any health	0.21***	0.22**	0.20**	0.23***	0.21**
expenditures	(0.03)	(0.07)	(0.06)	(0.03)	(0.06)
Solid food >1/day	-0.11*	-0.12	-0.12	-0.07	-0.10
	(0.05)	(0.09)	(0.08)	(0.05)	(0.06)
Nutrition program	0.05	0.02	0.02	0.05	-0.03
	(0.06)	(0.11)	(0.10)	(0.04)	(0.07)
Vitamin A past day	-0.12***	-0.07	-0.09+	-0.09***	-0.08+
	(0.03)	(0.05)	(0.05)	(0.02)	(0.04)
AE-L annual	0.00	0.00	0.00	0.00	0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.24**	-0.16	-0.17	-0.27**	-0.12
	(0.08)	(0.18)	(0.17)	(0.09)	(0.18)
Food group AE-L Kcal/day					
Cereals and Tubers	0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	-0.00	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	-0.12	0.14	0.13	-0.10	0.21
	(0.17)	(0.25)	(0.24)	(0.14)	(0.23)
Fruits and Vegetables	0.02	0.31	0.30	-0.04	0.26
	(0.15)	(0.26)	(0.25)	(0.14)	(0.26)
Meats, etc.	-0.41*	0.05	0.03	-0.28*	0.14
	(0.18)	(0.38)	(0.36)	(0.11)	(0.27)
Legumes, etc.	0.07	0.46	0.44	0.05	0.38
	(0.19)	(0.32)	(0.31)	(0.20)	(0.27)
N	1726	1726	1726	2883	2883
Adjusted R2	0.122	0.168	0.189	0.116	0.215

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + $p<0.10$ * $p<0.05$ ** $p<0.01$ *** $p<0.001$*

Table 3.6. G. Fixed-Effects Estimation - Effects of Health Inputs on Height (cm)

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	-0.29	7.03***	-0.46	-0.36	-0.72*
	(0.44)	(1.13)	(0.54)	(0.37)	(0.31)
DD	-0.00	0.54	0.74*	-0.11	0.28
	(0.39)	(0.40)	(0.36)	(0.41)	(0.38)
Health passport	-0.01	-0.49	-0.40	-0.94*	-0.76
	(0.38)	(0.65)	(0.45)	(0.37)	(0.47)
Under-5 Services	-0.89*	0.30	0.15	-0.65+	-0.32
	(0.40)	(0.34)	(0.37)	(0.35)	(0.44)
Any health	0.03	0.15	0.14	-0.25	-0.10
expenditures	(0.35)	(0.27)	(0.29)	(0.34)	(0.42)
Solid food >1/day	0.08	0.22	0.13	0.01	0.51
	(0.50)	(0.43)	(0.34)	(0.34)	(0.42)
Nutrition program	-0.58	-0.30	-0.54	-0.96*	-0.58
	(0.74)	(0.59)	(0.63)	(0.44)	(0.85)
Vitamin A past day	0.50	0.32	0.46	0.86**	0.93*
	(0.30)	(0.37)	(0.32)	(0.27)	(0.37)
AE-L annual	0.00	-0.00	-0.00	0.00	-0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-1.27	0.09	-0.09	-1.79	-0.60
	(1.36)	(1.85)	(1.64)	(1.10)	(1.50)
Food group AE-L Kcal/day					
Cereals and Tubers	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and					
Vegetables	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.01*	0.00	0.00	0.00	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	-2.29	1.28	1.27	-0.98	0.76
	(2.18)	(1.57)	(1.30)	(1.88)	(1.87)
Fruits and					
Vegetables	-0.68	1.75	2.06	-0.08	1.82
	(2.16)	(1.83)	(1.67)	(1.64)	(1.87)
Meats, etc.	-3.89	0.63	-0.04	-1.07	-0.50
	(2.95)	(2.14)	(1.82)	(2.59)	(2.32)
Legumes, etc.	-1.31	-0.37	0.51	-1.89	1.05
	(2.62)	(2.40)	(2.47)	(2.36)	(2.57)
N	1726	1726	1726	2883	2883
Adjusted R2	0.765	0.936	0.908	0.782	0.877

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. H. Fixed-Effects Estimation - Effects of Health Inputs on Weight-for-Age Z-Score

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	-0.13	1.38***	-0.20	-0.12	-0.18+
	(0.10)	(0.30)	(0.14)	(0.08)	(0.09)
DD	-0.01	0.02	0.07	-0.08	0.03
	(0.08)	(0.12)	(0.11)	(0.07)	(0.11)
Health passport	-0.02	-0.06	-0.05	-0.15*	-0.10
	(0.08)	(0.10)	(0.08)	(0.06)	(0.07)
Under-5 Services	-0.22**	0.04	0.00	-0.20**	-0.14+
	(0.07)	(0.09)	(0.09)	(0.06)	(0.08)
Any health	-0.12	-0.06	-0.06	-0.16+	-0.09
expenditures	(0.10)	(0.07)	(0.08)	(0.08)	(0.09)
Solid food >1/day	-0.01	-0.03	-0.05	-0.06	-0.06
	(0.09)	(0.10)	(0.08)	(0.06)	(0.09)
Nutrition program	-0.26	-0.15	-0.13	-0.24+	-0.18
	(0.16)	(0.13)	(0.13)	(0.14)	(0.17)
Vitamin A past day	0.10	-0.06	-0.03	0.11*	0.05
	(0.06)	(0.09)	(0.08)	(0.05)	(0.08)
AE-L annual	0.00+	0.00	0.00*	0.00**	0.00+
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.39	-0.33	-0.37	-0.49+	-0.36
	(0.31)	(0.33)	(0.32)	(0.24)	(0.31)
Food group AE-L Kcal/day					
Cereals and Tubers	-0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00	0.00	0.00	0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	-0.29	0.26	0.24	0.20	0.27
	(0.58)	(0.35)	(0.38)	(0.43)	(0.57)
Fruits and Vegetables	-0.33	0.02	0.07	0.08	0.28
	(0.60)	(0.30)	(0.34)	(0.47)	(0.44)
Meats, etc.	-0.31	-0.14	-0.29	0.05	-0.16
	(0.81)	(0.54)	(0.61)	(0.61)	(0.79)
Legumes, etc.	0.43	0.08	0.26	0.81	0.56
	(0.72)	(0.46)	(0.48)	(0.56)	(0.53)
N	1726	1726	1726	2883	2883
Adjusted R2	0.012	0.755	0.667	0.021	0.509

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. I. Fixed-Effects Estimation - Effects of Health Inputs on Height-for-Age Z-Score

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	0.01	2.17***	-0.08	-0.04	-0.15
	(0.12)	(0.40)	(0.18)	(0.11)	(0.09)
DD	-0.04	0.24	0.30*	-0.08	0.16
	(0.11)	(0.16)	(0.14)	(0.12)	(0.11)
Health passport	0.03	-0.08	-0.09	-0.18+	-0.15
	(0.12)	(0.17)	(0.12)	(0.10)	(0.14)
Under-5 Services	-0.34**	-0.12	-0.13	-0.27**	-0.26*
	(0.11)	(0.10)	(0.11)	(0.09)	(0.12)
Any health	0.04	0.11	0.11	-0.05	-0.02
expenditures	(0.10)	(0.09)	(0.09)	(0.09)	(0.11)
Solid food >1/day	-0.07	-0.02	-0.05	-0.06	-0.03
	(0.16)	(0.16)	(0.12)	(0.11)	(0.11)
Nutrition program	-0.23	-0.10	-0.15	-0.35*	-0.24
	(0.24)	(0.21)	(0.20)	(0.17)	(0.23)
Vitamin A past day	0.00	-0.13	-0.12	0.09	-0.03
	(0.08)	(0.13)	(0.11)	(0.07)	(0.09)
AE-L annual	0.00	-0.00	0.00	0.00	-0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.28	0.15	0.09	-0.38	0.02
	(0.38)	(0.46)	(0.43)	(0.28)	(0.38)
Food group AE-L Kcal/day					
Cereals and Tubers	0.00	0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00+	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	-0.55	0.45	0.44	-0.13	0.43
	(0.66)	(0.50)	(0.48)	(0.54)	(0.60)
Fruits and Vegetables	-0.01	0.73	0.82	0.19	0.82
	(0.63)	(0.55)	(0.52)	(0.50)	(0.53)
Meats, etc.	-1.11	0.35	0.15	-0.15	0.01
	(0.90)	(0.62)	(0.62)	(0.75)	(0.79)
Legumes, etc.	0.17	0.41	0.67	0.20	0.95
	(0.82)	(0.89)	(0.81)	(0.76)	(0.80)
N	1726	1726	1726	2883	2883
Adjusted R2	0.015	0.670	0.561	0.018	0.407

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. J. Fixed-Effects Estimation - Effects of Health Inputs on Weight-for-Height Z-Score

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	-0.19	0.13	-0.23	-0.13+	-0.13
	(0.11)	(0.34)	(0.16)	(0.08)	(0.11)
DD	0.02	-0.14	-0.12	-0.04	-0.07
	(0.09)	(0.14)	(0.13)	(0.08)	(0.13)
Health passport	-0.09	-0.06	-0.03	-0.06	-0.05
	(0.12)	(0.09)	(0.08)	(0.10)	(0.09)
Under-5 Services	-0.05	0.13	0.08	-0.08*	-0.02
	(0.04)	(0.12)	(0.10)	(0.04)	(0.08)
Any health	-0.18*	-0.14	-0.14	-0.18*	-0.11
expenditures	(0.09)	(0.10)	(0.10)	(0.07)	(0.11)
Solid food >1/day	0.03	-0.04	-0.04	-0.04	-0.10
	(0.09)	(0.09)	(0.08)	(0.07)	(0.14)
Nutrition program	-0.14	-0.09	-0.01	-0.04	-0.04
	(0.12)	(0.22)	(0.21)	(0.14)	(0.20)
Vitamin A past day	0.10	-0.02	0.00	0.05	0.02
	(0.07)	(0.10)	(0.10)	(0.05)	(0.11)
AE-L annual	0.00	0.00	0.00	0.00	0.00+
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.32	-0.58	-0.59	-0.38	-0.54
	(0.31)	(0.52)	(0.49)	(0.24)	(0.44)
Food group AE-L Kcal/day					
Cereals and Tubers	-0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00**	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00	0.00	0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	0.06	0.01	-0.01	0.42	0.07
	(0.43)	(0.57)	(0.56)	(0.38)	(0.64)
Fruits and Vegetables	-0.45	-0.60	-0.61	-0.02	-0.32
	(0.51)	(0.67)	(0.65)	(0.43)	(0.64)
Meats, etc.	0.44	-0.52	-0.58	0.23	-0.29
	(0.65)	(0.82)	(0.79)	(0.57)	(0.91)
Legumes, etc.	0.41	-0.31	-0.28	1.02+	-0.01
	(0.63)	(0.81)	(0.78)	(0.54)	(0.71)
N	1726	1726	1726	2883	2883
Adjusted R2	0.014	0.467	0.424	0.021	0.319

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. K. Fixed-Effects Estimation - Effects of Health Inputs on Incidence of Stunting

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	-0.02	-0.68***	-0.01	-0.00	0.04
	(0.05)	(0.16)	(0.08)	(0.04)	(0.04)
DD	0.01	-0.07	-0.09	0.03	-0.05
	(0.04)	(0.07)	(0.07)	(0.04)	(0.05)
Health passport	0.00	0.02	0.04	0.04	0.03
	(0.04)	(0.08)	(0.06)	(0.03)	(0.04)
Under-5 Services	0.12**	0.01	0.03	0.07**	0.05
	(0.03)	(0.05)	(0.05)	(0.02)	(0.04)
Any health	-0.01	-0.07+	-0.06	0.01	-0.03
expenditures	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
Solid food >1/day	0.04	0.02	0.04	0.04	0.05
	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)
Nutrition program	0.00	-0.07	-0.07	0.02	-0.01
	(0.05)	(0.11)	(0.10)	(0.04)	(0.10)
Vitamin A past day	0.01	0.02	0.02	-0.03	-0.02
	(0.03)	(0.05)	(0.04)	(0.03)	(0.04)
AE-L annual	0.00	0.00	-0.00	-0.00	0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	0.14	-0.07	-0.05	0.19+	-0.02
	(0.15)	(0.23)	(0.22)	(0.10)	(0.20)
Food group AE-L Kcal/day					
Cereals and Tubers	-0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and					
Vegetables	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00*	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	0.24	-0.27	-0.27	0.07	-0.19
	(0.23)	(0.22)	(0.22)	(0.19)	(0.30)
Fruits and					
Vegetables	0.04	-0.49*	-0.51*	-0.03	-0.42
	(0.22)	(0.23)	(0.22)	(0.19)	(0.27)
Meats, etc.	0.66+	-0.15	-0.07	0.14	-0.09
	(0.32)	(0.34)	(0.35)	(0.26)	(0.38)
Legumes, etc.	0.12	-0.23	-0.32	0.11	-0.25
	(0.24)	(0.25)	(0.27)	(0.21)	(0.29)
N	1726	1726	1726	2883	2883
Adjusted R2	0.009	0.487	0.401	0.006	0.300

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. L. Fixed-Effects Estimation - Effects of Health Inputs on Incidence of Wasting

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	0.01	0.01	0.02	0.01	0.02
	(0.01)	(0.06)	(0.02)	(0.01)	(0.02)
DD	0.00	-0.01	-0.01	0.00	-0.01
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Health passport	0.01	-0.00	-0.01	0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Under-5 Services	0.01	-0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Any health	0.02	0.02	0.02	0.02*	0.02
expenditures	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Solid food >1/day	0.00	-0.01	-0.01	0.02*	0.01
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Nutrition program	0.00	0.02	0.01	0.00	0.03
	(0.02)	(0.05)	(0.06)	(0.02)	(0.05)
Vitamin A past day	-0.01	-0.03	-0.03	0.00	-0.02
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
AE-L annual	0.00	0.00	0.00	0.00	0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	0.04	0.04	0.05	0.07+	0.07
	(0.05)	(0.09)	(0.09)	(0.04)	(0.08)
Food group AE-L Kcal/day					
Cereals and Tubers	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	-0.00**	-0.00	-0.00	-0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00	-0.00	0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	0.07+	0.02	0.02	0.04	0.02
	(0.04)	(0.10)	(0.09)	(0.05)	(0.11)
Fruits and Vegetables	0.12+	0.09	0.09	0.09	0.04
	(0.06)	(0.14)	(0.14)	(0.06)	(0.13)
Meats, etc.	0.01	0.03	0.04	0.00	0.01
	(0.05)	(0.12)	(0.11)	(0.06)	(0.13)
Legumes, etc.	0.03	-0.01	-0.01	0.01	0.05
	(0.07)	(0.15)	(0.14)	(0.07)	(0.14)
N	1726	1726	1726	2883	2883
Adjusted R2	0.009	0.106	0.079	0.012	0.061

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Table 3.6. M. Fixed-Effects Estimation - Effects of Health Inputs on Incidence of Underweight

	Child Panel			Household Panel	
	Pooled OLS	FE - child	FE - HH	Pooled OLS	FE - HH
Time	0.02	-0.30**	0.05	0.00	0.03
	(0.03)	(0.09)	(0.07)	(0.02)	(0.04)
DD	-0.01	-0.01	-0.02	0.03	0.01
	(0.02)	(0.05)	(0.04)	(0.02)	(0.04)
Health passport	-0.01	0.02	0.03	0.02	-0.01
	(0.02)	(0.04)	(0.04)	(0.02)	(0.03)
Under-5 Services	0.08***	0.02	0.03	0.04*	0.05+
	(0.02)	(0.04)	(0.03)	(0.02)	(0.03)
Any health	0.04	-0.00	-0.00	0.04+	0.02
expenditures	(0.03)	(0.04)	(0.04)	(0.02)	(0.04)
Solid food >1/day	-0.01	-0.05	-0.05	0.02	-0.03
	(0.03)	(0.05)	(0.04)	(0.01)	(0.03)
Nutrition program	0.14*	0.14+	0.11+	0.10*	0.05
	(0.05)	(0.07)	(0.06)	(0.04)	(0.06)
Vitamin A past day	-0.01	0.02	0.01	0.00	0.01
	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)
AE-L annual	-0.00**	-0.00	-0.00	-0.00*	-0.00
food expenditures	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	0.18+	0.13	0.14	0.20*	0.16
	(0.09)	(0.16)	(0.16)	(0.08)	(0.15)
Food group AE-L Kcal/day					
Cereals and Tubers	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and Vegetables	0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	0.00	-0.00	-0.00	-0.00	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legumes, etc.	0.00	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00+	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food Expenditure Shares					
Cereals and Tubers	0.10	-0.16	-0.16	-0.07	-0.15
	(0.15)	(0.18)	(0.17)	(0.13)	(0.17)
Fruits and Vegetables	0.09	-0.14	-0.15	-0.01	-0.23
	(0.15)	(0.16)	(0.16)	(0.14)	(0.15)
Meats, etc.	0.11	-0.05	-0.01	0.05	0.04
	(0.18)	(0.19)	(0.20)	(0.19)	(0.27)
Legumes, etc.	-0.11	-0.15	-0.19	-0.19	-0.24
	(0.15)	(0.31)	(0.30)	(0.15)	(0.31)
N	1726	1726	1726	2883	2883
Adjusted R2	0.012	0.543	0.489	0.008	0.316

*Notes: Pooled OLS and Fixed-Effects models control for contemporaneous child age in months and orphan status. Sample weights are applied to all models and robust standard errors are corrected for clustering at the Village Cluster level and are shown in parentheses. "HH" indicates household. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001*

Figure 3.1.A. Participant Flow Diagram - Panel of Children

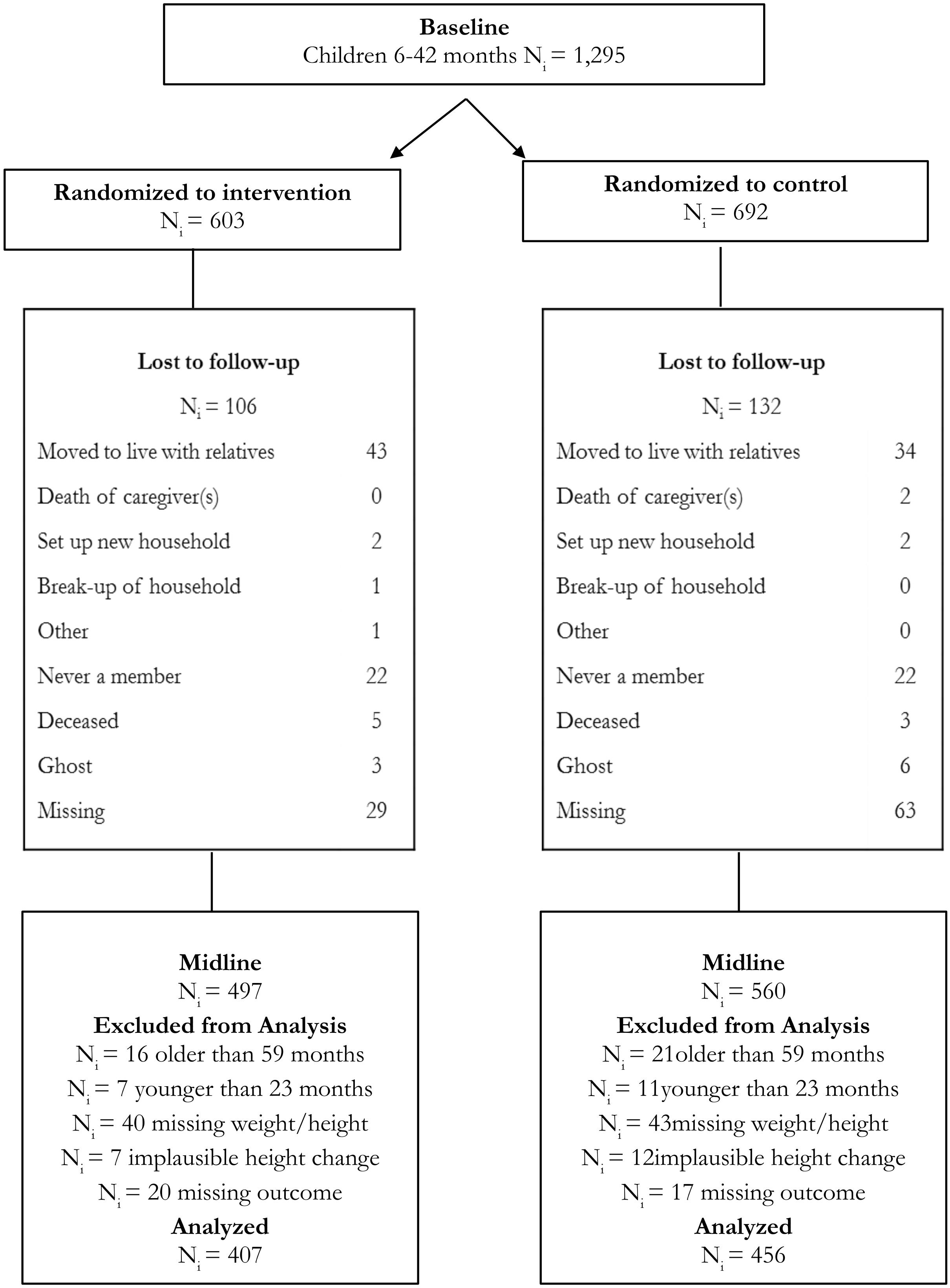
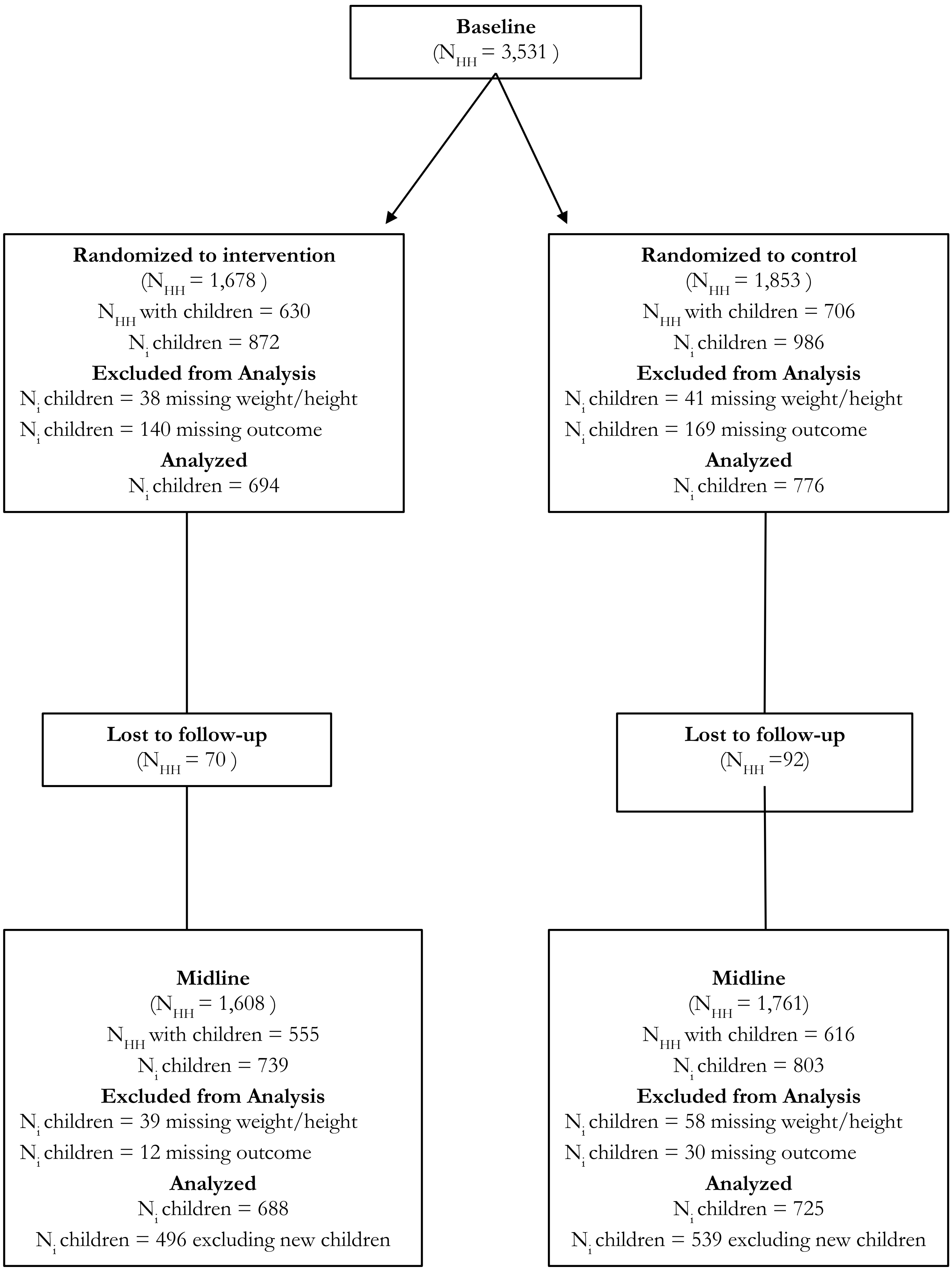


Figure 3.1.B. Participant Flow Diagram - Panel of Households



CHAPTER 4: CONCLUSION

The overall objective of this dissertation was to further understanding of the types of impacts unconditional income transfers can have on household food and nutrition security and child health. The first paper examined the impact of the Government of Malawi's Social Cash Transfer Program (SCTP) on three critical components of food and nutrition security: current economic vulnerability to food insecurity, diet quantity, and diet quality. The second paper used a structural approach to investigate the impacts of the SCTP on household demand for child health inputs and how those inputs ultimately affected important health outcomes among children under-five.

4.1. Summary of Key Findings

The first dissertation paper used a differences-in-differences approach to specify Generalized Linear Models to estimate the average treatment effect of the Malawi SCTP on a comprehensive set of food and nutrition security outcomes. Study results show protective impacts during the lean season on measures of diet quantity, but evidence of impacts on current economic vulnerability and diet quality were limited. The SCTP was associated with an 11 percentage point increase in the probability that beneficiary households consumed more than two meals per day ($p = 0.001$), a 267 Kcal increase in daily per capita apparent caloric availability ($p = 0.05$), a 10 percentage point decrease in the incidence of household food-energy deficiency ($p = 0.05$), and a 111 Kcal reduction in the average depth of hunger ($p = 0.05$). We did not detect significant impacts on households' feelings of food insecurity, per capita annual food expenditures, or the household diet diversity score. Additionally, the program significantly increased calories available from cereals, meat, and other foods, and there is evidence that within the cereal group households were substituting away from inferior cereals towards finer grains. From these results we conclude that after approximately one year of intervention exposure the program was protective against worsened calorie insecurity, but did little to ameliorate current economic vulnerability or lack of diet diversity.

The second dissertation paper examined the impact of the SCTP on household demand for child health inputs and the effect of these inputs on child health outcomes among ultra-poor and labor-constrained households in order to understand how a positive exogenous income shock acts to influence health. The empirical strategy combined the difference-in-differences approach with instrumental variables to estimate the households' derived health input demands and the health production function. A fixed-effects specification of the household production function was also examined as a robustness check against potentially weak instruments. We find that, aside from a nine percentage point reduction in the likelihood of having an under-five/well-baby checkup in the past six months ($p = 0.05$), program impacts on child health inputs were restricted to food and nutrition security indicators. Among a panel of children, beneficiary children had an average of MWK 9,090 higher per-adult equivalent annual food expenditures ($p = 0.001$), a two percentage point reduction in food share ($p = 0.05$), a two percentage point increase in the share of total food expenditures devoted to meat, fish, eggs, and dairy ($p = 0.05$), and increased apparent caloric availability of 313 Kcal-AE for foods from the cereal group ($p = 0.05$), 24 Kcal-AE for foods from the meat group ($p = 0.001$), and 140 Kcal-AE from the oils, sweets, spices, and beverages group ($p = 0.001$). These positive impacts on food security, however, did not appear to translate to significant effects on child health outcomes. Several other health inputs had significant associations with health outcomes, but none of these inputs were significantly impacted by the SCTP.

4.2. Dissertation Contributions

This dissertation makes several contributions to the literature on social cash transfer programs in sub-Saharan Africa.

The first contribution the dissertation makes is to provide current, actionable evidence about a government-run program as it goes to scale. The Malawi SCTP was first implemented in 2006 as a pilot in the Mchinji district. The 2007-2008 impact evaluation of the Malawi SCTP Pilot Scheme[21,57] provided positive evidence of the pilot project on household food security, curative care seeking, and education. While the Mchinji pilot study was very influential, it was also limited. The program has undergone changes in targeting and operations and has experienced significant expansion since 2009. This study leverages data from a large-scale evaluation in Mangochi and Salima districts to provide timely information to program implementers and policy makers.

The second contribution this dissertation makes is that it goes beyond estimating the average impact of receiving the program to understand the range of impacts that can occur given the level of treatment received. We investigate whether there is a 'dose' response to the cash payment by examining the transfer share, which is defined as the annual per capita value of the transfer as a percent of baseline annual per capita household expenditures. We model the transfer share as a continuous percentage, a binary indicator of whether the share comprises at least 20 percent of pre-program consumption, and a further refined categorical variable. To our knowledge this is one of the first studies of social cash transfer programs in sub-Saharan Africa to take this approach.

One of the limitations of this study was that the baseline data were collected post-harvest whereas midline data were collected near the end of the lean season. While this did not bias our estimates of program impact, it did mean that our impacts were largely protective as average consumption had decreased among study households between survey rounds. Poor rural households are most vulnerable at the end of the lean season because they have depleted their food stores and face high seasonal prices in food markets. Thus, it is conceivable that our estimates of program impact on household food and nutrition security indicators could represent lower bounds on the types of effects the SCTP is capable of achieving. More research is needed to understand how program impacts could change when households are not struggling to meet their most basic consumption needs in the lean season.

The first paper builds on previous research by providing evidence of protective program impacts on food insecurity during the lean season. An important contribution of this study is its use of multi-dimensional food and nutrition security indicators. This study is unique in that it tests program impacts on total and food group-specific apparent caloric availability, which is lacking in the literature on cash transfer programs in sub-Saharan Africa.

The second paper's main contribution to the literature was in its approach to modeling the causal pathway between an exogenous positive income shock and a change in child health outcomes. The paper used the health production function approach in an attempt to understand what types of health inputs the program directly affects and if the changes in those inputs transfers into improved health outcomes for young children. Knowledge of these processes can highlight areas where the program may be constrained in its ability to have positive impacts and can illuminate pathways to integrate cash transfer programs with complimentary social services.

4.3. Programmatic Implications and Suggestions for Future Research

This dissertation research has several important programmatic implications.

The purchasing power of the SCTP has important implications for the types of impacts the program can achieve. For example, the limited effect of the intervention on diet quality may be due in part to the erosion of the transfer's purchasing power between the post-harvest and lean seasons. Seasonal variation in food prices can be large and is a major determinant of child malnutrition in Malawi. [40] Potential policy solutions could include indexing the value of the cash transfer to food prices or simply increasing the transfer amount during the lean season to better help households smooth food consumption. The transfer amount was increased after midline data collection was completed to compensate for general inflation between the baseline and midline surveys, so it will be important for future research to investigate whether SCTP impacts have expanded beyond protection from caloric deficits and allowed households to feel more food secure and consume a more diverse diet.

Local infrastructure also has important implications for what the SCTP can achieve. While direct income transfers are demand-oriented interventions, there are certain supply-side pre-conditions that are necessary in order for these programs to achieve impacts, including well-functioning food markets and accessible quality health services. The vulnerability-based geographical targeting strategies of many African SCT programs often means that beneficiaries are in poor remote areas and face substantial resource and infrastructure limitations. Our study results that the program did not have strong impacts on diet quality may also be because while households have the cash and want to purchase better foods, these foods are not available locally or the poor are priced out of markets. More research is needed to understand why program beneficiaries are not consuming a more diverse diet during the lean season. If the answer is because they lack market access, then in-kind transfers may be more effective at improving household nutrition than cash programs.

Lastly, program administrators and policy makers need to understand that cash alone is not always enough to achieve the welfare goals of many African social transfers. Beneficiary households face multiple deprivations and experience multiple interrelated constraints to accessing food markets and health services, including transportation costs, lack of awareness that services are available, or lack of awareness that they even need to access services. Moving forward, the SCTP may be able to achieve a wider range of impacts and amplify the ones it already makes by linking the cash transfer to other essential social services. Another explanation as to why the program has limited effects on diet diversity is that households simply do not know the nutritional importance of a varied diet. In this case, nutritional and health information sessions could be held at payment points. Program implementers could also make referrals to child growth monitoring and nutrition services when beneficiaries come to collect payments. The effectiveness of social protection schemes that link cash transfers to other programs or layer other interventions or messages onto cash transfer programs is an important and emerging field. Future research should try to understand opportunities for these linkages. The Social Protection "PLUS" concept[108] may well dominate the next phase of social policy design.

APPENDIX 1: CHAPTER 2 ATTRITION ANALYSIS

There are two main sources of missing data in panel studies: sample attrition and item non-response. In the case of attrition, or unit nonresponse, an observation is surveyed at baseline but does not participate in the follow-up sample, and thus data are missing for all variables among these observations. With item non-response, the observation appears in both the baseline and follow-up samples, but does not have complete information on certain variables in one or both study waves.

The critical problem created by sample attrition and item non-response in this study is that the missing data may erode the benefits of the original random selection of participants into the study and random assignment of village clusters to treatment and control groups, thus threatening both the internal and external validity of the impact evaluation. The primary identification strategy of the Malawi SCTP impact evaluation comes from randomization of the intervention, which renders treatment and control groups equal in expectation on both observed and unobserved characteristics. This independence of potential outcomes and treatment assignment allows us to attribute any difference in post-treatment outcomes between the study groups to the cash transfer program. The sample selectivity arising from households attriting from the study or declining to answer questions due to reasons that also affect their potential outcomes may create bias in our estimates of program impact. Program impact estimates will also be less efficient simply due to the reduction in sample size.

Taking this a step further, bias arising from non-random attrition and item non-response threatens the internal validity of the study because those households who remain in the treatment group may differ from households remaining in the control group in both observable and unobservable ways, breaking our identification strategy of equality in expectation due to randomization. The external validity of the study may be compromised due to sample selection bias if participants non-randomly leave the study, thus reducing the original representativeness of the sample.

Differential attrition relates directly to the internal validity of the study, and it occurs when the types of households that remain in the treatment sample differ from those remaining in the control sample. General attrition refers to differences between households remaining in the study and those dropping out, regardless of treatment assignment, and relates to the external validity of the study.

Differential attrition was examined by comparing the average baseline characteristics of treatment and control households remaining in the analytical sample, and general attrition was examined by comparing the baseline characteristics of the analytical sample with households that attrited. Our bivariate attrition checks included 146 household outcome and background variables. There were no significant differences in any of the variables at or below the 5% significance level between treatment and control households in the analytical sample, indicating that differential attrition is not a problem in this analysis and the internal validity of the study is maintained. Appendix Table 1.1 shows the results of mean comparisons between treatment and control groups.

We examined general attrition by comparing mean values of the same 146 variables at baseline between all households remaining in the study versus attritors (Appendix Table 1.2). While the attrition rate is relatively low, bivariate analyses reveal that 46 of the 146 variables (about 32 percent) were significantly different between panel and attritors households, suggesting that general attrition is a problem. Many of the variables used in the attrition analysis are variations or subsets of each other, and given this high degree of correlation we would expect that if we find a significant difference for one variable, we will also find significant differences for related variables (e.g., household size, number of household members in different age groups, household dependency ratio, etc.). This is the case, as the majority of significant differences occur among household demographic variables and household head characteristics. We also find significant differences among many of the outcome variables of interest. On average, households that attrited fared better at baseline than panel households on indicators of current economic vulnerability to food insecurity, caloric availability and energy deficiency, and spending across all food groups. Heads of panel households were more likely to be women, while heads of attritor households were more likely to have a chronic illness or disability. Attritor households tended to be older and smaller, and panel households were more likely to be below the total and ultra-poverty lines, more likely to have members participating in *ganyu* labor, and were more likely to score in the top third of the health knowledge scale and to live within 1.5km of a food market.

We further examined general attrition using two series of multivariate tests. The first group of tests involved running attrition probits to determine which variables significantly predict attrition.[109] BGLW tests were used for the second series of multivariate tests;[110] baseline values of an outcome of interest are regressed on household and community variables, variables related to the interview process, an attrition dummy, and the attrition dummy interacted with the other explanatory variables. The significance of the attrition dummy and the joint significance of the interaction variables are used to determine if the effects of explanatory variables on an outcome of interest differ between panel and attritor households under a null hypothesis of no attrition.

The attrition probits controlled for outcomes of interest (excluding the hunger deficit), the vector of control and moderator variables used in the main analysis, and variables indicating the total time of the baseline interview, home ownership, whether any household member owns a cellphone, if there was a death or someone move out of the household in the past year, the type of main access road, and whether the community has a daily market, government primary school, and a place to purchase common medicines. Ten out of the 117 variables tested in the attrition probit (8.5 percent) were statistically significant, and the majority of the significant variables were of negligible magnitude.

Lastly, the BGLW test was conducted for all of the current economic vulnerability and diet quantity outcomes, as well as for the household dietary diversity score (HDDS). The BGLW tests included 40 attrition dummy interaction terms. The attrition dummy was not significant in any of the models, but the interaction terms were jointly significant in all of the models. Taken together, the bivariate mean comparisons, attrition probit, and BGLW tests suggest that there is a problem of general attrition which could threaten the generalizability of the impact evaluation results.

A common solution to the problem of missing data due to sample attrition and item non-response is to use Inverse Probability Weights (IPW) to reweight panel observations by the inverse probability of being in the panel (i.e., the propensity score).[111] A binary response model of the probability of being in the analytical sample was run using baseline data for outcomes of interest, the vector of control and moderator variables used in the main analysis, and higher-order terms and interactions of these variables. The preferred model yielded a pseudo-R-squared value of 0.3401, indicating that the model did a decent job of predicting selection. The propensity scores, however, had large mass points near 0.999 for panel households and 0.000 for attritors, which corresponded to very large weights that had higher variability than the original baseline sampling weights. Weight trimming at the one, five, and 10 percent levels helped to reduce the range and variation in the IPWs among panel households, but concern that a few very large weights would dominate the analysis remained.

Given the absence of both differential and general attrition in the full household panel,[64] the low rate of missing data (2.3 percent), and the risk of misspecification of the IPW model, we decided to assume that general attrition in the analytical sample was negligible and thus did not make any adjustments to the baseline sampling weights.

Appendix Table 1.1. Differential Attrition Checks

Variables	Control Mean	N1	Treatment Mean	N2	Mean Diff	Diff SE	p-value
Outcomes of interest							
Worried wouldn't have enough food past 7 days	0.828	1,729	0.842	1,561	0.014	0.042	0.746
Per capita food expenditure	33409.082	1,729	35169.032	1,561	1759.950	2732.381	0.525
Foodshare	0.772	1,729	0.771	1,561	-0.001	0.012	0.918
Household ate over one meal per day	0.818	1,729	0.795	1,561	-0.023	0.042	0.586
Daily per capita food energy availabiliy (Kcal)	1894.320	1,729	1831.025	1,561	-63.294	154.544	0.685
Household is food-energy deficient, light	0.602	1,729	0.623	1,561	0.022	0.051	0.677
Hunger depth, light (Kcal pc.)	420.745	1,729	464.100	1,561	43.355	66.781	0.521
HDDS	5.643	1,729	5.628	1,561	-0.015	0.244	0.951
Proportion staples	0.830	1,729	0.828	1,561	-0.002	0.019	0.924
Per capita real annual expenditures							
Cereals, roots, and tubers	18580.201	1,729	19422.401	1,561	842.200	1343.789	0.536
Fruits and vegetables	5371.986	1,729	5760.479	1,561	388.494	455.315	0.401
Legumes, nuts, and seeds	2347.291	1,729	2534.221	1,561	186.931	688.774	0.788
Meat, eggs, fish, and milk	3855.447	1,729	4412.696	1,561	557.249	625.364	0.380
Other	3254.158	1,729	3039.234	1,561	-214.924	532.459	0.690
Share of total food expenditure							
Cereals, roots, and tubers	0.577	1,729	0.570	1,561	-0.006	0.015	0.673
Fruits and vegetables	0.180	1,729	0.186	1,561	0.007	0.017	0.697
Legumes, nuts, and seeds	0.050	1,729	0.048	1,561	-0.002	0.010	0.830
Meat, eggs, fish, and milk	0.107	1,729	0.116	1,561	0.009	0.014	0.492
Other	0.087	1,729	0.080	1,561	-0.008	0.009	0.385
Household head characteristics							
Female	0.852	1,729	0.831	1,561	-0.021	0.022	0.341
Age	56.857	1,729	58.802	1,561	1.944	2.182	0.381
Chronic illness	0.406	1,729	0.471	1,561	0.065	0.044	0.149
Severe disability	0.104	1,729	0.108	1,561	0.004	0.017	0.817
Any school	0.296	1,729	0.290	1,561	-0.005	0.053	0.921
Literate	0.188	1,729	0.172	1,561	-0.016	0.031	0.613
Widow	0.419	1,729	0.435	1,561	0.017	0.036	0.645
Household demographic characteristics							

Baseline household size							
Total members	4.578	1,729	4.588	1,561	0.010	0.216	0.964
Members 0 to 5	0.675	1,729	0.679	1,561	0.004	0.065	0.955
Members 6 to 11	1.233	1,729	1.170	1,561	-0.063	0.081	0.440
Members 12 to 17	0.932	1,729	0.943	1,561	0.011	0.057	0.851
Members 18 to 64	1.177	1,729	1.168	1,561	-0.009	0.101	0.929
Members 65 and older	0.561	1,729	0.629	1,561	0.068	0.055	0.232
Number currently in school	1.702	1,729	1.647	1,561	-0.055	0.137	0.689
Any child orphans	0.365	1,729	0.408	1,561	0.043	0.037	0.258
Number of dependents (<15 or >65)	3.087	1,729	3.106	1,561	0.019	0.123	0.877
Number of working age (15-64)	1.491	1,729	1.482	1,561	-0.010	0.120	0.937
Labor constrained	0.289	1,729	0.324	1,561	0.035	0.050	0.488
Household Dependency Ratio	2.767	1,729	2.765	1,561	-0.002	0.101	0.984
Number of persons per room	2.466	1,722	2.557	1,557	0.091	0.157	0.567
Any member has disability	0.170	1,729	0.180	1,561	0.010	0.023	0.670
Any member has chronic illness	0.513	1,729	0.584	1,561	0.071	0.042	0.101
Salima district	0.413	1,729	0.358	1,561	-0.055	0.184	0.766
Household welfare indicators							
Poorest 50% of households at baseline	0.503	1,729	0.487	1,561	-0.015	0.053	0.772
Total real annual consumption per household	164612.302	1,729	172511.535	1,561	7899.234	10638.466	0.464
Per Capita Expenditure	42332.946	1,729	44562.522	1,561	2229.577	3183.141	0.489
Exp per cap < poverty line	0.925	1,729	0.906	1,561	-0.019	0.019	0.321
Exp per cap < ultra pov line	0.754	1,729	0.728	1,561	-0.025	0.039	0.523
Gap poor	41.615	1,217	41.490	1,082	-0.124	2.430	0.960
Gap ultra poor	30.955	722	31.493	634	0.538	2.544	0.834
Severity poor	22.207	1,217	21.981	1,082	-0.226	2.237	0.920
Severity ultra poor	13.951	722	13.872	634	-0.079	1.969	0.968
Household feels worse off compared to friends	0.486	1,729	0.519	1,561	0.033	0.048	0.492
Household feels worse off compared to neighbours	0.511	1,729	0.577	1,561	0.067	0.059	0.270
Subjective wealth of household	1.198	1,729	1.197	1,561	-0.001	0.029	0.978

from 1(poor) to 6(rich)							
Subjective wealth of most of friends from 1(poor) to 6(rich)	1.878	1,729	1.944	1,561	0.066	0.097	0.500
Subjective wealth of most of neighbours from 1(poor) to 6(rich)	1.858	1,729	1.919	1,561	0.061	0.098	0.536
Number of meals taken per day	1.949	1,729	1.909	1,561	-0.039	0.062	0.529
Maize from last harvest lasted at least 3 months	0.499	1,729	0.484	1,561	-0.015	0.046	0.738
Maize in grainery will last at least 3 months	0.094	1,729	0.094	1,561	-0.001	0.023	0.979
Number of months maize from last harvest lasted	3.910	1,728	3.923	1,561	0.013	0.240	0.956
Number of months maize in grainery will last	1.186	1,708	1.171	1,551	-0.015	0.197	0.941
Household other income, benefits, and shocks							
Owns current residence	0.912	1,729	0.923	1,561	0.011	0.008	0.171
Owns enterprise	0.224	1,729	0.242	1,561	0.018	0.043	0.681
Enterprise earnings in the past month	2225.507	402	2674.502	409	448.995	606.982	0.466
Enterprise hired labour	0.007	404	0.004	413	-0.003	0.005	0.528
Any member with wage employment	0.061	1,729	0.046	1,561	-0.015	0.018	0.433
Any member doing ganyu labour	0.597	1,729	0.567	1,561	-0.030	0.052	0.571
Number of days of ganyu for household	90.327	1,048	90.610	917	0.283	5.727	0.961
Average ganyu wage per day for household	509.978	1,047	575.496	917	65.518	39.258	0.106
Benefitted from any safety net programme	0.708	1,729	0.697	1,561	-0.011	0.059	0.857
Number of safety net programmes	1.125	1,729	1.142	1,561	0.016	0.235	0.945
Food/cash program	0.202	1,729	0.151	1,561	-0.052	0.059	0.392
Mother/child feeding program	0.161	1,729	0.150	1,561	-0.011	0.077	0.892
Community Based Childcare	0.024	1,729	0.026	1,561	0.002	0.012	0.866

Food/Cash-for-Work	0.087	1,729	0.066	1,561	-0.021	0.018	0.258
Free Food (other than Maize)	0.136	1,729	0.156	1,561	0.020	0.082	0.808
Free Maize	0.164	1,729	0.161	1,561	-0.003	0.094	0.972
School Feeding	0.136	1,729	0.168	1,561	0.032	0.075	0.672
Voucher to buy fertilizer or seeds (FISP)	0.541	1,729	0.534	1,561	-0.007	0.067	0.916
Household received a transfer	0.847	1,729	0.797	1,561	-0.050	0.044	0.263
Value of maize received	1.252	1,729	1.395	1,561	0.143	0.970	0.884
Value of transfers received	48654.235	1,729	40595.399	1,561	-8058.836	10055.483	0.430
Agricultural inputs	0.340	1,729	0.307	1,561	-0.033	0.039	0.410
Cash	0.706	1,729	0.662	1,561	-0.043	0.043	0.324
Food/other consumables	0.941	1,729	0.900	1,561	-0.041	0.027	0.141
Labor or time	0.547	1,729	0.495	1,561	-0.052	0.040	0.205
Transfer made out of the household	0.332	1,729	0.289	1,561	-0.043	0.040	0.285
Value of transfers made	3661.458	1,729	3801.146	1,561	139.688	707.818	0.845
Any credit at baseline	0.436	1,729	0.425	1,561	-0.011	0.034	0.751
Still owes on loan from 12+ months	0.064	1,729	0.066	1,561	0.002	0.017	0.923
Purchase on credit in last 12 months	0.280	1,729	0.298	1,561	0.018	0.032	0.566
Loan contracted in last 12 months	0.279	1,729	0.246	1,561	-0.033	0.027	0.244
Amount owed on loan from 12+ months	3918.814	122	3741.867	109	-176.947	1274.401	0.891
Experienced any shock in last 12 months	0.933	1,729	0.955	1,561	0.022	0.036	0.535
Number of shocks experienced	2.457	1,729	2.540	1,561	0.083	0.222	0.712
Serious accident or illness of hh member	0.169	1,729	0.179	1,561	0.010	0.025	0.703
Drought, flood, crop disease, high cost ag input	0.767	1,729	0.775	1,561	0.009	0.080	0.915
Floods/Landslides	0.060	1,729	0.086	1,561	0.026	0.046	0.573
Droughts or Irregular Rains	0.639	1,729	0.605	1,561	-0.034	0.100	0.736
Unusually High cost of Agric. inputs	0.426	1,729	0.468	1,561	0.043	0.065	0.519
Unusually high food prices	0.822	1,729	0.841	1,561	0.019	0.055	0.727
Household productivity indicators							
Engaged in fishing	0.012	1,729	0.007	1,561	-0.005	0.005	0.324

Sold fish	0.326	26	0.189	11	-0.136	0.120	0.267
Crop production household	0.961	1,729	0.956	1,561	-0.004	0.014	0.757
Irrigation	0.049	1,729	0.049	1,561	0.000	0.014	0.995
Fertilizer	0.653	1,729	0.665	1,561	0.012	0.064	0.856
Organic fertilizer	0.257	1,729	0.235	1,561	-0.022	0.031	0.487
Pesticides	0.018	1,729	0.027	1,561	0.009	0.010	0.380
Acres cultivated	1.488	1,656	1.410	1,498	-0.077	0.112	0.497
Under one acre	0.239	1,656	0.257	1,498	0.018	0.034	0.600
One to two acres	0.527	1,656	0.490	1,498	-0.037	0.026	0.176
Two to four acres	0.203	1,656	0.220	1,498	0.018	0.028	0.539
Over four acres	0.031	1,656	0.032	1,498	0.001	0.008	0.860
Hired labour for crop production	0.037	1,729	0.043	1,561	0.006	0.009	0.533
Sold any crops	0.240	1,570	0.212	1,435	-0.027	0.041	0.507
Sold groundnuts	1.000	331	0.981	308	-0.019	0.011	0.099
Sold maize	0.355	331	0.374	308	0.019	0.134	0.889
Sold rice	0.438	331	0.303	308	-0.135	0.175	0.446
Sold soyabeans	0.068	1,611	0.048	1,462	-0.019	0.034	0.576
Sold tanaposi	0.046	1,611	0.072	1,462	0.026	0.018	0.159
Owns hand hoe	0.876	1,729	0.870	1,561	-0.006	0.023	0.810
Owns axe	0.132	1,729	0.143	1,561	0.011	0.026	0.682
Owns panga knife	0.226	1,729	0.240	1,561	0.014	0.033	0.677
Owns sickle	0.185	1,729	0.180	1,561	-0.006	0.023	0.808
Purchased hand hoe in last 12 months	0.052	1,729	0.069	1,561	0.017	0.012	0.183
Purchased sickle in last 12 months	0.008	1,729	0.009	1,561	0.001	0.003	0.761
Raised any livestock	0.276	1,729	0.293	1,561	0.017	0.028	0.552
Raised goat or sheep in last 12 months	0.103	1,729	0.114	1,561	0.011	0.021	0.606
Raised chicken in last 12 months	0.185	1,729	0.205	1,561	0.019	0.020	0.355
Raised other livestock in last 12 months	0.030	1,729	0.035	1,561	0.005	0.010	0.594
Number of goat or sheep owned	0.264	1,729	0.259	1,561	-0.005	0.066	0.936
Number of chicken owned	0.573	1,729	0.654	1,561	0.081	0.101	0.428
number owned other livestock	0.189	1,729	0.283	1,561	0.094	0.091	0.306
Purchased livestock in last 12 months	0.053	1,729	0.054	1,561	0.000	0.010	0.962
Other control variables							
Top 3rd health knowledge score	0.107	241	0.344	3,290	0.236	0.024	0.000
Within 1.5km of market	0.188	241	0.575	3,290	0.387	0.045	0.000

Price of barsoal per Piece	74.227	241	73.206	3,290	-1.021	1.387	0.468
Price of beans per Kilo	447.559	241	442.768	3,290	-4.791	7.625	0.535
Price of beef per Kilo	1134.671	241	1145.655	3,290	10.984	12.666	0.393
Price of cooking oil per Sachet/Tube	47.099	241	47.568	3,290	0.469	2.206	0.833
Price of maizegrain per Kilo	155.153	241	165.727	3,290	10.574	7.267	0.157
Price of panadol per Piece	16.492	241	17.459	3,290	0.967	0.499	0.063
Price of rice per Kilo	329.571	241	332.104	3,290	2.533	4.535	0.581
Price of salt per Sachet/Tube	27.108	241	28.665	3,290	1.557	1.028	0.141
Price of sugar per Kilo	379.657	241	380.499	3,290	0.842	7.171	0.907
Price of tomatoes per Heap	50.992	241	52.328	3,290	1.336	2.471	0.593

Appendix Table 1.2. General Attrition Checks

Variables	Attritors Mean	N1	Panel Mean	N2	Mean Diff	Diff SE	p-value
Outcomes of interest							
Worried wouldn't have enough food past 7 days	0.767	241	0.835	3,290	0.068	0.027	0.017
Per capita food expenditure	65180.423	240	34274.005	3,290	-30906.418	4849.983	0.000
Foodshare	0.762	240	0.772	3,290	0.010	0.009	0.263
Household ate over one meal per day	0.804	241	0.807	3,290	0.003	0.031	0.919
Daily per capita food energy availability (Kcal)	2910.531	239	1863.214	3,290	-1047.317	165.642	0.000
Household is food-energy deficient, light	0.390	239	0.612	3,290	0.222	0.036	0.000
Hunger depth, light (Kcal pc.)	285.641	239	442.052	3,290	156.410	36.487	0.000
HDDS	5.959	240	5.636	3,290	-0.323	0.197	0.112
Proportion staples	0.791	239	0.829	3,290	0.038	0.011	0.002
Per capita real annual expenditures							
Cereals, roots, and tubers	31190.163	241	18994.098	3,290	-12196.066	1966.538	0.000
Fruits and vegetables	8965.409	241	5562.910	3,290	-3402.499	654.573	0.000
Legumes, nuts, and seeds	9632.275	241	2439.157	3,290	-7193.118	1850.534	0.001
Meat, eggs, fish, and milk	7480.912	240	4129.306	3,290	-3351.606	574.645	0.000
Other	7746.779	241	3148.534	3,290	-4598.245	1107.321	0.000
Share of total food expenditure							
Cereals, roots, and tubers	0.531	241	0.573	3,290	0.043	0.014	0.005
Fruits and vegetables	0.168	241	0.183	3,290	0.015	0.009	0.111
Legumes, nuts, and seeds	0.082	241	0.049	3,290	-0.033	0.010	0.003
Meat, eggs, fish, and milk	0.117	240	0.111	3,290	-0.006	0.006	0.280
Other	0.100	241	0.084	3,290	-0.016	0.009	0.100
Household head characteristics							
Female	0.743	241	0.842	3,290	0.099	0.035	0.009
Age	60.971	241	57.813	3,290	-3.158	2.023	0.130
Chronic illness	0.540	241	0.438	3,290	-0.102	0.035	0.007
Severe disability	0.204	241	0.106	3,290	-0.098	0.027	0.001
Any school	0.328	241	0.293	3,290	-0.035	0.042	0.418
Literate	0.236	241	0.180	3,290	-0.056	0.039	0.166
Widow	0.513	241	0.427	3,290	-0.086	0.044	0.059
Household demographic characteristics							
Baseline household size							
Total members	3.215	241	4.583	3,290	1.368	0.172	0.000
Members 0 to 5	0.491	241	0.677	3,290	0.186	0.044	0.000
Members 6 to 11	0.724	241	1.202	3,290	0.478	0.084	0.000
Members 12 to 17	0.520	241	0.937	3,290	0.417	0.059	0.000
Members 18 to 64	0.829	241	1.172	3,290	0.344	0.075	0.000
Members 65 and older	0.651	241	0.595	3,290	-0.056	0.041	0.185
Number currently in school	0.991	241	1.675	3,290	0.684	0.112	0.000
Any child orphans	0.206	241	0.386	3,290	0.180	0.026	0.000
Number of dependents (<15 or >65)	2.230	241	3.097	3,290	0.866	0.111	0.000

Number of working age (15-64)	0.984	241	1.486	3,290	0.502	0.090	0.000
Labor constrained	0.492	241	0.306	3,290	-0.186	0.044	0.000
Household Dependency Ratio	1.951	241	2.766	3,290	0.816	0.107	0.000
Number of persons per room	1.968	241	2.511	3,279	0.543	0.152	0.001
Any member has disability	0.242	241	0.175	3,290	-0.067	0.024	0.009
Any member has chronic illness	0.610	241	0.548	3,290	-0.062	0.032	0.062
Salima district	0.384	241	0.386	3,290	0.002	0.043	0.960
Household welfare indicators							
Poorest 50% of households at baseline	0.309	241	0.495	3,290	0.186	0.037	0.000
Total real annual consumption per household	184536.884	241	168494.361	3,290	-16042.523	18991.688	0.405
Per Capita Expenditure	56449.975	198	43428.666	3,290	-13021.309	3101.572	0.000
Exp per cap < poverty line	0.829	198	0.915	3,290	0.087	0.031	0.010
Exp per cap < ultra pov line	0.549	198	0.741	3,290	0.193	0.037	0.000
Gap poor	39.497	108	41.554	2,299	2.057	1.741	0.247
Gap ultra poor	29.956	59	31.212	1,356	1.256	2.775	0.654
Severity poor	20.562	108	22.098	2,299	1.536	1.597	0.344
Severity ultra poor	13.835	59	13.913	1,356	0.079	2.303	0.973
Household feels worse off compared to friends	0.476	241	0.502	3,290	0.026	0.032	0.414
Household feels worse off compared to neighbours	0.507	241	0.544	3,290	0.037	0.032	0.269
Subjective wealth of household from 1(poor) to 6(rich)	1.220	241	1.197	3,290	-0.023	0.035	0.519
Subjective wealth of most of friends from 1(poor) to 6(rich)	1.863	241	1.911	3,290	0.048	0.060	0.431
Subjective wealth of most of neighbours from 1(poor) to 6(rich)	1.822	241	1.888	3,290	0.066	0.063	0.305
Number of meals taken per day	1.942	241	1.929	3,290	-0.012	0.041	0.766
Maize from last harvest lasted at least 3 months	0.428	241	0.492	3,290	0.064	0.036	0.089
Maize in grainery will last at least 3 months	0.140	241	0.094	3,290	-0.046	0.031	0.152
Number of months maize from last harvest lasted	3.643	241	3.916	3,289	0.273	0.238	0.261
Number of months maize in grainery will last	1.411	237	1.178	3,259	-0.233	0.168	0.178
Household other income, benefits, and shocks							
Owns current residence	0.875	241	0.917	3,290	0.042	0.028	0.136
Owns enterprise	0.208	241	0.233	3,290	0.025	0.039	0.526
Enterprise earnings in the past month	3161.580	55	2453.853	811	-707.727	704.398	0.324
Enterprise hired labour	0.014	55	0.005	817	-0.009	0.013	0.502
Any member with wage employment	0.069	241	0.054	3,290	-0.016	0.016	0.340
Any member doing ganyu labour	0.396	241	0.583	3,290	0.187	0.040	0.000
Number of days of ganyu for household	80.597	102	90.462	1,965	9.865	10.280	0.345

Average ganyu wage per day for household	534.148	102	541.346	1,964	7.198	42.721	0.867
Benefitted from any safety net programme	0.641	241	0.702	3,290	0.062	0.028	0.034
Number of safety net programmes	0.955	241	1.133	3,290	0.178	0.068	0.014
Food/cash program	0.167	74	0.177	3,290	0.010	0.043	0.820
Mother/child feeding program	0.053	74	0.156	3,290	0.103	0.033	0.005
Community Based Childcare	0.019	241	0.025	3,290	0.006	0.009	0.539
Food/Cash-for-Work	0.046	241	0.077	3,290	0.031	0.013	0.023
Free Food (other than Maize)	0.110	241	0.145	3,290	0.035	0.021	0.110
Free Maize	0.160	241	0.163	3,290	0.002	0.028	0.931
School Feeding	0.085	241	0.151	3,290	0.066	0.026	0.015
Voucher to buy fertilizer or seeds (FISP)	0.499	241	0.537	3,290	0.038	0.029	0.196
Household received a transfer	0.853	241	0.822	3,290	-0.031	0.031	0.324
Value of maize received	1.421	241	1.322	3,290	-0.098	0.224	0.665
Value of transfers received	95126.874	241	44693.740	3,290	-50433.134	25860.827	0.061
Agricultural inputs	0.238	241	0.323	3,290	0.085	0.029	0.006
Cash	0.602	241	0.684	3,290	0.082	0.052	0.127
Food/other consumables	0.857	241	0.921	3,290	0.063	0.024	0.014
Labor or time	0.543	241	0.521	3,290	-0.022	0.041	0.592
Transfer made out of the household	0.266	241	0.311	3,290	0.045	0.031	0.162
Value of transfers made	5974.515	241	3730.107	3,290	-2244.408	1728.820	0.205
Any credit at baseline	0.384	241	0.431	3,290	0.046	0.037	0.219
Still owes on loan from 12+ months	0.054	241	0.065	3,290	0.011	0.014	0.439
Purchase on credit in last 12 months	0.279	241	0.289	3,290	0.009	0.028	0.741
Loan contracted in last 12 months	0.218	241	0.263	3,290	0.044	0.035	0.218
Amount owed on loan from 12+ months	5436.346	14	3830.705	231	-1605.642	1774.307	0.374
Experienced any shock in last 12 months	0.917	241	0.944	3,290	0.027	0.026	0.306
Number of shocks experienced	2.379	241	2.498	3,290	0.118	0.110	0.292
Serious accident or illness of hh member	0.177	241	0.174	3,290	-0.004	0.027	0.891
Drought, flood, crop disease, high cost ag input	0.715	241	0.771	3,290	0.055	0.040	0.182
Floods/Landslides	0.067	241	0.073	3,290	0.006	0.014	0.656
Droughts or Irregular Rains	0.583	241	0.622	3,290	0.039	0.039	0.321
Unusually High cost of Agric. inputs	0.401	241	0.447	3,290	0.046	0.034	0.191
Unusually high food prices	0.788	241	0.831	3,290	0.043	0.030	0.166
Household productivity indicators							
Engaged in fishing	0.012	241	0.010	3,290	-0.002	0.006	0.685
Sold fish	0.247	4	0.276	37	0.029	0.222	0.898
Crop production household	0.916	241	0.958	3,290	0.042	0.032	0.203
Irrigation	0.019	241	0.049	3,290	0.030	0.012	0.023
Fertilizer	0.613	241	0.659	3,290	0.046	0.043	0.295

Organic fertilizer	0.215	241	0.246	3,290	0.031	0.023	0.185
Pesticides	0.012	241	0.023	3,290	0.011	0.006	0.096
Acres cultivated	1.213	221	1.450	3,154	0.236	0.080	0.006
Under one acre	0.362	221	0.248	3,154	-0.115	0.030	0.001
One to two acres	0.444	221	0.509	3,154	0.065	0.035	0.072
Two to four acres	0.173	221	0.211	3,154	0.039	0.028	0.180
Over four acres	0.021	221	0.032	3,154	0.011	0.014	0.449
Hired labour for crop production	0.065	241	0.040	3,290	-0.025	0.016	0.122
Sold any crops	0.244	207	0.226	3,005	-0.018	0.030	0.564
Sold groundnuts	0.967	52	0.991	639	0.025	0.024	0.307
Sold maize	0.255	52	0.364	639	0.109	0.066	0.109
Sold rice	0.406	52	0.375	639	-0.030	0.074	0.685
Sold soyabeans	0.061	211	0.058	3,073	-0.002	0.011	0.821
Sold tanaposi	0.082	211	0.058	3,073	-0.023	0.022	0.298
Owns hand hoe	0.816	241	0.873	3,290	0.057	0.042	0.189
Owns axe	0.115	241	0.138	3,290	0.023	0.029	0.437
Owns panga knife	0.224	241	0.233	3,290	0.009	0.025	0.709
Owns sickle	0.200	241	0.183	3,290	-0.017	0.020	0.395
Purchased hand hoe in last 12 months	0.047	241	0.060	3,290	0.013	0.013	0.343
Purchased sickle in last 12 months	0.007	241	0.009	3,290	0.002	0.005	0.674
Raised any livestock	0.230	241	0.285	3,290	0.054	0.029	0.075
Raised goat or sheep in last 12 months	0.084	241	0.108	3,290	0.024	0.016	0.142
Raised chicken in last 12 months	0.173	241	0.195	3,290	0.022	0.031	0.476
Raised other livestock in last 12 months	0.036	241	0.033	3,290	-0.003	0.012	0.773
Number of goat or sheep owned	0.340	241	0.262	3,290	-0.078	0.078	0.326
Number of chicken owned	0.483	241	0.613	3,290	0.129	0.092	0.174
number owned other livestock	0.646	241	0.235	3,290	-0.411	0.381	0.290
Purchased livestock in last 12 months	0.047	241	0.054	3,290	0.006	0.020	0.756
Other control variables							
Top 3rd health knowledge score	0.107	241	0.344	3,290	0.236	0.024	0.000
Within 1.5km of market	0.188	241	0.575	3,290	0.387	0.045	0.000
Price of barsoal per Piece	74.227	241	73.206	3,290	-1.021	1.387	0.468
Price of beans per Kilo	447.559	241	442.768	3,290	-4.791	7.625	0.535
Price of beef per Kilo	1134.671	241	1145.655	3,290	10.984	12.666	0.393
Price of cooking oil per Sachet/Tube	47.099	241	47.568	3,290	0.469	2.206	0.833
Price of maizegrain per Kilo	155.153	241	165.727	3,290	10.574	7.267	0.157
Price of panadol per Piece	16.492	241	17.459	3,290	0.967	0.499	0.063
Price of rice per Kilo	329.571	241	332.104	3,290	2.533	4.535	0.581
Price of salt per Sachet/Tube	27.108	241	28.665	3,290	1.557	1.028	0.141
Price of sugar per Kilo	379.657	241	380.499	3,290	0.842	7.171	0.907
Price of tomatoes per Heap	50.992	241	52.328	3,290	1.336	2.471	0.593

APPENDIX 2: NOTES ON KEY STUDY VARIABLES

Appendix Table 2.1. Key Study Variables

Variable	Chapter 2	Chapter 3	Definition
Treatment	exposure	exposure	binary
Simulated transfer share	exposure	exposure	continuous
High share	exposure	exposure	binary
Low share	exposure	exposure	binary
Poorest 50% of households at baseline	moderator	moderator	binary
4 or fewer household members	moderator	moderator	binary
Distance to market	moderator	instrumental variable	binary
Caregiver health knowledge score	moderator	moderator	binary
Worried not enough food	outcome		binary
Per capita real annual food expenditures	outcome		continuous
Per adult equivalent (AE-L) real annual food expenditures		input	continuous
Food share	outcome	input	continuous
More than 1 meal/day	outcome		binary
Kcal per capita	outcome		continuous
Food energy deficient	outcome		binary
Depth of hunger	outcome		continuous
HDDS	outcome		count
Per capita real annual expenditures on 5 food groups*	outcome		continuous
Share of total food expenditures devoted to 5 food groups*	outcome	input	continuous
Kcal per capita per day for 5 food groups*	outcome		continuous
Kcal per adult equivalent per day for 5 food groups*		input	continuous
Share of total Kcals for 5 food groups*	outcome		continuous
Health status		outcome	binary
Health improvement		outcome	binary
Diarrhea		outcome	binary
Fever		outcome	binary
Cough		outcome	binary
Any illness		outcome	binary
Height		outcome	continuous
HAZ		outcome	continuous
Stunted		outcome	binary
WHZ		outcome	continuous
Wasted		outcome	binary
WAZ		outcome	continuous
Underweight		outcome	binary
Health passport		input	binary
Under-5 service		input	binary
Any health expenditures		input	binary
Solid food > 1/day		input	binary
Nutrition program		input	binary
Vitamin A past day		input	binary

* 5 food groups include: (1) cereals, roots, tubers (2) fruits and vegetables (3) meat, fish, eggs, dairy (4) legumes, nuts, pulses (5) oils, sweets, condiments, beverages

Health Knowledge Score

The health knowledge score was created from a series of eight questions the caregiver responded to about young child nutrition, diarrhea, malaria, and tuberculosis. The questions had multiple correct answers, so the score for each question was the sum of correct responses given for that question. The total sum of correct answers ranged from one to 19. We decided not to use the sum of the items as the score as suggested by Classical Test Theory, which implicitly assumes that all questions are equally important in contributing to the score; here, the score – or the latent construct – is "health knowledge". Rather, we employed polychoric factor analysis [112] to reduce the eight potentially collinear items (Bartlet's test of sphericity chi-square = 4,427.65, df(28), $p = 0.00$; Kaiser-Meyer-Olkin measure of sampling adequacy = 0.73). We retained the first factor, which had an Eigenvalue of 3.26 and explained 40.80 percent of the total covariance. The health knowledge score was calculated as the household's predicted value of the first factor. We sorted the score in increasing order, and those households scoring in the top 66.67 percent of health knowledge scores receive a value of one for the health knowledge variable. It is important to note that the health knowledge questions were only asked during the midline follow-up survey. As the SCTP does not contain an educational component, we consider health knowledge as time-invariant between the survey rounds and find no differential health knowledge scores between treatment and control groups ($p = 0.32$).

Appendix Table 2.2. Health Knowledge Score

Module 4B: Child Health Knowledge Questions
22. At what age should a baby be fed other foods and liquids (other than maternal milk)?
23. There is a nutrient found in food called 'iron' which helps children 'accumulate' blood (nutrient that makes them strong). Can you tell me some foods that are a good source of iron? Anything else?
24. Vitamin A is a nutrient that helps children grow. Can you tell me some of the foods that are rich in Vitamin A? Anything else?
25. What needs to be done when a child has diarrhea? Anything else?
26. What signs/symptoms would lead you to think that a person has malaria? Anything else?
27. What do you think is the cause of malaria? Anything else?
28. How can someone protect themselves against malaria? Anything else?
29. Have you ever heard of an illness called tuberculosis or TB?
30. How does tuberculosis spread from one person to another? Anything else?

Data Cleaning – Children Under-Five

The child panel data were cleaned prior to deriving the analytical sample and calculating the anthropometric indicators. We first identified the panel children, and then the change in the child's age in months between the baseline and midline surveys was reviewed to check for children getting younger or aging by implausible amounts (i.e., more than 24 months or less than 10 months). There were a total of 282 panel children with flagged ages; to reconcile the age variable we first looked at the child's reported age in years and months in the Child Health survey module for both rounds and compared it to the child's age in years as reported in the Household Roster. We then compared the baseline and midline ages with ages for the child reported at endline (where available) to triangulate which two out of three ages were most consistent. The last metric we considered was the time lapse between the baseline and midline surveys, which averaged to 17 months. We were able to correct ages for all but 25 children. In the case where a child was recorded as a different sex at baseline and midline, we deferred to midline data as enumerators using tablet-based CAPI (computer-assisted personal interviewing) were made aware of the discrepancy and instructed to verify the response in real-time. The last component of cleaning the anthropometric data among panel children was to investigate changes in height over time. Intuitively it makes sense to drop observations for children whose height decreased over time. However, we cannot be certain about the direction of measurement error, so dropping all observations with negative height gains without some way of also correcting for height increases due to positive measurement errors or attenuated height increases due to negative measurement errors can introduce bias into the sample. We decided to retain all panel children whose change in height between the midline and baseline surveys was within +/- three standard deviations of the mean height change among all panel children; fortunately all of the children with negative height changes (18 total) were within this range and so were eligible for study inclusion.

APPENDIX 3: CHAPTER 2 GLM DIAGNOSTICS

Appendix Table 3.1. Diagnostic Statistics for Binary General Linearized Models (N = 6580)

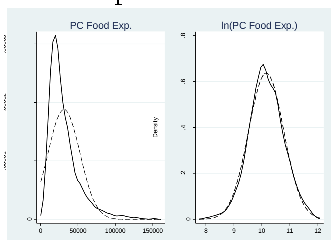
	AIC	BIC	Std. Deviance	(1/df) Pearson	PLT p-value	% Correctly Classified	A-ROC	HLT p-value	PCC p-value
Worried about food									
Probit	4.85	-25743.61	31860.20	5.82	0.23	83.50	0.70	0.22	0.01
Logit	4.85	-25770.54	31833.27	5.84	0.30	83.59	0.70	0.74	0.01
>1 Meal/Day									
Probit	4.23	-29844.21	27759.60	5.96	0.19	84.24	0.72	0.31	0.04
Logit	4.23	-29854.49	27749.32	5.84	0.13	84.29	0.72	0.34	0.04
Energy Deficient									
Probit	6.32	-16103.47	41500.33	5.72	0.00	72.72	0.74	0.84	0.00
Logit	6.32	-16105.45	41498.36	5.70	0.00	72.74	0.74	0.75	0.00

Notes: Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT), Area under the Receiver Operating Characteristic curve (A-ROC), Hosmer-Lemeshow Test (HLT).

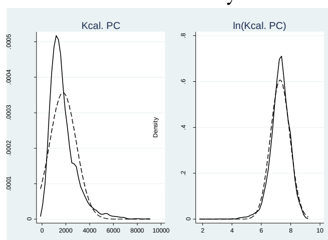
Appendix Figure 3.1. Diagnostic Distributional Plots of Continuous Outcome Variables

KERNEL DENSITY PLOTS

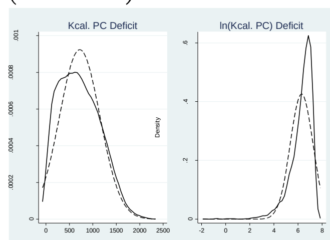
Real Annual Per Capita Food Expenditure



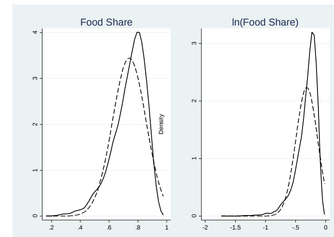
Daily Per Capita Caloric Availability



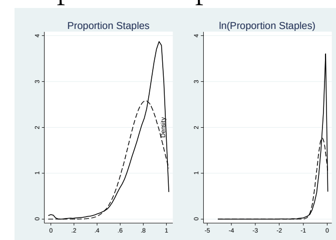
Hunger Depth (Kcal. PC)



Food Share

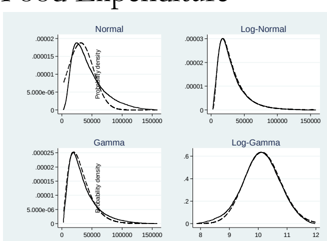


Proportion Staples

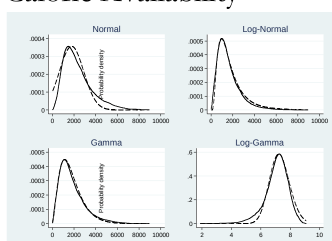


PROBABILITY DENSITY PLOTS

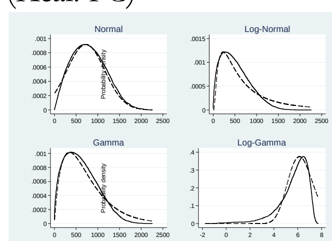
Real Annual Per Capita Food Expenditure



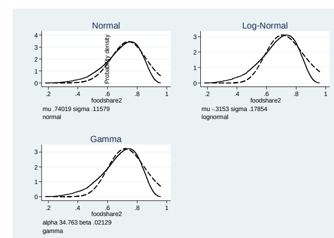
Daily Per Capita Caloric Availability



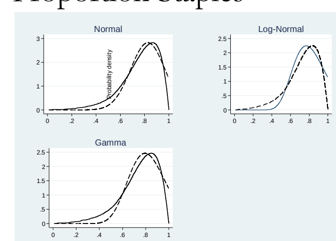
Hunger Depth (Kcal. PC)



Food Share



Proportion Staples



Notes: The reference distribution is represented by the dashed line and the sample distribution is given by the solid line. The log-gamma distribution is not tested for food share or proportion staples because the log of a fraction is negative, and the gamma distribution's probability density function is defined for values greater than or equal to zero.

Reference distribution parameters: mean, standard deviation, alpha, beta

(a) Real annual per capita food expenditure: level 31276.07, 21231.80, 2.72, 11491.66; natural log 10.16, 0.62, 260.65, 0.04

(b) Daily per capita caloric availability: level 1762.08, 1119.08, 2.74, 642.06; natural log 7.28, 0.66, 113.52, 0.06

(c) Hunger depth: level 917.85, 435.16, 1.91, 376.79; natural log 6.30, 0.94, 34.37, 0.18

(d) Food share: level 0.74, 0.12, 34.76, 0.02; natural log -0.32, 0.18, alpha and beta n/a

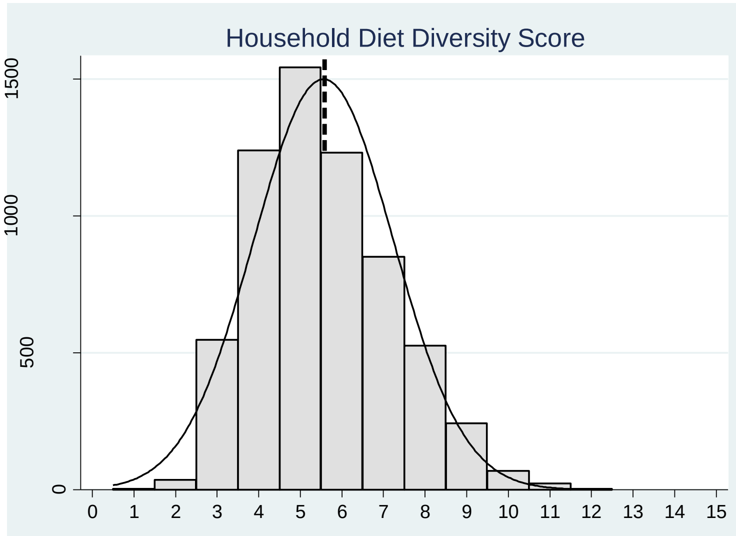
(e) Proportion staples: level 0.83, 0.14, 25.13, 0.03; natural log -0.21, 0.23, alpha and beta n/a

Appendix Table 3.2. Diagnostic Statistics for Continuous General Linearized Models (N = 6580)

	AIC	BIC	Standardized Deviance	PLT p-value	PCC p-value
PC Food Expenditure					
Gaussian Identity	132.52	1.19E+13	6528.00	0.00	1.00
Gaussian Log	132.39	1.17E+13	6528.00	0.53	0.33
Gamma Identity	128.27	-47405.82	5820.99	0.00	0.17
Gamma Log	128.26	-47463.58	5815.37	0.01	0.67
PC Kcal.					
Gaussian Identity	99.29	3.44E+10	6528.00	0.07	1.00
Gaussian Log	99.23	3.40E+10	6528.00	0.49	0.69
Gamma Identity	95.72	-46724.69	6809.49	0.00	0.33
Gamma Log	95.72	-46733.48	6815.78	0.00	0.80
Hunger Depth					
Gaussian Identity	90.05	6.59E+09	5588.00	0.00	1.00
Gaussian Log	90.05	6.59E+09	5588.00	0.04	0.80
Gamma Identity	*Model does not converge*				
Gamma Log	81.83	-32863.34	3261.32	0.00	0.00
Food Share					
Gaussian Identity	-4.02	-57171.49	6528.00	0.45	1.00
Gaussian Log	-4.02	-57171.65	6528.00	0.12	0.98
Gamma Identity	7.93	-56649.10	7666.61	0.22	0.22
Gamma Log	7.93	-56649.32	7666.86	0.06	0.24
Proportion Staples					
Gaussian Identity	-0.30	-56771.44	6528.00	0.65	1.00
Gaussian Log	-0.29	-56771.23	6528.00	0.22	0.97
Gamma Identity	9.10	-56194.61	7252.14	0.91	0.03
Gamma Log	9.10	-56194.39	7252.58	0.50	0.03

Notes: Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT).

Appendix Figure 3.2. Histogram of Diet Diversity Score



Notes: The normal distribution reference line is given by the solid curve, and the mean HDDS (5.58) is represented by the dashed line.

Appendix Table 3.3. Diagnostic Statistics for Count General Linearized Models (N = 6580)

	AIC	BIC	PCC p-value	PLT p-value	Z p-value	LMT p-value
Poisson	149500.50	149690.60	0.89	0.07	0.00	0.00
Negative Binomial	149500.50	149690.60	0.94	0.07	0.00	0.00
Zero-Truncated Poisson	149186.10	149376.30	0.61	0.07	0.00	0.00

Notes: The Zero-Truncated Negative Binomial model does not converge. The AIC and BIC values reported for Poisson and Negative Binomial models are derived from non-GLM models to facilitate comparison with Zero-Truncated Poisson results. Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT), Lagrange Multiplier Test (LMT). Results for the test for over-dispersion are given under the column "Z p-value".

Appendix Table 3.4. Diagnostic Statistics for Binary GLM: Probability of Positive Group Expenditure (N = 6580)

	AIC	BIC	Standardized Deviance	(1/df) Pearson	PLT p-value	% Correctly Classified	A-ROC	HLT p-value	PCC p-value
Cereals, roots, and tubers									
Probit	0.36	-55323.76	2280.04	3.24	0.37	99.41	0.88	0.93	0.00
Logit	0.36	-55319.86	2283.95	3.78	0.44	99.41	0.87	0.50	0.00
Fruits and vegetables									
Probit	0.43	-54800.83	2802.98	4.47	0.30	99.21	0.82	0.61	0.00
Logit	0.43	-54805.98	2797.83	5.14	0.00	99.21	0.82	0.50	0.00
Meat, eggs, fish, and milk									
Probit	6.54	-14608.40	42995.41	5.72	0.00	71.41	0.77	0.47	0.00
Logit	6.54	-14617.63	42986.18	5.72	0.00	71.43	0.77	0.59	0.00
Legumes, nuts, and seeds									
Probit	6.60	-14232.20	43371.61	5.67	0.00	67.51	0.72	0.57	0.00
Logit	6.60	-14211.65	43392.16	5.65	0.00	67.55	0.72	0.50	0.00
Other									
Probit	0.47	-54592.95	3010.86	4.30	0.44	99.13	0.81	0.68	0.00
Logit	0.47	-54591.28	3012.53	4.81	0.75	99.13	0.81	0.23	0.00

Notes: Results are identical to those for the probability of positive consumption shares. Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT), Area under the Receiver Operating Characteristic curve (A-ROC), Hosmer-Lemeshow Test (HLT).

Appendix Table 3.5. Diagnostic Statistics for Continuous GLM: Positive Group Expenditures

	AIC	BIC	Standardized Deviance	PCC p-value
Cereals, roots, and tubers (N = 6541)				
Gaussian Identity	125.91	3.73E+12	6489.00	0.42
Gaussian Log	125.70	3.59E+12	6489.00	0.02
Gamma Identity	120.69	-45627.71	5994.89	0.11
Gamma Log	120.66	-45813.99	6028.71	0.99
Fruits and vegetables (N = 6528)				
Gaussian Identity	119.49	1.18E+12	6476.00	0.68
Gaussian Log	119.48	1.18E+12	6476.00	0.75
Gamma Identity	110.31	-38417.78	5002.24	0.79
Gamma Log	110.32	-38348.31	5047.70	0.13
Meat, eggs, fish, and milk (N = 3693)				
Gaussian Identity	122.46	9.20E+11	3641.00	0.00
Gaussian Log	122.27	8.90E+11	3641.00	0.00
Gamma Identity	108.84	-12946.20	2366.28	0.00
Gamma Log	108.83	-12981.76	2327.32	0.00
Legumes, nuts, and seeds (N = 4126)				
Gaussian Identity	118.87	6.21E+11	4074.00	0.00
Gaussian Log	118.77	6.09E+11	4074.00	0.00
Gamma Identity	107.43	-18986.75	2940.66	0.00
Gamma Log	107.42	-18997.83	2947.25	0.00
Other (N = 6523)				
Gaussian Identity	116.05	6.42E+11	6471.00	0.86
Gaussian Log	115.96	6.31E+11	6471.00	0.02
Gamma Identity	99.59	-9975.48	3878.08	0.29
Gamma Log	99.53	-10353.61	3765.34	0.12

Notes: Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT).

Appendix Table 3.6. Diagnostic Statistics for Continuous GLM: Positive Group shares

	AIC	BIC	Standardized Deviance	PCC p-value
Cereals, roots, and tubers (N = 6541)				
Gaussian Identity	0.36	-56293.80	6489.00	0.73
Gaussian Log	0.37	-56292.46	6489.00	0.61
Gamma Identity	4.17	-53045.65	8187.23	0.14
Gamma Log	4.17	-53038.96	8191.02	0.10
Fruits and vegetables (N = 6528)				
Gaussian Identity	-1.65	-56444.26	6476.00	0.90
Gaussian Log	-1.63	-56442.03	6476.00	0.60
Gamma Identity	-5.92	-43653.06	6647.98	0.03
Gamma Log	-5.90	-43560.49	6654.67	0.02
Meat, eggs, fish, and milk (N = 3693)				
Gaussian Identity	-4.05	-29861.79	3641.00	0.03
Gaussian Log	-4.06	-29862.30	3641.00	0.01
Gamma Identity	-10.91	-19716.55	3296.84	0.00
Gamma Log	-10.91	-19700.76	3296.97	0.00
Legumes, nuts, and seeds (N = 4126)				
Gaussian Identity	-5.09	-33890.73	4074.00	0.00
Gaussian Log	-5.10	-33891.18	4074.00	0.00
Gamma Identity	-11.02	-23158.15	4052.00	0.00
Gamma Log	-11.02	-23158.06	4058.38	0.00
Other (N = 6523)				
Gaussian Identity	-7.88	-56828.94	6471.00	0.98
Gaussian Log	-7.91	-56829.91	6471.00	0.36
Gamma Identity	-18.55	-27457.18	5086.60	0.20
Gamma Log	-18.55	-27470.22	5045.69	0.42

Notes: Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT).

Appendix Table AX3.7 Diagnostic Statistics for Binary GLM: Probability of Positive Group Caloric Availability (N = 6580)

	AIC	BIC	Scaled Deviance	(1/df) Pearson	PLT p-value	% Correctly Classified	A-ROC	HLT p-value	PCC p-value
Foraged wild fruits or vegetables									
Probit	2.43	-41648.64	15955.17	5.53	0.03	93.72	0.66	0.42	0.05
Logit	2.44	-41635.35	15968.45	5.55	0.05	93.72	0.66	0.69	0.11
Cereals, roots, and tubers									
Probit	0.34	-55435.95	2167.86	2.74	0.25	99.41	0.90	0.88	0.00
Logit	0.34	-55430.35	2173.46	3.65	0.45	99.41	0.89	0.51	0.00
Fruits and vegetables									
Probit	0.66	-53322.31	4281.50	5.44	0.00	98.66	0.78	0.95	0.00
Logit	0.66	-53340.01	4263.80	5.82	0.00	98.66	0.78	0.43	0.00
Meat, eggs, fish, and milk									
Probit	6.36	-15822.66	41781.15	5.76	0.00	72.66	0.79	0.79	0.00
Logit	6.35	-15852.60	41751.21	5.76	0.00	72.75	0.79	0.00	0.00
Legumes, nuts, and seeds									
Probit	6.54	-14620.03	42983.77	5.66	0.00	68.04	0.73	0.28	0.00
Logit	6.55	-14586.36	43017.45	5.62	0.00	68.07	0.73	0.20	0.00
Other									
Probit	7.06	-11219.58	46384.23	5.76	0.00	65.50	0.71	0.71	0.00
Logit	7.05	-11240.59	46363.22	5.75	0.00	65.62	0.71	0.00	0.00

Notes: Results are identical to those for the probability of positive consumption shares. Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT), Area under the Receiver Operating Characteristic curve (A-ROC), Hosmer-Lemeshow Test (HLT).

Appendix Table 3.8. Diagnostic Statistics for Continuous GLM: Positive Group Per Capita Kcal

	AIC	BIC	Standardized Deviance	PCC p-value
Foraged wild fruits or vegetables (N =413)				
Gaussian Identity	56.07	1924812.30	357.00	1.00
Gaussian Log	55.77	1819387.70	357.00	0.04
Gamma Identity	47.72	-1036.83	337.41	0.02
Gamma Log	47.76	-1020.65	334.04	0.28
Cereals, roots, and tubers (N = 6541)				
Gaussian Identity	97.22	2.38E+10	6485.00	0.57
Gaussian Log	97.11	2.33E+10	6485.00	0.16
Gamma Identity	93.43	-46301.04	6745.20	0.85
Gamma Log	93.42	-46366.44	6761.22	0.86
Fruits and vegetables (N = 6492)				
Gaussian Identity	69.39	1.73E+08	6436.00	0.86
Gaussian Log	69.28	1.69E+08	6436.00	0.71
Gamma Log	55.66	-26924.40	4423.96	0.08
Meat, eggs, fish, and milk (N = 3658)				
Gaussian Identity	70.84	1.12E+08	3602.00	0.00
Gaussian Log	70.63	1.08E+08	3602.00	0.00
Gamma Identity	59.01	-16794.73	2464.67	0.00
Gamma Log	58.99	-16872.81	2525.44	0.00
Legumes, nuts, and seeds (N = 4101)				
Gaussian Identity	81.57	8.84E+08	4045.00	0.00
Gaussian Log	81.33	8.47E+08	4045.00	0.00
Gamma Log	70.00	-17589.16	3244.31	0.00
Other (N = 3075)				
Gaussian Identity	83.72	9.88E+08	3019.00	0.00
Gaussian Log	83.65	9.75E+08	3019.00	0.00
Gamma Log	71.00	-6065.59	3197.60	0.03

Notes: Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT).

Appendix Table 3.9. Diagnostic Statistics for Continuous GLM: Positive Group Kcal. shares

	AIC	BIC	Standardized Deviance	PCC p-value
Cereals, roots, and tubers (N = 6541)				
Gaussian Identity	-1.41	-56542.08	6485.00	0.73
Gaussian Log	-1.41	-56542.06	6485.00	0.73
Gamma Identity	9.14	-55839.01	8734.92	0.74
Gamma Log	9.14	-55838.85	8733.44	0.75
Fruits and vegetables (N = 6492)				
Gaussian Identity	-10.95	-56616.87	6436.00	0.97
Gaussian Log	-11.01	-56618.40	6436.00	0.39
Gamma Identity	-26.49	-22599.29	3304.85	0.06
Gamma Log	-26.50	-22688.13	3386.92	0.38
Meat, eggs, fish, and milk (N = 3658)				
Gaussian Identity	-12.89	-29731.37	3602.00	0.00
Gaussian Log	-12.98	-29732.20	3602.00	0.00
Gamma Identity	-25.28	-15462.45	2276.77	0.00
Gamma Log	-25.30	-15523.05	2316.45	0.00
Legumes, nuts, and seeds (N = 4101)				
Gaussian Identity	-5.79	-33684.99	4045.00	0.71
Gaussian Log	-5.82	-33686.22	4045.00	0.11
Gamma Identity	-14.75	-18872.51	3393.69	0.00
Gamma Log	-14.76	-18907.12	3387.26	0.00
Other (N = 3075)				
Gaussian Identity	-5.34	-24310.48	3019.00	0.00
Gaussian Log	-5.37	-24311.11	3019.00	0.00
Gamma Log	-14.71	-8020.31	3348.83	0.00

Notes: Pearson's Correlation Coefficient (PCC), Pregibon's Link Test (PLT).

APPENDIX 4: CHAPTER 2 FULL RESULTS OF MAIN IMPACT ANALYSIS MODELS

Appendix Table 4.1. Program Impacts on Current Economic Vulnerability and HDDS

	Worried about food		PC Food Exp		Food Share		HDDS	
Treat	-0.05	(0.04)	633.79	(1598.95)	-0.00	(0.01)	0.14	(0.22)
Time	-1.18***	(0.28)	21704.93+	(11534.81)	0.04	(0.08)	4.22**	(1.54)
DD	-0.06	(0.05)	3212.44	(2278.45)	-0.02+	(0.01)	0.23	(0.32)
Poorest	0.05**	(0.02)	-15087.13***	(616.87)	-0.02***	(0.00)	-0.99***	(0.09)
≤ 4 Members	-0.00	(0.01)	408.91	(619.16)	0.00	(0.01)	-0.07	(0.06)
Market within 1.5km	0.01	(0.01)	738.91	(563.91)	0.00	(0.00)	0.06	(0.07)
Top 3rd HK score	0.01	(0.01)	-18.17	(577.19)	0.00	(0.00)	-0.07	(0.05)
Salima	0.03	(0.02)	-2364.85	(1596.96)	-0.04***	(0.01)	-0.21	(0.24)
ln(household size)	0.01	(0.02)	-11926.96***	(1340.00)	0.03**	(0.01)	0.57***	(0.11)
Number members in age group								
0 to 5	0.02+	(0.01)	-622.33+	(368.17)	-0.00	(0.00)	-0.04	(0.03)
6 to 11	0.01	(0.01)	32.77	(285.80)	0.00	(0.00)	-0.02	(0.03)
12 to 17	-0.01	(0.01)	1074.26**	(345.03)	0.00	(0.00)	0.04	(0.03)
18 to 64	-0.03*	(0.01)	3000.73***	(642.26)	-0.00	(0.00)	0.03	(0.07)
65 and older	-0.02*	(0.01)	975.71	(640.31)	-0.01**	(0.00)	-0.04	(0.06)
Dependency ratio	-0.00	(0.01)	384.34	(301.11)	0.00	(0.00)	-0.04	(0.03)
Labor constrained	0.01	(0.01)	924.43	(663.27)	0.00	(0.00)	0.06	(0.08)
Any child orphans	-0.00	(0.01)	513.47	(460.93)	-0.00	(0.00)	-0.00	(0.05)
Household head								
Female	0.02	(0.02)	-1953.15**	(647.52)	-0.02***	(0.00)	-0.12*	(0.05)
Age	0.00	(0.00)	43.83*	(19.66)	0.00	(0.00)	-0.00	(0.00)
Chronically ill	0.01	(0.02)	-925.23*	(469.90)	-0.01***	(0.00)	-0.06	(0.05)
Severe disability	0.01	(0.02)	84.04	(912.44)	-0.01+	(0.01)	-0.10	(0.07)
Any school	0.01	(0.02)	944.58	(719.65)	-0.01**	(0.00)	0.25***	(0.07)
Literate	-0.03	(0.02)	-8.02	(657.20)	-0.01	(0.00)	0.01	(0.06)
Widow	0.00	(0.01)	-669.71	(438.97)	-0.01*	(0.00)	-0.12**	(0.05)
Participation in other programs								
Food/cash program	-0.02	(0.01)	-35.03	(519.42)	-0.00	(0.00)	0.16*	(0.07)

Mother/child feeding program	0.01	(0.01)	416.13	(781.38)	-0.01	(0.01)	0.05	(0.09)
Any credit	-0.00	(0.01)	832.98*	(361.08)	-0.01*	(0.00)	0.21***	(0.04)
Transfers received from non-members								
Cash	-0.02*	(0.01)	574.34	(689.70)	-0.01+	(0.01)	0.13*	(0.06)
Food/other consumables	0.04*	(0.02)	-1737.87*	(790.22)	0.00	(0.01)	-0.11	(0.10)
Labor or time	-0.00	(0.01)	1030.40*	(458.89)	0.00	(0.00)	0.17**	(0.05)
Agricultural inputs	-0.01	(0.01)	939.28	(679.99)	0.00	(0.00)	0.07	(0.06)
Baseline shocks								
Food shock	0.02	(0.04)	-3244.95***	(819.45)	-0.00	(0.01)	-0.06	(0.08)
Crop shock	-0.04	(0.03)	-514.20	(669.35)	-0.00	(0.01)	-0.13	(0.14)
Baseline prices								
Maize/grain	0.00	(0.00)	-4.44	(8.37)	-0.00*	(0.00)	-0.00	(0.00)
Rice	-0.00	(0.00)	15.52	(14.70)	0.00*	(0.00)	0.00	(0.00)
Beans	-0.00*	(0.00)	5.82	(6.84)	-0.00	(0.00)	0.00	(0.00)
Tomatoes	0.00*	(0.00)	-24.70	(22.50)	-0.00*	(0.00)	-0.00	(0.00)
Beef	-0.00	(0.00)	-1.62	(6.42)	0.00+	(0.00)	0.00	(0.00)
Salt	-0.00+	(0.00)	-3.48	(90.00)	0.00	(0.00)	0.01	(0.01)
Sugar	-0.00	(0.00)	9.91+	(5.52)	0.00	(0.00)	0.00	(0.00)
Cooking oil	-0.00	(0.00)	-5.44	(23.45)	-0.00+	(0.00)	0.01*	(0.00)
Bar of soap	-0.00***	(0.00)	32.67	(34.95)	0.00	(0.00)	0.02**	(0.01)
Panadol	-0.01**	(0.00)	141.57	(99.81)	0.00	(0.00)	0.02	(0.01)
Midline shocks								
Food shock	0.15***	(0.03)	-2750.39***	(799.81)	-0.01	(0.01)	-0.10	(0.08)
Crop shock	-0.02	(0.02)	-469.74	(894.14)	-0.02***	(0.01)	-0.10	(0.08)
Midline prices								
Maize/grain	-0.00	(0.00)	-14.50*	(6.24)	-0.00**	(0.00)	-0.00	(0.00)
Rice	0.00	(0.00)	-9.47	(18.15)	-0.00	(0.00)	-0.00	(0.00)
Beans	-0.00	(0.00)	-3.37	(2.12)	0.00***	(0.00)	-0.00	(0.00)
Tomatoes	0.00	(0.00)	2.83	(63.45)	-0.00	(0.00)	0.00	(0.00)
Beef	0.00	(0.00)	-1.29	(3.89)	-0.00	(0.00)	-0.00	(0.00)
Salt	0.00	(0.00)	-27.57	(31.52)	-0.00*	(0.00)	-0.00	(0.00)

Sugar	-0.00	(0.00)	7.77*	(3.80)	0.00*	(0.00)	0.00	(0.00)
Cooking oil	0.00	(0.00)	-55.51	(84.43)	-0.00	(0.00)	-0.01	(0.01)
Bar of soap	-0.00	(0.00)	2.74	(74.73)	0.00	(0.00)	0.01	(0.01)
Panadol	0.01***	(0.00)	-312.24+	(164.30)	-0.00	(0.00)	-0.03	(0.02)

Notes. Cluster-robust standard errors in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001

Appendix Table 4.2. Program Impacts on Diet Quantity

	>1 Meal/Day		PC Kcal.		Energy Deficient		Hunger Deficit	
Treat	-0.02	(0.02)	-24.34	(114.64)	0.00	(0.04)	-2.36	(33.94)
Time	0.32+	(0.19)	342.03	(535.63)	0.04	(0.21)	-177.58	(221.32)
DD	0.11***	(0.03)	267.49*	(122.60)	-0.10*	(0.04)	-111.11*	(44.08)
Poorest	-0.10***	(0.01)	-613.91***	(35.14)	0.24***	(0.01)	279.66***	(12.23)
≤ 4 Members	-0.01	(0.01)	41.43	(30.87)	0.00	(0.01)	-19.97	(21.30)
Market within 1.5km	0.00	(0.01)	50.35	(34.01)	-0.02	(0.01)	-29.12+	(15.80)
Top 3rd HK score	-0.02+	(0.01)	2.91	(33.08)	-0.02	(0.01)	21.84+	(12.36)
Salima	-0.10***	(0.02)	-162.79+	(85.36)	0.02	(0.02)	105.96***	(28.30)
ln(household size)	0.12***	(0.02)	-724.56***	(86.89)	0.19***	(0.04)	127.76**	(42.92)
Number members in age group								
0 to 5	-0.01	(0.01)	-0.78	(14.82)	-0.02**	(0.01)	-56.38***	(10.29)
6 to 11	-0.02**	(0.01)	34.97	(22.79)	-0.00	(0.01)	-16.24	(11.25)
12 to 17	-0.01	(0.01)	87.39***	(24.95)	0.02	(0.01)	42.52***	(12.23)
18 to 64	-0.02+	(0.01)	162.61***	(34.53)	-0.02+	(0.01)	13.53	(16.05)
65 and older	-0.01	(0.01)	79.34*	(33.85)	0.02	(0.01)	4.99	(15.00)
Dependency ratio	-0.01	(0.01)	3.79	(15.63)	-0.00	(0.01)	6.20	(7.47)
Labor constrained	0.00	(0.02)	-12.56	(41.46)	-0.02	(0.02)	10.20	(20.41)
Any child orphans	-0.01	(0.01)	12.11	(21.69)	-0.01	(0.01)	-0.64	(9.32)
Household head								
Female	0.02	(0.02)	-61.40+	(34.31)	0.00	(0.01)	-20.00	(17.07)
Age	0.00	(0.00)	2.36**	(0.84)	-0.00*	(0.00)	-0.83+	(0.45)
Chronically ill	0.00	(0.01)	-56.15+	(29.05)	0.03	(0.02)	32.96*	(14.86)
Severe disability	-0.03*	(0.02)	20.79	(51.04)	0.00	(0.02)	-11.58	(22.70)
Any school	0.01	(0.01)	64.18	(44.64)	-0.02	(0.02)	-25.41	(17.31)
Literate	0.03*	(0.01)	9.91	(34.28)	-0.02	(0.02)	-29.17	(19.83)
Widow	0.00	(0.01)	-28.01	(33.01)	0.01	(0.01)	17.68	(14.83)
Participation in other programs								
Food/cash program	0.02+	(0.01)	18.08	(28.15)	0.00	(0.01)	-12.20	(14.36)
Mother/child feeding program	-0.00	(0.01)	-37.74	(50.42)	0.02	(0.02)	7.25	(21.09)

Any credit	-0.00	(0.01)	35.46	(27.86)	0.01	(0.01)	-14.03	(12.76)
Transfers received from non-members								
Cash	0.01	(0.01)	52.68+	(30.87)	-0.01	(0.01)	-30.89**	(11.82)
Food/other consumables	-0.04+	(0.02)	-22.32	(41.04)	0.01	(0.02)	21.34	(20.94)
Labor or time	0.01	(0.01)	50.39+	(29.39)	-0.01	(0.01)	-22.63+	(13.71)
Agricultural inputs	0.03**	(0.01)	9.91	(30.66)	0.00	(0.01)	-0.84	(14.24)
Baseline shocks								
Food shock	-0.01	(0.02)	-124.48*	(58.72)	0.05+	(0.03)	82.40*	(36.26)
Crop shock	0.01	(0.02)	86.45+	(45.66)	-0.02	(0.02)	-36.38	(25.22)
Baseline prices								
Maize/grain	-0.00	(0.00)	-0.11	(0.51)	-0.00	(0.00)	-0.02	(0.16)
Rice	-0.00	(0.00)	-0.35	(0.95)	0.00	(0.00)	0.21	(0.31)
Beans	0.00*	(0.00)	0.93**	(0.33)	-0.00**	(0.00)	-0.21	(0.13)
Tomatoes	-0.00	(0.00)	-2.33*	(1.02)	0.00*	(0.00)	1.43***	(0.33)
Beef	-0.00	(0.00)	-0.57+	(0.31)	0.00	(0.00)	0.16+	(0.09)
Salt	0.00	(0.00)	3.79	(5.82)	-0.00	(0.00)	-2.22	(1.65)
Sugar	0.00	(0.00)	0.75*	(0.36)	-0.00	(0.00)	-0.19	(0.13)
Cooking oil	-0.00	(0.00)	1.18	(1.02)	-0.00	(0.00)	-1.26**	(0.40)
Bar of soap	0.00*	(0.00)	2.72	(1.99)	-0.00	(0.00)	-2.42**	(0.76)
Panadol	0.00	(0.00)	9.56+	(5.34)	-0.00	(0.00)	-2.25	(2.12)
Midline shocks								
Food shock	-0.01	(0.02)	-138.68***	(38.18)	0.03*	(0.01)	35.75*	(17.90)
Crop shock	-0.00	(0.02)	61.20	(50.27)	-0.02	(0.02)	-28.92	(23.22)
Midline prices								
Maize/grain	-0.00*	(0.00)	-0.85***	(0.25)	0.00**	(0.00)	0.39***	(0.10)
Rice	0.00	(0.00)	0.24	(0.79)	-0.00	(0.00)	0.14	(0.33)
Beans	0.00	(0.00)	0.12	(0.10)	-0.00	(0.00)	-0.07	(0.04)
Tomatoes	0.00+	(0.00)	-3.52	(2.19)	0.00	(0.00)	1.85+	(0.97)
Beef	-0.00*	(0.00)	-0.12	(0.18)	0.00	(0.00)	0.05	(0.07)
Salt	-0.00	(0.00)	-2.05	(1.51)	0.00	(0.00)	1.16+	(0.68)
Sugar	-0.00	(0.00)	0.69**	(0.23)	-0.00*	(0.00)	-0.31***	(0.09)
Cooking oil	0.00	(0.00)	0.41	(4.46)	-0.00	(0.00)	1.08	(1.86)

Bar of soap	-0.00	(0.00)	0.43	(3.28)	0.00	(0.00)	-1.06	(1.44)
Panadol	-0.01***	(0.00)	-11.07	(7.70)	0.00	(0.00)	4.38	(2.95)

Notes. Cluster-robust standard errors in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001

Appendix Table 4.3. Program Impacts on Food Group Expenditures

	cereal		fruit		meat		legumes		other	
Treat	-663.76	(875.22)	719.99+	(408.57)	-424.50	(392.55)	1309.08***	(339.31)	-371.35	(366.38)
Time	6394.07	(4850.53)	911.19	(4192.92)	2938.47	(3524.65)	5328.66+	(3191.07)	5846.89*	(2829.07)
DD	1759.26*	(830.24)	345.12	(643.55)	884.88+	(474.43)	-480.41	(541.79)	990.84*	(459.68)
Poorest	-6692.09***	(309.59)	-1886.32***	(152.42)	-2256.35***	(194.12)	-1954.59***	(136.66)	-2009.31***	(178.20)
≤ 4 Members	-121.66	(289.06)	354.21	(247.65)	-71.93	(254.73)	82.07	(164.98)	-18.43	(130.34)
Market within 1.5km	744.79***	(215.29)	221.76	(188.11)	76.86	(151.56)	-167.45	(102.66)	27.81	(118.90)
Top 3rd HK score	-144.99	(300.48)	100.71	(177.63)	33.48	(159.14)	65.06	(128.76)	-55.50	(105.12)
Salima	-3067.44***	(619.59)	1275.84**	(410.85)	424.28	(364.47)	-606.24*	(290.54)	-149.38	(363.56)
ln(household size)	-6824.18***	(583.33)	-2816.25***	(381.44)	-916.27*	(371.79)	-971.07**	(336.96)	-707.81*	(310.19)
Number members in age group										
0 to 5	67.04	(168.46)	-131.08	(109.19)	-195.64+	(110.40)	-73.65	(98.05)	-134.00	(88.86)
6 to 11	380.87*	(172.89)	-66.65	(90.97)	-60.33	(115.77)	-72.05	(99.41)	-135.69+	(82.00)
12 to 17	908.98***	(187.77)	88.89	(120.11)	24.02	(129.26)	71.95	(87.22)	-1.63	(101.14)
18 to 64	1424.07***	(303.36)	524.39**	(182.97)	493.09**	(177.99)	214.40	(161.22)	315.14**	(118.19)
65 and older	849.62**	(284.47)	212.96	(193.79)	-102.13	(135.74)	162.97	(132.02)	14.30	(172.73)
Dependency ratio	87.90	(142.19)	102.08	(91.52)	90.80	(84.77)	-29.42	(74.30)	83.66	(72.38)
Labor constrained	-9.57	(432.21)	-19.25	(267.16)	359.48	(218.74)	222.53	(191.08)	-14.87	(192.36)
Any child orphans	109.57	(275.96)	45.33	(149.16)	149.47	(147.91)	103.54	(116.15)	81.26	(106.79)
Household head										
Female	-546.88	(342.89)	-596.92*	(235.53)	-483.23*	(196.95)	-277.00	(170.62)	-143.13	(136.80)
Age	23.25*	(10.47)	-3.44	(5.37)	15.77**	(5.98)	2.36	(4.34)	8.61+	(4.85)
Chronically ill	-412.25+	(233.18)	-230.04	(172.11)	-41.81	(168.64)	-116.43	(128.73)	-155.77	(115.22)
Severe disability	54.99	(411.49)	48.02	(296.14)	-68.16	(263.34)	-149.70	(149.93)	132.17	(154.72)
Any school	313.95	(324.85)	88.83	(179.57)	47.71	(216.21)	116.35	(127.09)	362.23+	(192.52)
Literate	107.92	(335.65)	-230.04	(251.19)	10.25	(207.18)	35.00	(154.42)	103.89	(147.52)
Widow	-363.90	(271.91)	381.48*	(181.95)	-441.01**	(154.28)	-138.88	(135.00)	-99.68	(135.35)
Participation in other programs										
Food/cash program	-264.11	(258.34)	-282.78	(214.52)	-71.17	(174.48)	360.18*	(156.83)	214.31+	(125.96)
Mother/child feeding program	-199.24	(572.84)	598.55*	(240.77)	-130.36	(198.33)	58.03	(187.50)	66.68	(155.71)

Any credit	99.68	(263.34)	266.44+	(139.28)	34.31	(136.19)	277.22**	(86.56)	136.94+	(78.15)
Transfers received from non-members										
Cash	333.51	(338.12)	-196.48	(190.94)	40.22	(136.06)	312.60**	(105.17)	109.67	(146.40)
Food/other consumables	-674.66	(568.65)	-322.34	(246.22)	-724.80**	(270.01)	76.35	(185.77)	-102.96	(178.45)
Labor or time	382.30	(250.56)	123.06	(147.83)	16.79	(165.23)	440.57***	(119.10)	6.38	(108.22)
Agricultural inputs	396.35	(371.02)	257.79	(183.84)	181.44	(159.55)	17.98	(120.17)	88.95	(121.28)
Baseline shocks										
Food shock	-1459.57**	(563.30)	-682.46*	(321.89)	-577.42+	(324.83)	-217.07	(189.94)	-241.96	(147.38)
Crop shock	605.64	(506.80)	-22.37	(382.61)	-705.23**	(256.02)	-235.60	(242.43)	-233.51	(243.64)
Baseline prices										
Maize/grain	-0.47	(4.13)	2.12	(1.59)	-3.67*	(1.86)	-0.23	(1.33)	-2.33	(1.88)
Rice	8.23	(7.27)	8.55*	(3.50)	-3.74	(4.38)	2.50	(2.97)	1.06	(3.54)
Beans	-1.06	(3.09)	0.29	(1.64)	0.20	(2.12)	5.04***	(1.13)	0.60	(1.56)
Tomatoes	-13.55	(11.32)	3.91	(6.97)	-1.82	(5.58)	-8.54*	(3.97)	-4.22	(5.87)
Beef	0.12	(1.70)	-1.83+	(0.95)	-0.01	(1.98)	-1.56+	(0.92)	1.00	(1.78)
Salt	-27.06	(41.56)	-13.09	(17.73)	-14.10	(18.61)	28.23*	(13.74)	2.10	(18.04)
Sugar	4.62	(3.09)	-3.46**	(1.16)	5.82***	(1.51)	-0.74	(1.04)	3.81**	(1.36)
Cooking oil	-20.41*	(9.75)	7.27	(8.72)	-8.32	(6.43)	18.22***	(3.73)	1.00	(4.87)
Bar of soap	-9.74	(15.07)	-10.46	(10.06)	7.37	(11.60)	31.23***	(7.52)	12.15	(9.12)
Panadol	126.75***	(38.34)	29.56	(42.94)	4.60	(26.59)	-14.86	(14.53)	9.42	(26.73)
Midline shocks										
Food shock	-1379.56*	(558.81)	-3.96	(268.52)	-495.81*	(231.20)	-300.86	(192.31)	-391.84*	(193.43)
Crop shock	-21.93	(513.19)	33.16	(320.17)	-357.41+	(191.29)	-124.02	(181.58)	-187.40	(146.73)
Midline prices										
Maize/grain	-6.46***	(1.58)	-2.52	(2.05)	-0.15	(1.56)	-1.86	(1.24)	-1.99	(1.29)
Rice	-6.68	(4.99)	11.02	(7.86)	-6.78*	(3.08)	-2.49	(3.46)	-6.74*	(2.76)
Beans	-1.11	(0.69)	0.19	(0.81)	-1.67***	(0.43)	-0.26	(0.51)	-1.00**	(0.35)
Tomatoes	-10.73	(17.54)	17.46	(22.02)	-3.70	(8.92)	-6.25	(8.98)	4.67	(9.10)
Beef	-2.41**	(0.84)	2.81*	(1.29)	-0.24	(0.47)	-0.34	(0.68)	-1.30*	(0.55)
Salt	4.31	(15.62)	-15.98	(12.75)	-4.03	(6.74)	-6.62	(6.97)	-4.64	(5.18)
Sugar	5.11**	(1.66)	-4.69**	(1.63)	2.96**	(1.05)	1.45	(1.18)	1.19	(0.96)

Cooking oil	-36.58	(22.82)	26.65	(30.08)	-30.76+	(15.74)	14.26	(16.14)	-4.53	(13.19)
Bar of soap	2.11	(21.04)	-62.16+	(32.33)	37.98*	(15.59)	-3.22	(13.69)	32.86**	(11.49)
Panadol	-65.77	(44.52)	-139.73*	(58.09)	-42.73	(27.59)	-57.17	(36.86)	-36.25	(26.94)

Notes. Cluster-robust standard errors in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001

Appendix Table 4.4. Program Impact on Food Group Shares

	cereal		fruit		meat		legumes		other	
Treat	-0.03***	(0.01)	0.02+	(0.01)	-0.02*	(0.01)	0.04***	(0.01)	-0.02*	(0.01)
Time	-0.17	(0.12)	-0.12	(0.12)	0.02	(0.08)	0.08	(0.07)	0.09	(0.06)
DD	0.01	(0.02)	-0.01	(0.02)	0.02+	(0.01)	-0.03*	(0.01)	0.02*	(0.01)
Poorest	0.03***	(0.01)	0.04***	(0.00)	-0.04***	(0.00)	-0.01**	(0.00)	-0.02***	(0.00)
≤ 4 Members	-0.01+	(0.01)	0.01*	(0.01)	-0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Market within 1.5km	0.01	(0.01)	0.00	(0.01)	-0.00	(0.00)	-0.01*	(0.00)	-0.00	(0.00)
Top 3rd HK score	-0.01	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Salima	-0.05***	(0.01)	0.05***	(0.01)	0.01	(0.01)	-0.01	(0.01)	-0.00	(0.01)
ln(household size)	-0.02	(0.02)	-0.01	(0.01)	0.01	(0.01)	0.01	(0.01)	0.01	(0.01)
Number members in age group										
0 to 5	0.01*	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
6 to 11	0.01	(0.00)	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00+	(0.00)
12 to 17	0.01+	(0.01)	-0.01+	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
18 to 64	0.00	(0.01)	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)
65 and older	0.01	(0.01)	-0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)
Dependency ratio	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)
Labor constrained	-0.00	(0.01)	-0.01	(0.01)	0.01	(0.00)	0.00	(0.01)	0.00	(0.00)
Any child orphans	0.00	(0.01)	0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)
Household head										
Female	0.01	(0.01)	-0.00	(0.01)	-0.01+	(0.00)	-0.00	(0.00)	0.00	(0.00)
Age	0.00	(0.00)	-0.00*	(0.00)	0.00*	(0.00)	-0.00	(0.00)	0.00	(0.00)
Chronically ill	0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)
Severe disability	0.01	(0.01)	-0.00	(0.01)	-0.00	(0.00)	-0.01	(0.00)	0.00	(0.00)
Any school	-0.01	(0.01)	-0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)	0.01*	(0.00)
Literate	0.01	(0.01)	-0.01+	(0.01)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Widow	-0.00	(0.00)	0.01*	(0.01)	-0.01*	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Participation in other programs										
Food/cash program	-0.01	(0.01)	-0.01	(0.01)	-0.00	(0.00)	0.01**	(0.00)	0.01*	(0.00)
Mother/child feeding program	-0.01	(0.01)	0.02**	(0.01)	-0.00	(0.01)	-0.00	(0.01)	-0.00	(0.00)
Any credit	-0.01*	(0.00)	0.00	(0.00)	0.00	(0.00)	0.01*	(0.00)	0.00*	(0.00)

Transfers received from non-members										
Cash	-0.00	(0.00)	-0.01+	(0.00)	0.00	(0.00)	0.01**	(0.00)	0.00	(0.00)
Food/other consumables	0.01	(0.01)	0.00	(0.01)	-0.02**	(0.01)	0.01	(0.00)	0.00	(0.00)
Labor or time	-0.01*	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.01***	(0.00)	0.00	(0.00)
Agricultural inputs	-0.01	(0.01)	0.00	(0.01)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Baseline shocks										
Food shock	-0.00	(0.01)	0.00	(0.01)	-0.01	(0.01)	0.00	(0.01)	0.00	(0.00)
Crop shock	0.02+	(0.01)	0.00	(0.01)	-0.01*	(0.01)	-0.01	(0.01)	-0.01	(0.01)
Baseline prices										
Maize/grain	0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Rice	-0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Beans	-0.00+	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.00***	(0.00)	0.00	(0.00)
Tomatoes	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Beef	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00+	(0.00)	0.00	(0.00)
Salt	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.00*	(0.00)	-0.00	(0.00)
Sugar	-0.00	(0.00)	-0.00***	(0.00)	0.00***	(0.00)	-0.00	(0.00)	0.00***	(0.00)
Cooking oil	-0.00*	(0.00)	0.00	(0.00)	-0.00	(0.00)	0.00***	(0.00)	0.00	(0.00)
Bar of soap	-0.00+	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.00***	(0.00)	0.00	(0.00)
Panadol	0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)	-0.00*	(0.00)	-0.00	(0.00)
Midline shocks										
Food shock	0.00	(0.01)	0.02*	(0.01)	-0.01+	(0.01)	-0.00	(0.00)	-0.01	(0.00)
Crop shock	0.01	(0.01)	-0.00	(0.01)	-0.01	(0.00)	-0.01	(0.00)	-0.00	(0.00)
Midline prices										
Maize/grain	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Rice	0.00	(0.00)	0.00*	(0.00)	-0.00+	(0.00)	-0.00	(0.00)	-0.00**	(0.00)
Beans	0.00	(0.00)	0.00+	(0.00)	-0.00**	(0.00)	0.00	(0.00)	-0.00**	(0.00)
Tomatoes	-0.00	(0.00)	0.00*	(0.00)	-0.00	(0.00)	-0.00	(0.00)	0.00	(0.00)
Beef	-0.00+	(0.00)	0.00***	(0.00)	-0.00	(0.00)	0.00	(0.00)	-0.00*	(0.00)
Salt	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)
Sugar	0.00	(0.00)	-0.00***	(0.00)	0.00**	(0.00)	0.00	(0.00)	0.00	(0.00)
Cooking oil	-0.00	(0.00)	0.00	(0.00)	-0.00+	(0.00)	0.00	(0.00)	-0.00	(0.00)
Bar of soap	0.00	(0.00)	-0.00**	(0.00)	0.00**	(0.00)	-0.00	(0.00)	0.00**	(0.00)

Panadol	0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)	-0.00	(0.00)

Notes. Cluster-robust standard errors in parentheses. + p<0.10 * p<0.05 ** p<0.01 *** p<0.001

APPENDIX 5: CHAPTER 3 ATTRITION ANALYSIS FOR PANEL OF CHILDREN

We examined the panel of children for evidence of differential and general attrition. Sample attrition and item non-response among panel children can threaten both the internal and external validity of the study. Differential attrition relates to the internal validity of the study and occurs when the types of children who remain in the treatment sample differ from those in the control panel. General attrition refers to differences between children remaining in the study and those dropping out, regardless of treatment assignment. The primary identification strategy used in the Malawi SCTP impact evaluation is derived from the random assignment of the program, which creates treatment and control groups that are equal in expectation on both observed and unobserved characteristics at baseline, allowing us to attribute changes in the outcomes over time to the program. Estimates of program impact may be biased if the reasons that children attrit or are missing data on outcomes are also related to their potential outcomes. The external validity of the study may be reduced if certain types of children non-randomly leave the study, compromising the original representativeness of the evaluation sample.

We tested 172 child- and household-level characteristics to check for the presence of differential attrition or general attrition. Differential attrition was examined by comparing the average baseline characteristics of treatment and control children in the analytical panel, and general attrition was examined by comparing the baseline characteristics of the child panel with children who attrited or were missing data.

Only two of the 172 variables (1.16 percent) tested for differential attrition were significant at the five-percent level (Appendix Table 5.1). Panel households in the control group had slightly more adolescent children ages 12 to 17 on average (1.1 in control households and 0.9 in treatment households), and treatment households were about seven percentage points more likely to use organic fertilizer (33 percent controls and 26 percent treatment).

Of the 172 variables tested for overall attrition (Appendix Table 5.2), 15 were significant (8.72 percent) at or below the five percent level, indicating that there could be a slight issue of general attrition. Compared to children who remained in the panel, children who attrited were more likely to be the grandchild of the household head, live in households with a male head, and have more elderly household members. Attritors were also less likely to live in a household that received transfers from non-members or participated in a free-food program. Children that attrited were less likely to have had a fever during the previous two weeks and were less likely to be underweight.

From these findings we conclude that differential attrition is not a problem for the analysis of panel children and the internal validity of the study is maintained. Because fewer than 10 percent of the characteristics examined in the general attrition check were significant, we assume that general attrition is negligible and do not make any adjustments to baseline sampling weights for panel children.

Appendix Table 5.1. Differential Attrition in Panel of Children (Control vs. Treatment for Panel Households)

Variables	Control Mean	N1	Treatment Mean	N2	Mean Diff	Diff SE	p-value
<u>Child Characteristics</u>							
Female	0.506	456	0.500	407	-0.007	0.037	0.861
Age (months)	24.803	456	25.067	407	0.263	0.702	0.710
Grandchild of head	0.179	456	0.225	407	0.046	0.045	0.317
<u>Household head characteristics</u>							
Female	0.862	456	0.894	407	0.032	0.028	0.258
Age (years)	41.723	456	42.015	407	0.292	1.761	0.870
Any schooling	0.464	456	0.435	407	-0.029	0.050	0.563
Literate	0.279	456	0.217	407	-0.062	0.037	0.110
Widow	0.230	456	0.238	407	0.008	0.046	0.870
Never married	0.021	456	0.020	407	-0.000	0.010	0.987
Muslim	0.817	456	0.782	407	-0.035	0.100	0.732
Chronic illness	0.239	456	0.258	407	0.019	0.061	0.756
Disability	0.053	456	0.047	407	-0.005	0.017	0.769
<u>Household characteristics</u>							
Household size	6.399	456	6.422	407	0.022	0.149	0.882
Dependency ratio	3.503	456	3.373	407	-0.130	0.174	0.461
Any orphans	0.350	456	0.388	407	0.038	0.049	0.450
Salima district	0.464	456	0.406	407	-0.059	0.206	0.778
Total number members							
0 to 5	1.851	456	1.911	407	0.060	0.086	0.492
6 to 11	1.642	456	1.661	407	0.019	0.105	0.855
12 to 17	1.107	456	0.940	407	-0.168	0.076	0.035
18 to 64	1.611	456	1.643	407	0.032	0.088	0.720
65 and older	0.188	456	0.267	407	0.079	0.040	0.059
Community epidemic past year	0.706	456	0.840	407	0.133	0.178	0.461
Member with disability	0.140	456	0.109	407	-0.031	0.030	0.313
Member with chronic illness	0.391	456	0.412	407	0.020	0.059	0.733
AE-L annual expenditures at baseline	44,430.342	456	46,823.621	407	2,393.278	3,963.453	0.551
Improved drinking water source	0.897	456	0.880	407	-0.018	0.045	0.696
Improved toilet facility	0.453	456	0.451	407	-0.002	0.060	0.973
Room exclusively for cooking	0.505	456	0.501	407	-0.004	0.058	0.948
Improved cookstove, clean fuel, or ventilation	0.722	456	0.700	407	-0.021	0.069	0.758
Member sleeps under malaria net	0.597	456	0.593	407	-0.004	0.050	0.936
<u>Household welfare indicators</u>							
Total real annual consumption per household	185,961.153	456	191,414.396	407	5,453.243	19,046.835	0.777
AE-L annual expenditures at baseline	44,430.342	456	46,823.621	407	2,393.278	3,963.453	0.551
Poor	0.981	454	0.990	406	0.009	0.012	0.481
Ultrapoor	0.928	456	0.924	407	-0.004	0.024	0.865
Poorest 50% at baselind	0.722	456	0.706	407	-0.017	0.060	0.782
Poverty gap	48.845	403	47.641	356	-1.204	3.344	0.722
Ultra poverty gap	35.774	291	34.616	252	-1.159	3.166	0.717
Poverty severity	28.596	403	27.329	356	-1.267	3.067	0.683
Ultra poverty severity	17.347	291	16.283	252	-1.063	2.463	0.669
Subjective wealth of household from 1(poor) to 6(rich)	1.186	456	1.243	407	0.057	0.044	0.205

Subjective wealth of most of friends from 1(poor) to 6(rich)	2.021	456	2.104	407	0.083	0.107	0.443
Subjective wealth of most of neighbours from 1(poor) to 6(rich)	1.815	456	2.000	407	0.185	0.107	0.094
Household feels worse off compared to friends	0.535	456	0.560	407	0.025	0.057	0.663
Household feels worse off compared to neighbours	0.504	456	0.590	407	0.087	0.058	0.150
Maize from last harvest lasted at least 3 months	0.462	456	0.505	407	0.043	0.066	0.520
Maize in grainery will last at least 3 months	0.053	456	0.071	407	0.018	0.023	0.457
Number of months maize from last harvest lasted	3.702	456	3.934	407	0.232	0.349	0.512
Number of months maize in grainery will last	0.866	448	0.910	404	0.044	0.198	0.826
Household other income, benefits, and shocks							
Crop production household	0.987	456	0.985	407	-0.002	0.010	0.822
Irrigation	0.055	456	0.067	407	0.013	0.020	0.525
Fertilizer	0.619	456	0.613	407	-0.006	0.093	0.950
Organic fertilizer	0.331	456	0.264	407	-0.067	0.030	0.034
Pesticides	0.019	456	0.027	407	0.008	0.014	0.589
Acres cultivated	1.415	449	1.437	401	0.022	0.138	0.877
Under one acre	0.258	449	0.298	401	0.039	0.045	0.394
One to two acres	0.533	449	0.454	401	-0.079	0.039	0.052
Two to four acres	0.174	449	0.208	401	0.034	0.039	0.394
Over four acres	0.035	449	0.040	401	0.006	0.017	0.744
Hired labour for crop production	0.019	456	0.025	407	0.006	0.011	0.585
Sold any crops	0.225	436	0.199	384	-0.025	0.055	0.648
Sold groundnuts	0.289	84	0.353	79	0.064	0.153	0.678
Sold soyabeans	0.496	84	0.443	79	-0.053	0.224	0.814
Sold rice	0.070	446	0.047	397	-0.023	0.039	0.563
Sold tanaposi	0.049	446	0.064	397	0.015	0.029	0.602
Owns hand hoe	0.881	456	0.895	407	0.014	0.032	0.657
Owns axe	0.109	456	0.141	407	0.032	0.031	0.307
Owns panga knife	0.206	456	0.279	407	0.072	0.049	0.152
Owns sickle	0.178	456	0.168	407	-0.010	0.028	0.725
Purchased hand hoe in last 12 months	0.060	456	0.076	407	0.016	0.020	0.443
Purchased sickle in last 12 months	0.014	456	0.005	407	-0.009	0.007	0.234
Raised any livestock	0.282	456	0.312	407	0.030	0.057	0.602
Raised goat or sheep in last 12 months	0.116	456	0.109	407	-0.007	0.029	0.811
Raised chicken in last 12 months	0.182	456	0.227	407	0.044	0.050	0.384
Raised other livestock in last 12 months	0.030	456	0.040	407	0.010	0.017	0.575
Number of goat or sheep owned	0.251	456	0.255	407	0.004	0.106	0.974
Number of chicken owned	0.529	456	0.700	407	0.172	0.205	0.409
Number of goat or sheep owned	0.233	456	0.221	407	-0.012	0.151	0.937
pur_livestock	0.065	456	0.075	407	0.009	0.023	0.690

Engaged in fishing	0.008	456	0.000	407	-0.008	0.005	0.118
Owns enterprise	0.284	456	0.342	407	0.057	0.065	0.389
Enterprise earnings in the past month	1,410.945	134	4,082.839	151	2,671.895	1,494.725	0.085
Enterprise hired labour	0.012	134	0.000	151	-0.012	0.012	0.326
Any member with wage employment	0.113	456	0.085	407	-0.029	0.042	0.500
Any member doing ganyu labour	0.880	456	0.876	407	-0.004	0.034	0.909
Number of days of ganyu for household	104.049	406	98.992	361	-5.057	9.240	0.588
Average ganyu wage per day for household	507.022	404	583.422	361	76.401	46.144	0.109
Still owes on loan from 12+ months	0.122	456	0.092	407	-0.030	0.028	0.285
Purchase on credit in last 12 months	0.349	456	0.373	407	0.024	0.037	0.513
Loan contracted in last 12 months	0.371	456	0.309	407	-0.061	0.043	0.161
Amount owed on loan from 12+ months	5,452.656	62	6,025.610	37	572.954	3,577.300	0.874
Transfer made out of the household	0.404	456	0.369	407	-0.035	0.059	0.552
Household received a transfer	0.829	456	0.772	407	-0.057	0.061	0.357
Value of transfers made	3,857.092	456	4,670.766	407	813.675	1,145.224	0.483
Value of transfers received	25,606.000	456	26,328.317	407	722.316	5,616.254	0.899
Benefitted from any safety net programme	0.692	456	0.675	407	-0.017	0.070	0.810
Number of safety net programmes	1.166	456	1.217	407	0.051	0.245	0.836
Free Maize	0.153	456	0.172	407	0.019	0.098	0.848
Value of maize received	1.108	456	1.470	407	0.361	0.971	0.713
Free Food (other than Maize)	0.135	456	0.178	407	0.042	0.086	0.625
Food/Cash-for-Work	0.113	456	0.094	407	-0.019	0.038	0.620
School Feeding	0.161	456	0.222	407	0.062	0.095	0.521
Voucher to buy fertilizer or seeds (FISP)	0.488	456	0.453	407	-0.035	0.096	0.719
Community Based Childcare	0.063	456	0.054	407	-0.010	0.029	0.740
Maternal or child health/nutrition program	0.206	456	0.211	407	0.005	0.105	0.965
Food or cash program	0.189	456	0.134	407	-0.055	0.056	0.332
Agricultural inputs	0.337	456	0.265	407	-0.072	0.055	0.204
Cash or time	0.559	456	0.530	407	-0.028	0.068	0.679
Food or cash	0.923	456	0.849	407	-0.075	0.043	0.096
Labor or time	0.396	456	0.320	407	-0.076	0.065	0.251
Outcomes of interest							
Child has a Health Passport	0.905	456	0.893	407	-0.012	0.027	0.666
Under-5 health service	0.857	456	0.865	407	0.008	0.034	0.814
Any expenditure for non-illness med care/non-rx meds past month	0.161	456	0.205	407	0.044	0.040	0.283
Ate solid foods more than once per day	0.816	456	0.853	407	0.038	0.063	0.557

Child participates in a nutrition program	0.035	456	0.038	407	0.003	0.015	0.835
Consumed Vitamin A-Rich Fruits and Vegetables in the Last Day	0.641	456	0.703	407	0.062	0.057	0.285
Foodshare	0.777	456	0.778	407	0.001	0.013	0.953
Daily hh food energy availability AE-L	2,040.742	456	1,977.230	407	-63.512	181.527	0.729
Proportion calories from staples	0.841	456	0.842	407	0.001	0.026	0.982
AE-L annual expenditures							
Cereals, tubers	20,335.980	456	21,246.497	407	910.517	1,713.994	0.599
Fruits and vegetables	5,711.504	456	6,233.083	407	521.578	439.586	0.245
Meats, etc.	2,176.237	456	2,169.441	407	-6.795	717.760	0.993
Legumes	3,516.406	456	3,918.120	407	401.714	687.654	0.564
Oils, etc	3,382.963	456	3,229.406	407	-153.557	742.789	0.838
AE-L apparent caloric availability per day							
Cereals, tubers	1,707.010	456	1,645.752	407	-61.258	125.834	0.630
Fruits and vegetables	35.733	456	44.761	407	9.028	4.950	0.079
Meats, etc.	29.799	456	19.592	407	-10.207	7.442	0.181
Legumes	169.278	456	164.434	407	-4.844	42.235	0.910
Oils, etc	98.921	456	102.691	407	3.770	30.981	0.904
Calorie shares							
Cereals, tubers	0.839	456	0.839	407	-0.000	0.026	0.996
Fruits and vegetables	0.025	456	0.026	407	0.001	0.005	0.778
Meats, etc.	0.016	456	0.010	407	-0.005	0.004	0.173
Legumes	0.078	456	0.077	407	-0.001	0.016	0.967
Oils, etc	0.043	456	0.048	407	0.005	0.014	0.733
Health status (good, very good, excellent)	0.880	456	0.880	407	-0.000	0.035	0.995
Health improved past year	0.237	456	0.254	407	0.017	0.051	0.740
Diarrhea past 2 weeks	0.206	456	0.193	407	-0.013	0.035	0.717
Fever past 2 weeks	0.326	456	0.278	407	-0.048	0.048	0.329
Cough past 2 weeks	0.273	456	0.283	407	0.010	0.047	0.829
Any illness past 2 weeks	0.494	456	0.482	407	-0.012	0.057	0.840
Height	80.833	456	80.412	407	-0.421	0.737	0.573
Weight-for-age z-score	-0.866	456	-0.907	407	-0.041	0.092	0.659
Length/height-for-age z-score	-1.592	456	-1.879	407	-0.287	0.166	0.096
Weight-for-length/height z-score	0.014	456	0.162	407	0.148	0.089	0.109
Stunted	0.391	456	0.475	407	0.084	0.044	0.067
Wasted	0.036	456	0.042	407	0.006	0.012	0.620
Underweight	0.163	456	0.161	407	-0.002	0.030	0.953
Severely stunted	0.168	456	0.225	407	0.057	0.031	0.081
Severely wasted	0.013	456	0.009	407	-0.004	0.005	0.478
Severely underweight	0.033	456	0.052	407	0.019	0.019	0.338
Instrumental variables							
Distance to nearest tar road	6.402	456	6.217	407	-0.186	2.774	0.947
Weekly market	0.469	456	0.764	407	0.294	0.184	0.122
ADMARC	0.172	456	0.156	407	-0.016	0.143	0.912
Clinic	0.125	456	0.236	407	0.111	0.153	0.472
Distance to clinic	5.804	456	3.565	407	-2.239	1.558	0.162
Clinic of bad quality	0.767	456	0.922	407	0.154	0.134	0.258
Village clinic	0.595	456	0.405	407	-0.190	0.205	0.361
Distance to nearest doctor	37.755	456	19.325	407	-18.430	11.709	0.127
Wage – male labor	509.676	456	679.801	407	170.124	94.610	0.083

Wage – female labor	443.198	456	478.459	407	35.261	67.548	0.606
Wage – male ganyu	601.383	456	567.822	407	-33.561	90.563	0.714
Prices							
Maize grain	174.982	456	166.909	407	-8.072	48.055	0.868
Rice	338.361	456	326.064	407	-12.297	20.765	0.558
Beans	435.154	456	453.843	407	18.689	34.917	0.597
Tomatoes	44.087	456	60.705	407	16.618	11.567	0.162
Beef	1,091.008	456	1,249.704	407	158.696	112.851	0.171
Salt	31.740	456	24.944	407	-6.796	5.992	0.266
Sugar	354.316	456	422.281	407	67.965	43.533	0.130
Cooking oil	48.263	456	43.377	407	-4.887	8.891	0.587
Bar of soap	77.311	456	69.512	407	-7.799	10.089	0.446
Panadol	16.054	456	18.506	407	2.452	2.196	0.274
Unusually high prices for food	0.874	456	0.865	407	-0.009	0.046	0.847
Drought, flood, crop disease, high cost ag input	0.827	456	0.813	407	-0.015	0.082	0.859

Appendix Table 5.2. Overall Attrition in Panel of Children (Attritors vs. Panel Children)

Variables	Attritors Mean	N1	Panel Mean	N2	Mean Diff	Diff SE	p-value
Child characteristics							
Female	0.304	380	0.503	863	-0.016	0.034	0.636
Age (months)	24.600	380	24.931	863	-0.369	1.092	0.738
Grandchild of head	0.422	380	0.201	863	-0.077	0.035	0.037
Household head characteristics							
Female	0.839	380	0.877	863	0.063	0.026	0.024
Age (years)	48.255	380	41.865	863	-2.733	1.465	0.073
Any schooling	0.368	380	0.450	863	-0.008	0.032	0.801
Literate	0.258	380	0.248	863	-0.051	0.037	0.176
Widow	0.283	380	0.234	863	0.002	0.044	0.965
Never married	0.036	380	0.021	863	-0.001	0.012	0.962
Muslim	0.821	380	0.800	863	0.026	0.029	0.385
Chronic illness	0.329	380	0.248	863	-0.070	0.037	0.069
Disability	0.069	380	0.050	863	-0.003	0.016	0.836
Household characteristics							
Household size	6.645	380	6.410	863	-0.019	0.168	0.911
Dependency ratio	3.232	380	3.440	863	-0.002	0.169	0.989
Any orphans	0.426	380	0.368	863	-0.049	0.051	0.346
Salima	0.411	380	0.436	863	-0.051	0.052	0.334
Number of members							
0 to 5	1.963	380	1.880	863	-0.010	0.071	0.891
6 to 11	1.436	380	1.651	863	0.128	0.103	0.223
12 to 17	1.038	380	1.026	863	-0.072	0.099	0.470
18 to 64	1.808	380	1.627	863	0.003	0.058	0.955
65 and older	0.400	380	0.226	863	-0.068	0.028	0.019
Community epidemic past year	0.758	380	0.771	863	-0.003	0.035	0.927
Member with disability	0.141	380	0.125	863	0.001	0.030	0.974
Member with chronic illness	0.481	380	0.401	863	-0.043	0.038	0.267
AE-L annual expenditures at baseline	50,956.285	380	45,593.092	863	-3,063.453	2,216.287	0.178
Improved drinking water source	0.879	380	0.889	863	0.018	0.034	0.604
Improved toilet facility	0.484	380	0.452	863	-0.054	0.030	0.077
Room used exclusively for cooking	0.548	380	0.503	863	-0.054	0.040	0.191
Improved cookstove, clean fuel, or improved ventilation	0.698	380	0.711	863	0.024	0.033	0.468
Member sleeps under malaria net	0.673	380	0.595	863	-0.091	0.037	0.019
Household welfare indicators							
Total real annual consumption per household	215,380.043	380	188,610.554	863	-10,111.41	7,538.614	0.191
AE-L annual expenditures at baseline	50,956.285	380	45,593.092	863	-3,063.453	2,216.287	0.178
Poor	0.979	380	0.985	860	-0.005	0.005	0.297
Ultrapoor	0.852	380	0.926	863	0.049	0.026	0.073
Poorest 50%	0.616	380	0.714	863	0.052	0.042	0.229
Poverty gap	46.264	305	48.265	759	1.249	2.028	0.543
Ultra poverty gap	33.117	212	35.225	543	2.526	2.120	0.243
Poverty severity	26.064	305	27.986	759	1.445	1.741	0.414
Ultra poverty severity	15.745	212	16.842	543	1.385	1.679	0.417
Subjective wealth of household from 1(poor)	1.239	380	1.213	863	0.026	0.031	0.416

to 6(rich)							
Subjective wealth of most of friends from 1(poor) to 6(rich)	2.029	380	2.061	863	0.073	0.083	0.390
Subjective wealth of most of neighbours from 1(poor) to 6(rich)	1.937	380	1.905	863	0.051	0.071	0.481
Household feels worse off compared to friends	0.555	380	0.547	863	0.006	0.041	0.879
Household feels worse off compared to neighbours	0.573	380	0.546	863	-0.013	0.038	0.737
Maize from last harvest lasted at least 3 months	0.554	380	0.483	863	-0.021	0.039	0.598
Maize in grainery will last at least 3 months	0.105	380	0.061	863	-0.004	0.014	0.774
Number of months maize from last harvest lasted	4.191	379	3.815	863	-0.068	0.201	0.738
Number of months maize in grainery will last	1.205	376	0.888	852	-0.021	0.110	0.849
<u>Household other income, benefits, and shocks</u>							
Crop production household	0.969	380	0.986	863	0.024	0.014	0.105
Irrigation	0.060	380	0.061	863	0.027	0.015	0.079
Fertilizer	0.692	380	0.616	863	-0.025	0.043	0.573
Organic fertilizer	0.301	380	0.299	863	0.020	0.031	0.517
Pesticides	0.024	380	0.023	863	-0.014	0.015	0.363
Acres cultivated	1.531	367	1.426	850	-0.096	0.124	0.447
Under one acre	0.232	367	0.277	850	0.054	0.028	0.067
One to two acres	0.491	367	0.494	850	-0.020	0.040	0.627
Two to four acres	0.237	367	0.191	850	-0.043	0.026	0.111
Over four acres	0.039	367	0.037	850	0.009	0.016	0.604
Hired labour for crop production	0.047	380	0.022	863	-0.022	0.026	0.404
Sold any crops	0.214	349	0.212	820	0.021	0.034	0.535
Sold groundnuts	0.387	72	0.318	163	-0.183	0.068	0.012
Sold soyabeans	0.270	72	0.472	163	0.240	0.083	0.007
Sold rice	0.043	361	0.059	843	0.009	0.017	0.584
Sold tanaposi	0.060	361	0.057	843	0.016	0.018	0.384
Owns hand hoe	0.892	380	0.888	863	0.011	0.023	0.627
Owns axe	0.161	380	0.124	863	-0.012	0.025	0.627
Owns panga knife	0.224	380	0.241	863	0.037	0.035	0.304
Owns sickle	0.184	380	0.173	863	0.018	0.024	0.468
Purchased hand hoe in last 12 months	0.091	380	0.068	863	-0.014	0.018	0.444
Purchased sickle in last 12 months	0.015	380	0.009	863	0.006	0.006	0.319
Raised any livestock	0.297	380	0.296	863	0.043	0.033	0.211
Raised goat or sheep in last 12 months	0.131	380	0.112	863	0.007	0.022	0.738
Raised chicken in last 12 months	0.179	380	0.204	863	0.057	0.024	0.026
Raised other livestock in last 12 months	0.040	380	0.035	863	-0.008	0.018	0.659
Number of goat or sheep owned	0.315	380	0.253	863	0.032	0.046	0.497
Number of chicken owned	0.623	380	0.612	863	0.127	0.099	0.212
Number of goat or sheep owned	0.240	380	0.227	863	-0.057	0.123	0.648

Purchased livestock	0.056	380	0.070	863	0.014	0.017	0.412
Engaged in fishing	0.013	380	0.004	863	-0.018	0.009	0.054
Owns enterprise	0.339	380	0.312	863	-0.021	0.032	0.529
Enterprise earnings in the past month	2,698.023	133	2,831.195	285	553.422	921.843	0.553
Enterprise hired labour	0.011	134	0.005	285	-0.014	0.010	0.170
Any member with wage employment	0.073	380	0.099	863	0.050	0.023	0.041
Any member doing ganyu labour	0.795	380	0.878	863	0.069	0.040	0.099
Number of days of ganyu for household	109.625	301	101.598	767	-1.270	6.588	0.849
Average ganyu wage per day for household	583.671	301	544.135	765	4.541	39.752	0.910
Still owes on loan from 12+ months	0.071	380	0.107	863	0.027	0.022	0.227
Purchase on credit in last 12 months	0.344	380	0.361	863	0.014	0.049	0.783
Loan contracted in last 12 months	0.324	380	0.341	863	-0.009	0.033	0.787
Amount owed on loan from 12+ months	3,601.889	30	5,690.870	99	1,741.790	2,027.209	0.399
Transfer made out of the household	0.320	380	0.387	863	0.060	0.038	0.126
Household received a transfer	0.737	380	0.801	863	0.080	0.035	0.032
Value of transfers made	3,564.418	380	4,252.407	863	806.314	917.347	0.387
Value of transfers received	25,359.790	380	25,956.930	863	1,315.442	3,444.315	0.705
Benefitted from any safety net programme	0.705	380	0.684	863	-0.002	0.033	0.955
Number of safety net programmes	1.089	380	1.190	863	0.104	0.091	0.263
Free Maize	0.124	380	0.162	863	0.025	0.029	0.402
Value of maize received	0.958	380	1.284	863	0.182	0.250	0.473
Free Food (other than Maize)	0.099	380	0.156	863	0.057	0.026	0.037
Food/Cash-for-Work	0.080	380	0.104	863	0.046	0.026	0.088
School Feeding	0.153	380	0.190	863	0.003	0.029	0.919
Voucher to buy fertilizer or seeds (FISP)	0.534	380	0.471	863	-0.005	0.040	0.895
Community Based Childcare	0.032	380	0.059	863	0.012	0.013	0.352
Maternal and child health/nutrition program	0.172	380	0.208	863	-0.010	0.021	0.624
Food or cash program	0.187	380	0.163	863	-0.034	0.027	0.214
Received agricultural inputs	0.292	380	0.302	863	0.063	0.039	0.117
Received cash transfer from non-family	0.604	380	0.545	863	-0.016	0.037	0.658
Received food or cash	0.887	380	0.887	863	-0.008	0.026	0.752
Received Labor or time	0.441	380	0.359	863	-0.015	0.027	0.576
Outcomes of interest							
Child has a Health Passport	0.865	380	0.899	863	0.047	0.031	0.141
Under-5 services	0.818	380	0.860	863	0.067	0.040	0.101
Any expenditure for non-illness med care/non-rx meds past	0.187	380	0.182	863	0.003	0.037	0.934

month							
Ate solid foods more than once per day	0.809	380	0.834	863	0.039	0.030	0.194
Child participates in a nutrition program	0.055	377	0.036	863	-0.034	0.015	0.032
Consumed Vitamin A-Rich Fruits and Vegetables in the Last Day	0.630	380	0.671	863	0.069	0.032	0.043
Foodshare	0.771	380	0.778	863	0.019	0.010	0.074
Daily hh food energy availability per AE-L	2,171.830	380	2,009.885	863	-50.159	115.710	0.668
Proportion calories from staples	0.831	380	0.841	863	-0.002	0.012	0.850
AE-L annual expenditures							
Cereals, tubers	22,190.022	380	20,778.345	863	-619.855	1,112.048	0.582
Fruits and vegetables	6,660.723	380	5,964.908	863	-743.961	517.270	0.161
Meat, etc.	2,923.123	380	2,172.935	863	-373.311	524.892	0.483
Legumes, etc.	4,407.573	380	3,711.575	863	-480.121	537.952	0.380
Oils, etc.	4,089.886	380	3,308.359	863	334.381	284.026	0.249
AE-L daily caloric availability							
Cereals, tubers	1,787.971	380	1,677.248	863	-62.338	96.357	0.523
Fruits and vegetables	43.418	380	40.119	863	1.219	5.375	0.822
Meat, etc.	29.979	380	24.840	863	-4.628	4.311	0.292
Legumes, etc.	184.038	380	166.925	863	-7.304	25.775	0.779
Oils, etc.	126.424	380	100.753	863	22.892	12.917	0.087
Calorie shares							
Cereals, tubers	0.829	380	0.839	863	-0.002	0.013	0.876
Fruits and vegetables	0.024	380	0.025	863	0.002	0.004	0.487
Meat, etc.	0.014	380	0.013	863	-0.003	0.003	0.259
Legumes, etc.	0.081	380	0.077	863	-0.003	0.010	0.738
Oils, etc.	0.052	380	0.045	863	0.006	0.006	0.295
Health status (good, very good, excellent)	0.887	378	0.880	863	0.028	0.029	0.353
Health improved past year	0.279	371	0.245	863	-0.057	0.034	0.106
Diarrhea in the past 2 weeks	0.201	377	0.200	863	-0.001	0.035	0.986
Fever in the past 2 weeks	0.227	377	0.303	863	0.076	0.032	0.026
Cough in the past 2 weeks	0.259	377	0.278	863	-0.002	0.031	0.955
Any illness in the past 2 weeks	0.428	377	0.488	863	0.063	0.036	0.093
Height	80.337	331	80.628	863	-0.411	1.069	0.704
Weight-for-age z-score	-0.609	192	-0.886	863	-0.277	0.146	0.069
Length/height-for-age z-score	-1.629	192	-1.732	863	-0.103	0.304	0.738
Weight-for-length/height z-score	0.311	188	0.086	863	-0.225	0.233	0.343
Stunted	0.392	177	0.432	863	0.040	0.043	0.366
Wasted	0.049	177	0.039	863	-0.010	0.021	0.647
Underweight	0.101	188	0.162	863	0.061	0.025	0.020
Severely stunted	0.191	177	0.196	863	0.005	0.029	0.873
Severely wasted	0.021	177	0.011	863	-0.010	0.013	0.421
Severely underweight	0.016	188	0.042	863	0.025	0.015	0.112
Instrumental variables							
Distance to nearest tar road	5.615	380	6.312	863	0.133	0.564	0.815
Weekly market	0.638	380	0.612	863	-0.043	0.046	0.349
ADMARC	0.155	380	0.164	863	0.007	0.033	0.843

Clinic	0.192	380	0.179	863	-0.013	0.056	0.818
Distance to clinic	5.121	380	4.716	863	-0.649	0.515	0.218
Clinic of bad quality	0.888	380	0.842	863	-0.040	0.030	0.190
Village clinic	0.534	380	0.502	863	-0.026	0.052	0.622
Distance to nearest doctor	26.976	380	28.801	863	0.476	2.633	0.858
Wage – male labor	655.602	380	592.330	863	-76.146	52.907	0.161
Wage – female labor	468.093	380	460.329	863	-4.070	15.370	0.793
Wage – male ganyu	603.714	380	585.078	863	-48.636	21.027	0.028
Prices							
Maize grain	177.238	380	171.060	863	10.316	5.865	0.090
Rice	334.870	380	332.387	863	1.609	4.173	0.703
Beans	444.449	380	444.234	863	1.569	9.616	0.872
Tomatoes	55.439	380	52.161	863	-2.744	3.697	0.464
Beef	1,148.880	380	1,168.109	863	32.303	28.834	0.272
Salt	29.186	380	28.439	863	0.498	0.846	0.561
Sugar	391.913	380	387.336	863	4.855	7.138	0.502
Cooking oil	45.972	380	45.889	863	-0.352	2.671	0.896
Bar of soap	72.938	380	73.522	863	0.868	2.144	0.689
Panadol	17.910	380	17.246	863	-0.636	0.590	0.290
Unusually high prices for food	0.820	380	0.869	863	0.057	0.034	0.105
Drought, flood, crop disease, high cost ag input	0.765	380	0.820	863	0.071	0.039	0.079

APPENDIX 6: CHAPTER 3 INSTRUMENTAL VARIABLES DIAGNOSTICS

Appendix Tables 3 and 4 present test statistics for instrumental variable tests for regressor endogeneity, weak instruments, and overidentification. We use the instrumental variables estimator in this study to solve the problem of endogenous inputs in the child health production function. Instrumental variables must be valid in that they are correlated with the endogenous input variables, they must meet the exclusion restriction which stipulates that they are not correlated with the health outcome of interest except indirectly via the endogenous input, and the system must be identified, which means that there are at least as many exogenous instrumental variables excluded from the health production function structural equation as there are endogenous input variables.

We first test that the input demands are actually endogenous to the health outcome equations using a variation of the Durbin-Wu-Hausman test that allows for sample weights and clustered standard errors. Specifying an input as endogenous when it is actually exogenous will not cause the IV estimates to be biased, but they will likely be less efficient than OLS. The null hypothesis under the test is that the endogenous regressor(s) are exogenous. As seen in Appendix Table 3, all test statistics are significant except for the F-statistic for the health status structural equation in the panel of children. From these results, we conclude that the input demands should be treated as endogenous in the health outcome equations.

We next test for the problem of weak instruments. Even if an instrument is valid in that it is correlated with the endogenous regressor, estimation efficiency decreases if this correlation is low. Appendix Table 4 presents R-squared values and F-statistics of instrument joint significance from the first-stage results of the 2SLS model. The adjusted R-square value comes from the OLS regression of the endogenous input demands on the exogenous controls and instruments and has the standard interpretation of percent of variance in the outcome accounted for by the model. While we would like to see a high adjusted R-square value, it does not tell us much about the strength of the instruments because we cannot assess what portion of the variance is explained by the exogenous controls common to both the input demand and health production equations and what portion is due to the instruments. The partial R-squared statistic gives a measure of the correlation between the endogenous health input and the instruments, after partialling out the effects of the exogenous covariates on the health input. This helps us to understand the relevance of the instruments – that is, the additional information they provide – after accounting for the correlation between the exogenous controls and the endogenous input. Stronger associations between the endogenous input variable and the instruments typically yield a more strongly identified model.

Despite high adjusted R-squared values for some of the health input equations, the partial R-squared values are low for both the panel of children and models run among children from panel households. This may indicate that the set of instrumental variables employed in this study do not provide substantial additional information that is not already accounted for by control variables common to both the first and second stage equations. The F-statistics presented in Appendix Table 4 are for the joint significance of the instrumental variables in each input equation. In the case of one endogenous regressor, a common rule of thumb is that F-statistics larger than 10 provide evidence of strong instruments. In the case of multiple endogenous regressors with multiple instruments, it is common to calculate additional critical values for the F-statistic, which are typically greater than 10. Unfortunately, these critical values cannot be calculated for models that use clustered standard errors and sample weights. A quick review of the F-statistics reveals that the joint significance of the instruments is weak in the nutrition program input equation for both sub-samples, in the AE-L Kcal/day from legumes equation among children from panel households, and in the AE-L Kcal/day from cereals and tubers among panel children.

Lastly, we test the overidentifying restrictions using Sargan's test statistic (Appendix Table 3). The null hypothesis of the test is that all of the instruments are valid, and rejection of the null hypothesis indicates that one or more of the instruments is not valid (i.e. the instrument is correlated with the error term in the health outcome structural equation). None of the Sargan's test statistics are significant, leading us to conclude that the instruments are valid.

Appendix Table 6.1. IV Tests for Endogeneity and Overidentification

	Children from Panel Households (N = 2,883)				Panel of Children (N = 1,726)			
	Endogeneity of Input Demands		Test of Overidentifying Restrictions		Endogeneity of Input Demands		Test of Overidentifying Restrictions	
	F-stat	*p-value*	Sargan's stat	*p-value*	F-stat	*p-value*	Sargan's stat	*p-value*
Health status	4.01	*0.00*	3.88	*0.79*	1.81	0.08	4.50	0.72
Health improvement	7.48	*0.00*	4.31	*0.74*	9.98	0.00	4.93	0.67
Diarrhea	3.49	*0.00*	3.72	*0.81*	2.92	0.01	1.93	0.96
Cough	3.53	*0.00*	3.37	*0.85*	9.27	0.00	1.17	0.99
Fever	17.17	*0.00*	2.20	*0.95*	5.02	0.00	5.27	0.63
Any illness	8.89	*0.00*	4.33	*0.74*	4.52	0.00	5.95	0.55
Height (cm)	6.11	*0.00*	8.01	*0.33*	6.26	0.00	0.56	1.00
HAZ	4.94	*0.00*	3.09	*0.88*	10.84	0.00	0.90	1.00
WAZ	8.15	*0.00*	8.70	*0.27*	3.37	0.00	0.91	1.00
WHZ	5.54	*0.00*	3.13	*0.87*	5.51	0.00	0.72	1.00
Stunted	4.21	*0.00*	10.18	*0.18*	4.37	0.00	1.72	0.97
Wasted	2.53	*0.01*	9.24	*0.24*	3.75	0.00	2.99	0.89
Underweight	7.30	*0.00*	4.25	*0.75*	17.42	0.00	0.38	1.00

Notes:

Appendix Table 6.2. IV Tests of Weak Instruments

	Children from Panel Households (N = 2,883)				Panel of Children (N = 1,726)			
	Adjusted R^2	Partial R^2	F stat (24,28)	*p-value*	Adjusted R^2	Partial R^2	F stat (24,28)	*p-value*
Health passport	0.07	0.02	45.70	*0.00*	0.05	0.03	106.78	0.00
Under-5 services	0.21	0.04	164.62	*0.00*	0.20	0.05	17.09	0.00
Any health expenditures	0.04	0.03	70.24	*0.00*	0.06	0.04	23.82	0.00
Solid food ≥ 1/day	0.13	0.04	60.41	*0.00*	0.15	0.06	73.33	0.00
Nutrition program	0.02	0.03	7.03	*0.00*	0.01	0.03	7.09	0.00
Vitamin A past day	0.15	0.06	18.86	*0.00*	0.17	0.07	31.70	0.00
AE-L annual food expenditures	0.54	0.04	19.44	*0.00*	0.50	0.05	73.56	0.00
Food share	0.16	0.02	74.80	*0.00*	0.16	0.03	29.78	0.00
Food group AE-L Kcal/day								
Cereals and tubers	0.41	0.03	76.15	*0.00*	0.19	0.03	4.41	0.00
Fruits and vegetables	0.26	0.06	24.52	*0.00*	0.19	0.08	33.43	0.00
Meats, etc.	0.22	0.04	32.08	*0.00*	0.18	0.04	74.19	0.00
Legumes, etc.	0.23	0.05	5.98	*0.00*	0.24	0.06	18.50	0.00
Oils, etc.	0.18	0.04	45.29	*0.00*	0.17	0.05	19.02	0.00
Food expenditure shares								
Cereals and tubers	0.10	0.02	11.46	*0.00*	0.10	0.02	10.03	0.00
Fruits and vegetables	0.17	0.06	19.51	*0.00*	0.17	0.05	27.99	0.00
Meats, etc.	0.20	0.04	27.60	*0.00*	0.22	0.05	56.02	0.00
Legumes, etc.	0.12	0.05	30.83	*0.00*	0.12	0.05	39.82	0.00

Notes: share of oil is excluded as reference?

APPENDIX 7: CHAPTER 3 EXTENSION TABLES

Appendix Table 7.1. Input Demands (1st Stage 2SLS Results) – Children 6-23 Months, Household Panel (N = 766)

	time	treat	DD
Health passport	0.07*	0.02	-0.03
	(0.03)	(0.03)	(0.04)
Under-5 services	0.02	0.01	-0.01
	(0.05)	(0.03)	(0.05)
Any health expenditures	0.06	-0.00	-0.00
	(0.06)	(0.05)	(0.08)
Solid food > 1/day	0.17**	0.12**	-0.05
	(0.05)	(0.04)	(0.05)
Nutrition program	0.13***	0.01	-0.02
	(0.03)	(0.02)	(0.03)
Vitamin A past day	0.42***	0.10	-0.17+
	(0.09)	(0.06)	(0.09)
AE-L annual food	-9,013.68**	-2,249.99	2,798.42
	(2,695.16)	(1,888.43)	(2,946.80)
Food share	-0.06***	0.02	-0.05**
	(0.01)	(0.01)	(0.02)
Food group AE-L Kcal/day			
Cereals and tubers	-361.73+	-307.76*	158.29
	(178.71)	(115.06)	(190.61)
Fruits and vegetables	48.95*	4.54	2.77
	(23.53)	(16.06)	(27.77)
Meat, etc.	9.89	-10.84	5.82
	(10.14)	(8.38)	(12.61)
Legumes, etc.	-107.42*	-10.75	38.57
	(46.34)	(33.28)	(36.13)
Oils, etc.	60.49	-58.51*	90.95*
	(37.58)	(27.82)	(36.05)
Food expenditure shares			
Cereals and tubers	-0.02	0.03	-0.07+
	(0.03)	(0.02)	(0.04)
Fruits and vegetables	0.04	0.00	-0.02
	(0.03)	(0.02)	(0.03)
Meat, etc.	0.03**	-0.01	0.03+
	(0.01)	(0.01)	(0.01)
Legumes, etc.	-0.00	0.00	0.01
	(0.02)	(0.01)	(0.02)

Notes

Appendix Table 7.2. Production of Child Health (2nd Stage Results) – Children 6-23 Months, Household Panel (N = 766)

	Health Status	Health Improved	Any Illness	Diarrhea	Fever	Cough	Height	WAZ	HAZ	WHZ	Stunted	Wasted	Underweight
Time	-0.23	0.30	0.30	-0.14	-0.09	0.04	1.91	0.18	0.42	-0.07	0.06	0.04	-0.20
	(0.38)	(0.65)	(0.67)	(0.46)	(0.52)	(0.38)	(4.24)	(1.00)	(1.47)	(1.22)	(0.39)	(0.21)	(0.36)
Treat	0.08	-0.12	-0.04	0.01	0.03	-0.13	-1.70*	-0.40	-0.68*	-0.06	0.06	-0.01	0.02
	(0.09)	(0.12)	(0.14)	(0.09)	(0.09)	(0.08)	(0.79)	(0.27)	(0.29)	(0.36)	(0.07)	(0.05)	(0.07)
DD	-0.11	0.30	-0.07	-0.13	-0.39*	0.28+	2.63	0.56	0.91	0.05	-0.12	0.09	0.01
	(0.21)	(0.30)	(0.30)	(0.16)	(0.20)	(0.17)	(1.87)	(0.63)	(0.69)	(0.82)	(0.18)	(0.10)	(0.17)
Health passport	-0.53	0.94	0.36	0.39	0.06	0.03	-1.17	-0.84	-0.55	-0.80	0.45	0.15	0.34
	(0.43)	(0.92)	(0.93)	(0.65)	(0.73)	(0.56)	(6.18)	(1.70)	(2.22)	(2.07)	(0.65)	(0.31)	(0.47)
Under-5 Services	-0.32	0.28	0.51	-0.51	-0.43	-0.45	3.07	-0.44	0.65	-1.17	-0.69	-0.01	-0.77
	(0.87)	(1.41)	(1.47)	(1.06)	(1.23)	(0.90)	(8.98)	(2.98)	(3.17)	(3.46)	(0.90)	(0.49)	(0.96)
Any health expenditures	-0.18	0.05	0.09	0.24	0.08	0.43	0.63	0.57	0.06	0.61	0.03	0.01	-0.26
	(0.33)	(0.71)	(0.49)	(0.32)	(0.35)	(0.38)	(4.02)	(1.13)	(1.41)	(1.34)	(0.40)	(0.23)	(0.31)
Solid food ≥ 1/day	-0.18	-0.09	0.21	-0.04	-0.01	0.32	-0.56	-0.20	-0.56	0.17	0.17	-0.08	-0.28
	(0.31)	(0.59)	(0.39)	(0.28)	(0.28)	(0.33)	(3.70)	(0.90)	(1.31)	(1.29)	(0.38)	(0.19)	(0.30)
Nutrition program	-0.19	0.18	0.20	0.00	-0.59	1.09+	1.25	-1.26	-0.16	-1.80	0.19	0.37	0.44
	(0.48)	(1.05)	(0.83)	(0.48)	(0.58)	(0.60)	(6.04)	(2.43)	(2.22)	(2.88)	(0.61)	(0.44)	(0.59)
Vitamin A past day	0.54	-0.86	-0.56	0.06	0.03	-0.42	-3.24	0.61	-0.90	1.70	0.27	-0.26	0.37
	(0.46)	(0.72)	(0.82)	(0.48)	(0.66)	(0.46)	(5.04)	(1.96)	(1.73)	(2.32)	(0.49)	(0.29)	(0.48)
AE-L annual food exp.	-0.00	0.00	0.00+	0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	-0.70	4.33	-1.30	-3.15	-4.43	0.99	44.63	5.56	14.65	-3.73	-3.61	1.65	-3.33
	(3.34)	(4.04)	(5.14)	(2.74)	(3.79)	(2.66)	(30.19)	(11.01)	(10.85)	(13.63)	(3.06)	(1.40)	(3.19)
Food group AE-L Kcal/day													
Cereals and tubers	0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and vegetables	0.00	0.00	0.00	0.00	0.00+	-0.00	0.01	-0.00	0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00	-0.00	0.00	-0.00	-0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	-0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	0.00	-0.00	-0.00	0.00	-0.00

	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Food expenditure shares													
Cereals and tubers	-2.21	3.14	-2.31	-1.81	-5.50*	2.52	18.07	11.28+	8.26	8.24	-1.22	1.88	-0.93
	(1.96)	(3.56)	(2.71)	(2.42)	(2.59)	(2.27)	(19.93)	(6.30)	(7.22)	(8.39)	(2.13)	(1.43)	(1.69)
Fruits and vegetables	-1.62	3.21	-2.44	-3.07	-5.68*	2.16	25.74	8.66	10.71	2.95	-2.95	2.59+	-0.96
	(2.03)	(3.84)	(2.78)	(2.46)	(2.70)	(2.19)	(23.72)	(7.57)	(8.50)	(9.86)	(2.40)	(1.35)	(1.76)
Meats, etc.	-0.70	0.95	-5.36	0.05	-3.84	-0.84	-15.77	11.10	-0.08	14.26	-0.94	0.48	-0.07
	(3.90)	(6.83)	(7.74)	(4.95)	(6.14)	(4.05)	(40.85)	(11.08)	(14.00)	(13.09)	(3.85)	(2.20)	(3.06)
Legumes, etc.	0.24	2.43	-2.64	-1.23	-4.54+	1.04	33.23	11.98*	14.26+	5.34	-2.55	2.34+	-2.23
	(1.62)	(3.57)	(2.86)	(2.08)	(2.64)	(2.55)	(24.01)	(5.92)	(8.34)	(8.17)	(2.40)	(1.25)	(1.84)

Notes

Appendix Table 7.3. Input Demands (1st Stage 2SLS Results) – Children 24-59 Months, Household Panel (N = 2,117)

	time	treat	DD
Health passport	0.07*	-0.04+	0.04
	(0.03)	(0.02)	(0.03)
Under-5 services	-0.02	-0.01	-0.01
	(0.06)	(0.04)	(0.05)
Any health expenditures	-0.01	0.01	0.02
	(0.03)	(0.03)	(0.04)
Solid food > 1/day	0.07+	0.04	0.02
	(0.04)	(0.03)	(0.03)
Nutrition program	0.03	-0.03+	-0.01
	(0.02)	(0.02)	(0.02)
Vitamin A past day	0.15**	0.01	0.04
	(0.04)	(0.03)	(0.05)
AE-L annual food	-12,186.54***	-2,087.13	7,879.53**
	(2,428.71)	(1,473.15)	(2,248.96)
Food share	-0.09***	-0.00	-0.01
	(0.01)	(0.01)	(0.01)
Food group AE-L Kcal/day			
Cereals and tubers	-620.76**	-144.79	520.73***
	(180.17)	(116.69)	(139.55)
Fruits and vegetables	48.60**	3.18	12.77
	(16.03)	(11.00)	(16.01)
Meat, etc.	-10.62+	-8.87+	31.40***
	(5.71)	(4.56)	(4.93)
Legumes, etc.	-128.53***	12.39	40.99
	(32.56)	(25.33)	(28.04)
Oils, etc.	-48.85	-18.06	133.54***
	(40.70)	(26.66)	(34.03)
Food expenditure shares			
Cereals and tubers	-0.08**	-0.01	-0.02
	(0.02)	(0.02)	(0.02)
Fruits and vegetables	0.10***	-0.02	-0.02
	(0.02)	(0.02)	(0.02)
Meat, etc.	0.04***	0.00	0.02+
	(0.01)	(0.01)	(0.01)
Legumes, etc.	-0.01	0.03**	-0.01
	(0.01)	(0.01)	(0.01)

Notes

Appendix Table 7.4. Production of Child Health (2nd Stage Results) – Children 24-59 Months, Household Panel (N = 2,117

	Health Status	Health Improved	Any Illness	Diarrhea	Fever	Cough	Height	WAZ	HAZ	WHZ	Stunted	Wasted	Underweight
Time	-0.17	0.70	0.05	0.05	0.10	-0.16	-0.39	-0.07	0.04	-0.17	-0.35	0.04	-0.07
	(0.25)	(0.62)	(0.25)	(0.22)	(0.40)	(0.38)	(1.78)	(0.66)	(0.52)	(0.65)	(0.60)	(0.10)	(0.38)
Treat	0.00	-0.01	-0.02	-0.01	-0.06	0.11	-0.01	0.04	0.03	0.03	-0.03	-0.01	-0.06
	(0.09)	(0.20)	(0.12)	(0.08)	(0.17)	(0.15)	(0.93)	(0.33)	(0.29)	(0.31)	(0.24)	(0.04)	(0.15)
DD	-0.05	0.01	-0.02	0.02	0.10	-0.12	1.75	0.54	0.48	0.33	-0.32	-0.01	-0.16
	(0.19)	(0.40)	(0.16)	(0.16)	(0.22)	(0.28)	(1.36)	(0.46)	(0.41)	(0.50)	(0.44)	(0.08)	(0.18)
Health passport	0.05	-0.55	0.36	-0.00	0.19	0.53	1.83	-0.17	0.44	-0.69	0.10	-0.07	0.15
	(0.28)	(0.90)	(0.48)	(0.30)	(0.56)	(0.58)	(3.60)	(1.26)	(1.10)	(1.21)	(0.83)	(0.17)	(0.53)
Under-5 Services	-0.01	0.16	0.09	-0.20	0.18	0.19	0.97	0.76	0.24	0.97	0.29	-0.06	0.24
	(0.33)	(0.70)	(0.35)	(0.29)	(0.44)	(0.44)	(2.25)	(0.68)	(0.69)	(0.60)	(0.72)	(0.11)	(0.36)
Any health expenditures	-0.22	0.09	-0.13	0.01	-0.40	-0.28	0.84	0.01	0.20	-0.03	0.12	0.21	-0.04
	(0.53)	(0.91)	(0.49)	(0.35)	(0.71)	(0.65)	(4.44)	(1.52)	(1.31)	(1.61)	(1.07)	(0.20)	(0.63)
Solid food > 1/day	-0.26	0.02	-0.23	0.08	-0.23	-0.53	0.93	0.64	0.47	0.48	-0.65	0.12	0.13
	(0.38)	(0.65)	(0.50)	(0.44)	(0.57)	(0.56)	(4.08)	(1.24)	(1.12)	(1.23)	(0.71)	(0.13)	(0.50)
Nutrition program	-0.80	-0.70	-0.49	0.16	-0.40	-0.80	5.40	2.64	2.08	1.88	-1.68	0.09	-1.11
	(1.54)	(2.54)	(1.20)	(1.04)	(1.67)	(1.68)	(8.69)	(2.81)	(2.50)	(2.51)	(2.30)	(0.40)	(1.18)
Vitamin A past day	0.00	0.37	-0.05	0.14	-0.08	-0.48	-1.76	-0.71	-0.56	-0.57	0.55	0.11	0.36
	(0.23)	(0.59)	(0.41)	(0.21)	(0.48)	(0.32)	(1.57)	(0.78)	(0.52)	(0.81)	(0.55)	(0.11)	(0.34)
AE-L annual food exp.	-0.00	0.00	0.00	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	1.01	-2.46	-1.51	-1.82	-2.01	1.74	9.57	2.54	2.10	2.45	0.70	-0.72	-0.76
	(2.10)	(3.24)	(2.60)	(1.83)	(3.16)	(2.55)	(17.69)	(5.24)	(5.37)	(4.50)	(3.65)	(0.89)	(2.30)
Food group AE-L Kcal/day													
Cereals and tubers	0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and vegetables	0.00	-0.00	0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00	-0.00	-0.01	0.00	-0.01	-0.00	-0.01	-0.01	-0.00	-0.02	-0.00	0.00	0.00
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.05)	(0.02)	(0.02)	(0.02)	(0.01)	(0.00)	(0.01)
Legumes, etc.	0.00	-0.00	0.00	-0.00	-0.00	0.00	-0.01	-0.00	-0.00	-0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00	-0.00	-0.00	-0.00	-0.00	0.00	-0.01	-0.00	-0.00	-0.00	0.00	-0.00	0.00

	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food expenditure shares													
Cereals and tubers	0.84	0.57	2.86	-0.64	2.03	3.75	-5.32	2.61	-0.68	4.68	-0.15	-0.47	-2.82
	(2.29)	(5.86)	(3.25)	(2.12)	(5.17)	(3.42)	(22.50)	(12.60)	(7.54)	(12.26)	(7.22)	(0.97)	(4.71)
Fruits and vegetables	2.11	-4.08	1.09	-1.43	-0.23	4.84	-1.29	2.70	-0.77	5.55	3.50	-0.48	-1.10
	(3.47)	(5.72)	(3.87)	(2.65)	(4.51)	(4.75)	(25.06)	(10.48)	(8.14)	(10.01)	(7.15)	(1.24)	(4.12)
Meats, etc.	2.03	-2.40	2.28	-0.93	2.38	4.39	11.19	10.15	2.85	12.28	1.10	-1.25	-4.72
	(2.88)	(7.53)	(4.07)	(2.56)	(5.52)	(4.07)	(28.68)	(14.85)	(9.39)	(13.86)	(8.29)	(1.29)	(5.44)
Legumes, etc.	-0.15	2.68	1.63	1.36	0.77	-0.94	10.83	1.22	3.94	-2.10	-3.29	1.13	-3.80
	(2.16)	(5.86)	(2.67)	(1.92)	(4.18)	(4.07)	(25.16)	(9.18)	(7.88)	(7.99)	(7.62)	(1.18)	(3.90)

Notes

Appendix Table 7.5. Input Demands (1st Stage Results) – Household Panel Excluding Children New at Midline (N= 2,505)

	Children in HH Panel, exclude new at ML		
	time	treat	DD
Health passport	0.07*	-0.05*	0.04
	(0.03)	(0.02)	(0.03)
Under-5 services	-0.00	-0.01	-0.03
	(0.06)	(0.04)	(0.05)
Any health expenditures	-0.00	-0.01	0.03
	(0.04)	(0.03)	(0.04)
Solid food > 1/day	0.08+	0.04	0.01
	(0.04)	(0.03)	(0.03)
Nutrition program	0.03	-0.03+	-0.02
	(0.02)	(0.02)	(0.02)
Vitamin A past day	0.13**	0.01	0.05
	(0.04)	(0.03)	(0.05)
AE-L annual food	-12,370.08***	-2,505.11+	9,054.78***
	(2,701.59)	(1,457.74)	(2,345.64)
Food share	-0.08***	-0.00	-0.02
	(0.01)	(0.01)	(0.01)
Food group AE-L Kcal/day			
Cereals and tubers	-489.38**	-134.78	370.77**
	(158.83)	(95.87)	(110.15)
Fruits and vegetables	41.23**	2.84	10.16
	(14.59)	(10.80)	(16.00)
Meat, etc.	-2.59	-9.62*	25.92***
	(3.94)	(3.78)	(3.87)
Legumes, etc.	-127.98**	8.08	42.98
	(35.05)	(23.37)	(27.22)
Oils, etc.	-43.57	-23.02	139.89***
	(42.42)	(25.67)	(34.28)
Food expenditure shares			
Cereals and tubers	-0.08**	-0.01	-0.01
	(0.02)	(0.02)	(0.02)
Fruits and vegetables	0.10***	-0.01	-0.03
	(0.02)	(0.02)	(0.02)
Meat, etc.	0.04***	0.00	0.02*
	(0.01)	(0.01)	(0.01)
Legumes, etc.	-0.01	0.03**	-0.01
	(0.01)	(0.01)	(0.01)

Notes

Appendix Table 7.6. Production of Child Health (2nd Stage Results) – Household Panel Excluding Children New at Midline (N = 2,505)

	Health Status	Health Improved	Any Illness	Diarrhea	Fever	Cough	Height	WAZ	HAZ	WHZ	Stunted	Wasted	Underweight
Time	-0.20	0.01	-0.17	-0.03	-0.25	-0.17	-0.07	0.20	-0.08	0.38	0.01	0.01	0.10
	(0.13)	(0.35)	(0.26)	(0.11)	(0.23)	(0.26)	(1.99)	(0.55)	(0.56)	(0.51)	(0.21)	(0.08)	(0.18)
Treat	0.01	-0.04	-0.01	-0.01	-0.02	0.06	0.41	0.13	-0.00	0.17	-0.01	-0.00	-0.06
	(0.03)	(0.08)	(0.07)	(0.03)	(0.07)	(0.08)	(0.60)	(0.16)	(0.16)	(0.16)	(0.06)	(0.02)	(0.07)
DD	-0.00	-0.02	-0.04	0.03	-0.06	-0.01	1.69	0.34	0.59+	0.04	-0.12	-0.01	-0.02
	(0.09)	(0.13)	(0.10)	(0.09)	(0.11)	(0.14)	(1.24)	(0.33)	(0.33)	(0.26)	(0.11)	(0.04)	(0.12)
Health passport	0.27	0.19	0.07	-0.20	-0.06	0.36	2.20	-0.73	0.27	-1.36+	0.29	0.19	0.28
	(0.25)	(0.61)	(0.46)	(0.22)	(0.42)	(0.38)	(4.96)	(1.10)	(1.33)	(0.75)	(0.39)	(0.12)	(0.43)
Under-5 Services	-0.10	0.10	-0.01	-0.31	-0.14	-0.02	-2.19	-1.14	-0.82	-0.93	0.41	0.12	0.55
	(0.23)	(0.46)	(0.42)	(0.22)	(0.44)	(0.49)	(2.60)	(0.90)	(0.72)	(1.05)	(0.34)	(0.14)	(0.38)
Any health expenditures	-0.10	0.20	0.64	0.43	0.64	0.39	3.52	2.22+	1.10	2.31	-0.45	-0.30+	-0.94+
	(0.22)	(0.58)	(0.54)	(0.36)	(0.67)	(0.51)	(2.83)	(1.17)	(0.78)	(1.46)	(0.40)	(0.18)	(0.51)
Solid food > 1/day	-0.01	0.17	-0.38	-0.19	-0.40	-0.41	-3.88	-1.23	-1.28	-0.79	0.40	0.06	0.44
	(0.28)	(0.57)	(0.51)	(0.21)	(0.39)	(0.59)	(3.59)	(1.18)	(1.02)	(1.11)	(0.34)	(0.14)	(0.38)
Nutrition program	-0.33	-1.19	0.05	0.36	-0.18	0.40	9.73	2.83	2.96	1.60	-1.13	-0.07	-0.91
	(0.62)	(1.12)	(1.14)	(0.47)	(0.84)	(1.22)	(7.57)	(1.74)	(2.05)	(1.84)	(0.73)	(0.31)	(0.76)
Vitamin A past day	0.03	0.14	-0.45+	0.03	-0.39+	-0.62*	-0.76	-0.45	-0.21	-0.44	0.02	0.14	0.27
	(0.15)	(0.29)	(0.26)	(0.15)	(0.23)	(0.28)	(1.64)	(0.65)	(0.43)	(0.80)	(0.14)	(0.13)	(0.28)
AE-L annual food exp.	-0.00+	0.00	-0.00	-0.00	-0.00*	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food share	0.77	-1.68	1.05	0.08	-0.04	2.07	19.65	7.32	6.25	6.42	-1.19	-0.80	-1.63
	(1.86)	(3.80)	(2.86)	(1.85)	(2.30)	(3.23)	(20.80)	(6.49)	(5.59)	(6.57)	(2.01)	(0.97)	(2.36)
Food group AE-L Kcal/day													
Cereals and tubers	-0.00	0.00	0.00	0.00+	0.00*	0.00	0.00	0.00	0.00	0.00	-0.00	0.00	-0.00+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fruits and vegetables	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.01	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Meats, etc.	-0.00	-0.00	0.00	0.00	-0.00	0.00	0.04	0.01	0.01	0.01	-0.01	-0.00	-0.00
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.04)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Legumes, etc.	-0.00	-0.00	0.00	-0.00+	-0.00	0.00	-0.01	-0.00	-0.00	0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Oils, etc.	0.00	-0.00	0.00	-0.00	0.00	0.00+	-0.01	-0.00	-0.00	0.00	0.00	-0.00	-0.00

	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Food expenditure shares													
Cereals and tubers	-0.55	0.26	1.87	-0.28	-0.66	3.60	-5.67	-1.26	-0.51	-0.66	-0.59	0.11	0.54
	(2.00)	(2.95)	(2.59)	(1.54)	(2.51)	(3.18)	(28.01)	(7.92)	(7.48)	(6.38)	(2.30)	(0.94)	(2.66)
Fruits and vegetables	0.52	-1.10	3.20	-0.44	0.51	5.46	12.26	2.69	3.75	1.75	-1.32	-0.08	-0.51
	(2.67)	(3.76)	(3.32)	(1.74)	(2.82)	(3.96)	(28.39)	(9.17)	(7.90)	(8.06)	(2.44)	(1.17)	(2.91)
Meats, etc.	0.72	1.77	2.08	-0.37	0.81	2.85	1.68	-2.34	0.87	-4.09	-0.18	-0.34	-0.19
	(2.36)	(2.75)	(3.13)	(1.61)	(3.36)	(3.85)	(39.82)	(10.84)	(11.07)	(7.87)	(3.27)	(1.08)	(3.27)
Legumes, etc.	-0.40	0.40	1.50	2.36	-0.57	2.42	22.82	6.99	7.64	4.08	-2.88	0.24	-2.01
	(1.84)	(3.51)	(3.86)	(1.79)	(3.46)	(4.07)	(31.50)	(8.82)	(8.60)	(7.33)	(2.74)	(1.06)	(2.96)

Notes

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