Chapter 12

School Feeding Programs in Middle Childhood and Adolescence

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INTRODUCTION

Almost every country in the world has a national school feeding program to provide daily snacks or meals to school-attending children and adolescents. The interventions reach an estimated 368 million children and adolescents globally. The total investment in the intervention is projected to be as much as US$75 billion annually (WFP 2013), largely from government budgets.

School feeding may contribute to multiple objectives, including social safety nets, education, nutrition, health, and local agriculture. Its contribution to education objectives is well recognized and documented, while its role as a social safety net was underscored following the food and fuel crises of 2007 and 2008 (Bundy and others 2009). In terms of health and nutrition, school feeding contributes to the continuum of development by building on investments made earlier in the life course, including maternal and infant health interventions and early child development interventions (see chapter 7 in this volume, Alderman and others 2017). School feeding may also help leverage global efforts to enhance the inclusiveness of education for out-of-school children, adolescent girls, and disabled persons, as called for in the Sustainable Development Goals (see chapter 17 in this volume, Graham and others 2017).

Although the *Disease Control Priorities* series focuses on low- and middle-income countries (LMICs), evidence from high-income countries (HICs) is included because of the near universality of school feeding and the insights that inclusion can provide as economies develop. For example, the design of school feeding in countries undergoing the nutrition transition[1] may provide some lessons on how to shift from providing access to sufficient calories to promoting healthful diets and dietary behaviors for children and adolescents (WFP 2013).

Agricultural development has increasingly gained attention. It is clear that to enable the transition to sustainable, scalable government-run programs, the inclusion of the agricultural sector is essential (Bundy and others 2009; Drake and others 2016). Accounting for the full benefits of school feeding through cost-effectiveness and benefit-cost analysis is challenging, similar to other complex interventions, but undertaking this accounting is critical for assessing the tradeoffs with competing investments.

This chapter reviews the evidence about how school feeding meets these objectives and provides some indication of costs in relation to benefits. The costs of the intervention are well established; estimates that encompass all the benefits of school feeding are more challenging. The benefits must be quantified and translated to the same unit to allow for aggregation. Moreover, how school feeding interventions are designed and implemented varies significantly across

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countries. Given that delivery of school feeding often involves multiple sectors, common policy frameworks and cross-sectoral coordination are required to achieve maximum benefit (Bundy and others 2009).

Several other chapters in the volume highlight school feeding. These include chapter 11 (Lassi, Moin, and Bhutta 2017), chapter 20 (Bundy and others 2017), chapter 22 (Plaut and others 2017), and chapter 25 (Fernandes and Aurino 2017).

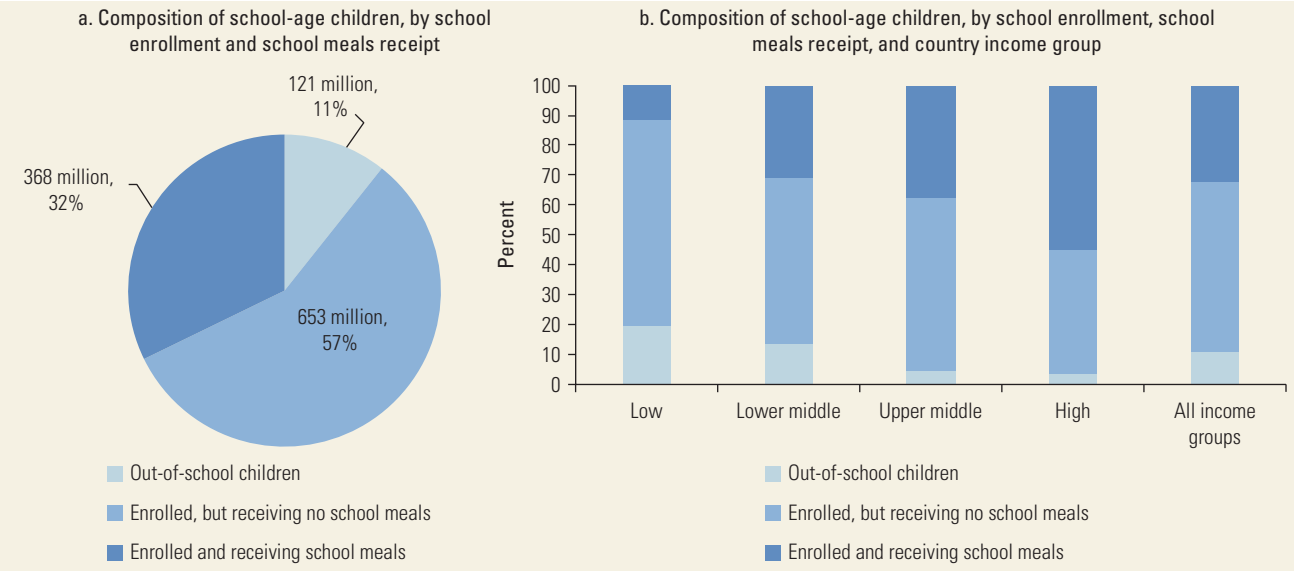
THE GLOBAL PICTURE

Almost all countries practice school feeding (Bundy and others 2009); about one of three primary and lower-secondary schoolchildren benefit, although the number of children varies markedly across countries (figure 12.1). Approximately 18 percent of schoolchildren in low-income countries (LICs) received school meals in 2012, compared with 49 percent in upper-middle-income countries (WFP 2013). On the basis of global estimates of coverage and investment, the authors estimate that an additional investment of US$1.7 billion is needed to support the increase in program coverage in 23 LICs to the levels of upper-middle-income countries—the equivalent of 2 percent to 3 percent of total global investment in school feeding and a 10 percent increase in total beneficiaries.[2] India's Mid-Day Meal Scheme is the largest national school feeding program in the world, serving an estimated 113.8 million children each day (Drake and others 2016). Brazil's national program, the next largest, provides daily meals to more than 43 million children (Drake and others 2016). China's National Nutrition Improvement Plan provided school meals to 33.5 million children ages 7–15 years across China in 2015 (Liu 2016).

School feeding interventions, most notably implementation modalities of delivery, vary across countries. School feeding may include hot meals, biscuits, or snacks provided in school or as take-home rations, where the households of schoolchildren receive a regular commodity ration on meeting conditions, such as regular attendance. School feeding programs vary in targeting. School meals may be provided free and at reduced, subsidized, or full price. Countries that follow a rights-based approach, such as Brazil and India, provide free school meals to all children in certain age groups. In most LMICs, however, free school meals are targeted geographically to areas with high prevalence of food insecurity and poverty, or individually, based on conditions of vulnerability, such as those in orphanages or disadvantaged households (WFP 2013).

School feeding programs have evolved with levels of development. Many HICs, such as the United States, introduced school feeding programs in the first half of the twentieth century as welfare interventions and to support agricultural markets. More recently, countries such as Brazil have systematically incorporated school feeding procurement with agriculture development interventions. In contrast, national school feeding programs in many LMICs were introduced more recently,

Figure 12.1 School Feeding Participation Worldwide



Sources: UNESCO 2014; World Bank 2016.
Note: Primary and lower-secondary schoolchildren only.

with education as the primary objective (Bundy and others 2009) or as a means of social protection in face of crises, given that experience has shown they are relatively easy to scale up during emergencies (Alderman and Bundy 2011). From 2000 to 2012, at least eight LICs launched school feeding programs—six in Sub-Saharan Africa—within the broader framework of the Education for All agenda (WFP 2013). Some of this growth may be due to the inclusion of homegrown school feeding, an approach that sources foods for school meals from local producers or markets, under the food security pillar of the Comprehensive Africa Agriculture Development Programme of 2003 (NEPAD 2003). The number of homegrown school feeding programs has grown steadily in Sub-Saharan Africa since that time (GCNF 2014).

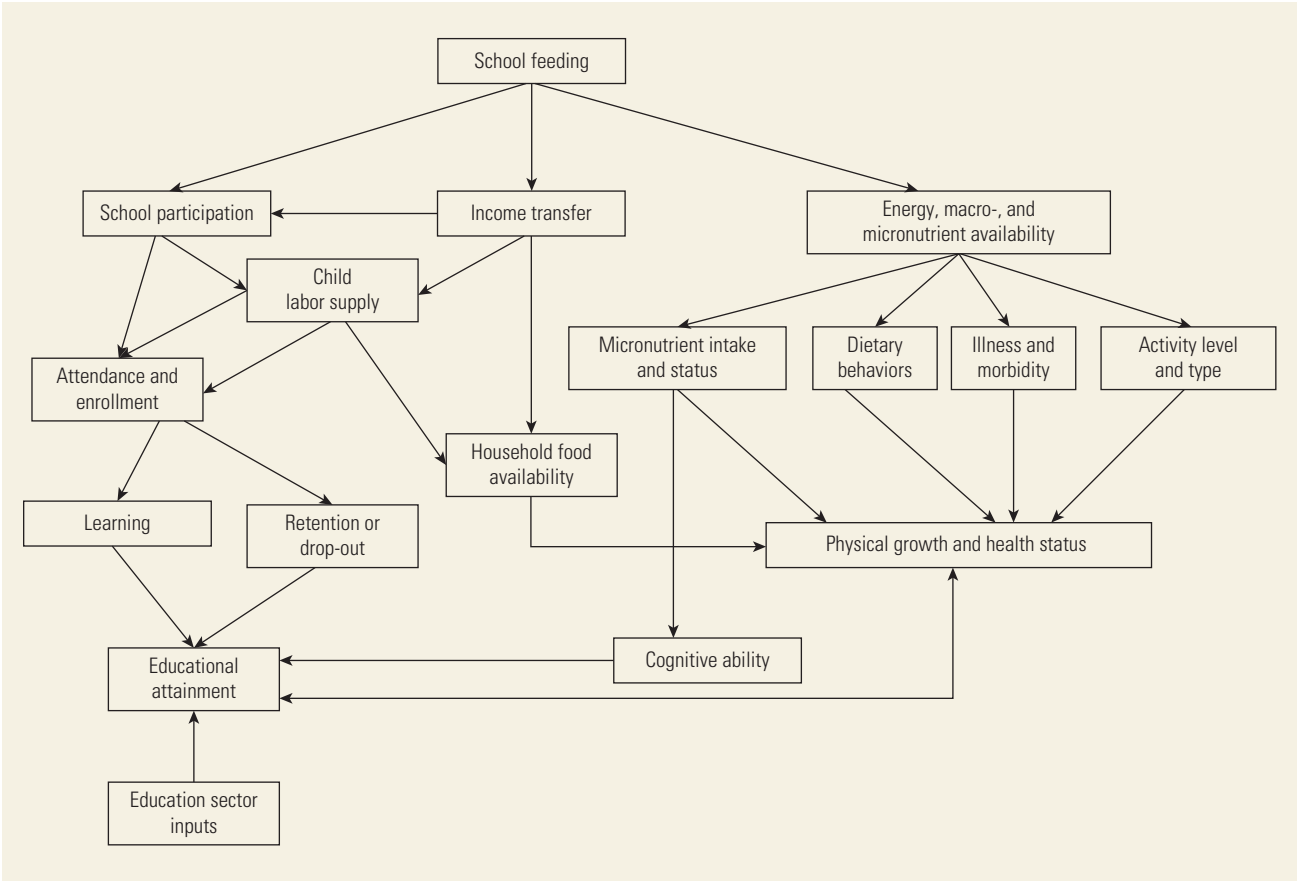
THE EVIDENCE FOR EFFECTIVENESS

This section reviews the large evidence base highlighting the effectiveness of school feeding for multiple outcomes. The evidence suggests that school feeding is a social protection tool that can contribute to education, nutrition, health, and agricultural objectives supporting child and adolescent development (Bundy and others 2009; Jomaa, McDonnell, and Probart 2011). Figure 12.2 presents ways school feeding can affect these outcomes. Homegrown school feeding may also contribute to agricultural development, but not enough evidence exists yet to be incorporated in this review, although box 12.1 presents specific examples.

Design and Implementation Issues

Characteristics such as age, gender, and level of disadvantage may modify the strength of some of these pathways (Kristjansson and others 2009). Moreover, external factors, such as the quality of school inputs, may confound the overall impact of school feeding (Adelman, Gilligan, and Lehrer 2008; Greenhalgh, Kristjansson, and Robinson 2007; Kristjansson and others 2009; chapter 22 in this volume, Plaut and others 2017; Watkins and others 2015). Intervention implementation and study design may also

Figure 12.2 School Feeding Pathways to Shaping Child and Adolescent Development



Source: Adapted from Adelman, Gilligan, and Lehrer 2008.

Box 12.1

Homegrown School Feeding: Supporting Local Agriculture

The O'Meals program in Nigeria (Osun State Elementary School Feeding and Health Programme) is viewed as a means to combat hunger, increase primary school enrollment, and encourage local and statewide economic growth. The program provides hot, nutritionally balanced school meals daily to more than 252,000 primary schoolchildren. At the same time, it provides employment and income to thousands of local caterers, farmers, and traders, which may indirectly improve their health. Recently, the menu replaced yam with the more-nutritious cocoyam, and organizers are investigating the introduction of orange-fleshed sweet potato (Drake and others 2016).

In Ghana, preliminary evidence from an impact evaluation of homegrown school feeding suggests sizable gains with regard to income from sales of produce and increases in farming households' agricultural incomes (Aurino and others 2016).

School Meal Planner, Ghana

Monday	Yam + fish stew + orange
Tuesday	Rice + beans + stew + chicken + orange
Wednesday	Bean porridge + bread + whole egg + banana
Thursday	Rice + egusi garnished with vegetable + chicken + banana
Friday	Cocoyam porridge + vegetable + beef + slice of paw paw

Source: Drake and others 2016.

affect the results. The key issues that can be reflected in the process indicators include consistency of implementation of the intervention over the entire study period, compliance of beneficiaries with the intervention, adequacy of energy transferred, duration of the study, and palatability (Greenhalgh, Kristjansson, and Robinson 2007).

To illustrate this point, table 12.1 presents a selection of parameters for nationally led school feeding programs in 15 countries (Drake and others 2016). Ration design is key, particularly for assessing the quality of the meals and the potential link to local agriculture. The number of school days may enhance the nutritional impact of school feeding, as well as the educational impact, while also influencing the implementation costs.

It is important to understand not only whether school feeding is effective but also the causal chain according to which impact is achieved, which is context specific. This is an important area for further research (Greenhalgh, Kristjansson, and Robinson 2007). More rigorous design evaluations are also needed on government-led school feeding programs, given that the bulk of such evidence is based on school feeding implemented by the World Food Programme (WFP), which may be considerably different. For example, WFP school feeding rations typically include a basic set of foods, such as multifortified cornsoy blend, sugar, and salt, which are internationally procured, in contrast with the rations presented in table 12.1.

Benchmarking School Feeding Programs across Countries

School feeding programs across countries can be benchmarked using the Systems Assessment for Better Education Results (SABER) tool, which is structured around five pillars (Bundy and others 2009; Drake and others 2016):

- Policy frameworks
- Institutional capacity and coordination
- Budget and financing
- Design and implementation
- Community participation.

A national school feeding policy can contribute to sustainability and integration with other policy priorities. Capacity and coordination among relevant institutions

Table 12.1 Government-Led School Feeding Interventions in 15 Countries, Selected Parameters

Country	Income level[a]	Timing	Ration contents	Ration calories	Number of school days	Net enrollment rate, overall (%)	Gender parity index
Botswana	Upper middle	Daily mid-morning hot meal; second meal provided in some districts	Sorghum porridge, stewed canned beef, maize, beans, vegetable oil, bread, milk	572	185	90	0.97
Brazil	Upper middle	Modality varies across states and municipalities	At least 20 percent of daily nutritional needs provided, including three portions of fruits and vegetables	335	200	—	—
Cabo Verde	Lower middle	Hot in-school meal; a glass of milk provided in some schools	Cereals (rice or pasta), beans, oil (vegetable or soya), carrot, fish, Portuguese cabbage	300	—	98	0.92
Chile	Upper middle	Modality varies by age group	Food items vary by vendor but should include meat and fresh fruit and vegetables	850	180	94	0.97
China	Upper middle	Hot meal; mid-morning snacks	Hot dishes include meat and vegetables; snacks include biscuits and bread	810 for meals; 300 for snacks	200	100	0.87
Côte d'Ivoire	Lower middle	Hot meal	Cereals, flours, and legumes	1,141	52	77	0.87
Ecuador	Upper middle	Breakfast meal; milk snack also provided in some schools	Fortified drink composed of wheat flour and soy, granola in flakes, cereal bar, and four types of biscuits	396	—	95	1.00
Ghana	Lower middle	Hot midday meal	Maize, legumes, rice, fish, yams, eggs, groundnuts, vegetables	800	195	76	1.00
India	Lower middle	Hot midday meal	Cereals, pulses, eggs, and fruits	575	200	94	1.03
Kenya[b]	Lower middle	Hot midday meal	Cereals, pulses, vegetable oil, and salt	700	—	82	1.00
Mali	Lower middle	Cooked lunch	Staple foods (millet, sorghum, maize, and rice) with legumes, oil, pulses (such as cowpeas), and meat, fish, or both	735	180	70	0.88
Mexico	Upper middle	Cold or warm breakfast	Skim or partially skim milk, wholemeal cereals, and fresh or dried fruit	395	—	95	1.00
Namibia	Upper middle	Mid-morning meal	Fortified maize meal blend porridge	475	200	86	0.97
Nigeria[c]	Lower middle	Hot midday meal	Includes eggs, fish, and meat	536	—	64	0.92
South Africa	Upper middle	Mid-morning meal	Protein, starch, and a vegetable or fruit	—	182	90	0.95

Sources: Drake and others 2016; World Bank 2016, latest year available for each country.
Note: — = not available. The net enrollment rate is the ratio of children of official school age who are enrolled in school to the population of the corresponding official school age. The gender parity index for gross enrollment ratio in primary education is the ratio of girls to boys enrolled at the primary level in public and private schools.
a. World Bank income level in 2012.
b. School feeding details specific to homegrown school feeding program.
c. Osun State. See box 12.1 for more information about this program.

at the national, regional, and local levels are needed, particularly across different ministries. Channels for financing the program and the implementers, for example, payments to caterers, need to be defined. Communities must be engaged in the program; their contributions, such as firewood, condiments, and meal preparation, may be needed.

Social Protection

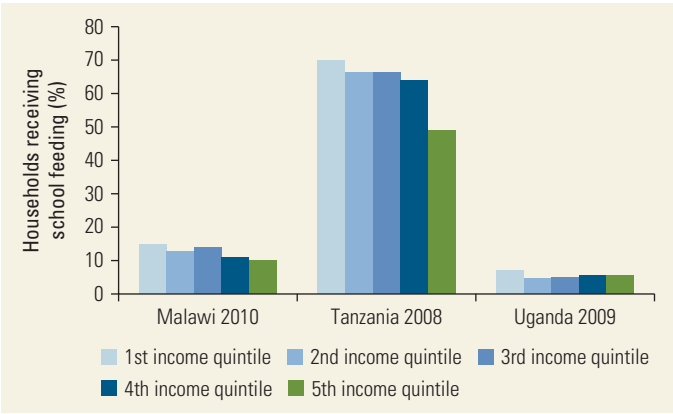
School feeding provides a transfer to households in the value of food distributed (Alderman and Bundy 2011). This transfer can reduce a household's food needs; when provided regularly over the school year, it smooths volatility, thereby increasing disposable income to meet other immediate needs or investments. A range of outcomes is possible, including better nutrition. A quasi-experimental design analysis found that India's school feeding program mitigated the effects of drought on physical growth, which had occurred earlier in the lives of the beneficiaries (Singh, Park, and Dercon 2014). In response to the food and fuel price crises of 2007–08, at least 38 LMICs scaled up school feeding programs, in recognition of its potential as a social safety net (WFP 2013). A global review of social safety net programs found that school feeding was one of the largest in estimated number of beneficiaries (World Bank 2014; also see chapter 8 in this volume, Watkins and others 2017).

Several factors determine the effectiveness of school feeding as a social protection tool. One factor is targeting the poorest and most vulnerable households and communities (Alderman and Bundy 2011). The efficiency of geographic targeting is conditioned by the degree to which poverty and food insecurity are concentrated in one or multiple areas, as well as the smallest geographic unit at which targeting can be applied. Poor accessibility to these areas and insufficient infrastructure to deliver school feeding may present barriers. An evaluation from the Lao People's Democratic Republic (Lao PDR) indicated that, because of similar barriers, only one-half to two-thirds of schools eligible for school feeding in select districts actually received school feeding (Buttenheim, Alderman, and Friedman 2011). Rising urban poverty and income inequality may justify individual or school-targeting approaches, although care must be taken to ensure that food provided in targeted schools does not inadvertently draw students from nearby schools receiving no food. Moreover, individual targeting may be challenging if some children in a classroom receive food while other children do not.

A review of eight social protection programs in Latin America and the Caribbean found that school feeding focused on the most disadvantaged households in most countries. However, in some countries such as Guatemala where the poorest children do not attend school, school feeding was less well targeted (Lindert, Skoufias, and Shapiro 2006). We replicated Lindert, Skoufias, and Shapiro (2006) by using data from Malawi, Tanzania, and Uganda. The share of households in the lowest income quintile were more likely to receive school meals, with the largest population share evident in Tanzania (figure 12.3).

In Ghana, the Ministry of Employment and Social Welfare, in a review of targeting in the national school feeding program in 2010, found that higher investment was not consistently made in districts with greater poverty and food insecurity (WFP 2013). The program was retargeted in 2012.

Figure 12.3 Targeting Efficiency of School Feeding in Malawi, Tanzania, and Uganda



Source: Analysis based on the Atlas of Social Protection: Indicators of Resilience and Equity, World Bank.

Education

School feeding can promote access to education, as measured by indicators such as enrollment, attendance, and retention (Krishnaratne, White, and Carpenter 2013). Evidence for these links helped identify school feeding as a means for contributing to the Millennium Development Goal 2 of universal enrollment in primary education. Given the links between nutrition status and cognition, school feeding programs, if integrated with interventions to improve education quality, can also contribute to learning and academic achievement (Adelman, Gilligan, and Lehrer 2008; Krishnaratne, White, and Carpenter 2013). Moreover, school feeding may directly or indirectly reduce gender disparities in education outcomes. The following section reviews the evidence, giving greater weight to systematic reviews

and studies with rigorous designs, such as randomized controlled trials.

Access to Education

A review of rigorously designed studies indicated a standardized effect size of 0.156 for enrollment ($p < 0.05$, three studies), 0.449 for drop-out ($p < 0.001$, two studies), and 0.690 for progression ($p < 0.001$, one study) (Krishnaratne, White, and Carpenter 2013). The review did not find statistically significant effects on attendance and learning, although the coefficients were positive (Krishnaratne, White, and Carpenter 2013). In addition to providing an incentive to attend school, evidence indicates that school feeding reduces absenteeism. A review of studies from multiple LMICs found that school feeding was associated with an average of four to six more days attendance at school per year (Kristjansson and others 2009).

The choice of modality may also play an important role. For example, Afridi, Barooah, and Somanathan (2014) showed that monthly attendance increases in response to a switch to a cooked meal from snacks, with modest increases in the state budget in India. Fortified biscuits in Bangladesh improved school enrollment by 14.2 percent, reduced the probability of drop out by 7.5 percent, and raised attendance by about 1.3 days a month (Ahmed 2004). Adelman, Gilligan, and Lehrer (2012) in Northern Uganda, and Kazianga, de Walque, and Alderman (2009) in Burkina Faso found that both school meals and take-home rations effectively increased enrollment. Ahmed and del Ninno (2002) showed that take-home rations for poor households in rural Bangladesh increased school access, with an 8 percent increase in school enrollment and 12 percent increase in attendance.

Moreover, the evidence suggests that school feeding can mitigate gender disparities in school enrollment where girls face greater barriers (Gelli, Meir, and Espejo 2007). In particular, the provision of take-home rations to girls can represent a significant income transfer to households, outweighing the forgone benefits of nonattendance (Bundy and others 2009). The WFP experience suggests that making provision of take-home rations conditional on attendance rates of more than 80 percent was effective, especially in low-resource communities where child labor is common (WFP 2013). In Burkina Faso, the provision of school meals or monthly take-home rations of 10 kilograms of cereal flour conditional on a 90 percent attendance rate increased the enrollment of girls ages 6–12 years by about 6 percent (Kazianga, de Walque, and Alderman 2014).

Learning and Academic Achievement

A smaller but still substantial body of evidence explores the impacts of school feeding on learning and academic achievement. Although some indications of a positive relationship have been documented, other studies have not found statistically significant results. The mixed findings may be due to several factors, including differences in school quality. These differences are consistent with other types of schooling interventions, for which evidence on what works is inconclusive (Glewwe and others 2013).

In Chile, more frequent consumption of dairy products improved education outcomes for primary and secondary students (WHO 1998). Preliminary evidence from Ghana suggests improved learning outcomes for girls in schools where micronutrients were given in the meals. The improvements related to literacy (14 percent), mathematics (13 percent), and reasoning ability (8 percent) (Aurino and others 2016). Other studies, in contrast, have found minimal to no impact of school feeding on academic achievement. Timing of delivery of the feeding and overall learning environments can contribute to explaining the inconsistency of evidence related to school feeding and academic achievement (Powell and others 1998; Vermeersch and Kremer 2004). For instance, Vermeersch and Kremer (2004) attribute their negative finding to the disruptive role of school feeding in the school day, whereas the positive outcome from Powell and others (1998) may be due to the timing of the program (just before the school start). In addition, Chang and others (1996) found that school feeding was associated with improved on-task behaviors in well-organized classrooms but not in disorganized classrooms.

Table 12.2 presents overall average estimates for the impact of school feeding on educational outcomes

Table 12.2 Summary of Educational Impacts of School Feeding

	Overall weighted average effect	Number of studies
Access to schooling		
Enrollment	0.14	7
Attendance	0.09	6
Drop-out	–0.06	3
Completion	0	2
Learning outcomes		
Language arts scores	0.09	8
Math scores	0.10	10
Composite test score	0.14	3

Source: Snilstveit and others 2015.
Note: Weighted average effects are based on the Cohen's index and were estimated based on the standardized mean differences calculated from individual studies. These effects reflect the estimated change in percentile rank for an average student in the control group had he or she received school feeding.

drawing from a systematic review of studies with rigorous design undertaken in LMICs between 1990 and 2015 (Snilstveit and others 2015). These studies primarily included randomized controlled trials, as well as quasi-randomized trials, with adjustments for nonrandom selection to groups such as propensity score matching or regression discontinuity design. Standardized effect sizes were estimated for individual studies, and meta-analysis was used to obtain overall estimates.

Nutrition

The World Health Organization recommends that school feeding programs contribute 30 percent to 45 percent of the recommended daily allowance of energy and nutrients for half-day schools, and 60 percent to 75 percent for full-day schools (WHO 1998). HICs, including Chile, Mexico, the United Kingdom, and the United States, have introduced nutrient-based standards in school feeding programs to enhance the contribution of school meals to recommended dietary intake. Nutrient-based standards are less common in LMICs, however, with the exception of India (Drake and others 2016). A review of national school feeding programs in 12 LMICs indicated that many seek to provide more diversified food baskets that include fresh produce, although this objective is often only aspirational (Aliyar, Gelli, and Hamdani 2015).

School feeding may help children and adolescents receive sufficient nutrients and grow. The inclusion of micronutrient-rich foods or powders may address anemia and support improved cognition (Abizari and others 2012; Abizari and others 2014; Finkelstein and others 2015). School meals may also foster understanding of healthy diets and behaviors that can extend beyond school and throughout life, particularly if nutrition education is incorporated into the program (Kubik and others 2003; Story, Neumark-Sztainer, and French 2002).

However, counteracting factors may weaken these relationships. For example, households may allocate food to siblings not receiving the school meals, possibly offsetting the impact of school feeding on the nutritional status of the target child. Studies analyzing this issue show, nevertheless, that overall energy intake increases almost as much as the transfer provided at school—the flypaper effect (Afridi 2010; Ahmed 2004; IFPRI 2008; Jacoby 2002). In addition, Jacoby (2002) and Ahmed (2004) have shown that children who received snacks shared them with their younger siblings. Few studies have tracked the nutritional status of siblings too young to attend school, however, although Adelman, Gilligan, and Lehrer (2012) and Kazianga, de Walque, and Alderman (2014) have shown that take-home rations improved weight-for-age by 0.4 standard deviations for the younger siblings of the beneficiaries compared with control groups.

Nutrient Adequacy

Evidence suggests that school feeding can be effective in promoting macronutrient and micronutrient adequacy in the diet (Jomaa, McDonnell, and Probart 2011). For food supplementation programs, evidence from a randomized controlled trial in Kenya showed that the inclusion of meat or milk in the school feeding menus improved plasma vitamin B_{12} concentrations. No other measures of micronutrient status were affected, however, probably because of concurrent incidence of malaria or other infectious diseases (Jomaa, McDonnell, and Probart 2011; Siekmann and others 2003). In a quasi-randomized study, Afridi (2010) found that in the state of Andhra Pradesh in India, the Mid-Day Meal Scheme eliminated daily protein deficiency and decreased calorie deficiency by almost 30 percent and daily iron deficiency by nearly 10 percent (Afridi 2010). Regarding efficacy, Best and others (2011) reported in a review that micronutrient supplementation increased micronutrients and reduced anemia more than supplementation of a single micronutrient or no supplementation.

In 8 out of 10 studies reviewed in Best and others (2011), school feeding raised serum concentrations of iron, iodine, vitamin A, and vitamin B, while improving hemoglobin levels. Two studies identified increased levels of zinc (Nga and others 2009; Winichagoon and others 2006). The impact of school feeding on micronutrient status may depend on the dose, initial micronutrient status, and interactions with other micronutrients supplemented. The iron status of Kenyan schoolchildren was associated with the dosage of iron-fortified flour (Andang'o and others 2007), while a randomized controlled trial in Vietnam showed that only multifortified biscuits reduced anemia more than iron supplementation, which suggests that other micronutrients affect anemia status (Hieu and others 2012).

Food-based strategies in school feeding programs can effectively address micronutrient deficiencies. The introduction of orange-flesh sweet potato in meals, for example, improved vitamin A status in South Africa (van Jaarsveld and others 2005), while consumption of carotene-rich yellow and green leafy vegetables improved vitamin A and hemoglobin concentration and decreased anemia rates in Filipino schoolchildren (Maramag and others 2010). The incorporation of locally available, micronutrient-rich

foods may also promote local agriculture. Homegrown school feeding programs follow this approach (box 12.1). A survey of 36 LMICs (mostly Sub-Saharan African) indicated that national sourcing (local purchasing) resulted in the inclusion of more diverse and fresh foods (GCNF 2014).

Last, mixed approaches that combine food supplementation and micronutrient supplementation or food fortification can also promote nutrient adequacy. In Northern Uganda, school meals and take-home rations were found to reduce anemia prevalence in girls ages 10–13 years by 17 to 20 percentage points (Adelman, Gilligan, and Lehrer 2012). In contrast, impacts on anemia were not detected in randomized controlled trials from Burkina Faso and Lao PDR, where the rations did not include multifortified foods (Buttenheim, Alderman, and Friedman 2011; Kazianga, de Walque, and Alderman 2014). The success of these approaches critically depends on the regularity of the supplementation throughout the school year.

Nutrition and Cognition

A large body of literature shows the links between malnutrition, including micronutrient deficiencies, and poor cognition (Glewwe and Miguel 2008; Grantham-McGregor and Ani 2001). In this area, studies have focused on how school feeding can promote cognitive skills such as better attention and short-term memory by reducing deficiencies in iron and other micronutrients. One randomized controlled study found that regular provision of fortified biscuits improved the micronutrient status and cognitive function of children (van Stuijvenberg and others 1999). Two randomized controlled studies from Kenya found that the inclusion of animal source foods improved cognition and child learning, although the magnitude of effects were small (Neumann and others 2003; Whaley and others 2003). Afridi, Barooah, and Somanathan (2013) found that the provision of free meals increased student effort, as measured by their performance in solving puzzles of increasing difficulty, in India.

The timing of the meal may be important. Breakfast programs may support cognitive function during school hours, especially for children who had previously skipped breakfast. Findings from two rigorous studies suggest that eating breakfast improves on-task time (amount of time spent focused on the school activity) and attention (Bro and others 1994; Bro and others 1996). A universal, free breakfast program in Boston public schools in the United States improved school attendance and math achievement, and decreased days tardy for children at nutritional risk as assessed in a pre-post study during a six-month period (Kleinman and others 2002). Nutritional risk in this study was defined as less than 50 percent of the recommended daily allowance of total energy intake or of two or more micronutrients, or both. A study from Mexico found that children in schools participating in a school breakfast program had higher response speed and memory compared with children from nearby schools that did not participate in the program (Vera Noriega and others 2000). A review did not find that the timing of meal delivery affects cognition, although one study from Israel did find that children performed better shortly after a meal (Vaisman and others 1996).

Anthropometry and Nutrition

A Cochrane review on school feeding (Kristjansson and others 2009) conducted a meta-analysis of three randomized controlled trials in three LMICs: Jamaica (Powell and others 1998), Kenya (Grillenberger and others 2003), and China (Du and others 2004). The meta-analysis found a small yet significant effect on weight (0.39 kilogram, 95 percent confidence interval 0.11, 0.67) and a small nonsignificant effect on height gain (0.38 centimeters, 95 percent confidence interval –0.32, 1.08). The three school feeding programs differed greatly in modality of implementation and target population. In the Jamaica study, 395 children in grades 2–5 were given breakfast for a year (Powell and others 1998). In Kenya, grade 1 schoolchildren were given meat, milk, or an energy supplement for 18 months (Grillenberger and others 2003). In China, the study focused on girls age 10 years who received milk supplementation (Du and others 2004). A more recent review (Watkins and others 2015), which broadened the inclusion criteria by considering studies such as controlled before-and-after studies, found that school feeding had significant effects on weight and height gain.

Micronutrient supplementation and fortified foods delivered through school feeding programs may also affect nutrition outcomes of children. Best and others (2011) reported that 10 studies found that school meals with micronutrient supplementation had statistically significant impacts on micronutrient status even after controlling for baseline status. Findings from several controlled before-and-after studies suggest that micronutrient supplementation may also have statistically significant impacts on height and weight. Table 12.3 summarizes the evidence.

Dietary Behaviors

Schools and school feeding programs, through nutrition education, can serve as a platform for shaping behaviors and food preferences for healthier nutrition

Table 12.3 Summary of Nutrition and Cognitive Impacts of School Feeding

School feeding activity	Anthropometric Status		Micronutrient Status						Cognition
	Height or stunting	Weight or underweight	Iron	Hemoglobin or anemia	Iodine	Vitamin A	Zinc	B vitamins	
In-school meals	+++	+++	+	++	n.a.	+	+	+	+++
Take-home rations	++	++	—	+	n.a.	—	—	—	++
Multiple micronutrient fortification	++	++	+++	+++	+	+++	+++	+	++
Multiple micronutrient powder	++	++	++	++	+	++	++	+	++

Source: Watkins and others 2015.
Note: RCT = randomized controlled trial.
n.a. = not assessed by an RCT; + = evidence from one RCT; ++ = evidence from two RCTs; +++ = evidence from more than two RCTs; — = lack of any evidence.

(Hawkes and others 2015). The development of healthy dietary habits during childhood can also help prevent diet-related diseases later in life, with the evidence showing that dietary habits tend to be persistent from childhood through adulthood (Dunn and others 2000). Dietary diversity may provide an indicator of better diets among children and adolescents. The inclusion of animal-source foods in school snacks increased dietary diversity in Kenya (Murphy and others 2003).

Encouraging lifelong healthy diet choices has so far received more attention in HICs; however, it is increasingly relevant in LMICs, where childhood overweight and obesity are increasing (Lobstein and others 2015). Some studies conducted in HICs found a positive association between school meals and overweight and obesity (Schanzenbach 2009). Others suggest instead that programs targeted to primary-school-age children most effectively reduced obesity, especially when healthy meals were accompanied by communication promoting behavioral change (Corcoran, Elbel, and Schwartz 2014). Initiatives at school that combine healthy eating and active living have been introduced in HICs to support child and adolescent development (De Bourdeaudhuij and others 2011; Herforth and Ahmed 2015; Story, Nanney, and Schwartz 2009). Similar action in LMICs may be needed to respond to the nutrition transition (Faber and others 2014).

Communication materials aimed at changing behavior, alongside school meals, can help inculcate these ideas in schoolchildren and influence household diet. For example, radio jingles and posters were developed in Ghana to complement initiatives undertaken in the Ghana School Feeding Programme to improve nutrition among children, adolescents, and their communities (Gelli and others 2016). Evidence on the impact of nutrition education is scant, particularly in developing countries, and more research is needed.

Agriculture

Initial evidence has shown that home-grown school feeding can change the eating preferences of households, improve community incomes, support smallholder production, and facilitate better market access. Thereby, it has an impact on rural economies. The impact on rural investments and agricultural development has increasingly gained attention through links to the school feeding market. It is also clear that to enable the transition to sustainable, scalable government-run programs, the inclusion of the agricultural sector is critical (Bundy and others 2009; Drake and others 2016).

Initial evidence has shown that homegrown school feeding can not only change eating preferences of households, community incomes, and smalholder production and market access, but can also benefit smallholder farmers and investments in rural economies.

Preliminary findings from an impact evaluation in Ghana show a 33 percent increase in agricultural sales and a strong increase in household income in interventions in which homegrown school feeding is implemented (Aurino and others 2016). However, it is clear that rigorous evidence regarding the impacts that school feeding has on employment and income in the agricultural sector needs to be reinforced (Aurino and others 2016; Drake and others 2016; GCNF 2014; Masset and others 2012).

The following issues need further exploration:

- Transparency in price and payment is key for smallholder trust.
- Timely access to price, quality, and quantity information enhances operational efficiencies of aggregators and market systems.

- Adaptation of quantity and quality requirements and effective communication on them can ease the transition to supplying structured markets.
- The mobile phone platform can allow easier aggregation and management of commodities despite the short period of aggregation.

WEIGHING THE COSTS AGAINST BENEFITS: AN ECONOMIC ASSESSMENT OF SCHOOL FEEDING

This section reviews the literature on quantifiable costs and benefits for an overall assessment of the economics of school feeding. Three issues are particularly salient:

- The heterogeneity in the design and implementation of school feeding interventions across countries underscores the need for standardization when possible. A comparison of costs with benefits is essential for any economic assessment of school feeding or modification to the intervention. For example, retargeting school feeding to the most disadvantaged areas, or shifting from geographic to individual targeting, may reach disadvantaged populations more efficiently.
- Such changes may also entail significant monetary and other costs, including resistance from local government officials whose districts will no longer receive the intervention, or risk of stigma that children and adolescents may experience for receiving free or reduced-price meals if the program is not designed to mitigate that risk.
- Some important drivers of costs may be outside the scope of the intervention, such as global food prices or poor road conditions.

Costs of School Feeding

Costs of school feeding include costs associated with procuring food, transportation and storage, and staff time to monitor program implementation. Some programs hire cooks or caterers to prepare meals; others rely on community volunteers. Communities may provide other, in-kind contributions, such as fresh fruit or vegetables, fuel, condiments, and utensils. The provision of multifortified biscuits and take-home rations entails costs in staffing and delivery. Efficiencies may be gained through integrating school feeding with other school health interventions, such as water, hygiene and sanitation, or deworming (Azomahou, Diallo, and Raymond 2014).

Modality is a key determinant of school feeding costs. On average, school meals, biscuits, and take-home rations cost US$27, US$11, and US$43, respectively, per child per year (Gelli and others 2011). The differences are driven largely by differences in meal size or modality of the transfer; take-home rations cost more because they provide an additional transfer to the household beyond the food delivered in school.

Significant variation in cost is also evident across countries. Drawing from a sample of 74 low-, middle-, and high-income countries, school feeding costs an average of US$173 per child per year, ranging from US$54 in LICs to US$82 in middle-income countries and US$693 in HICs (Gelli and Daryanani 2013). These estimates are standardized for several parameters to support cross-country comparability, including the number of kilocalories in the ration and the number of days school feeding was provided. Food costs were typically the largest component, accounting for more than half of total program costs (Galloway and others 2009; Gelli and others 2011).[3] Although the contributions of communities are not usually reflected in these estimates,[4] they are estimated to be about 5 percent of total cost in LICs, or about US$2 per year (Galloway and others 2009).

The benchmarking of school feeding costs as a percentage of primary school education costs can also support comparability across countries. As table 12.4 shows, school feeding costs become a smaller proportion of primary education costs as the income level of the country increases. For LICs, the share is 68 percent, compared with 19 percent for MICs and 11 percent for HICs.

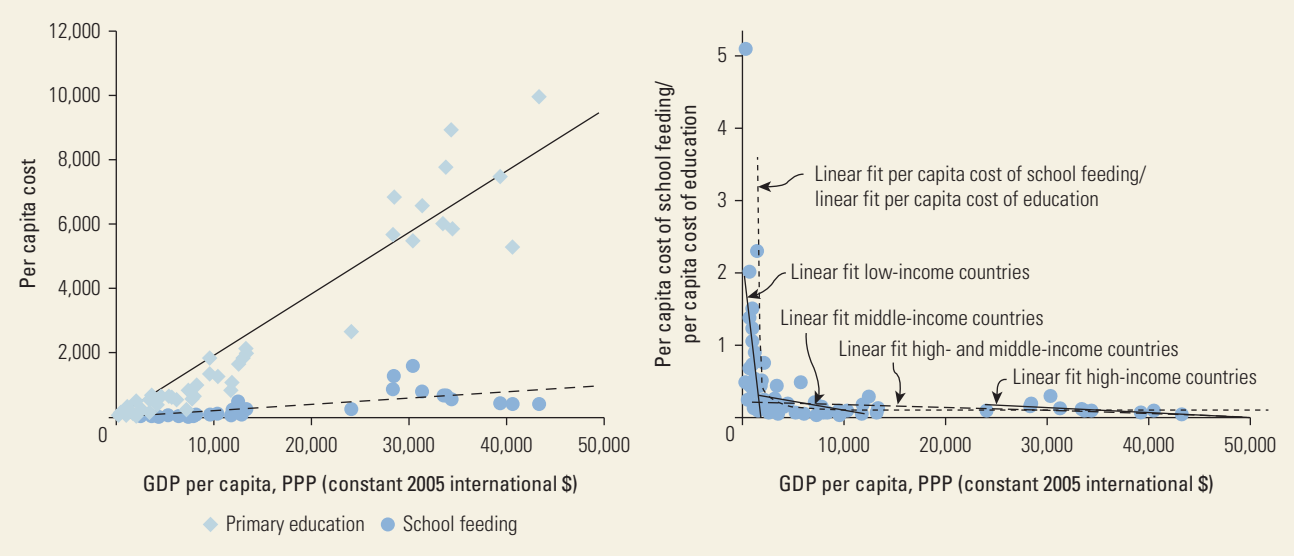
As gross domestic product increases, the per capita cost of primary school education increases more rapidly than the per capita cost of school feeding, which drives this finding (figure 12.4) (Bundy and others

Table 12.4 School Feeding Costs in 74 Countries

Income level of country	Total cost (US$)	Share of per capita cost of primary education (%)
Low (n = 22)	54	68
Middle (n = 40)	82	19
High (n = 12)	693	11
Total (n = 74)	173	33

Source: Gelli and Daryanani 2013.
Note: n = number of observations.

Figure 12.4 School Feeding and Primary Education Costs per Child per Year



Sources: Bundy and others 2009; Gelli and Daryanani 2013.
Note: GDP = gross domestic product; PPP = purchasing power parity.

2009; Gelli and Daryanani 2013). The high cost of school feeding relative to education is notable, particularly in LICs.

Assessing Costs against Benefits

This section reviews the cost of school feeding by output and outcome. For output, figure B12.2.1 presents the cost of delivering 30 percent of the recommended daily allowances of key micronutrients in 12 countries based on school feeding menus (Drake and others 2016). The composition of school meals varies widely, and diversification may lead to higher costs. Some studies have found positive effects on anthropometric indicators from meat or milk in the meals (Du and others 2004; Grillenberger and others 2003). However, LICs are unlikely to be able to sustain the higher costs of meat, and possibly milk, in meal programs. As economies develop, these food items can be gradually introduced and governments might be able to use schools to encourage the development of dairy sectors. Bangladesh, Rwanda, and Vietnam are encouraging these links through their school feeding programs.

For decentralized programs, setting the appropriate reimbursement rate to meet recommended nutrient levels is critical (Parish and Gelli 2015). Tools such as the School Meals Planner can support the design of costed menus that incorporate nutrient-rich foods (box 12.2). The addition of supplements such as micronutrient powders to school meals may also increase cost efficiency relative to nutrient content. In Ghana, the provision of micronutrient powders in school meals costs only an estimated additional US$2.92 per child for the entire school year (Stopford and others, forthcoming).

Estimation of the overall cost-effectiveness of school feeding is complicated by the multiple benefits of the intervention and the need to transform the units of different outcomes into the same unit. To simplify the problem, school feeding can be viewed as increasing the quantity and quality of education obtained, with improved nutrition outcomes contributing to quality (Gelli and others 2014). Capturing both education and nutrition outcomes in such calculations is critical for comparisons with other interventions, such as conditional cash transfers,[5] as well as direct schooling investment. Compared with conditional cash transfers, school feeding has high nontransfer costs of approximately 20 percent to 40 percent (Bundy and others 2009).

Previous studies (Jamison and Leslie 1990; Schuh 1981) have hypothesized that the benefit-cost of school feeding programs are attractive. A recent systematic review and meta-analysis (Snilstveit and others 2015) found that school feeding had significant effects on school attendance equivalent to an additional 8 days attended. There were also effects in the expected direction on improving enrollment, decreasing dropout, and improving various measures of attainment

Box 12.2

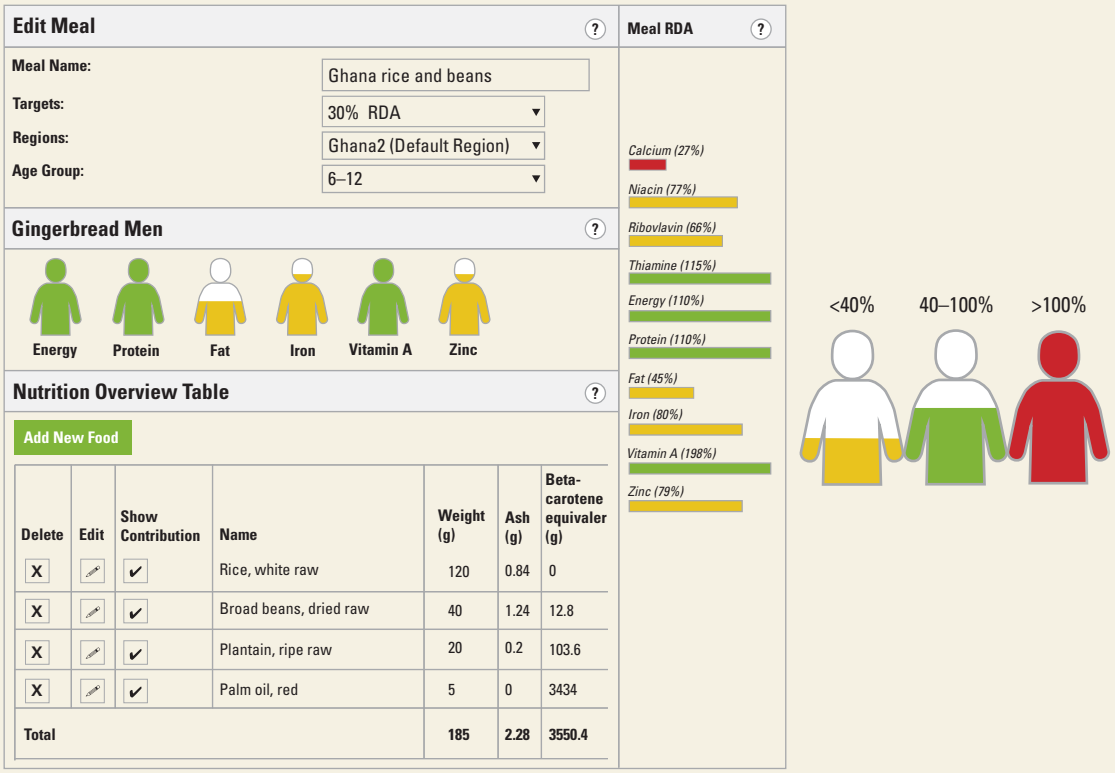
School Meals Planner

The School Meals Planner software and accompanying materials were developed in response to demand from governments to support the design of nutritious, well-balanced meals for homegrown school feeding programs.

The tool is a user-friendly dashboard that helps planning officials who may not be nutritionists (figure B12.2.1). It was adapted to Ghana and tested during the 2014/15 school year. Food composition tables and nutrition recommendations specific to Ghana were developed through high-level political engagement. Officials from 42 districts located across the 10 regions of Ghana designed menus using the School Meals Planner. These menus reached more than 320,000 children.

A set of handy calibrated measures was provided to each school caterer to ensure provision of food quantities listed on the menus. A communication campaign sensitized schools and communities to the health and broader developmental benefits of locally grown, healthy diets.

Figure B12.2.1 The School Meals Planner



Source: Fernandes and others 2016.
Note: RDA = recommended daily allowance.

(cognitive scores, maths scores, and language arts scores), although none of these was significant. Higher school attendance, in turn, has returns in higher wages upon graduation, and the returns to education in Sub-Saharan Africa are high. Fernandes and Aurino (2017, chapter 25 in this volume) estimate the benefit-cost of the effect of attendance as around 3 for low-income countries, and around 7 for lower-middle-income countries. If there are additional effects of improved cognition, the returns could be even higher.

CONCLUSIONS

School feeding is commonly implemented across low-, middle-, and high-income countries; however, there is significant variation driven by context to a large degree. The research most strongly indicates that school feeding has social protection and educational benefits; more recent studies have explored its nutritional benefits.

School feeding can serve to protect earlier investments in child welfare, buffering the effects of early shocks and contributing to the continuum of interventions from childhood through adolescence and into adulthood. Furthermore, school feeding also has the potential to address emerging issues such as the nutrition transition and could be integrated with other school health interventions, such as deworming, for greater impact.

Homegrown school feeding can not only change eating preferences of households, improve community incomes, and smalholder production and market access, but can also benefit investments in rural economies and contribute to national food security.

Much still needs to be learned about the barriers to these potential benefits. The costs of school feeding vary significantly across countries. An economic modeling exercise indicates that the returns to greater quantity and quality of education are a primary contributor to benefits. Future research is needed on the quantification of benefits to ensure more valid comparisons with other interventions.

NOTES

World Bank Income Classifications as of July 2014 are as follows, based on estimates of gross national income (GNI) per capita for 2013:

- Low-income countries (LICs) = US$1,045 or less
- Middle-income countries (MICs) are subdivided:
  a) lower-middle-income = US$1,046 to US$4,125
  b) upper-middle-income (UMICs) = US$4,126 to US$12,745
- High-income countries (HICs) = US$12,746 or more.

1. The nutrition transition is the rapid transition in LMICs from traditional diets rich in cereals and fiber to westernized diets high in fat, sugars, and animal-source food.
2. Calculation by authors using data from WFP (2013).
3. One study estimated that commodities contributed 57 percent to overall costs (Galloway and others 2009). Gelli and others (2011) found that commodity costs were, on average, 58 percent of total costs, and were highest for take-home rations and biscuit programs (68 percent and 71 percent, respectively).
4. Gelli and Daryanani's (2013) study is an exception because the authors were able to calculate projections for community contributions, where relevant.
5. The value of increased equity in both school feeding and conditional cash transfers is a benefit that is often part of the design but not one that is easily quantified (Alderman, Behrman, and Tasneem 2015).

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