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**IMPACT OF SCHOOL FEEDING PROGRAMS ON EDUCATIONAL,
NUTRITIONAL, AND AGRICULTURAL DEVELOPMENT GOALS: A
SYSTEMATIC REVIEW OF LITERATURE**

By

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ABSTRACT

School feeding program as a social safety net has been popular in developing countries as an instrument for achieving the Millennium Development Goals. These programs are frequently targeted towards populations that are food insecure and reside in areas with high concentrations of families from low socioeconomic status, or towards schools that face poor attendance and enrollment of students. There are many studies that have evaluated the impacts of school feeding. However, the evidence on the impact of these programs is not always conclusive. This study presents a conceptual framework of how the Food for Education (FFE) programs work, how they impact children and families, and how they can be linked to agricultural development. The study uses the technique of systematic review of the literature to assess the effectiveness of these programs in achieving educational, nutritional and agricultural development goals.

A protocol for finding studies that met the review criteria was established, which resulted in the identification of twenty-six studies from across academic disciplines, including economics, nutrition and education. Analysis of the information extracted from these studies shows that school feeding programs conclusively impact the micronutrient level of targeted children, but have modest and mixed effects on health outcomes as evaluated by anthropometric measurements. While the impact of these interventions on cognitive skills and abilities of students is still uncertain, there is strong evidence that school feeding programs positively affect school enrollment and attendance rates, especially for girls. The review points to several gaps in the literature, including the lack of a systematic analysis of linkages between FFE, sustainability, and agricultural development. There is also a lack of evidence on the cost effectiveness of school feeding programs in delivering desirable outcomes. These are identified as topics for further research.

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KEY TO ABBREVIATIONS

BMI – Body Mass Index

FAO – Food and Agriculture Organization of the United Nations

FFE – Food for Education

HGSF – Home Grown School Feeding

HSES – High Socio-Economic Status

LSES – Low Socio-Economic Status

MUAC – Mid-Upper Arm Circumference

NGO – Non-governmental Organization

RCT – Randomized Control Trial

SES – Socio-Economic Status

SFP – School Feeding Program

SSA – Sub-Saharan Africa

THR – Take-Home Ration

WFP – World Food Programme

WHO – World Health Organization

Chapter 1. Introduction

1.1 Background on School Feeding Programs

According to the 2007 Food and Agriculture Organization's (FAO) estimate, 923 million people in the world were chronically hungry, which was an increase of about 75 million people from the 2003-05 estimates (FAO 2008). Many of these are children, and a vast majority of them are in developing countries. These numbers suggest that the Millennium Development Goals related to hunger and malnutrition may not be met by 2015. The persistence of hunger, malnutrition, and micronutrient deficiencies can have long lasting effects on the health status and productivity of people and their nations. Early malnutrition can adversely affect physical, mental, and social aspects of child health, which in turn leads to underweight, stunted growth, lowered immunity, and mortality. Research has shown that the physical effects of malnutrition as measured by indicators such as body mass index (BMI), have a significant impact on an individual's productivity and wages (Broca and Stamoulis 2003). Jomaa et al. (2011, p. 84) state that "childhood undernutrition imposes significant economic costs on individuals and nations, and that improving children's diets and nutrition can have positive effects on their academic performance and behaviors at school as well as their long-term productivity as adults." Alderman, Hoddinott, and Kinsley (2006) found that malnutrition led to delayed entry to school, less overall schooling, smaller stature, and 14% lower earnings as adults.

Policy makers may use a number of interventions to target various groups within a population through social safety nets to address the problem of hunger and malnutrition. One intervention that governments and non-governmental organizations (NGO) have utilized in targeted areas where a significant part of the population faces poverty and chronic hunger is

Food for Education (FFE). FFE provides food to school children or their family in exchange for enrollment and attendance in school, and directly relates to the first three Millennium Development Goals: to eradicate extreme poverty and hunger, achieve universal primary education, and promote gender equality and empower women by 2015.

As early as the 1930s, the United States and the United Kingdom utilized FFE to improve children's health (Gokah 2008); these early programs took the form of school feeding programs (SFP), where participants were fed a meal or a snack at school. As a social safety net, FFE programs have also gained popularity among political leaders and policy makers in developing countries in Asia, Africa, and Latin America. The 2011 World Food Prize was shared by John Agyekum Kufuor, former president of Ghana, and Luiz Inácio Lula da Silva, former president of Brazil, for the successful social programs, including school feeding, that each nation has established. Brazil and India have established school feeding programs by passing legislations. Brazil added school feeding to its constitution (Bundy et al. 2009) while in 2001 in India, the Supreme Court mandated that all state governments must provide cooked meals in targeted schools (Afridi 2010).

One of the motivations for establishing school feeding programs is to provide targeted families and their children, including girls, an incentive to attend school (Jomaa 2011). However, in recent years, the idea of using school feeding programs as a vehicle for agricultural development has also gained momentum. The rationale behind school feeding programs based on the use of locally-produced food is that they can provide a regular market opportunity and a reliable source of income for smallholder farmers (Sumberg and Sabates-Wheeler 2011). In addition, there are other benefits to using locally-produced food for school feeding particularly around appropriateness of the food, sustainability, and cost. A recent \$12 million grant by the

Bill and Melinda Gates Foundation to the Imperial College in London for ‘Home Grown School Feeding’ (HGSF) is an example of an initiative supporting government action to deliver cost effective school feeding programs sourced from local farmers in sub-Saharan Africa to foster the development of local economies. The 2011 funded USAID, Brazil and Mozambique “Trilateral Cooperation – Food Security” project to design and promote the “Alive School” program in Mozambique is another example of a school feeding program designed on the concept and principle of ‘home grown school feeding’ whereby food will be directly purchased from the local farming community to foster local economic development.

School feeding programs can thus be a powerful instrument for achieving many multi-sectoral benefits – education, gender equality, food security, poverty reduction, nutrition and health, and agricultural development. The recent food, fuel and financial crises have highlighted the importance of school feeding programs both as a social safety net for children living in poverty and food insecurity, and as a tool for stimulating local agricultural production and economic opportunities in rural communities.

1.2 Rationale and Objectives of this Study

There are many studies and reviews that examine the effectiveness and benefits of school feeding programs. The review by Bundy et al. (2009) suggests that appropriately designed school feeding programs increase access to education and learning and improve children’s health and nutrition, especially when integrated into comprehensive school health and nutrition programs. The systematic review of school feeding programs by Kristjansson et al. (2007) based on 18 studies concludes that school meals have some small benefits for disadvantaged children measured by indicators of physical growth and cognitive abilities. Similarly, a recent review by

Jomaa et al. (2011) reveal relatively consistent positive effects of school feeding on energy intake, micronutrient status, school enrollment, and attendance of the children participating in school feeding programs compared to non-participants. However, the impact of school feeding on growth, cognition, and academic achievement was less conclusive based on the review by Jomaa et al. (2011).

School feeding programs vary widely from country to country in design, implementation, and evaluation. Reviews in the literature cannot often be compared as SFP is not a uniform unit of intervention. Yet reviews too often fail to bring out the heterogeneity in the design, implementation and evaluations underlying FFE. Moreover, these reviews have not shed light on the linkage between FFE and agricultural development, nor on the sustainability of FFE. In my systematic review of the literature, I attempt to verify the conclusions of these previous reviews by bringing in additional and more recent studies, including several that are currently unpublished. I add to what these reviews did by exploring linkages between FFE and agricultural development. Understanding the variety of school feeding program design elements (such as what, when, where, how and how much food is delivered to children), with whom and how the program is implemented, the method of program evaluation used, and how these relate to the specific FFE program's effectiveness and sustainability are important pieces of information to derive policy and programmatic implications.

To address this need for improved evidence on these important issues, this paper systematically reviews studies of school feeding programs targeted to disadvantaged population.

The objectives of this study are to:

1. Develop a conceptual framework to understand the role of FFE and multiple pathways towards achieving multi-sectoral benefits.

2. Conduct a systematic review of the literature to:
 - a. Make an inventory of the different types/models/designs of school feeding programs operational (i.e., in the past or currently) around the world that are aimed at improving the health and educational status of socio-economically disadvantaged children.
 - b. Document the evidence of impacts of these different types of school feeding programs in terms of:
 - i. effectiveness in improving physical, health, cognitive development, and school performance outcomes for targeted population (i.e., school children)
 - ii. cost effectiveness of school feeding program models/designs, including the feasibility and sustainability of models based on local procurement of some share of the food
 - c. Understand the processes by which school feeding programs achieve (or fail to achieve) the desired/hypothesized impacts (i.e., factors behind the success or failure of school feeding programs)
 - d. Understand what design elements tried by others contribute to (or fail to contribute to) the sustainability of a school feeding program

This study first describes the types of Food for Education (FFE) Programs and presents a conceptual framework of how FFE programs work, how they impact children and families, and how they can be linked to agricultural development. The conceptual framework of FFE programs' impact on children and families draws from existing literature; the framework linking

agricultural development to FFE is based on the proposed framework by Sumberg and Sabates-Wheeler (2011). Chapter 3 outlines the methodology of ‘systematic review’ and the criteria used to determine which studies to include or exclude from the review. This is followed by the presentation and discussion of the main findings and results of the systematic review, including characteristics of the studies and the FFE programs, evidence of impact of the programs on educational achievement, physical growth and health outcomes, cost effectiveness, linkages to food producers, and issues of sustainability. I conclude with key lessons and policy implications that should be considered for designing future SFP projects.

Chapter 2. Conceptual Framework

2.1 Types of Food for Education Programs

There are two forms of distribution of food in FFE programs: school feeding programs and take-home rations. School feeding programs (SFP) provide meals or snacks to school children on the site, whereas take-home rations (THR) are provided to school children for consumption at home. Under SFP, the food provided to school children can be either prepackaged or cooked on site. Table 1 lists some of the pros and cons of these different types of FFE programs from the perspective of achieving the desired effects and takes into consideration the possibility of linking with agricultural development goal.

The benefit of the food provided under the school feeding programs is conditional on the attendance of the child on that specific day. Thus an advantage of the SFP is that it serves as an incentive for children to attend school on a daily basis to receive a meal, whereas to receive the benefit of THR, students need only to attend a specified minimum number of days. The meals served at school may be nutritionally dense and can be easily fortified with additional nutrients that may be scarce in local diets, such as iron or vitamins A and E. Targeting is broad in that all children at the school are fed; it would be difficult to discern between children of different socio-economic status (SES) within a school setting and likely disruptive to the educational experience if some students were fed while others were not. Food may be cooked on site or in the form of prepackaged processed foods such as nutritional biscuits.

There are various ways in which food may be procured for the school feeding programs. Until the recent past, food for these programs often came from donations from developed countries in the form of food aid and delivered through organizations such as the World Food

Program (WFP). More recently, there has been more emphasis on local (i.e., national or community level) procurement, as in the case of Burkina Faso (Upton et al. 2012). Local (national level) value-added production has also become more frequent in Bangladesh where wheat flour donated through WFP was processed by seven local firms in a competitive bidding process to produce the fortified biscuits used in the Bangladesh school feeding program (Ahmed 2004), while in the Brazilian HGSF model as much food as possible is sourced from local communities to keep down costs and support local agriculture. . Among the three options described in Table 1, SFP where children are served cooked meals on site has the greatest potential for supporting local community level agricultural activities through the procurement of fresh produce (and is thus most amenable to the ‘home grown school feeding’ model). In the case of THR and SFP based on pre-packaged snack or a beverage, the program may have to rely on a functional food processing sector at the regional or national level to meet the needs.

Take-home rations (THR) are usually conditional to meeting a minimum threshold of attendance, and are usually distributed monthly; in Burkina Faso, the WFP managed program requires attendance of 90% for that month to receive the monthly ration (Kazianga et al. 2008). This type of program may be useful in targeting specific groups of children or families within a community, as the distribution may occur in a separate location from the school or may occur outside of regular school hours. In areas where enrollment and attendance of children is lower for girls, THR programs may be employed to boost their attendance (and thus promote education for girls). Some FFE programs may include both SFP and THR, and some SFPs may act as a possible THR when children are given pre-packaged foods that can be consumed at home and possibly shared with other family members.

Table 1: Different types of Food for Education programs and their pros and cons.

	School Feeding Program (Prepackaged)	School Feeding Program (Cooked Meals)	Take-Home Rations
Pros	<ul style="list-style-type: none"> • Children who are supposed to benefit are reached with daily attendance • Parents & students motivated to attend regularly • Food may be shared with younger siblings, who may be in greater need of nutritional support • Alleviates short term hunger so students may focus in classroom • Foods are often fortified 	<ul style="list-style-type: none"> • Children who are supposed to benefit are reached with daily attendance • Parents & students motivated to attend regularly • Able to utilize local fresh produce from nearby farmers • Alleviates short term hunger so students may focus in classroom • Meals often include milk products or other nutritionally dense foods 	<ul style="list-style-type: none"> • Children and families benefit when child attendance levels are fulfilled • Parents & students motivated to attend regularly • Food may be shared with younger siblings, who may be in greater need of nutritional support • Does not take away from teaching time • Able to target specific families and students (i.e. families with girls or younger children)
Cons	<ul style="list-style-type: none"> • Targeting is broad • May take away from teaching time 	<ul style="list-style-type: none"> • Costs may be higher (salaries for cooks, loss of economies of scale, etc.) • Targeting is broad • May take away from teaching time 	<ul style="list-style-type: none"> • Nutritional benefits may be diluted within household • Rations are often cereals and oils (might not be fortified)

Households may decide to keep children from school based upon the direct and indirect costs of attending school. Direct costs include fees, books and supplies, uniforms and travel to school, while indirect costs are in the form of the opportunity costs of children’s time. Rather than attending school, households may elect to have their children take care for other family members, engage in household chores, work on the family farm or business, or work in a wage earning job (Cheung and Perrotta 2010). If the expected benefits of a child’s education do not exceed the costs of attending school, then the household will not send their child to school (Adelman et al. 2009). For families that can afford to send only one or some of their children to school, the decision of which children to enroll in school may be determined by who the family

feels has the highest expected returns to education, which in many cases means that girls are kept at home. Reducing the cost of schooling would increase enrollment and attendance rates for children in such circumstances. In the case of a SFP, both a hungry child and parents will have an incentive for daily attendance, while for a THR program the parents have the incentive to send their children to school for at least the minimum amount of time required to receive the rations (which varies by program). The additional food provided from a THR program can be used to supplement the family's nutritional needs or sold for additional income. For households that benefit from SFPs, the meal provided at school is one fewer meal that the household needs to provide to their child. From this perspective, both the SFP and THR help the families by subsidizing the cost (i.e., the opportunity cost) of sending their children to school.

2.2 Food for Education Programs: The Conceptual Basis and Economic Rationale

School feeding programs are a visible social safety net used by political leaders around the world. Communities that participate in these programs can see the tangible benefits to their children, such as their children being fed regularly or families supplied with additional food, and the visibility of such programs can be attributed back to the politicians who support them.

Food for Education programs are typically targeted towards populations that are food insecure, reside in areas with high concentrations of low socioeconomic status families, or that face poor attendance and enrollment. In developing countries, SFP is usually not set up to target specific children at a school, but rather all students attending a school are recipients of the program. This may reduce the cost effectiveness of the program if not all students receiving the food from the program belong to families who are food insecure or of low socioeconomic status. The THR programs, on the other hand can be more easily targeted to specific families, such as

those of lower socioeconomic or food security status or to families with girls. Both programs, however, may not be able to target all the children who are facing food insecurity. Since school children are the target of these types of interventions, children who are younger than five years old are left out. This is considered one of the limitations of FFE programs as a nutritional safety net. It is now well established that the first one thousand days of a child's life, from conception until the second birthday, is the most vital period during which undernutrition may have its largest impact. Nutritional interventions that occur within this time line are much more powerful in impacting upon a child's survival, health and development (Adelman et al. 2009). Due to the greater impact that pre-natal and pre-school programs may play, and due to their higher cost-benefit ratios, it has been pointed out that FFE programs should be considered (and categorized) as educational interventions and not as nutritional interventions, so as to not undermine budgetary resource allocations for nutritional interventions (World Bank 2006).

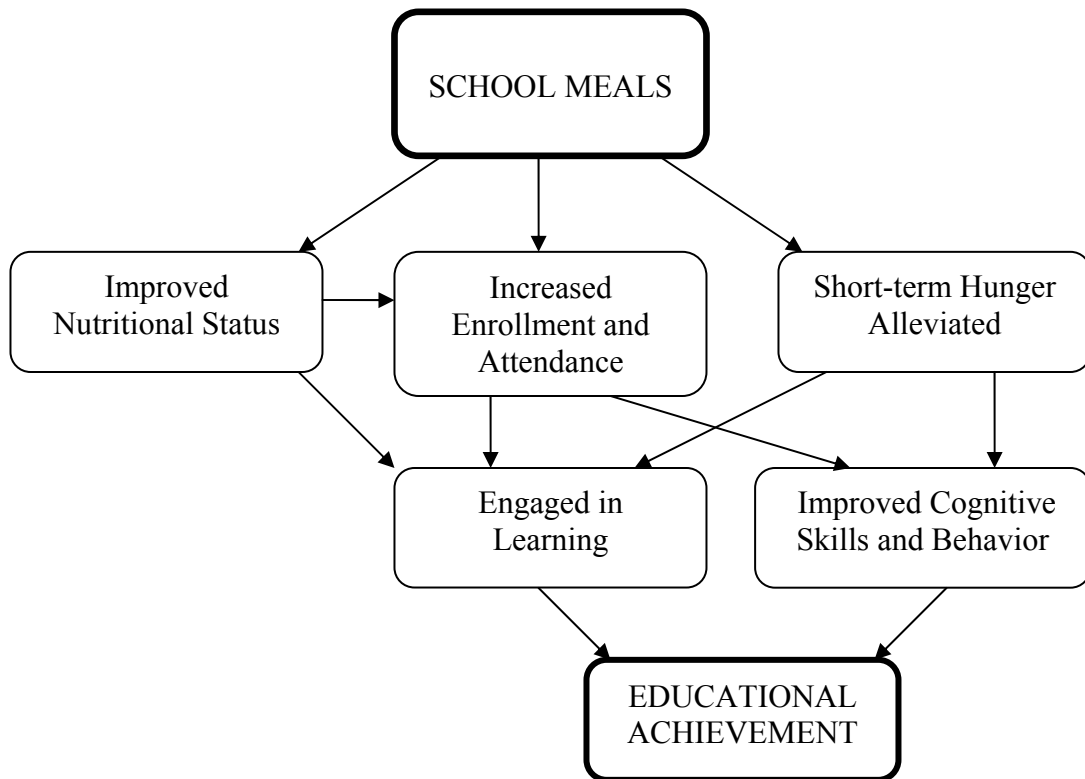
2.3 Potential Outcomes and Impacts of Food for Education Programs

2.3.1 Impact on Educational Achievements

The potential impact goal of targeting children through Food for Education programs is to increase their educational achievement so as to improve their potential future productivity and earnings. However, improvement in educational achievement due to serving food in SFPs is thought to occur through three pathways, as demonstrated in Figure 1. First, FFE programs increase school attendance by lowering the opportunity costs of attending school and providing additional incentives to engage in formal education. This leads to more time spent in school and more time spent towards learning. The second is through the alleviation of short term hunger

which improves children’s cognitive functioning and attention span. The third path is through the improved nutritional status of children by providing them calories and nutrients in addition to their regular diet. This leads to better health and better resistance to infections diseases and illnesses that would keep children from attending school (Buttenheim et al. 2011). Thus, better nutrition indirectly improves educational achievement by increasing school attendance by children.

Figure 1. Relationship between SFP and potential outcomes and impacts on school children



Source: Adapted from Grantham-McGregor et al. (1998) and Jacoby et al. (1998).

However, there are some possible negative attributes to the first and the third paths that should be considered as well that may take away from improvements in educational achievement. For example, increases in enrollment may lead to overcrowding and lowering the

effectiveness of classroom time or stretch the limited amount of school resources such as books. Depending on how the SFP is set up, teaching time may be reduced if teachers are used in overseeing the meal time (Grantham-McGregor et al. 1998).

2.3.2 Impact on Nutritional Status

Although FFE programs are promoted for increasing educational achievement, they also play an important role in achieving the nutritional goal (albeit for children that already passed the critical early childhood influencing phase). For families facing poverty, food choices are usually limited, resulting in nutritionally inadequate diets that are often deficient in vital micronutrients (Ash et al. 2003). Deficiencies of micronutrients such as iron or vitamin B-12 can result in increased vulnerability to infections, stunted growth and diminished cognitive performance in school-age children (Arsenault et al. 2009). The most important period of growth and body composition occurs in the first several years of life, well before enrollment in a FFE program would begin. But SFP meals or snacks can be easily fortified to help provide micronutrients that are commonly missing from children's diets. This is especially important for school-age children, as the brain is sensitive to a lack of nutrients in the short term, which may be especially a problem for malnourished children (Pollitt 1995).

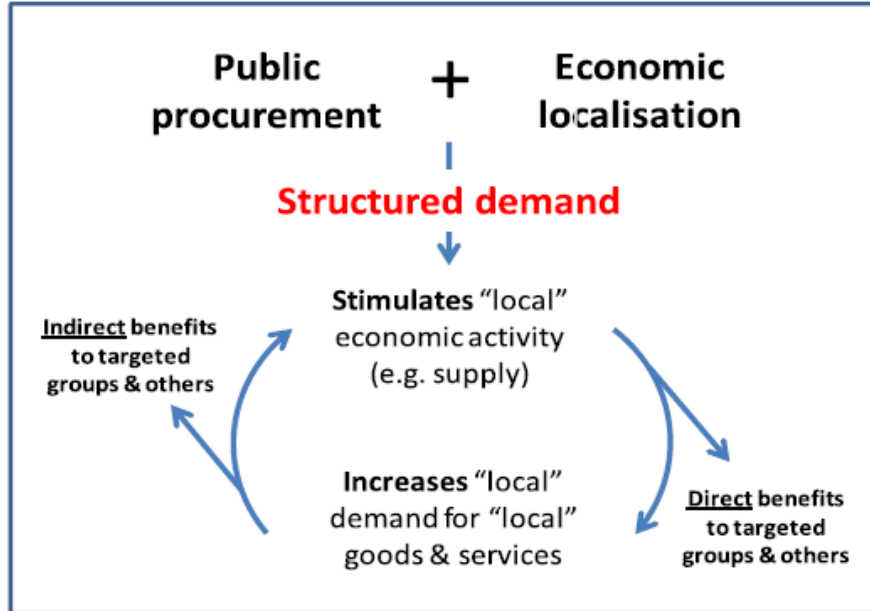
2.3.3 Impact on Agricultural Development

Traditionally, FFE programs have been thought of as social safety net interventions to achieve educational and nutritional goals. But more recently these programs and others that involve food aid have been thought of as a possible tool for agricultural development (Sumberg and Sabates-Wheeler 2011). The manner in which these goals link together can be seen in the

proposed Home Grown School Feeding (HGSF) programs, which are designed to supply food for FFE programs from purchases and procurement of locally produced food while enhancing the domestic production and demand for food (Ahmed 2004). Traditionally, the procurement of food for FFE programs usually came from foreign food aid. When food aid is distributed, there are distortions to the local markets, which often results in lower prices and provide disincentives to local producers (Barrett 2006). This has led to the development of programs such as the WFP's Purchase for Progress (P4P) initiative to reverse this trend, and helped lead others to look to HGSF as a tool for agricultural development.

The theory for linking FFE to agricultural development begins with a demand shift as the initial kick to the local economy in a HGSF system, as the food previously supplied to the schools came from donors now must be filled by the local producers (Figure 2). The demand is more predictable for producers, which in turn decreases their risk, allowing for more development of local markets (Sumberg and Sabates-Wheeler 2011). Increased demand for locally produced food was seen in the case of Indonesia's SFP during the 1990's. In a survey conducted after the economic crisis in Indonesia in 1997-98, 72% of surveyed farmers reported having more opportunities to sell their produce as a result of the purchases by the SFP's (Studdert et al. 2004, as reported by Sabates-Wheeler et al. 2009).

Figure 2. The HGSF model: theory of change. Adapted from Sumberg and Sabates-Wheeler (2011).



Despite the theoretical justification for HGSF and the potential role it can play in agricultural development, there are some practical limitations in implementing this model. First, locally produced food needs to be received, stored and cooked which all require a school-, district- or nation-wide infrastructure and logistical support system to be successful. Second, there could potentially be a mismatch between demand and supply of food needed for SFPs. To be able to rely on locally produced food as the source of food in SFP, the farmers will need to supply the food consistently throughout the school year. The seasonality in local food production can be a constraint in implementing the HGSF model.

Chapter 3. Methodology

3.1 The Approach of ‘Systematic Review’

A systematic review is a literature review that tries to identify, evaluate, select and synthesize evidence relevant to a research question. Systematic reviews of high quality randomized control trials are crucial to evidence-based medicine. However, with the growing movement towards evidence-based policy, systematic review is also gaining popularity as a research methodology in the fields of public health, education, and development to better understand the impact of interventions and apply the evidence of research findings to address a public policy issue.

A systematic review contrasts to a literature review by the exhaustiveness and reproducibility. According to Gasteen (2010, p.2):

“Developing and publishing the protocol and carefully documenting the progress of the review means that a systematic review is more transparent than literature reviews as it is easier to scrutinize the methods and audit the process. A systematic review is also more rigorous than a literature review as anyone could follow the review protocol and arrive at similar conclusions.”

There are different methods of conducting a systematic review, but four requirements are common across such reviews: (1) definition of the problem, inclusion and exclusion criteria; (2) the search strategy; (3) criteria for the evaluation of studies; and (4) data extraction (Badger et al. 2000, p.221). Additional methods employed by various systematic reviews involve the inclusion of unpublished papers and those from grey literature to avoid bias, conducting quantitative meta-

analysis of the data when possible, and utilizing peer review of the systematic review¹. The systematic review procedure followed in this paper does not employ some of these additional features. For example, it does not include quantitative meta-analysis techniques. Also, other than the review of the methodology and results by the thesis committee members, the data collected from the review itself has not undergone a ‘peer’ review process.

The remainder of this chapter lays out the criteria for studies to be included or excluded, the literature search, and the extraction and analysis of the data.

3.2 Inclusion Criteria

Studies had to meet several exclusion and inclusion criteria to be considered for this review. First, interventions needed to include the provision of food to school children through either a meal or a snack, or through take-home rations; those that only involved micronutrient supplementation (e.g., vitamins and pills) or fortification of existing foods were excluded. Second, studies that measured or investigated at least one of the following outcomes of interest for this review were included: physical growth outcomes such as anthropometric measurements; health outcomes in the form of micronutrient status or hemoglobin levels; educational or cognitive outcomes; behavioral outcomes such as attendance, enrollment or attention; measures of program cost-effectiveness; and measures of spillover effects to other family members or the community. Studies that reported only an intermediate health outcome such as diminished hunger or increased nutrient intake were excluded.

¹ For more on systematic reviews see www.3ieimpact.org, ies.ed.gov/ncee/wwc/, and www.campbellcollaboration.org/

Third, studies were included in the review if they took into account the geographic and socioeconomic status. For studies occurring in developing countries, children had to meet one or more of the following conditions:

- Living in a rural community,
- Living in an urban area and described as socioeconomically disadvantaged,
- A significant number (30% or more) of children in the sample were described as underweight or exhibited stunted growth, or,
- Classified as disadvantaged in some specific way (e.g. belonging to scheduled tribes and castes in India).

In higher income countries, studies that classified children as disadvantaged by the following criteria were included:

- Living in an areas described as economically marginalized or disadvantaged
- Of low socioeconomic status (SES)
- More than half were from lower SES groups
- Described as marginalized or “at-risk” due to social circumstances.

Papers that occurred in either developing or higher income countries where students were described as being from middle or high SES backgrounds, or where the SES was mixed but results were not separated out by either SES or other proxy variables were not included.

Additionally, studies were considered that examined students aged five to nineteen years who were enrolled at primary or secondary schools. Finally, only studies published between 1980 and 2011 were included in the review.

3.3 Literature Search

The literature search was done through electronic searches of journals in the discipline of economics, education, nutrition and health. Key words used in searching for relevant studies included food for education (FFE), school feeding, school meal, school breakfast, school lunch, homegrown school feeding, and take-home rations (THR). Studies were also found through contacting some study authors, and through searching annotated bibliographies. Additionally, electronic searches were conducted on papers cited in other papers already included in this review, as well as cross checking the references cited in other meta-analysis papers on school feeding programs.

3.4 Study Design

In conducting this review, three types of study designs were focused: randomized controlled trials (RCTs), quasi-experimental, and non-experimental. In research, RCTs are considered the “gold standard” (Jomaa et al. 2011, p. 85) of study design, as these are statistically the most robust designs and provides a strong evidence of causality. When randomization is not feasible due to ethical issues or project implementation decisions not in the control of an evaluator, quasi-experimental or non-experimental design would be considered the next best options. These are evaluation designs where the treatment and control/comparison groups included in the evaluation are not assigned to a group randomly (for example an *ex ante* designed non-randomized experiment) or they are formed using statistical techniques based on observational data *ex post* of the implementation of a school feeding program. Studies were included in the review pool as long as they demonstrated a clear identification strategy to assess the counterfactual either based on RCT, quasi-experimental or non-experimental designs.

3.5 Data Collection and Analysis

Once studies were found to be appropriate for inclusion in this review, a protocol was followed to systematically extract information on the intervention features, study characteristics, and results/outcomes. The information was recorded as a database in Excel spreadsheet. The information for some variables was coded, scored and sorted to standardize the salient information from the studies. The review of these studies included the following types of information:

1. Characteristics of the intervention

- a) Data on the design of the feeding program (including type of school, location of school, number of schools, who designed and implemented the feeding program, stated objectives of the feeding program, source of financial support for the feeding program)
- b) Description of the intervention (including the process of procuring food, what type of food was fed, serving size and nutritional value, how frequently it was fed, time of the day the food was fed, social and institutional setting of the intervention, etc.)
- c) Process of delivering the food to the children (was it peer supervised, teacher supervised, supervised by lunchroom staff, or by volunteers?)
- d) Details on complementary interventions (e.g., deworming, giving take-home educational materials, any take-home food/snacks, etc.)
- e) Details on participants (including age, sex, number in each group)
- f) Issues of monitoring food intake and compliance, quality/acceptability (cultural sensitivity) of food given
- g) Length/duration of the intervention (the start and end date of the intervention)

2. Study characteristics

- h) Design of impact evaluation (for e.g., was it an RCT, non-experimental controlled design, quasi-experimental design, etc.)
 - i) Definition of the treatment and control groups
 - j) Who conducted the impact evaluation
 - k) Method, frequency and time of data collection for the impact evaluation
 - l) Sample size for the impact evaluation
3. Study results/outcomes
- m) Types of effects measured (results of the impact evaluation in terms of physical, cognitive, and behavioral outcomes, evidence of spillover effects, any data on cost-effectiveness of the intervention)
 - n) Evidence of impacts in terms of quantitative indicators (average treatment effects) and qualitative outcomes
 - o) Were the results different by age, sex, socio-economic background of students?
 - p) What were the key “lessons learned” noted by the study?
 - q) Policy implications derived and discussed in the study (key points)
 - r) Any discussion on the sustainability of the program or ideas on how to make it more sustainable.

The aim of the systematic review is to collect uniform information and data from each study reviewed. The list of variables included in the database was exhaustive to ensure a broad coverage of potential issues. But not all the variables were relevant to all the studies or provided by the studies, resulting in data gaps. This template was then used for the synthesis and analysis of the impact of the interventions on the outcomes of interest.

Chapter 4. Results and Findings from the Review

4.1 Search Results

Twenty-six studies were found that met the inclusion criteria described in Chapter 3. The main characteristics of these studies are summarized in Table 2. In the next section, I describe the key characteristics of these studies, and then present the evidence regarding four categories of effects from the school feeding programs: cognitive, anthropometric, health and nutrition, and behavioral outcomes such as attendance and enrollment. Twelve studies contained outcomes from only one category, while fourteen found outcomes in multiple categories, and two studies found outcomes from all four categories (Ahmed 2004, Kazianga et al. 2009). The literature search provided ten unique studies that are not found in the previous reviews by Kristjansson et al. (2007), Bundy et al. (2009), or Jomaa et al. (2011); of the ten new studies, two are currently unpublished (He 2010, Adrogué and Orlicki 2011).

4.2 Study Characteristics

Of the 26 studies reviewed, six examined THR together with SFP, only one looked solely at THR, and 19 looked solely at SFP. Among the 19 SFP-only studies, 11 were evaluations of programs that offered a snack or a beverage while the others offered a meal.

The 26 studies use a wide range of methodologies to examine outcomes in our four categories. Eleven used randomized control trials (experimental design), four applied quasi-experimental designs, and eleven used non-experimental designs. Among our four outcome categories (anthropometric, behavioral, cognitive, and health and nutrition), the most commonly examined was behavioral with 15, followed by cognitive with 14, 12 for health and nutrition, and nine for anthropometric outcomes.

Table 2: Summary of Studies Reviewed

Study	Location	Years and Duration of Study	Age or Grades	Treatment	Treatment Group Sample Size	Control Group Sample Size	Design of Impact Evaluation	Method of Impact Estimation^a	Outcomes Measured^b
Adrogué and Orlicki, 2011	Argentina	Evaluation of an ongoing program from 1997, 1999 and 2000 school years	Grade 3	SFP	6325 schools	4138 schools	Non-experimental controlled	DID	B, C
Afridi, 2007	Madhya Pradesh, India	2003 (6 months)	5-12y	SFP	1106 students, 615 hhs, 74 schools	1106 students, 615 hhs, 74 schools (same group of children)	Non-experimental controlled	DID, PROBIT	B
Afridi, 2010	Madhya Pradesh, India	2004 (2 months)	5-12y	SFP	1096 students, 615 households, 74 schools	1096 students, 615 households, 74 schools (same group of children)	Non-experimental controlled	Single Difference, OLS, 2SLS (Reference day was a school day)	H&N
Ahmed, 2004	Bangladesh	Evaluation of an ongoing program begun in 2002; surveys from Sept-Oct 2003	6-12	SFP (snack)	34 schools, 3193 hhs ^c	34 schools, 1260 hhs	Randomized Control Trial	DID, OLS, PROBIT, TOBIT	A, B, C, H&N
Ahmed and del Ninno, 2002	Bangladesh	1993 (ongoing)	6-10y	THR	2 treatment groups of 5254 and 5195 students	5243 students	Non-experimental controlled	TOBIT, PROBIT, means	B
Alderman et al., 2010	Northern Uganda (refugee camps)	2005 (18 months)	6-17y	SFP or THR	11 refugee camps (SFP); 10 refugee camps (THR)	10 refugee camps	Randomized Control Trial	Single difference, DID	B

Table 2 (cont'd)

Study	Location	Baseline and timeline	Age or Grades	Treatment	Treatment Group Sample Size	Control Group Sample Size	Design of Impact Evaluation	Method of Impact Estimation^a	Outcomes Measured^b
Arsenault et al., 2009	Bogotá, Columbia	2006 (4 months)	5-12y	SFP (snack)	1803 students, 25 schools	1399 students, 13 schools	Non-experimental controlled	Linear regression, Poisson regression	A, B, H&N
Ash et al., 2003	Mpwapwa District, Tanzania	1995 (10 months)	6-11y	SFP (beverage)	392 students, 6 schools	382 students, same 6 schools	Randomized Control Trial	Means, Relative risk	A, H&N
Baker et al., 1980	Mid Glamorgan, South Wales	1976 (2 years)	7-9y	SFP (beverage)	281 students, 25 schools	239 students, same 25 schools	Randomized Control Trial	Means	A
Buttenheim et al., 2011	Phongsaly province, Lao PDR	2006 (2 years)	3-14 y ^d	SFP and/or THR	SFP: 5682 hhs, 92 villages, 35 schools; SFP+THR: 4858 hhs, 113 villages, 47 schools; THR: 4514 hhs, 91 villages, 34 schools	6931 hhs, 112 villages	Quasi-experimental design	DID, PROBIT	A, B, H&N
Chandler et al., 1995	Jamaica	2 1-week periods	Grades 3 and 4	SFP (snack)	97 students, 4 schools	100 students, same 4 schools	Non-experimental controlled	ANOVA	C
Cheung and Perrotta, 2010	Cambodia	Evaluation of an ongoing program phased in gradually from 1999 to 2003	Grades 1-6	SFP/THR	3089 total schools surveyed across 6 provinces (treatment + control)	3089 total schools surveyed across 6 provinces (treatment + control)	Non-experimental controlled	DID, OLS	B

Table 2 (cont'd)

Study	Location	Baseline and timeline	Age or Grades	Treatment	Treatment Group Sample Size	Control Group Sample Size	Design of Impact Evaluation	Method of Impact Estimation^a	Outcomes Measured^b
Gelli et al., 2007	32 SSA nations	2002 (3 years)	Primary	SFP/THR	N/A (schools from 32 nations)	N/A (schools from 32 nations)	Quasi-experimental design	Means	B
Grantham-McGregor et al., 1998	Jamaica	2 1-week periods	8-11y	SFP	100 students, 4 schools	Same students in a crossover design	Randomized Control Trial	Means	B, C
He, 2009	Sri Lanka	Evaluation of two ongoing programs from 2002-2007	5-14y	SFP	2 treatment groups of 1350 and 6320 schools	2072 schools	Non-experimental controlled	OLS, Means	B
Jacoby, E. et al., 1998	Peru	Evaluation of an ongoing program Sept. to Dec. 1993	5-10y	SFP	58 students, 10 schools	58 students, 10 schools	Non-experimental controlled	Means	B, C, H&N
Jacoby, H., 2002	Metro Cebu area, Philippines	1994 (1 year)	6-12y	SFP (snack)	3189 children, 159 schools in survey	3189 children surveyed	Quasi-experimental design	OLS, 2SLS (Instrument Variable not given)	H&N
Kazianga et al., 2009	Burkina Faso	2006 (1 year)	6-15y	SFP or THR	4140 children surveyed, 2208 hhs, 46 schools	4140 children surveyed, 2208 hhs, 46 schools	Randomized Control Trial	DID	A, B, C, H&N
Lien et al., 2009	Vietnam	2004 (6 months)	7-8y	SFP (beverage)	2 groups of 150 and 151 students, 2 schools	143 students, 1 school	Randomized Control Trial	ANOVA	A, C, H&N
Meyers et al., 1989	Lawrence, Massachusetts, US	1987 (5 months)	Grades 3-6	SFP	335 students, 6 schools	688 students, 6 schools	Non-experimental controlled	ANOVA, Multiple regression	B, C

Table 2 (cont'd)

Study	Location	Baseline and timeline	Age or Grades	Treatment	Treatment Group Sample Size	Control Group Sample Size	Design of Impact Evaluation	Method of Impact Estimation^a	Outcomes Measured^b
Muthayya et al., 2007	Bangalore, India	(3 weeks with control and treatments done on separate weeks)	7-9y	SFP (snack)	69 students (34 LSES, 35 HSES)	N/A; students compared across SES	Non-experimental controlled	ANOVA	C
Muthayya et al., 2009	Bangalore, India	2005 – 2007 (17 months)	6-10y	SFP (snack)	4 treatment groups of 150, 148, 149 and 151 students	N/A	Randomized Control Trial	Variance, Kruskal-Wallis H-test and chi-squared test	A, C, H&N
Osendarp et al., 2007	Adelaide, Australia & Jakarta, Indonesia	2003 (1 year)	6-10y	SFP (beverage)	Indonesia: 279 students; Australia: 205 students	Indonesia: 88 students; Australia: 71 students	Randomized Control Trial	Means	C, H&N
Tan et al., 1999	Philippines	1990 (1 year)	Grades 1-5	SFP	2 treatment groups of 5 schools each	9 schools	Quasi-experimental design	IV (lagged test scores), Heckmann's correction	B, C
van Stuijvenberg et al., 1999	KwaZulu-Natal, South Africa	(1 year)	6-11y	SFP (snack and beverage)	115 students, 1 school	113 students, same school	Randomized Control Trial	Wilcoxon, chi-squared, Spearman correlation	A, C, H&N
Whaley et al., 2003	Embu, Kenya	1998 (21 months)	7.63y	SFP	3 treatment groups of 134, 144, and 148 students	129 students	Randomized Control Trial	Hierarchical linear model	C

Notes: ^a Instrumental variables listed in parentheses.

^b Anthropometric (A), Behavioral (B), Cognitive (C), Health and Nutrition (H&N)

^c An additional 1,648 students were tested in grade 5 for all schools for Bengali, English, and mathematics (treatment and control numbers not given).

^d Younger and older children included to catch spillover effects.

All of the studies looked at primary school age students. Two studies (Buttenheim et al. 2011, Kazianga et al. 2009) also included younger siblings at least three years in age to capture spillover effects from the intervention, while another study (Alderman et al. 2010) added secondary school students. Fourteen of the studies targeted only rural schools, five only urban schools, and three both rural and urban schools.

Asia was the most common location with 13 studies in the review pool. Sub-Saharan Africa (SSA) was next with six studies, followed by five from Latin America and the Caribbean, and three studies from developed nations (the U.S., Wales, and Australia). One study included students from both Australia and Indonesia to compare the outcomes of the intervention on children of different socio-economic status (Osendarp et al. 2007). The study by Gelli et al. (2007) was multi-country focused; it studied the outcomes of school feeding programs run by the WFP from 32 SSA nations.

In 14 studies, authors were themselves involved in data collection and in ten of the studies this collection was outsourced to others outside of the study. In one study data collection was done by both the authors and an outside group, and one study did not report who was involved. Most of the studies where the data was collected by non-authors involved some facet of the local government, such as the Statistics Branch of the Ministry of Education in Sri Lanka. In the one case where the local government was not involved, the local WFP staff and trained enumerators were involved, and in the other instance data collection was done by teams of trained research assistants.

The duration of the studies varied considerably. Two studies were as brief as two weeks, while the longest was five years. Mean duration is nearly 16 months long, while the median is

12 months. The length of the interventions is an important design feature and depends on the type of outcome of interest. This issue is addressed in the following sections.

4.3 Key Results: Evidence of Outcomes and Impacts

4.3.1 Anthropometric Outcomes

Measuring the growth of children is an important indicator of the health and nutritional status of a population (WHO 2010). Nutritional status is usually quantified by anthropometric measurements, most commonly stunting, wasting, and underweight (see Appendix 1 for definition of these outcome indicators). Using anthropometric measurements aids in measuring the achieved nutritional status instead of the nutritional inputs; anthropometric indicators are easier and less expensive to measure and less prone to measurement error than measuring the food consumed (Adelman, Gilligan, Lehrer 2008). Changes in anthropometry as an outcome of school feeding programs can be attributed to two physical growth indicators: weight and height gain due to increased caloric intake. Improving the micronutrient intake of children further adds to the growth, promotes increased muscle mass, and improves immunity to infections that may hurt growth (Adelman, Gilligan, Lehrer 2008).

Out of the 26 studies in this review, nine measured anthropometric outcomes of school feeding programs. Six of the nine studies specifically measure the most commonly used anthropometric measurements: stunting (height-for-age Z scores), underweight (weight-for-age), and wasting (weight-for-height); other outcome indicators included body mass index (BMI),

BMI-for-age, weight, height, and mid-upper arm circumference (MUAC). The nine studies reporting anthropometric measurements are shown in Table 3.

Those studies focusing on anthropometric outcomes tended to be of longer duration, which was consistent with the expectation since these outcomes measure changes in physical growth of the children that take time to show impact. Six of the studies reporting anthropometric outcomes were one or two years in length, while the remaining three studies were less than 10 months duration (Arsenault et al. 2009, Lien et al. 2009, and Ash et al. 2003). On average, the duration of the evaluation across the nine studies that measured anthropometric indicators was 13 months.

Two studies – one each from Lao People’s Democratic Republic (Lao PDR) (Buttenheim et al. 2011) and Burkina Faso (Kazianga et al. 2009) – offered school meals and rations in the treatment groups while the other studies provided a snack or beverage at school. Both Buttenheim et al. (2011) and Kazianga et al. (2009) also looked at the effects on younger siblings to assess “spillover effects” from the Food for Education programs. Neither study found any significant anthropometric effects from SFP programs on students or their younger siblings (Table 2)². Positive effects were found for THR in both the studies on anthropometric outcomes; Kazianga et al. (2009) found increases in weight-for-age and weight-for-height in school children and even larger increases in those indicators in their siblings when THR were available for households. No significant impact was found on the height-for-age indicator among siblings, which the authors point out “is more of a long-run measure of child nutritional status which cannot be influenced in a relatively short period of time and which reflects breast feeding and weaning practices as much as household food availability” (Kazianga et al. 2009, p.17). The

² This is not surprising as Jacoby (2002) shows that families do not reallocate food from children in SFPs to their younger siblings, as shown later in this review.

Table 3: Impact of interventions on indicators of physical growth of children

Study	Location	Duration (months)	Age Group	Treatment	Stunting	Underweight	Wasting	Other	Statistical Design	Comments
Ahmed, 2004	Bangladesh	12	6-12y	SFP (snack)				BMI **	RCT	
Arsenault et al., 2009	Bogotá, Columbia	4	5-12y	SFP (snack)	*			n.s.	N	
Ash et al., 2003	Mpwapwa District, Tanzania	10	6-11y	SFP (beverage)				BMI **** Weight **** Height ****	RCT	
Baker et al., 1980	Mid Glamorgan, South Wales	24	7-9y	SFP (beverage)				Weight ** Height **	RCT	
Buttenheim et al., 2011	Phongsaly province, Lao PDR	24	3-14 y	THR	***	All children **; 3-5y boys *			Q	
			3-14 y	SFP (meal)	n.s.	n.s.		Q		
			3-14 y	SFP (meal) + THR	n.s.	**		Q	Implementation problems in district	
Kazianga et al., 2009	Burkina Faso	12	6-15y	THR	n.s.	**	n.s.	BMI n.s.	RCT	
			Siblings, 12-60 months	THR	n.s.	**	*		RCT	
			6-15y	SFP	n.s.	n.s.	n.s.		RCT	
			Siblings, 12-60 months	SFP	n.s.	n.s.	n.s.		RCT	
Lien et al., 2009	Vietnam	6	7-8y	SFP (beverage)	**	**			RCT	
Muthayya et al., 2009	Bangalore, India	12	6-10y	SFP (snack and beverage)	***	n.s.		MUAC n.s.	RCT	

Table 3 (cont'd)

Study	Location	Duration (months)	Age Group	Treatment	Stunting	Underweight	Wasting	Other	Statistical Design	Comments
Van Stuijvenberg et al., 1999	KwaZulu-Natal, South Africa	12	6-11y	SFP (snack)	n.s.	n.s.		Height n.s. Weight n.s.	RCT	

Note: n.s. is not statistically significant, * is statistically significant at the 10%,

** is significant at the 5% level, *** is significant at the 1% level

N is Non-experimental design, Q is Quasi-experimental design, and RCT is Randomized Control Trial

Kazianga et al. (2009) study was for one school year, while the Buttenheim et al. (2011) study occurred over two years and in which some positive impacts were seen on height-for-age. In this latter study, in a district where THR was the only FFE intervention, the results show an increase in height-for-age and in weight-for-age in all children, and in 3-5 year old children it showed even greater gains in weight-for-age. Impacts from this study were however, inconclusive because in another district treated with both SFP and THR no significant impacts were measured for height-for-age indicator, and only marginally significant increases in weight-for-age were observed (Buttenheim et al. 2011) (Table 3). A key explanation that the authors provide for these results is that only 57% of eligible schools in this second district reported providing a meal every day compared to 97% for the SFP only district (Buttenheim et al. 2011)³.

Baker et al. (1980) studied the effects of a SFP where children were provided 190 ml of milk as a treatment to a group of randomly selected 7 and 8 year olds. Students were chosen from 25 public schools in Wales where 20% or more of the pupils qualified for free school meals due to their socioeconomic status. After 21 months of the intervention, students in the treatment group were shown to have a significantly higher growth outcomes of approximately 3% in both height and weight (or 2.8 mm and 130 g, respectively) than the control group. Results were similar in boys and girls. Arsenault et al. (2009) found mixed results for height-for-age and BMI-for-age from a snack program at city-wide public schools in Bogotá, Colombia. From a four month follow up study, it was found that children in both the treatment and the control group decreased their height-for-age z-scores, indicating that the children were still experiencing nutritional deficiencies. Yet the treatment group deteriorated less than the control group. On the

³ When setting up these FFE programs, the WFP and the Lao Ministry of Education decided to implement the interventions on a district level in order to deal with concerns of spillover effects and perceived equity; the FFE program assigned to each district in the implementing province was chosen randomly (Buttenheim et al. 2011).

other hand, the change in the BMI-for-age indicator did not differ for the treatment and control group.

Mixed results for impacts on anthropometric measurements were found from other studies in this review. Multiple studies included fortification as a treatment technique. Van Stuijvenberg et al. (1999) studied the effects of micronutrient-fortified biscuits on the micronutrient status of primary school children. The design of the study compared 115 children who were fed fortified biscuits with a control group of 113 from a rural primary school. The students, ages 6-11 years, were treated for 43 weeks, and the authors assessed the micronutrient status as well as height-for-age and weight-for-age Z-scores. The study showed no changes for the treatment and control groups for either anthropometric measurement. However, the authors point out that the studied groups had a low prevalence of stunting and underweight to begin with. In another fortification study, Ash et al. (2003) found different results. Their six month long study of children from six primary schools in rural Tanzania treated students in a double-blind study with either a fortified or unfortified beverage. The fortified treatment group saw significant gains in weight of 0.55 kg and in height of 0.57 cm, resulting in a gain of 0.32 more BMI units over the control group. In Bangladesh, Ahmed (2004; described below in further detail) also found that a fortified food had a significant, positive effect on the physical growth indicators of school children. The biscuits consumed in that study resulted in a 4.3% or 0.62 BMI unit increase over the control group. Muthayya et al. (2009) tested the effects of omega-3 fatty acids amongst treatment groups in Bangalore, India in a 2-by-2 factorial, double-blind, randomized controlled trial of 598 children. These 6 to 10 year olds were assigned to one of four intervention groups that received different variations of an omega-3 enriched beverage over a twelve month period. Children in the high micronutrient treatment group showed significant

gains of 0.19 cm in height after the intervention, although there were no differences seen in weight gain or MUAC. Lien et al. (2009) gave milk and fortified milk over a six month period in a double-blind study of 454 primary aged children in Vietnam. Stunting and underweight each decreased by about 10% in the children in the treatment group compared to the control group. There was no statistical difference in outcomes between the milk and fortified milk treatment groups. In summary, the results of school feeding and THR programs on anthropometric measurements in primary aged children are mixed (Table 3).

Results from these studies suggest that FFE programs provide only modest gains in measurements of growth in school children. Stunting (height-for-age) showed no significant gains for interventions when students received school meals, but did have significant positive effects from interventions involving snacks or beverages. The provision of snacks and beverages in schools, which are often nutritionally dense or fortified, also showed significant increases in weight and height. In their meta-analysis, Kristjansson et al. (2007) conclude that SFP results in small improvements in weight, while for height, results were mixed. The review by Jomaa et al. (2011) concludes that the evidence is mixed on the effects of SFP on impacting weight and heights in children. In the case of THR programs, stunting saw gains for an intervention with only THR, but not when combined with SFP. Interventions with THR did make an impact on wasting (weight-for-height) and underweight (weight-for-age), particularly in siblings. The studies that measured anthropometric outcomes lasted, on average, just over a year, which perhaps is not enough time for these FFE interventions to affect these outcomes.

4.3.2 Behavioral Outcomes

School feeding programs are premised on the expectation that serving food at school will increase enrollment and daily attendance of students. Thus, school feeding programs are hypothesized to alter the schooling decision for families who would not have sent their children to school otherwise (Adelman, Gilligan, and Lehrer 2008). This behavioral change by both the parents and the children is reflected in the rates of increase in such outcomes as enrollment, attendance, and length of schooling, and decrease in dropout rate, tardiness, and absenteeism.

Fifteen studies report the effect of FFE programs on behavioral outcomes (Table 4). Ahmed and del Ninno (2002) used a non-experimental design to assess the FFE program set up in Bangladesh designed to transfer food to the poorest households through THR programs in primary schools. Households qualified for the program if at least one of the following was true: they owned less than a half acre of land or were landless, the head of household was employed as a laborer, the head of household is female, or the household earns income from certain low-income professions (Ahmed and del Ninno 2002). Local committees drew up a list of eligible households in the communities, and the government of Bangladesh capped the total share of students in any one school to receive the THR benefit at 40%. Through this government program, qualified households with children who attended at least 85% of classes received the THR comprised of 15 kg of wheat or 12 kg of rice per month for one child and 20 kg of wheat or 16 kg of rice for two or more children. In the 110 rural schools sampled, it was found that the program increased enrollment by 35% from the year before the FFE program started, including 44% for girls. Schools where there was no FFE intervention saw increases in enrollment by only 2.5% during this same period (Table 4). In comparing FFE and non-FFE schools, schools' self-reported attendance was 70% for those receiving the intervention and 58% for those that did not

Table 4: Impact of interventions on behavioral outcomes

Study	Location	Duration (months)	Age Group	Treatment	Attendance	Enrollment	Design ^a	Other/ Comments
Adrogué and Orlicki, 2011	Argentina	48	Grade 3	SFP or THR			N	Dropping out: n.s.
Afridi, 2007	Madhya Pradesh, India	6	5-12y	SFP (meal)	Girls: **	Girls from Scheduled Tribes: *	N	
Ahmed, 2004	Bangladesh	12	6-12y	SFP (snack)	***	**	RCT	
Ahmed and del Ninno, 2002	Bangladesh	12	6-10y	THR		***	N	
Alderman et al., 2010	Northern Uganda (refugee camps)	18	6-17y	SFP (meal) or THR	SFP: mornings: *, afternoons: ***, THR: mornings: *, afternoons: ***	SFP: **, THR: n.s.	RCT	
Arsenault et al., 2009	Bogotá, Columbia	4	5-12y	SFP (meal)	**		N	
Buttenheim et al., 2011	Phongsaly province, Lao PDR	24	3-14y	SFP (meal) or THR, or SFP (meal) + THR		SFP: *, THR: ***, SFP+THR: n.s.	Q	SFP+THR district had implementation problems
Cheung and Perrotta, 2010	Cambodia	48	grades 1-6	SFP, THR, deworming		SFP: **, SFP+THR: **, SFP+THR+ deworming: ***	RCT	
Gelli et al., 2007	32 SSA nations	36	primary students	SFP (meal) + THR or SFP (meal) only		**	Q	
He, 2009	Sri Lanka	60	5-14y	SFP (meal)		Standard program: n.s.; welfare program: ***	N	

Table 4 (cont'd)

Study	Location	Duration (months)	Age Group	Treatment	Attendance	Enrollment	Design ^a	Other/ Comments
Jacoby et al., 1998	Peru	4	5-10y	SFP (snack and beverage)	Positive effect but no test statistics given.		Q	
Kazianga et al., 2009	Burkina Faso	12	6-15y	SFP (meal) and/or THR	SFP: boys: n.s.; girls *** (negative impact); THR: boys: n/a; girls *** (negative impact)	SFP: overall: n.s.; girls: **; THR: overall: ***; girls: **	RCT	
Meyers et al., 1989	Lawrence, Massachusetts, US	5	Grades 3-6	SFP (meal)			N	Tardiness rates decreased in participants and increased for nonparticipants* **.
Tan et al., 1999	Philippines	12	Primary	SFP (meal)			Q	Dropping out: n.s.

Note: n.s. is not statistically significant, * is statistically significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level, **** is significant at the 0.1% level.

^a Non-experimental Controlled (N), Randomized Control Trial (RCT)

receive the intervention. The researchers conducted random surprise visits to ensure that attendance figures were accurate and found little difference between visual head-counts and the recorded daily figures. Ahmed and del Ninno also looked at the dropout rate as affected by the THR program, and found that from 1999 to 2000, 15% of students from households who did not receive rations dropped out while only 6% dropped-out among those receiving the THR ration.

Beginning in 2002, the government of Bangladesh began a school feeding program with the WFP, providing fortified nutritional biscuits to school children in chronically food insecure communities. This program was analyzed by Ahmed (2004) a year after inception, who looked at 4,453 households from 12 rural and urban communities. Enrollment after the SFP was implemented increased by 14.2%, while mean attendance per student increased 1.34 school days per month (representing 6% of the total days per month) (Ahmed 2004). The probability of dropping out decreased by 7.5% in schools receiving the SFP intervention (Ahmed 2004).

Gelli, Meir, and Espejo (2007) performed a retrospective study of school-level surveys in 32 African countries where the WFP operated FFE programs in primary schools. These school surveys were conducted from 2002 to 2005 in areas identified as food insecure that also lacked access to education. In total, over 1 million students in over 4,000 schools were included in the surveys; selected schools were receiving SFP, SFP and THR, or were due to start receiving a FFE intervention (used as proxy controls). When there were adequate numbers of schools in each country, schools were randomly selected, and when there were fewer than 150 schools that were benefiting from WFP assistance, all assisted schools were surveyed. Results reported were school-level averages weighted by the number of recipients of the programs (Gelli, Meir, and Espejo 2007). In the first year of any WFP intervention average absolute enrollment increased 22% for boys and 28% for girls, before falling back the next year to enrollment rates similar to

those in the years previous to the FFE programs (Gelli, Meir, and Espejo 2007). Comparing the SFP-only schools to SFP and THR schools for girls' enrollment, the authors found that absolute enrollment increased in the first year by nearly 30% in each type of school. These higher rates were sustained in SFP+THR schools during the study years (2001-05), but regressed back to the previous enrollment rates in SFP-only schools by the next year (Gelli, Meir, and Espejo 2007). Gelli, Meir, and Espejo (2007) also looked at the enrollment gender parity index (GPI), which is the ratio of girls to boys enrolled in a school. They found a 19% increase in GPI after the first year in programs offering SFP and THR but no significant change for SFP-only programs.

Afridi (2007) examined the feeding program effects on school enrollment and attendance of a school feeding program in Madhya Pradesh, India, in 2004. The 74 schools surveyed were at different stages in transferring from providing either no food assistance or providing raw grains to students enrolled in school, to a cooked school meal (SFP). Using difference-in-difference estimation, girls' attendance was found to increase 10.5% in schools which implemented the SFP in grade 1. The number of girls attending grade 1 increased by 1.77 per school day and in grade 3 by 0.81 due to the school meal program, while attendance for boys showed a positive but insignificant increase for grade 1. Girls from scheduled tribes (traditional socioeconomically disadvantaged groups protected by the Indian constitution) were marginally more likely to enroll due to SFP.

A midmorning snack provided in public primary schools in Bogotá, Colombia, was the subject of a study by Arsenault et al., (2009). Over the four months of the study, the behavioral and health outcomes of 3,202 children were observed as part of the impact evaluation of the program. The main purpose of the study was to determine if the program had an effect on the health and nutritional status of the children, but the researchers note that the number of days

absent from school was 23% lower in those receiving the snack (Arsenault et al. 2009). The authors qualify the meaning of their findings by pointing out that randomization was not an option due to the roll-out of the government plan, and add that it was not clear from the study if the absenteeism, when reported, was due to illness in children or other reasons.

He (2009) compares two types of school feeding programs in Sri Lanka. The study surveyed more than 9,000 schools over 12 years that participated in either a WFP-run school feeding program or a program where local welfare recipients were paid on a per student basis to provide school meals. In this study, the WFP schools did not increase enrollment, while the welfare program revealed increases of 5.9% at the school-grade level, and 2.1% at the school level. However, the study found that the welfare program generated no increase in enrollment when data were examined at a division level. This is due to students switching schools from those that did not have FFE programs to those that did, and was further fueled by the incentive the welfare recipient schools had for increasing enrollment since they were paid per student. The author also points out that there is no gender gap in education in Sri Lanka, which is parallel to the results found in this study, and for areas of Sri Lanka with “already high enrollment, food may not be a large enough inducement to bring out-of-school children to school” (He 2010, p.47).

In Burkina Faso, Kazianga, de Walque, and Alderman (2009) found that both THR and SFP interventions had a statistically significant impact on the overall enrollment and the enrollment of girls⁴. Communities were randomly selected as SFP, THR, or control interventions. In THR villages, schools increased new enrollment overall by 6.2%, and girls’ enrollment increased by 5.6%; SFP schools saw an increase of 5% for new girls’ enrollment

⁴ The authors of this study did not discuss or analyze the impact of the THR program on boys’ enrollment (Kazianga, de Walque, and Alderman 2009).

(Kazianga, de Walque, and Alderman 2009). The researchers found that while boys' attendance did not change, girls in SFP or THR schools missed one day more than schools not involved in either program (Kazianga, de Walque, and Alderman 2009). The authors looked at child labor supply to help explain this, and found that the interventions caused absenteeism to increase in households with low child labor supply (i.e., households that had only one or zero additional non-school age children), while absenteeism decreased for households with a relatively large child labor supply (i.e., households with two or more non-school age children; (Kazianga, de Walque, and Alderman 2009). The authors go on to point out "attendance *conditional on enrollment* is likely to be lower with the program than without the program" (Kazianga, de Walque, and Alderman 2009, p.15). In other words, attendance is not likely to change for students who were in the program before the FFE program was introduced, but for new enrollees in the schools, the household may still value the child labor lost over the education gained and will occasionally utilize that child labor, thus increasing overall absenteeism in the school. Families in THR schools may choose to send children to school for only the minimum number of days needed to receive the benefit; families in SFP schools would send their children to school only "when the household values the school meals more than the child labor" (Kazianga, de Walque, and Alderman 2009, p.15). They also noted that the interventions did not eliminate the child labor supply problem, but shifted the "allocation of child labor (especially among girls) away from productive activities and more toward domestic activities which the children may be more able to combine with school activities" (Kazianga, de Walque, and Alderman 2009, p.17).

Cheung and Perrotta (2010) compared three different FFE programs managed by the WFP in rural Cambodia from 1998 to 2003 in 8,443 schools. The three FFE programs, which were introduced in different years, involved a: i) breakfast before school, ii) breakfast plus a

THR for poor families with girls in grades 4 to 6, and iii) breakfast plus a THR plus deworming medicine. The authors used difference-in-difference estimation to see the impacts of the different FFE programs on enrollment, school attendance, and length of time to complete the education. The first intervention increased enrollment by 5.8%, the second by 5.2%, and the third by 19% after the first year of the treatments. The largest effect of the treatment was observed among girls, and for students in grades 4 to 6. Across all treatment types, Cheung and Perrotta (2010) found that children in communities with any of the FFE programs were 10% more likely to be in school, and would remain in school for a total of 1.8 more months⁵ than in communities without any intervention (i.e., the FFE programs improve the highest grade achieved). For all the treatments, improvements in the highest grade achieved were found amongst girls and children of fathers with lower education (which the authors consider as a proxy for income) (Cheung and Perrotta 2010). Looking at the probability of being in school, the authors find children of parents with lower education are more likely to be in school following the rollout of any of the treatments (Cheung and Perrotta 2010). The authors also find that the likelihood of being in school after the rollout of the treatments in Cambodia is highest with the poorest quintile (using per capita consumption as a proxy for per capita income), and decrease as incomes rise; the authors propose that this indicates the FFE programs are “pro-poor interventions” (Cheung and Perrotta 2010). Several years after the start of the rollouts, the authors looked at the effect of the FFE programs on children by age cohorts and found that students who were younger (12-14 years old) when the program started had a very strong positive effect on the highest grade achieved. There was no such impact observed for the elder cohorts (12-17 and 18-20) (Cheung and Perrotta 2010).

⁵ Cheung and Perrotta (2010) point out this figure is for all children, but for a sub-group of students who have only attended some school at some point, this rises to 2.8 more months.

Alderman, Gilligan, and Lehrer (2010) analyzed the impacts of FFE on children in refugee camps in northern Uganda. The refugee FFE programs were administered by WFP and each camp had either SFP or THR programs. In the camps with SFP, the program was found to generate an 8.9% increase in the probability of enrollment of 6-13 year old children, and slightly more for 6-9 year old children at 9.4% (Alderman, Gilligan, and Lehrer 2010). The impacts in THR camps were smaller and not significant, while the difference between THR and SFP was also not significant. Both treatments were found to significantly increase attendance in morning and afternoon classes, in both genders and for different age groups. Morning attendance improved in for the overall age groups (6-17 years), and especially for older students (10-17 years) when either the SFP or THR programs were implemented. Breaking this down by gender, the authors find that the introduction of SFP increased girls' morning attendance for all age groups compared to boys. Among boys, the increase in morning attendance due to the introduction of THR was only found in all boys (6-17) and older boys (10-17) (Alderman, Gilligan, and Lehrer 2010). The introduction of SFP or THR also impacted the attendance for the afternoon school, though in a different manner than the morning attendance. Both programs impacted all afternoon attendance when looking at boys and girls combined, with the exception of THR on 10-12 year olds. Looking at this by gender, the authors find that for the afternoon attendance, younger girls and older boys are the most affected by either type of an FFE program. The authors point out however, that "for most age group and gender categories, we cannot reject the equality of impacts of both programs (Alderman, Gilligan, and Lehrer 2010, p. 25) Both SFP and THR programs significantly reduced the age at entry to primary school by about two standard deviations. The researchers found that with the introduction of SFP, the likelihood of remaining in primary school – i.e., not advancing to secondary - increased for students in grades

6 and 7. To explain this phenomenon, they suggest that the SFP program may encourage students to stay in primary school longer in order to receive meals, delaying advancement to secondary school where no school meals are provided (Alderman, Gilligan, and Lehrer 2010). It is not perhaps surprising that this study found this result because of the quantity of food being given to the students, which totaled 1049 calories in an area the authors describe as having “poor food security” (Alderman, Gilligan, and Lehrer 2010). In comparison, most of the other studies in this review that provided the details on the portion size of the snacks and school meals reported servings in the range of 200-400 calories, and the WFP recommended daily caloric intake is 2100 calories.

Buttenheim, Alderman, and Friedman (2011) see limited effects from FFE programs in Lao PDR. Schools in the district that benefited from SFP saw a 5% increase in enrollment over the control district, while schools in the district with THR-only saw an increase of 7% (Buttenheim, Alderman, and Friedman 2011). The authors are not confident of any significant impact from FFE programs on enrollment, as the district with both SFP and THR did not see any increase in enrollment. The authors point to problems of implementation in the programs and do not feel the results show consistent effects on enrollment.

Studies from Lawrence, Massachusetts (Meyers et al. 1989), the Philippines (Tan, Lane, and Lassibille 1999), and Argentina (Adrogué and Orlicki 2011) focused on impacts other than enrollment and attendance from FFE programs, but did find mixed evidence of impacts on tardiness and the dropout rate. Meyers et al. (1989) looked at six schools where low-income students participated in the national School Breakfast Program (SBP). Participants showed lower rates of absenteeism and tardiness than non-participants. The authors do caution that causal inferences may not be valid as the study was not a controlled experiment.

In the study by Tan, Lane, and Lassibille (1999), interventions in schools were conducted in four treatments: school feeding, multi-level learning materials, school feeding combined with parent-teacher partnerships, and multi-level learning materials with parent-teacher partnerships. Using difference-in-difference estimation, the authors found the two treatments that included SFP made no statistical impact on dropout rates, while students in the multi-level learning materials (designed as pedagogical materials for teachers) showed lower dropout rate. The national program in Argentina showed no impact on the dropout rate (Adrogué and Orlicki (2011). However, the authors point out flaws in their survey that did not allow for an objective measure for determining the dropout rate; the directors of each school subjectively determined whether the dropout rate was a problem or not at their own school.

Summarizing across this literature, we find strong evidence that FFE programs positively influence the decisions and behaviors of households and children regarding enrollment and attendance. This effect is particularly seen for girls in areas where these rates are low and even stronger when THR is a part of the mix of interventions. Effects on other possible outcomes such as highest grade achieved and the dropout rate, are inconclusive at this point and require further research. The reviews by Bundy et al. (2009) and Jomaa et al. (2011) also find that the provision of FFE programs increases the access to learning and education for schoolchildren by improving enrollment and attendance rates.

4.3.3 Cognitive Outcomes

Fourteen studies looked at the impact of FFE programs on the cognitive development of school children. Of these, six looked at impacts on academic performance, while ten looked at other cognitive effects, as tested by tools such as the Wechsler Intelligence Scale for Children (WISC) and the Raven's Colored Progressive Matrices. These tests measured various signs of cognitive development, such as reasoning, memory, attention, and speed of decision making. Table 5 provides a summary of the results of academic performance and other cognitive development measuring tests found in the studies reviewed.

In the Bangladesh study, Ahmed (2004) tested 1,648 grade five students from the treatment groups to see the effects of fortified snacks on school performance. Since students had not finished grade five at the time of the testing, all students were tested using a grade four test. The test scores for three subjects, Bengali, English, and mathematics, and a combined score were all estimated using Tobit regressions. Total test scores improved by 15.7% in the treatment group over the control, with mathematics improving by 28.5% and English 22.2%; Bengali scores increased but not statistically significantly. Similar to the study by Ahmed, Meyers et al. (1989) found significantly greater improvements in total scale score and language subscore, while marginal improvements were seen in mathematics and reading subscores.

Not all of the results from studies looking at impacts of the FFE programs on student achievement were as strong as those found by Ahmed (2004) and Meyers et al. (1989). Adrogué and Orlicki (2011) analyzed a SFP conducted in Argentine national public schools; in their non-experimental design, they found the impact of the SFP on school scores for students in grade three. The language scores for the third grade students increased by 0.15 SD, but there was no significant effect on mathematics scores. Kazianga et al. (2009) found no significant impact on

performance in mathematics. Tan, Lane, and Lassibille (1999) saw improved math and English test scores due to the school feeding programs, but no impact on Filipino language test scores. Whaley et al. (2003) examined the impact of three different diets in rural Kenya on the cognitive development of school children. Four different feeding interventions - meat, milk, energy or the control (who were not fed) - were randomly assigned to 555 grade one children for 21 months. The study found that children who received supplementary meat or energy diets statistically outperformed the control group on arithmetic ability. Verbal comprehension showed no statistically significant difference in test scores. The other studies in this review compared milk or meat to other treatment groups, though the study by Lien et al. (2009) in Vietnam used milk or fortified milk to compare to a control group that consumed nothing. Lien et al. (2009) did conduct several cognitive development tests in which milk drinking children were found to have significantly higher work speed and higher efficiency in the later part of the exercise. Recall of memorized words and numbers was significantly higher for milk drinkers. Those consuming fortified milk outperformed the regular milk drinking group (but results were not reported) (Lien et al. 2009).

Osendarp et al. (2007) conducted a study of school-aged children (6-10 years old) in Adelaide, Australia, and Jakarta, Indonesia. Treatment groups were given one of four different beverages fortified with differing amounts of a variety of micronutrients and two omega-3 fatty acids. The children (396 in Australia and 384 in Indonesia) were assigned to the treatment groups in 2-by-2 factorial randomized control double blind trials over the course of a year. Subjects from these two locations were chosen to represent two socio-economic groups: (a) children who were well-nourished and came from families with a high socioeconomic status, and (b) children who were marginally nourished and came from low socioeconomic status families. Cognitive testing

occurred at the baseline, 6 months, and 12 months, and included the longest battery of tests of any study in this review. Results indicate significant increases in scores on tests representing verbal learning and memory in Australia. A similar effect was observed among Indonesian girls (Osendarp et al. 2007). No effects were found on tests measuring general intelligence or attention. Omega-3 fatty acids showed no effect on cognitive test performance in either country.

Verbal fluency improved in a study of undernourished children in rural Jamaica (Chandler et al. 1995 and Grantham-McGregor, Chang, and Walker 1998). In this study, the authors looked at the short-term effects of eating breakfast on cognitive performance, contrasting undernourished children (n=97) with adequately nourished children (n=100) who were in grades 3 and 4. A cross-over design was employed so that each child was tested twice; they received both the breakfast and a placebo (a quarter orange as a control for the amount of attention the teacher may have given to those with the breakfast). Examining the results with ANOVA, the authors found a significant treatment effect in verbal fluency, and a significant interaction between nutritional group and treatment. Scores for the adequately nourished children did not change, while the undernourished children performed better when they received breakfast, suggesting that the alleviation of hunger may affect cognitive functions. No significant effects in other cognitive function tests were observed (i.e., visual search, digit-span forwards, and speed of decision making). Similarly, a study from the Peruvian Andes (Jacoby, Cueto, and Pollitt 1998) found that results of one of four cognitive tests (vocabulary) improved for nutritionally at-risk children, while tests for coding, mathematics and reading did not.

Table 5: Impact of interventions on cognitive outcomes

Study	Location	Duration (months)	Age Group	Treatment	Academic test results	Other cognitive results	Design ^a
Adrogué and Orlicki, 2011	Argentina	48	Grade 3	SFP (meal)	Language: ***; mathematics: n.s.		N
Ahmed, 2004	Bangladesh	12	6-12y	SFP (snack)	Total Test scores: **; mathematics: **; English: *; Bengali: n.s.		RCT
Chandler et al., 1995	Jamaica	0.5	Grades 3-4	SFP (snack and beverage)		Verbal fluency: **	N
Grantham-McGregor et al., 1998	Jamaica	0.5	8-11y	SFP (meal)		Categoric fluency: ** (undernourished children only); visual search: n.s. ; digit-span forwards: n.s.; speed of decision making: n.s.	RCT
Jacoby, E. et al., 1998	Peru	4	5-10y	SFP (snack and beverage)	Mathematics: n.s.; reading: n.s.	Vocabulary: **; coding: n.s.	N
Kazianga et al., 2009	Burkina Faso	12	6-15y	SFP or THR	Mathematics: n.s.	Digit span: n.s.; WISC: n.s.; Raven's: n.s.	RCT
Lien et al., 2009	Vietnam	6	7-8y	SFP (beverage)		Significant higher work volume (speed) and higher work efficiency. Significantly higher recall of memorized words and numbers. Consuming fortified milk showed superior performance compared to the regular milk drinking group. (No results shown)	RCT
Meyers et al., 1989	Lawrence, Massachusetts, US	5	Grades 3-6	SFP (meal)	Battery total score: ***; language: **; mathematics: *; reading: *		N

Table 5 cont'd

Study	Location	Duration (months)	Age Group	Treatment	Academic test results	Other cognitive results	Design^a
Muthayya et al., 2007	Bangalore, India	0.5	7-9y	SFP (meal and snack)		Memory: LSES children: **; HSES: n.s.; Sustained attention: n.s.; Psychomotor speed: n.s.	N
Muthayya et al., 2009	Bangalore, India	12	6-10y	SFP (snack and beverage)		n.s.	RCT
Osendarp et al., 2007	Adelaide, Australia & Jakarta, Indonesia	12	6-10y	SFP (snack and beverage)		Verbal learning and memory: Australia: positive (significance not reported); Indonesian girls **: General intelligence: n.s.; Attention: n.s.	RCT
Tan et al., 1999	Philippines	12	Primary	SFP (meal)	Mathematics: **; English: **; Filipino: n.s.		Q
van Stuijvenberg et al. 1999	KwaZulu-Natal, South Africa	12	6-11y	SFP (snack and beverage)		Digit span forward task (short-term memory): **	RCT
Whaley et al., 2003	Embu, Kenya	21	7.63y average age	SFP (meal)	Verbal; n.s. (all groups); Mathematics: meat: **; energy: ***, milk: n.s.	Raven's Progressive Matrices: meat: **; energy: n.s.; milk: n.s.	RCT

Note: n.s. is not statistically significant, * is statistically significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level, **** is significant at the 0.1% level.

^a Non-experimental Controlled (N), Randomized Control Trial (RCT)

In their study in South Africa, van Stuijvenberg et al. (1999) used cognitive tests designed to measure a range of mental processes, fine motor skills, verbal learning, visual memory, arousal, attention, retrieval, eye–hand perception, and coordination. The researchers chose these tests to measure the impact of the intervention on cognitive skills, which are diminished by nutritional deficiencies; the community where the study occurred faced a high prevalence of micronutrient deficiencies. Tests were timed to see how long the children took to complete each set of tasks. Only one test – the digit span forward test that measures short-term memory and attention – showed significant improvement (van Stuijvenberg et al. 1999).

In a controlled setting in urban Bangalore, India, children were tested to see the effects of a mid-morning snack on cognitive performance. Children (seven to nine years old) from low (n=34) and high (n=35) socioeconomic status were randomly assigned to three iso-caloric diet interventions. The control group received no snack but did consume breakfast and lunch of equal total calories to those of the other groups. This study was not conducted in a school setting, but was considered for this review because of the use of the socioeconomic status (SES) of the children in measuring the effects. Each child in the treatment group received all three interventions for one day each week, and was tested for cognitive performance before breakfast, after breakfast, after the mid-morning snack and after lunch. Children in the control group were also tested at the same time and frequency. Cognitive tests were administered to measure memory, sustained attention, and psychomotor speed. The authors found no impacts on sustained attention and psychomotor speed from consuming a snack on either the low or high socioeconomic status (LSES or HSES) children. The mid-morning snack reduced the decline in immediate and delayed memory performance among LSES children, but not HSES, even when the snack was given on a single occasion.

In the other study from Bangalore, India (Muthayya et al. 2007), children from two primary schools from LSES communities were given a battery of 11 cognitive subtests to measure the impacts on fluid reasoning, short-term memory, retrieval ability, and cognitive speediness. Testing occurred at baseline, six and 12 months, and showed that the high micronutrient treatment improved short-term memory at six months. The omega-3 treatments had no measured effects on cognitive performance. The authors argue that had they ethically been allowed to test with a placebo group, the impact of the omega-3 and micronutrient fortification would have been seen on the testing outcomes since all treatments were shown to generate a substantial increase in the amounts of consumed protein and calories over the children's regular diets (Muthayya et al. 2007).

Kazianga et al. (2009), however, found no significant impact on any cognitive tests, including those on short-term memory (digit span) conducted on children between five and 15 years of age by the SFP or THR interventions. This study also tested using WISC and Raven's colored progressive matrices for which again there were no discernible impact.

On average, the duration of all studies that measured cognitive skill outcomes lasted 11 months, while those that measured academic related cognitive tests such as language, reading, and mathematics averaged eight months in length. Recent reviews (Kristjansson et al. 2007, Jomaa et al. 2011) find that mathematics tests were consistently positively impacted by SFP, but little evidence for other cognitive tests; this differs from the finding of my review. The evidence for school feeding programs impacting cognitive ability is mixed from the studies in this review; no consistent positive results were seen in cognitive ability tests, except for tests measuring language skills. Tests for language skills or English skills measured positive gains for all six studies; however tests for local languages in Bangladesh and the Philippines showed no

statistically significant changes⁶. Three of the studies that measured impacts on mathematical skills did not find any statistically significant difference in test scores and three other studies found positive gains. A seventh study, in which students were given different treatment diets in the SFP, showed positive effects on mathematics test score depending on the treatment. Other tests, such as memory or reading, exhibited a mixture of positive gains versus not statistically significant difference in test scores between the treatment and the control groups.

4.3.4 Health and Nutrition Outcomes

Twelve studies in this review included evaluation of impacts of FFE interventions on health and nutrition related outcomes. The studies covered different types of outcomes, which can be grouped into four categories: anemia, calories (energy), nutrient status, and morbidity and illnesses. Results for morbidity impacts are given in Table 6 and those for anemia, calories and nutritional status are given in Table 7. Results exhibit consistent positive effects on the well-being of the children, with the exception of nutrient related outcomes, which had mixed results. Calories, in themselves, would normally be an input in the interventions and inappropriate as an outcome. However, the authors of the studies that included calories (or energy), were attempting to measure the degree to which the intervention “sticks” to the children. In other words, the researchers wondered if the children receive all of the benefit from the FFE and are not penalized later by parents by changing the distribution of food within the household to others (i.e., siblings, adults) not receiving the FFE benefits.

⁶ One possible explanation of this may be the high comfort level of students with their local languages relative to English (and thus not much scope to observe an effect).

Table 6: Impact of interventions on morbidity and illnesses

Study	Location	Duration (months)	Age Group	Treatment	Morbidity and Illnesses	Design^a
Arsenault et al., 2009	Bogotá, Columbia	4	5-12y	SFP (snack and beverage)	Decreased rates of reported morbidity, resulting in 23% few days absent from school (p<0.05), and 44% fewer doctor visits (p<0.05).	N
Lien et al., 2009	Vietnam	6	7-8y	SFP (beverage)	The self-reported health related quality of life showed a considerable decrease in the parameters: stomach-aches or abdominal pain, headaches, dizziness, and sick or nauseous in the children consuming either fortified or regular milk (significance levels not reported).	RCT
van Stuijvenberg et al. 1999	KwaZulu-Natal, South Africa	12	6-11y	SFP (snack and beverage)	Fewer school days were missed by children in the intervention group than in the control group as a result of respiratory-related illnesses (p<0.10) and fewer as a result of diarrhea-related illnesses (p<0.05). The prevalence of goiter did not decrease after 12 mo of iodine fortification.	RCT

Note: ^a Non-experimental Controlled (N), Randomized Control Trial (RCT)

In the study by van Stuijvenberg et al. (1999), fortified biscuits were compared to regular biscuits to see the impact on the micronutrient status of primary school children. The study had particular interest in improving the status of iron, iodine, and vitamin A in children, as deficiencies in any of these three have been shown to affect the mental development and learning ability of children, lead to greater susceptibility of illnesses and infections and lead to further long-term health issues (van Stuijvenberg et al. 1999). The biscuits were fortified with iron, iodine and β -carotene, which is a form of vitamin A. After a cross-sectional survey of the community dietary intakes, which revealed micronutrient deficiencies children faced, data on micronutrient status of the treatment and control groups were collected at the baseline, six months and 12 months after the intervention. Significant treatment effects were found for serum

retinol (a measure of vitamin A); serum ferritin, serum iron, transferrin saturation (measures of iron); urinary iodine; hemoglobin and hematocrit (measures of degree of anemia). The presence of anemia decreased at a higher rate for those in the treatment group over the course of the intervention, while goiter did not decrease. The intervention also impacted the number of days the children in the treatment group missed school for respiratory related illnesses. Days missed from school due to diarrhea related illnesses were significantly fewer.

Ash et al. (2003) provided fortified beverages and placebos to children in six rural primary schools in Tanzania. Like the intervention in Tanzania, the fortification included iron, a form of vitamin A, and iodine plus other micronutrients, such as zinc and vitamin B-12 (Ash et al. 2003). In the treatment group, of those anemic at baseline, a cure rate of 21% was seen and 27% of the potential new cases of anemia were avoided in the treatment group (Ash et al. (2003). The rate of serum retinol concentrations (vitamin A) decreased from 21.4% to 11.3% in the treatment group compared to no significant change in the control group (Ash et al. 2003). The treatment significantly increased hemoglobin concentration in the fortified group over the nonfortified group. In another fortified food program, Muthayya et al. (2009) found that the high micronutrient treatments significantly improved a number of micronutrient and biochemical indicators. Twelve months after the beginning of the intervention, the researchers found that for anemia, iron, folate, and vitamin B-12 deficiencies, the high micronutrient groups were able to significantly drop the prevalence over that of the low micronutrient groups. Similar impacts were seen in both the high socioeconomic (Australia) and low socioeconomic status (Indonesia) children in the Osendarp et al. (2007) study. Treatment groups that received micronutrients showed improved blood concentrations of hemoglobin, folate, vitamin B-12, and serum ferritin over the course of the 12 month study.

Table 7: Impact of Interventions on Health and Nutrition

Study	Location	Duration (months)	Age Group	Treatment	Anemia	Calories	Nutrients	Design ^a
Afridi, 2010	Madhya Pradesh, India	2	5-12y	SFP (meal)		***	Iron ***; protein **	N
Ahmed, 2004	Bangladesh	12	6-12y	SFP (snack)		***		RCT
Arsenault et al., 2009	Bogotá, Columbia	4	5-12y	SFP (snack and beverage)			Vitamin B-12 ***; hemoglobin n.s.; ferritin n.s.; folate n.s.	N
Ash et al., 2003	Mpwapwa District, Tanzania	10	6-11y	SFP (beverage)	***		Hemoglobin ***	RCT
Buttenheim et al., 2011	Phongsaly province, Lao PDR	24	3-14y	SFP (meal) and/or THR	THR district: children 6-10y **, 11-14y girls **; THR + SFP district: 11-14y girls**, n.s. in other children.			Q
Jacoby, E. et al., 1998	Peru	4	5-10y	SFP (snack and beverage)	Drop of incidence of anemia reported, but significance level not reported.	****	Protein ****; Iron ****	N
Jacoby, H., 2002	Metropolitan Cebu area, Philippines	12	6-12y	SFP (meal)		****		Q
Kazianga et al. 2009	Burkina Faso	12	6-15y	SFP (meal) or THR			n.s.	RCT
Lien et al., 2009	Vietnam	6	7-8y	SFP (beverage)	**	**	Protein **; iron *** and vitamin A *** in fortified group only.	RCT

Table 7 (cont'd)

Study	Location	Duration (months)	Age Group	Treatment	Anemia	Calories	Nutrients	Design ^a
Muthayya et al., 2009	Bangalore, India	12	6-10y	SFP (snack and beverage)	Drop of incidence of anemia reported, but significance level not reported.		Iron ****, folate ****, vitamin B-12 ****, hemoglobin ****, n-3 FA ****	RCT
Osendarp et al., 2007	Adelaide, Australia & Jakarta, Indonesia	12	6-10y	SFP (snack and beverage)			Iron, hemoglobin, folate, vitamin B-12, all improved, but significance levels not reported.	RCT
van Stuijvenberg et al. 1999	KwaZulu-Natal, South Africa	12	6-11y	SFP (snack and beverage)	***		Iron ****, iodine ****, hemoglobin ***, hematocrit *	RCT

Note: n.s. is not statistically significant, * is statistically significant at the 10% level, ** is significant at the 5% level, *** is significant at the 1% level, **** is significant at the 0.1% level.

^a Non-experimental Controlled (N), Randomized Control Trial (RCT)

Ash et al. (2003) provided fortified beverages and placebos to children in six rural primary schools in Tanzania. Like the intervention in Tanzania, the fortification included iron, a form of vitamin A, and iodine plus other micronutrients, such as zinc and vitamin B-12 (Ash et al. 2003). In the treatment group, of those anemic at baseline, a cure rate of 21% was seen and 27% of the potential new cases of anemia were avoided in the treatment group (Ash et al. (2003). The rate of serum retinol concentrations (vitamin A) decreased from 21.4% to 11.3% in the treatment group compared to no significant change in the control group (Ash et al. 2003). The treatment significantly increased hemoglobin concentration in the fortified group over the nonfortified group. In another fortified food program, Muthayya et al. (2009) found that the high micronutrient treatments significantly improved a number of micronutrient and biochemical indicators. Twelve months after the beginning of the intervention, the researchers found that for anemia, iron, folate, and vitamin B-12 deficiencies, the high micronutrient groups were able to significantly drop the prevalence over that of the low micronutrient groups. Similar impacts were seen in both the high socioeconomic (Australia) and low socioeconomic status (Indonesia) children in the Osendarp et al. (2007) study. Treatment groups that received micronutrients showed improved blood concentrations of hemoglobin, folate, vitamin B-12, and serum ferritin over the course of the 12 month study.

In the case of the intervention of milk and fortified milk in Vietnam, Lien et al. (2009) found the incidences of anemia decreased for the two treatments and the control group, but they note that the decrease was strongest for the fortified group, from 47% to 9%. Students who consumed two cartons of milk (of either type) daily increased their energy intakes by more than 20%, and daily protein intake increased by 14 g (almost 40%). For the fortified treatment group, students had significantly increased iron intake to 4.9 mg/day and vitamin A by 0.41 mg/day.

The two treatment groups also showed improvements in morbidity of the children. The self-reported health related quality of life indicators showed decreases in stomach ache or abdominal pains, headaches, dizziness, and nausea in children consuming either the fortified or regular milk.

Interventions where micronutrient fortification did not occur did not provide as many positive impacts as fortification. In Burkina Faso, in the WFP funded FFE intervention, Kazianga et al. (2009) found no significant impact on hemoglobin levels from any of the programs. Limited impacts were measured in another WFP program in Lao PDR (Buttenheim et al. 2011). Stratified reductions in anemia were the only significant impacts found in 3 to 5 year old children in the THR only district, while older girls in the THR only and SFP plus THR district saw a reduction in anemia rates (Buttenheim et al. 2011).

In the Bogotá's school snack program reported by Arsenault et al. (2009), where children were served a rotating menu of 9 different snacks, measurements were taken of plasma vitamin B-12, hemoglobin, ferritin, and folate. The only significant changes found were an increase in the plasma vitamin B-12 levels in those children who received the snack over those that did not. Children receiving the snack program had lower rates of reported morbidity, including fewer days of reported fever, cough, diarrhea, and vomiting. These resulted in a decrease in the number of doctor visits (44%) and number of days absent from school (23%).

Afridi (2010) surveyed children for their dietary intakes from two consecutive days in Madhya Pradesh, India to determine the impacts on students from the national SFP. Children were administered a 24 hour food consumption and activity recall survey from which the author assessed the impact of the SFP on energy, carbohydrates, proteins, calcium and iron. The households were randomly sampled, and more than 50% of the sampled households included in

the survey were found to be below the poverty line. All the surveys occurred on the same day in each individual village, and it was noted if it was a school day or a non-school day, such as a holiday or a Sunday. Initially, 615 households were visited, and a subsample of 180 households was questioned in a follow up survey. In the follow up survey, children were asked to recall consumption on both a school and a non-school day. In this experiment, the treatment was a school day, and the control was the non-school day (a Sunday or public holiday); or put another way, the study was measuring the difference in the amount of food consumed by school age children when they are in a school that provides SFP compared to schools that do not or do not attend school, or to what is provided by a household on non-school days. Afridi found, using difference-in-difference estimation, that the students increased their daily nutrient intake by 49% to 100% of the nutrients provided from the school meals. The program also reduced the daily protein deficiency by 10%, the calorie deficiency by almost 30%, and the daily iron deficiency by nearly 10%.

Two other studies in this review looked at the impact of the FFE programs on the total calories consumed by the students (Jacoby 2002; Ahmed 2004). Jacoby used a survey of 3,189 students from Cebu Island in The Philippines, where the urban and rural communities suffered from low nutritional status and about 15% of the students participated in a SFP managed by CARE. Using OLS and 2SLS estimates, Jacoby was able to find that the school feeding snack increased the daily caloric intake by approximately 100%. This means that parents were not withdrawing snack or meal calories from their children who were benefiting from the SFP in order to reallocate those same calories amongst other family members. This result is important because it confirms the “flypaper effect,” indicating that the benefits of the SFP are able to “stick” to the intended beneficiaries and not to those for whom the program is not intended.

Jacoby indicates that there may be some evidence that the “flypaper effect” is weaker amongst the poorer households, but not significantly. In Bangladesh, Ahmed (2004) finds similar results: calories consumed from the package of biscuits provided by the FFE are 97% more likely to be additional food in the child’s normal diet (Ahmed 2004). The parents of children in this program did not penalize the child by giving less food at home knowing that they received food at school. The average calorie intake of FFE students are higher than control populations by 11% for rural and 19% for urban slum children. Interestingly, Ahmed (2004) finds a spillover effect from sharing some of the biscuits with siblings in which the biscuits contribute 7% of total calorie intake for younger siblings (2 to 5 years) in rural households. Ahmed (2004) also reports the result of a survey conducted which focused on the perceptions of mothers of students in the SFP program areas. The reported perceptions show a high percentage (ranging from 64 to 88 percent) of mothers claim several positive effects including increased concentration on studies, improved health status, more interest in attending school, less cases of sickness, children are physically more active, happier and livelier than before the SFP program was implemented (Ahmed 2004). While this is not directly a measurable outcome, these claims of the students’ mothers would suggest that the SFP program is impacting upon the targeted students in a positive manner.

The results from these studies show conclusive evidence on the impact of FFE programs on nutrition and health outcomes. Biochemical analyses of micronutrients show that the various FFE programs contribute to the improvement of these nutrients in the beneficiary students. Rates of anemia decrease as a result of these interventions, while overall caloric intake increases in students. These interventions also improve morbidity and illness rates, resulting in fewer days missed from school and fewer doctor visits. These results verify the findings of other reviews; Bundy et al. (2009) also agrees that FFE improves on children’s health and nutrition, while

Jomaa et al. (2011) points out an increase in both energy intake and micronutrients are a result of the provision of school meals.

4.4 Comments on Methods and Study Design

In the twenty six studies included in this review, there were four studies that used quasi-experimental design, eleven used non-experimental design, and eleven were based on randomized-control trials (RCT). None of the study designs seemed more or less likely to favor any of the measured outcomes. For example, for health and nutrition outcomes, all the three study design types indicated that FFE programs had positive impacts on outcome indicators studied. For cognitive outcomes, both RCTs and non-experimental designed evaluations revealed mixed results.

All three study designs were utilized for snacks, SFP meals, and THR treatments. When beverages were a part of the treatment, five studies used RCT in the design. Seven of the nine studies measuring anthropometric outcomes were conducted using the RCT evaluation design. Two RCTs were less than six months in length, and three lasted longer than a year. On the other hand, studies based on quasi-experimental designs lasted between one and three years. Studies which used non-experimental design varied widely in length, ranging from less than six months to up to five years. Given these wide range of design features encountered within a specific type of evaluation method, it is difficult to discern any clear patterns and draw generalizations on the relationship between the evaluation methodology and results of the impact evaluation (Table 2).

Chapter 5. Sustainability, Cost Effectiveness, and Implementation Challenges in Designing Food for Education Programs

5.1 Measures of Cost Effectiveness

The cost of sustaining FFEs is a concern for agencies running these interventions. However few studies included in this review measured cost effectiveness in relation to the outcomes achieved. Five of the studies from this review calculated or commented on the cost effectiveness of the FFE interventions. In Madhya Pradesh, India, costs ranged between 1.44 cents for porridge to 3.04 cents for bread with vegetables or lentils per child per day for the SFP (Afridi 2010). This would come to per child per year costs of \$2.88 and \$6.08⁷, respectively. Afridi does not state what these costs cover, but given the fact that these costs are much lower compared to other programs, they may be reflecting only the cost of the food input and not the cost of delivery. The SFP program that provided biscuits in Bangladesh cost \$18 per child per year, of which \$13.5 was for the production of the biscuits; a packet of biscuits cost 0.56 cents (Ahmed 2004). The previous FFE program in Bangladesh costs \$37 per child per year (Ahmed 2004), while the average cost of the WFP managed school feeding programs worldwide during this time period was reported to be \$34 per child per year (WFP 2002, as reported in Ahmed 2004). The WFP-managed program in Cambodia provided school meals in the first two years of the FFE program (1999-2001), expanded in the third year the number of schools and the coverage to include to include take-home rations to a select number of girls in grades four through six, and in the fourth year expanded again with more schools and also included the deworming in the intervention (Cheung and Perrotta 2010). The authors found the cost was

⁷ These calculations are done by this author and are based on a school year as consisting of 200 school days in India (UNESCO Education Bureau of Education, 2011).

about \$37 per child per year for take-home rations and 22 cents per child per year for deworming (Cheung and Perrotta 2010). The on site school feeding cost was about \$8 per child per year (Cheung and Perrotta 2010). In the study by Tan, Lane, and Lassibille (1999), SFP was compared to other educational program interventions in the Philippines, and found that the school feeding program was by far the least cost effective of the interventions in the study by a magnitude of ten. On average, the SFP cost P 946 (pesos) per child per year, while pedagogical materials cost P 90 and the parent-teacher partnerships P 33 per child (Tan, Lane, and Lassibille 1999). In South Africa, van Stuijvenberg et al. (1999) found that the cost to fortify the cold drinks and biscuits was \$0.70 per child per school day, and the author claims that if a more bioavailable form of iron is used, then the vitamin C needed to help with absorption would no longer be needed, and so the drink could also be eliminated, resulting in reducing the cost of the intervention by half.

A note of caution about comparing costs—different studies reported different number of school days per year to calculate costs, such as 200 days by Cheung and Perrotta (2010) versus 240 days by Ahmed (2004). These two studies also differed on the calculations for the programs; Ahmed (2004) included indirect costs, such as transportation, while Cheung and Perrotta (2010) did not. Bundy et al. (2009, p.39) point out that comparison between programs is problematic for several reasons: “(1) lack of standardization and comparability between programs; (2) the particular lack of small impact studies on take-home rations and fortified biscuit programs; and (3) the lack of standardization of the outcome metrics.” The absence of studies addressing the important issue of cost effectiveness of SFP points to the gap in the literature that needs further research and analysis.

5.2 Issues of Sustainability and Impact on Local Agricultural Development

The issues of sustainability and effects on local agricultural development were not considered in any of the studies included in this review. The studies all focused on the direct impacts of FFE on school children, while sustainability is more an issue of the design and modalities of institutional support from the perspective of the society. However, several of the papers reviewed describe methods/models of the school feeding programs implemented that show opportunities for deriving lessons on the issue of sustainability and linking SFP with agricultural development goal. Three of the studies (Ahmed 2004, Jacoby, Cueto, and Pollit 1998, and van Stuijvenberg et al. 1999) explain that food for the FFE programs in each case was manufactured by private firms within each country, and one study (Ahmed and del Ninno 2002) showed that local private firms were effective partners in delivering grains to all participating communities within the FFE program as they found such partnership profitable. While the practice of contracting local firms to manufacture or distribute foods for these FFE programs is in itself not a measure of sustainability, the development of the private sector to fulfill contracts and participate in the supply chain of FFE programs are important steps towards sustainability of the program. This is one key piece in the development of the theory of change proposed by Sumberg and Sabates-Wheeler (2011) using the HGSF model (Figure 2); in this case the agribusiness sector is drawn into the development of local FFE programs. Another example of linkages of FFE programs to the agricultural sector would be in the case of the welfare program organized by the government of Sri Lanka, where the SFP at each school is run by a parent-teacher feeding committee which decides which foods are the most appropriate to serve (He 2010). This likely means that food is procured locally and thus would have linkages to the local

agriculture sector, providing an opportunity to increase demand for locally produced agricultural commodities.

Local procurement of foods for FFE programs is a direct way for these interventions to expand and exploit linkages to the local agricultural sector. The studies in this review do not cover this issue in their analyses, and there are only a few examples of local procurement programs being used in the developing world that are attempting to harness the synergies of school feeding and local agriculture. Bundy et al. (2009) lay out some of the issues that need to be considered when implementing local procurement including: a constant supply of food during the school year; food must meet health, hygiene, and nutrition standards; and the potential for high transaction costs from local procurement. There is also a concern that local procurement could drive up prices in the local market since there will be an increase in demand for the agricultural products going to FFE programs, benefiting local farmers but hurting consumers.

A recent study by Upton et al. (2012) examined two school feeding programs in Burkina Faso in which one received foods imported from the United States while the other from locally procured sources. Sourcing from local producers resulted in a cost savings of 20% to the agencies purchasing the food, while still meeting the government standards in food quality (Upton et al. 2012). Additionally, the local procurement of commodities did not distort the market prices while producers were able to realize higher prices (Upton et al. 2012). This was possible because the producers were able to sell their products at times when prices were high since they knew there would be demand throughout the school year, demonstrating that the linkage of FFE with local agricultural procurement can create synergies between the two to enhance multiplier effects in the local agricultural sector (Upton et al. 2012).

5.3 Issues of Implementation of FFE Programs

There were several issues surrounding the implementation of the FFE programs across these studies, which in some cases may have influenced the measurement of the impact outcomes. Each study represented unique challenges and opportunities while providing food to the children through SFP or THR. For some of the programs, there were logistical problems, interruptions in food delivery, or food being given to untargeted students or children. In this section I will briefly summarize the problems discussed by the authors in the studies reviewed and highlight design features that must receive special attention in implementing effective Food for Education programs.

Ahmed and del Ninno (2002) report on THR programs in Bangladesh; in order to improve educational quality in schools with these programs, the government withholds allocation of food in the lowest quartile. Previous to the study, teachers helped with the implementation of the THR programs, but due to concerns by the government of the quality of education, private dealers are now contracted to distribute the food. Ahmed and del Ninno (2002) find that this has led to some problems, including the diversion of some of the food grains to the black market. In one specific case, the authors found “some of the extremely poor participants...in a highly distressed union reported that the dealer had lent money to them at exorbitant interest rates. Subsequently, the dealer took their FFE wheat entitlements because they could not repay the loan with interest” (Ahmed and del Ninno 2002). Not surprisingly the authors find that 92% of the surveyed households prefer the previous system where the School Managing Committees oversaw the distribution of the food grains, and 82% of households believed that there had been no improvement in education quality (Ahmed and del Ninno 2002).

In Lao PDR, there were several problems with the WFP run program; this program provided SFP, THR, or a combination of both, where THR was provided only to girls and informal boarders at the school who maintained at least 80% attendance (Buttenheim et al. 2011). In order to participate in one of these FFE programs, villages had to decide if they wanted to participate, for which they would need to build food storage facilities, provide labor for food preparation, and sometimes travel to WFP distribution points to pickup food (Buttenheim et al. 2011). In the two districts which were chosen for SFP or the combination of SFP and THR, there was variation in the uptake of the FFEs, as the SFP district realized 97% uptake as opposed to 57% in the combination district, and school meals were served on 58% of all possible school days in the former, compared to 49% in the latter (Buttenheim et al. 2011). Reasons provided from surveys for the communities' non-take up of FFE programs included not enough volunteers in village, distribution points were too far away, too much trouble to build warehouse, and no access to a road (Buttenheim et al. 2011). Additionally, the authors point out that there is evidence the SFP snack was provided to non-enrolled children, thus diluting the benefits of the program.

Another study also had an issue with benefits being shared with non-targeted students in Cambodia. Cheung and Perrotta (2010) find that it is likely that boys may have been given THR, which in this program was intended only for girls in grades 4-6. Similarly, in Sri Lanka, 44% of schools receiving SFP managed by the WFP served students above the intended grades of 1-9 (He 2009). This program in Sri Lanka had another important issue as well, with "26% of these schools reported not to have received the correct amount of food for the correct amount of days" which the author attributes mostly to transportation issues (He 2009, p. 13).

One recent issue that could affect school feeding programs has been the volatile prices for commodities. However, none of the studies in this review commented on this aspect that could affect FFE programs; this may be due to the fact that most of the studies were conducted prior to the recent volatility. This is possibly an area for concern as this may impact the quantities of food available, increase the incentives for private traders to sell food on the black market, and impact the reliability of timely delivery.

It is imperative in the implementation of social safety net programs, such as FFE, that food is distributed on time, in the correct amounts, and only to the intended beneficiaries. Failure to comply with these goals will lessen the impact of these interventions. One of the explicit goals of FFE programs, and a necessary condition to observe the impact, is to increase enrollment and attendance of children in school. But it would be hard to imagine that children would continue to stay in school or families will send them regularly when the incentive falls short of expectations. If a program has trouble fulfilling the expectations of parents and students, children may stay at home for the same reasons that kept them out of school prior to the program, thus lessening the impact of these interventions.

In analyzing problems in implementation, questions arise of how to go about designing a FFE program. Bundy et al. (2009) and Del Rosso (1999) both lay out several guidelines for consideration when designing such programs. First, an initial assessment needs to be conducted to understand what policy goals the program would satisfy. Resulting from this assessment would be an answer of where and who the program should be targeted. The WFP has created the Vulnerability Analysis and Mapping tool, an information tool for beneficiary and geographical targeting of the food insecure, which would be of use at this stage (Bundy et al. 2009). Second, the design needs to decide on the modalities of FFE programs that will be feasible considering

such things as infrastructure, costs, and how the program goals can be met. Appropriate food choices need to be addressed regarding nutritional needs and local tastes. The design process also needs to plan for management and implementation arrangements at all levels, including local participation of parents and school officials (Bundy et al. 2009). Third, the program needs to be monitored and evaluated to ensure the desired goals and outcomes are being achieved and the food is distributed timely, in appropriate quantity, and only to the intended beneficiaries. Finally, special consideration, when appropriate, needs to be given to the role of the private sector in the implementation of the programs, especially if this can achieve efficiency, cost savings, and to help make connections between local producers and markets (Del Rosso 1999, Bundy et al. 2009).

Chapter 6. Conclusions

Food for Education programs are one type of intervention used by policy makers and non-governmental organizations as a social safety net in developing nations to aid in several policy areas. These programs are believed to be effective because of the ability of the interventions to target a specific population that is vulnerable – school-aged children. There are various modalities in which these interventions are utilized to attain impactful outcomes on students and their families. This systematic review looked at the role of Food for Education programs in achieving these outcomes.

The interventions studied by the papers included in this review show that Food for Education programs conclusively impact the health and nutrition of targeted children as measured by some indicators. For example, the programs have been shown to increase the caloric intake of students, and these calories given to students in school meals “stick” to the targeted students. The studies suggest that households do not significantly reallocate food within the family; thus, the students are able to benefit fully from the nutrients provided through school meals. This leads to increased levels of many vital micronutrients in diets, such as vitamin A, iron, and iodine, for which these targeted populations are often deficient. Secondly, the FFE programs have shown to help decrease the rates of anemia, morbidity and illness among children participating in such programs.

Evidence from the studies reviewed suggests modest and mixed results for health outcomes as measured by anthropometric indicators. Studies in this category primarily used wasting, stunting, and underweight as indicators of physical growth, which are the three most commonly used anthropometric measurements for demonstrating overall long-term health of

individuals and populations. Take-home rations showed the strongest evidence of the impact of FFE interventions for decreasing wasting and underweight rates, yet programs that fed students a meal at school showed no significant impacts on these anthropometric outcomes. One possible explanation for this inconclusive result is that studies that evaluated anthropometric outcomes for SFP lasted on average 13 months. Thirteen months may not be sufficiently long to observe such effects from dietary interventions, as compared to the studies that measured anthropometric measurements as outcomes of interest for THR programs were 12 and 24 months long. Perhaps much longer-term studies of the impact of FFE on these outcomes are needed to determine if SFP can influence these measurements or to better understand why THR seem to be performing better than SFP. None of the studies in this review examined the effects of receiving take-home rations on families' consumption and purchasing habits. It would be important to know if families are choosing to substitute the value of the food supplied in the rations, which are usually in the form of grains and occasionally include fortified cooking oils, for more nutrient-rich foods such as animal protein or fruits and vegetables, which may be more effective in improving the growth of children.

Evidence from the studies in this review is most conclusive regarding children getting into the classroom. There is very strong evidence that FFE programs improve enrollment and attendance. These impacts are more pronounced on girls, particularly when take-home rations are part of the FFE program, whether alone or in combination with SFP. The studies also suggest that these interventions positively impact the highest grade in school achieved by students and decrease the dropout rate.

The impact of FFE programs on cognitive skills and abilities of students is uncertain from the studies included in this systematic review. Results indicate that the impact on mathematical

skills is varied, whereas results are stronger for language skills. While the results are not conclusive in terms of improving cognitive skills, the FFE programs do aid in the education and thus the long-term economic development of participants by getting students into school that would otherwise not be enrolled.

My conclusions verify some of the findings of other recent reviews and meta-analyses while disagreeing with others. The reviews by Jomaa et al. (2011) and Bundy (2009) are in agreement that FFE programs improve rates of enrollment and attendance, as well as impacting the overall health and nutrition of school children. However, the meta-analysis by Kristjansson et al. (2007) and review by Jomaa et al. (2011), which both looked solely at SFP, are not in such agreement over the effectiveness of these programs for impacting schoolchildren's anthropometric and cognitive outcomes. These two papers find differing impacts from my own on the abilities of these programs to affect mathematics and language skills. Additionally, Kristjansson et al. (2007) finds a small impact of these programs on weight gain but mixed results for height, while Jomaa et al. (2011) and I concur that there are mixed results for both weight and height.

There is a growing body of literature that is providing evidence on the importance of nutrition in the first thousand days of a person's life (from conception to the second birthday) (Li et al. 2003, Stein et al. 2010, Victora et al. 2010). Studies have shown that the ability of a child to catch up from early nutritional deficiencies is limited after age two, and may in fact be irreversible (Mendez and Adair 1999, Levinson and Bassett 2007). The need for interventions during this time (conception to second birthday) is the most important as there is evidence that height-for-age and weight gain by the second birthday is a strong predictor of school and economic success, and undernutrition is linked to lower human capital (Glewwe and Jacoby

1994, Victora et al. 2008, Martorell et al. 2010). Based on this evidence, it has been argued that Food for Education programs is not the best mechanism for addressing the goal of impacting the long term health and nutrition of children; it is too late to have that as a goal for any feeding program targeted towards school age children. Despite these arguments, there is support for FFE programs based on the indirect (second generation) benefits it generates through the education effect. For example, Smith and Haddad (1999) report that improvement in the education and status of women is the largest driver of reduction of child malnutrition in developing countries. There is perhaps no better way to improve this than providing education to girls, which as this and other reviews have shown, the FFE programs have been particularly successful in accomplishing. Increasing enrollment and attendance in school should therefore be the primary objective for FFE, in order to achieve the long-term goal of reducing child malnutrition.

The systematic review conducted by this study points to several gaps in the literature that should be the focus of further research. First, the studies reviewed do not shed light on the linkage between FFE, sustainability, and agricultural development to any measureable extent. Second, the studies in this review provide little evidence on the cost effectiveness of the interventions in delivering desirable outcomes. Recent research suggests that school feeding programs can be used in the manner theorized to aid in driving local agricultural development. Further research should focus on the impacts of school feeding on agricultural and economic development in rural communities in developing nations, and in gathering more evidence on the cost-effectiveness of FFE programs vis-à-vis other publicly funded programs aimed at boosting educational, health and agricultural development goals.

APPENDIX

Appendix 1: Definitions for Wasting, Stunting and Underweight

The international standard to assess the nutritional status of a population is to take anthropometric measurements and to compare these to developed indices; these indices have been compiled into the NCHS/WHO international reference population (de Onis and Blössner 2003). The World Health Organization (2010) defines the three most common anthropometric measurements used to gauge population health as:

The percentage of children with a low height-for-age (stunting) reflects the cumulative effects of undernutrition and infections since and even before birth. This measure can therefore be interpreted as an indication of poor environmental conditions or long-term restriction of a child's growth potential. The percentage of children who have low weight-for-age (underweight) can reflect 'wasting' (i.e. low weight for height), indicating acute weight loss, 'stunting', or both. Thus, 'underweight' is a composite indicator and may be difficult to interpret.

Scoring against the NCHS/WHO indices, z-scores are calculated, helping to establish what determines if a population is showing signs of stunting, wasting, or underweight. All three terms are defined as a population that is 2 standard deviations (SD) below the NCHS/WHO standard for each measurement (WHO 2010). The z-score is defined as:

$$\text{Z-score (or SD-score)} = \frac{\text{observed value} - \text{median value of the reference population}}{\text{standard deviation value of reference population}}$$

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