WFP EVALUATION

WFP
World Food Programme

SAVING LIVES
CHANGING LIVES

School feeding programmes in low- and lower-middle-income countries

A focused review of recent evidence from impact evaluations

April 2021

Acknowledgements

This review was conducted by Adetoun Dapo-Famodu during the summer 2020, while working on a summer capstone experience at the World Food Programme's Office of Evaluation (OEV). Direct technical guidance and quality assurance support was provided by Simone Lombardini and Jonas Heirman. Overall professional and strategic oversight provided by Michael Carbon and Andrea Cook. We wish to acknowledge the efforts of Silvio Galeano and OEV's Comms Unit in providing copy-editing support.

Special thanks to the WFP School-based Programmes Division (SBP), especially Edward Lloyd-Evans and Nail Lazrak from the Research and Policy team and Niamh O'Grady, Evaluation Officer for their roles in providing information and technical documentation on school feeding programmes' design, implementation and evaluation within WFP and globally.

We are very grateful to the DIME team at World Bank – Serge Adjnon, Chloe Fernandez, Florence Klondylis - whose critical feedback resulted in a much stronger review. We wish to specially thank Dahyeon Jeong for peer-reviewing the paper.

Finally, we acknowledge Massachusetts Institute of Technology's Department of Economics and the Abdul Latif Jameel Poverty Action Lab (J-PAL) for facilitating the placement of the main author with WFP, as part of the summer capstone experience requirement of their Data, Economics, and Development Policy master's program.

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Key personnel

MAIN AUTHOR

Adetoun Dapo-Famodu	Monitoring Consultant

OFFICE OF EVALUATION

Andrea Cook	Director of Evaluation
Michael Carbon	Senior Evaluation Officer
Jonas Heirman	Evaluation Officer (Impact Evaluation)
Simone Lombardini	Evaluation Specialist (Impact Evaluation)

WORLD BANK – DEVELOPMENT IMPACT EVALUATION (DIME)

Dahyeon Jeong	Economist

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Executive summary

1. Human capital is considered the most important component of a country's wealth. Although human capital development continues over a lifetime, the most important phase is the first 8,000 days of a person's life, when the critical aspects of physical, cognitive and socio-emotional development occur. Well-designed school feeding interventions can potentially have multiple benefits for schoolchildren, their families and their communities, and contribute to achieving eight Sustainable Development Goals, especially in developing economies.

2. With the primary purpose of providing an evidence base for the impact evaluation initiatives of the World Food Programme's school feeding programmes, this review explores recent research on school feeding interventions. It synthesizes the evidence from 20 publications on school feeding, including 12 randomized experiments and quasi-experiments, conducted in low- and lower-middle-income countries, published in the past ten years. This review presents a broad summary of the evidence, describing the school feeding modalities evaluated, the outcome measures used in the studies and the reported impact in the key outcome areas.

3. The studies that evaluated the impact of school feeding between 2009 and 2019 in low- and lower-middle income countries were significantly different in terms of context, design – including duration and implementation modalities, and even outcome measures assessed. In the reviewed literature, the most researched areas were the impact of school feeding on health and nutrition outcomes, followed by the impact on education outcomes. Not much research was conducted on economic and social outcomes. Enrolment and absenteeism were the most reported impact measures for education; haemoglobin concentration, anaemia prevalence and anthropometry measures were the most reported for health and nutrition. Aside from child labour, the indicators reported for household economy and social protection varied widely among studies, and most studies used education or health and nutrition indicators as proxies.

4. A qualitative assessment of the included publications showed a relatively consistent positive impact of school feeding interventions on school enrolment, learning outcomes and micronutrient status of participating children. However, it was equivocal on the effect on school attendance, physical growth and body composition, the prevalence of malnutrition, and measures of household and local economy and social protection. Interestingly, the interventions appear to clearly benefit socially disadvantaged children and seem to deliver better results when bundled with other school-based interventions, such as deworming.

5. This review suggests possible research questions focused on the design and implementation of school feeding impact evaluation. Suggested research questions include exploring the potential complementarities between school feeding programmes and other interventions such as deworming; investigating the effect of school feeding interventions on social inequalities; comprehensive cost-effectiveness and cost–benefit analysis; and examining the impact of school feeding interventions in humanitarian settings.

1. Introduction

1. A strong positive and cyclical relationship undoubtedly exists between countries' economic development and their human capital.[1] Measured as the value of earnings over an individual's lifetime, human capital is considered the most important component of a country's wealth (Lange *et al.* 2018). Improving people's health, knowledge, resilience and skills – human capital – can make people more productive, innovative and flexible (World Bank 2018). Although the development of human capital can take place over a lifetime, the foundations are created in childhood and adolescence, specifically the first 8,000 days of life when most of the physical, cognitive and socio-emotional growth and development occurs (Bundy *et al.* 2018). Therefore, it is essential for any country that intends to cultivate an optimally productive future workforce, with higher-order cognitive and socio-behavioural skills, to invest in the health, education and development of children and adolescents (World Bank 2019). With the potential capacity to have multiple benefits for schoolchildren, their families and local economies, investments in well-designed school feeding programmes (SFPs)[2] can yield excellent returns in human capital development, especially in low- and middle-income countries (LMICs) (Bundy *et al.* 2018).

1.1 PURPOSE OF PAPER AND METHODOLOGY

2. In 2019, the World Food Programme (WFP), through its Office of Evaluation (OEV), launched a new WFP Impact Evaluation Strategy to guide the organization in the generation and use of evidence from rigorous impact evaluations for learning, accountability and policymaking (WFP Office of Evaluation 2020a). As part of the strategy, OEV is trying out impact evaluation "windows", which are OEV-led initiatives to coordinate a portfolio of rigorously designed impact evaluations on WFP programmes in priority areas. Each window is guided by a window-level evidence review followed by the development of a concept note and a pre-analysis plan. As at the time of this review, WFP had launched two windows, and the plan is for the next window to focus on school-based programming, including school feeding (WFP Office of Evaluation 2019). To this end, the purpose of this document is to present a targeted review of the rigorous evidence on school feeding interventions in the past decade (2009–2019) in low- and lower-middle income countries.

3. This review is not intended to be an in-depth systematic review or meta-analysis. Instead, it is meant to provide a broad summary of the available recent evidence from rigorous experimental or quasi-experimental research on SFPs, including the modalities evaluated, the outcome measures used and the reported impact in key areas. The paper is organized into five sections. The introduction provides a summary of the review's objectives and methodology, and there is a brief overview of the background to SFPs, including a broad outline of the theory of change in the second section. The third section explores the school feeding modalities evaluated in recent research and the outcome measures used. The fourth section presents a review of the evidence of the impact of SFPs across different development areas, including gender and costs analysis, while the fifth section concludes and identifies potential areas for future SFP research.

1.2 LITERATURE SEARCH METHODS AND ELIGIBILITY CRITERIA

4. The review process started with an extensive literature search across 16 electronic publication databases and trial registries, including PubMed, ClinincalTrials.gov, EconPapers and the Cochrane Library. Although not a systematic review, the search strategy and the quality criteria for inclusion of publications in this targeted review were guided by the *Cochrane Handbook of Systematic Reviews of Interventions* and the Cochrane Effective Practice and Organisation of Care (EPOC) resources for review authors (EPOC n.d.; Higgins *et al.* 2019). The search was conducted from June to July 2020, and the search terms used in the databases were "school feeding" and "school meal(s)". Where available, in-built search filters in the database were used to further limit the search results to potentially relevant articles. The full list of the databases searched, including weblinks and the search limits, is contained in Appendix A.

5. The titles and abstracts of the publications in the returned search results were screened to identify potentially relevant articles. Then, an in-depth review of the full text of the potentially relevant articles was conducted, and studies that met the eligibility criteria were included in the review. A manual search was conducted through the references lists of pertinent publications, to identify additional eligible studies. The literature search was limited to

[1] According to the World Bank, human capital consists of "the knowledge, skills, and health that people accumulate over their lives, enabling them to realize their potential as productive members of society. It has large payoffs for individuals, societies, and countries" (World Bank 2018a: 14).

[2] Defined as the provision of meals, snacks or take-home incentives through schools, conditional on the enrolment or attendance of children in school.

peer-reviewed journals or working papers published in English within the past ten completed years (2009–2019), whose full text is freely accessible online or via regular institutional electronic library access.[3] Eligible studies must have been conducted in a country classified by the World Bank to be at a low- or lower-middle-income level when the study was implemented.[4] Potentially relevant publications were restricted to articles that reported quantitative evidence from the impact evaluations of school feeding interventions; those that used mixed methods – i.e. both quantitative and qualitative designs – were also considered for inclusion. In addition, comprehensive systematic reviews and meta-analysis of studies that explored the impact of school feeding programmes, or provision of fortified or unfortified supplementary meals, snacks or rations to school-age children or adolescents through schools, were included in this review. Figure 1 provides an overview of the screening and study selection process.[5,6]

6. Eligible study designs were rigorous experimental or quasi-experimental designs that captured the causal effect of school feeding interventions. Specifically, the study designs considered for inclusion in this review were studies that randomly assigned individuals or clusters into clearly stated intervention(s) and comparison groups, ex-ante (randomized controlled trials (RCTs)) or well-designed studies that used exogenous variations in treatment allocation or appropriate statistical methods to construct credible counterfactuals (quasi-experimental). Difference-in-differences, multivariate regression analysis, instrumental variables, statistical matching, regression discontinuity design and interrupted time series were the common quasi-experimental designs considered for inclusion. Quasi-experimental studies that used pre-post or simple difference methods were excluded. Also, included studies must have clearly stated empirical strategies, conduct baseline balance check on observables and use appropriate methods to control for imbalance or confounders (as necessary).

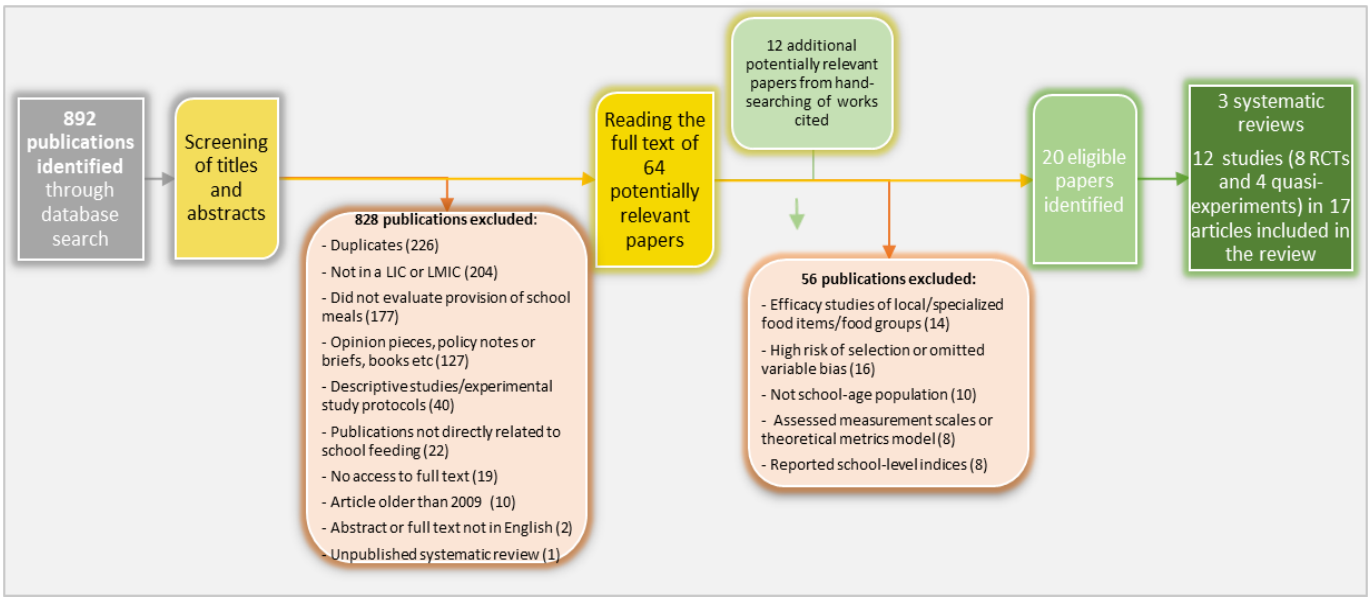
7. Included studies must experimentally compare the provision of school feeding (either as fortified or unfortified onsite provided school meals, snacks or dry take-home rations (THR)) to non-provision of school feeding or provision of other school health and nutrition or social assistance interventions. Efficacy, or clinical biology studies of specially designed meals (e.g., peanut paste), established food groups (e.g., milk, meat and egg) or local food items (e.g., guava, crickets) were excluded. Eligible studies must have investigated the effect of SFPs on at least one outcome measure at the child, household or population level in the areas of education, health and nutrition, household economy and social protection, and agriculture and local economy. Included studies must provide at least a basic description of the data collection and estimation methods used for the quantitative metric and report the estimated effect size with the associated statistical significance level to allow for informed comparison of effect sizes.

8. Broadly in line with the "PICOS" elements of the Cochrane EPOC review guidelines (EPOC n.d.), in summary, the inclusion criteria are:

- **P**opulation – School-age children and adolescents in primary or secondary schools in low- and lower-middle income countries
- **I**ntervention – Provision of fortified or unfortified school meals, snacks or THR using the school system
- **C**omparator/Comparison – No school feeding, different school feeding modality, different school health and nutrition intervention, or other social assistance interventions
- **O**utcome – Child, household or community-level outcome in at least one of the focus areas
- **S**tudy design – Rigorous quantitative experimental and quasi-experimental studies
- Other – Published between 2009 and 2019 inclusive, in English and readily accessible electronically.

[3] Relevant full-text publications that required the use of inter-library lending services were excluded because of library closures resulting from COVID-19.
[4] Using the historical classification by income-level data from the World Bank (n.d.).
[5] Although articles might fail to meet more than one of the inclusion criteria, they are classified as excluded under the most basic criteria not met.
[6] The number of articles was more than that of studies because results from four of the included studies were published in more than one paper.

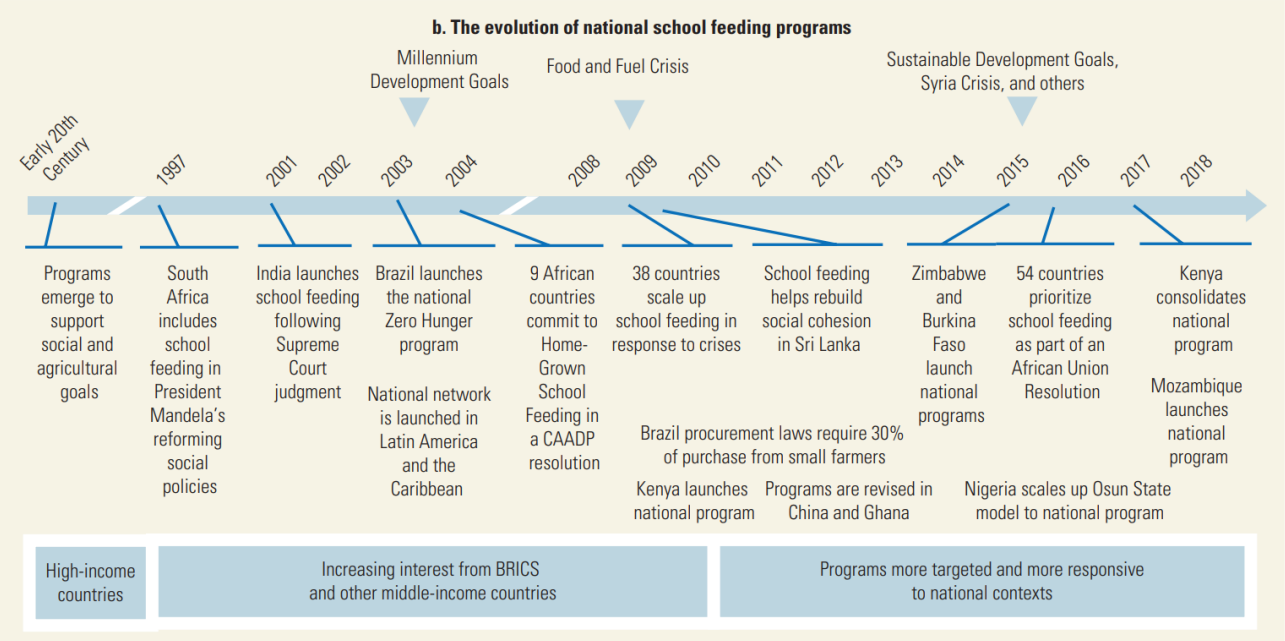
Figure 1: Chart of the screening process for eligible publications



2. School feeding – a brief history

9. Mainly targeted at primary or elementary schoolchildren, school feeding[7] programmes have been implemented for centuries and have evolved over the years. The earliest documented record of school feeding was in 1790 when Benjamin Thompson, an American-born British physicist and inventor, began a programme in Munich, Germany, that provided schooling and meals to hungry children who worked part time in exchange (Gunderson 2003). In the nineteenth century, the provision of school meals for children had become widespread in most high-income countries. By the early twentieth century, these countries began to view school feeding not only as a tool for alleviating short-term hunger in schoolchildren but also as a way of meeting social and agricultural goals (Bundy *et al.* 2018). The drive for social change through development goals, and the food, fuel and financial crises of 2008, were especially pivotal in reshaping the thinking around school feeding worldwide. Currently, government-supported SFPs are implemented in some form in almost all countries in the world (World Bank 2018b).[8]

Figure 2: Evolution of national school feeding programmes



Source: Bundy et al. 2018.

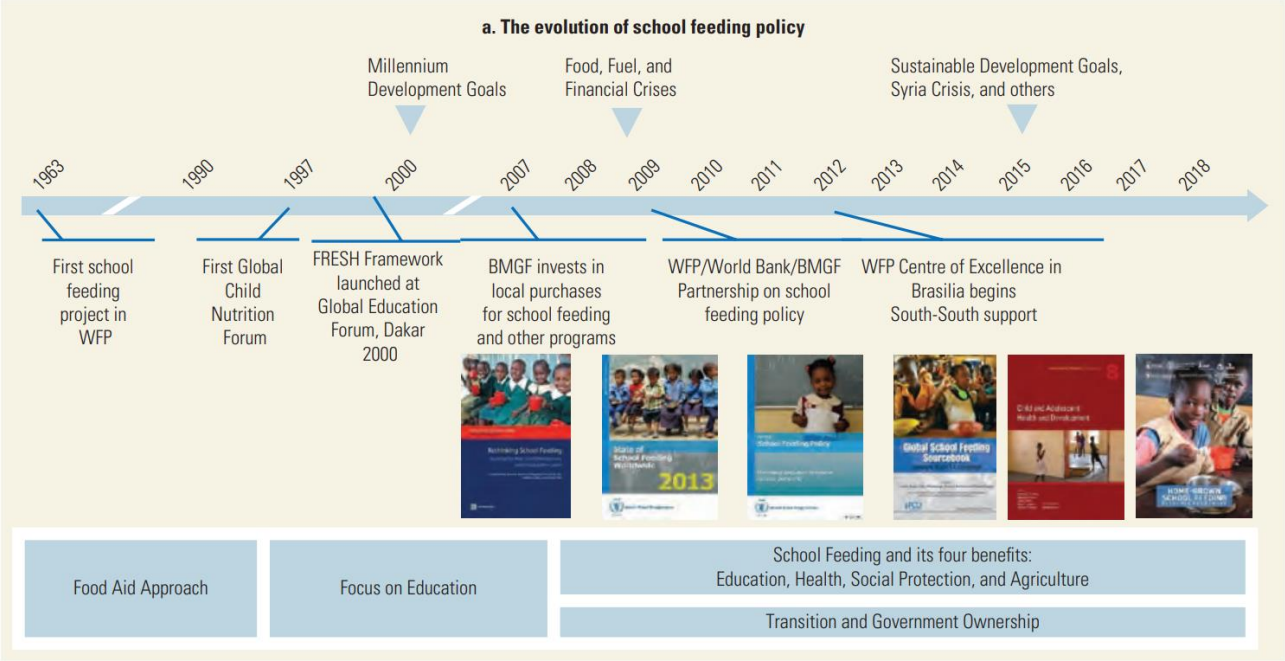
10. Globally, the coverage of and scale of investment in school feeding programmes are not trivial. It is estimated that up to US$75 billion is expended annually, mostly by governments, in providing school feeding to no less than 368 million children daily (305 million of which are in LMICs). However, there appears to be an inverse relationship between investment and need; countries most in need of school feeding have lower coverage and scale. In low-income countries, only 18 percent of schoolchildren receive free meals, and 83 percent of the resources expended are from donor funds (WFP 2013). It is estimated that 73 million school-age children living in extreme poverty in 60 countries are not being reached by SFPs and are also likely not receiving other essential school-based health interventions (WFP 2020b).

11. Created to provide multilateral food aid through the UN system, WFP implemented its first school meals project in central and northern Togo in 1963, barely two years after being established (WFP n.d.). Currently, WFP is the largest humanitarian organization implementing SFPs worldwide. The focus of WFP's early school feeding programmes was food aid, mainly targeted at alleviating hunger, until the late 1990s when the focus shifted to food for education. Changes in the global economic and financial landscape (e.g. the 2008 global financial crisis), together with shifts and reforms within WFP and the United Nations as a whole (the shift from food aid to food assistance for WFP and the launch of the United Nations Sustainable Development Goals or SDGs), created a change in how SFPs were being conceptualized, planned and implemented. Early in 2020, WFP presented its new approach to school

[7] Defined as the provision of meals, snacks or take-home incentives through schools, conditional on attendance of children.
[8] More details on the history and evolution of school feeding programmes and policies can be found in Gunderson (2003) (mainly focused on high-income countries), Bundy *et al.* (2009), and Bundy *et al.* (2018).

feeding in the WFP School Feeding Strategy 2020–2030 (WFP 2020b). The ten-year strategy delineates how WFP will globally champion school feeding interventions as a critical pillar within an integrated multisectoral school health and nutrition response. WFP plans to leverage partnerships to advocate for integrated school health and nutrition interventions and to strengthen the programmatic approaches of SFPs in critical areas, such as gender sensitivity, climate change, the triple humanitarian–development–peace nexus, and knowledge generation and sharing (WFP 2020b). The strategy also entails working with other partners to provide context-specific operational and technical support to governments to ensure that all primary schoolchildren are fed at schools daily within a larger integrated package of school health and nutrition (WFP 2020b; Bundy *et al.* 2018). The multiple potential returns of an integrated school feeding and school health package suggest that they can work as strategic interventions to mitigate crises and support national development (Drake *et al.* 2018).

Figure 3: Evolution of school feeding policies and programmes



Note: The documents illustrated include the key milestones: *Rethinking School Feeding* (Bundy and others 2009), *The State of School Feeding Worldwide* (WFP 2013), and *Global School Feeding Sourcebook* (Drake and others 2016). BMGF = Bill & Melinda Gates Foundation; FRESH = Focusing Resources on Effective School Health; WFP = World Food Programme.

Source: Bundy et al. 2018.

12. Conceptually, SFPs can contribute to the achievement of at least eight SDGs – no poverty (SDG1), zero hunger (SDG2), good health and well-being (SDG3), quality education (SDG4), gender equality (SDG5), economic growth (SDG8), reduced inequalities (SDG10) and strengthened partnerships (SDG17). With the potential to have a positive impact on education and other development areas, such as health, social protection, and agriculture and local economy,[9] appropriately designed and well-implemented SFPs could enable governments to achieve multiple social development goals.

2.1 THEORY OF CHANGE

13. Not to be confused with impact indicators, the term "impact" in this context refers to the short-term or long-term effects of an intervention, and the changes as a result of it. In this review, the impact of an SFP is defined as the positive and negative, direct or indirect, intended or unintended changes in the lives of those who received a school feeding intervention of any modality. An understanding of the potential impact pathways is critical to measuring the changes in the development outcomes of interest for schoolchildren, their households and their communities, as a result of a school feeding intervention.

14. In the short term, SFPs can have a direct benefit on: education by improving schooling via increased enrolment and attendance, especially for socially disadvantaged populations; health by increasing the quantity and quality of diet, thereby improving nutritional status; social protection, agriculture and local economy, by providing a transfer of the value of the meals to households and by increasing household income as a result of increased local food purchase (in the home-grown school feeding model (HGSF)). In the medium term, singly or in complementarity,

[9] When SFPs are implemented as home-grown school feeding (HGSF) programmes.

improvements in a child's physical and psychosocial health and increased schooling can result in better cognitive and learning outcomes. On the agriculture and local economy front, sustained transfer of the income value of school food or rations and steady demand for produce from local farmers and traders (in the HGSF model) can, in turn, lead to an increase in the production and diversity of locally available food produce, thereby increasing household income and food security. In the long term, a virtuous cycle of increased economic growth and productivity could be created. On the one hand, the effects of improved health, nutrition and education can result in better educated and healthier adults who are economically productive and more likely to have richer families later in life. On the other hand, improved social protection, agriculture and local economy outcomes could mean wealthier households that will invest more in the health, nutrition and education of their children. Another longer-term impact pathway of SFPs is the potential indirect effect on economic development through the empowerment of women and a reduction in social inequalities. SFPs can possibly lead to improved gender (social) equity outcomes, reducing child labour, child marriage and early pregnancy, especially when girls (disadvantaged social groups) are specifically targeted (Masset and Gelli 2013; Watkins *et al.* 2015).

3. Measuring the impact of school feeding programmes

16. This section outlines the school feeding modalities evaluated and the outcomes measured in the included studies, including the metrics used. Generally, school feeding interventions are highly context-specific, and there is no "best" model of school feeding. The approaches and modalities that are better suited to different contexts and settings vary. Although there is significant heterogeneity in the designs and implementation models of SFPs worldwide, the underlying theory behind how school feeding might benefit children, households, schools and communities is relatively universal.

3.1 SCHOOL FEEDING MODALITIES

17. In general terms, SFPs could be implemented in two ways: provision of in-school/on-site meals or snacks (including biscuits) or provision of THR. While school meals[10] are provided daily, conditional on attendance on that day, THR is mostly provided monthly, conditional on meeting a particular school attendance target, usually not less than 80 percent. School meals and THR could be fortified with multiple micronutrients (MMN), a single micronutrient such as iron, or not fortified at all (Bundy *et al.* 2009).

18. The studies included in this review all examined the impact of providing at least one modality of school feeding to school-age children. There are significant heterogeneities in the intervention modalities assessed by the different studies. Appendix B provides details of the various school feeding intervention modalities that were evaluated by the included studies. Three studies (3, 4, 6) investigated the impact of providing in-school feeding (cooked meals) compared with not providing school feeding. Two studies (7, 10) examined the effect of providing in-school meals or THR in contrast with providing no school feeding intervention, while two studies (1, 2) compared the effects of in-school meals or THR with that of general food distribution (GFD) interventions. Two studies (9, 12) assessed the impact of providing micronutrient-fortified school meals versus the provision of non-fortified meals, while another (5) examined the impact of different formulations of MMN-fortified in-school cooked rice meals in comparison with non-fortified cooked rice meals. One study (11) explored the effect of school food fortification and deworming, and another (8) assessed the impact of providing fortified biscuits compared with iron supplementation or unfortified biscuits.

3.2 STUDY POPULATION AND DURATION

19. The third edition of the Disease Control Priorities series (DCP3) established that human capital development requires significant investments in child and adolescent development throughout the first 8,000 days of life (Bundy *et al.* 2018). DCP3 and the WFP School Feeding Strategy 2020–2030 (WFP 2020b) also clearly stated that school feeding is a crucial component of any essential school health and nutrition package that improves child and adolescent development. However, there is a dearth of recent rigorous experimental evidence on the impact of SFPs on adolescents; none of the studies included in this review investigated the impact of school feeding on secondary school-age children, who are mostly adolescents. The paucity in evidence of the impact of SFPs on secondary school-age children may be because the shift in global thinking towards the importance of strategically and intentionally investing in middle childhood and adolescence is relatively new but gradually gaining traction (Bundy *et al.* 2018).

20. The studies included in this review varied in duration from 4 months to 5 years. Of the 12 studies, 7 were implemented for 1 year or less, 2 for more than a year but less than 2 years, while 3 had a study duration of 2 years or more. It is particularly important to note that all the RCTs were implemented for two years or less. The relatively short duration of these RCTs implies that both the effect of SFPs on longer-term outcomes (e.g. impact on prevalence of child marriage) and the impact of longer-term exposure to SFPs (e.g. impact of a six-year exposure to school feeding on learning outcomes compared with a three-year exposure), were mostly not captured by the RCTs. Additional details on the included studies, such as study duration, location and target subjects, are presented in the Annotated bibliography of included studies (Appendix E).

3.3 OUTCOMES AND IMPACT MEASURES

21. This section presents an overview of the outcomes that were evaluated in the included studies, including the impact measures and indicators used. Conceptually, school feeding is thought to significantly benefit these four

[10] Unless otherwise stated, throughout the document, this refers to either meals or snacks provided to children at school.

major areas: education, health and nutrition, household economy and social protection, and agriculture and local economy (in the form of HGSF). The outcomes evaluated and impact measures used have been grouped by these four areas. Of the 12 studies, 6 measured at least 1 education outcome; 10 reported health and nutrition outcomes. Six attempted to quantify the impact of SFPs on household economy and social protection, while none reported agriculture and local economy outcomes. The lack of studies on the impact of school feeding on agriculture and local economy outcomes is perhaps attributable to the fact that the implementation of the HGSF model of school feeding – the model through which SFPs can have an impact on agriculture and the local economy – gained attention reasonably recently in LMICs and there is probably field-level research and analysis work ongoing. Some of the studies evaluated more than one outcome area, while others only focused on a particular outcome area. Only one of the studies (reporting in two publications) attempted to conduct a comprehensive analysis of the impact of school feeding across three of the four impact areas.

22. In the past decade, the impact of school feeding on health and nutrition outcomes was the most researched within the reviewed school feeding literature, followed by the impact on education outcomes; not much research has been conducted from the household economy and social protection angle. Enrolment and absenteeism were the most reported impact measures for education; haemoglobin concentration, anaemia and anthropometry[11] measures were the most reported for health and nutrition. Most of the household economy and social protection measures were proxy indicators for education or health and nutrition outcomes. Each study tended to use a different measure to estimate the impact on household economy and social protection outcomes, making between-study comparison difficult.

Additional details on the number of included studies that reported the effect of SFPs on respective outcome areas and impact measures/indicators are given in Appendix C.

3.4 MEASUREMENT

23. The similarity of data collection and measurement methods for indicators of outcome measures makes it easier to compare estimated effect sizes of impact between studies. For studies included in this review, indicators and data collection methods for biochemical micronutrient status were the most similar and easily comparable; those measuring household economy and social protection outcomes were the most varied.

24. Biochemical indicators of micronutrient status, such as haemoglobin concentration, body iron stores, serum or plasma concentration of a particular micronutrient, were probably the most objective and reliable metrics reported in the studies. The sample collection methodology and cut-offs for classifying the micronutrient status as normal or deficient were relatively similar across all studies that reported on a particular micronutrient status metric. However, the required resources (especially equipment and human capacity) for conducting these biochemical tests might not be readily available, making it logistically challenging and expensive to include them as outcome indicators when implementing studies in low- and lower-middle income countries. The authors of the included articles that reported micronutrient biochemistry ([1], [6], [7], [8], [12], [13], [14], [15], [16], [17] in Appendix E) stated that, except for haemoglobin concentration,[12] blood, urine or stool samples had to be carefully stored and transported to special laboratories in bigger cities or another country entirely, for most of the laboratory-related analysis.

25. Anthropometry, as well as dietary assessments, are well-known methods of assessing the health and nutritional status of individuals. Commonly used anthropometric measurements are height or length, weight and mid-upper arm circumference (MUAC), while energy intake, meal frequency and meal diversity are commonly used for dietary assessments. Unlike the widely accepted growth standards and dietary assessment cut-offs for children under 5 years, there is limited evidence and experience on the anthropometric measurements and dietary cut-offs that work best to classify nutritional status in middle childhood and adolescence (Cashin and Oot 2018). The World Health Organization (WHO) recommends using sex-specific BMI-for-age and height-for-age measurements to assess thinness/overweight/obesity and stunting, respectively, in school-age children and adolescents. Sex-specific weight-for-age measurements are not recommended for use when classifying children and adolescents as overweight or obese but could be used to determine whether a child aged 5–10 years is underweight. However, the recommended growth reference is not without significant limitations (de Onis *et al.* 2007; Butte *et al.* 2007; de Onis and Lobstein 2010). Seven included articles ([4], [9], [10], [12], [14], [15], [17] in Appendix E) investigated the impact of SFPs on body growth and composition, but only two presented data on weight and height gain and the prevalence of underweight, thinness, overweight/obesity and stunting. Furthermore, MUAC measurement – a widely accepted, relatively easy-to-use and low-cost means of detecting acute malnutrition among children under 5 years and women of reproductive age in low- and lower-middle income countries – was reported by only one study. None of the included articles presented the impact of SFPs on energy intake, diet diversity and diet adequacy at the child or

[11] Defined as the measurement of the human body.
[12] There are easy-to-use point-of-care analysis kits for collecting and analysing blood samples for haemoglobin concentration.

household level. The lack of universally accepted cut-offs for school-age children and adolescents might be one reason for the low reporting on the impact of SFPs on nutrient intake and adequacy and prevalence of nutritional conditions. Cashin and Oot (2018) provide a compact summary of anthropometric measurement and interpretation for school-age children and adolescents aged 5 to 19 years. However, there is still no universally agreed minimum dietary diversity, meal frequency or dietary adequacy standards for school-age children.

26. For education impact measures, enrolment was a binary variable indicating whether a child was enrolled at any level of education, and it was collected through household surveys for all the studies that investigated the impact of SFPs on enrolment. For two studies, the metric for attendance/absenteeism was the number of school days missed by a child in the week preceding the survey. In contrast, a third study used the number of days a child was absent from school in the month preceding the survey as a metric. Two studies estimated the impact of SFPs on grade attainment; one collected data on the current grade (the educational grade (in years) that a child is currently enrolled in) while the other used the number of years of education completed. Although very similar, there might be slight differences between the two indicators depending on how the question is phrased and interpreted during data collection at the households. For example, a child in grade four who repeated grade two might have four recorded for him for the first indicator and five recorded for the second. The education measures were self-reported (or parent-reported); the studies did not state whether a revealed preference or an objectively verifiable approach (e.g. validating self-report with schools or with household copies of academic reports) was used while collecting the data. It is necessary to note that the inherent social desirability bias in self-reported indicators might bias the estimated effect size.

27. Cognition was measured using standardized tests such as Raven's progressive matrices, and subtests of the Wechsler Intelligence Scale for Children (also known as WISC test) such as digit span. However, only three studies reported the impact of SFPs on cognition. Two of the studies administered the cognitive tests at the children's home using trained household survey enumerators, while the third engaged trained psychology technicians to administer the tests. This suggests that the cognitive tests are relatively comparable between the studies and could be successfully implemented as part of household survey data collection. However, trained psychologists should ideally be engaged when designing and field-testing data collection instruments that will include cognitive measurement. Metrics for learning were varied: one study used a standardized national learning assessment test, another a 15-item maths and literacy test, and a third "four simple arithmetic questions" to evaluate the impact of SFPs on learning outcomes. The extent to which these tests are internally and externally valid indicators of learning outcomes does impact on whether we can quantitatively compare the effect sizes reported.

28. Researchers attempted to capture the causal effect of SFPs on the household economy and social protection mainly by using education and health and nutrition indicators. Aside from the impact of SFPs on child labour, which had a reasonably consistent definition across the three studies investigating it, other indicators varied from study to study. Proxy indicators used include test scores of ineligible siblings, anthropometric measures of preschool siblings and children exposed to an economic shock, and the prevalence of moderate-to-severe anaemia among other vulnerable members of the household. Although not an uncommon practice to use proxy indicators, the fact that they varied from study to study implies that only qualitative assertions can be made on the impact of SFPs on household-level dynamics.

29. A crucial point to note is that none of the included studies reported all four outcome areas that SFPs can conceptually benefit. Only 1 of the 12 studies (reporting in 2 publications) attempted to conduct a comprehensive analysis of the impact of school feeding across three of the four focus areas. Most of the studies reported results in one to two outcome areas. Even in recent evidence, there is still no complete impact measure on which to base a comprehensive estimate of the cost-effectiveness of SFPs. Gelli *et al.* (2014) suggest two alternative models for comprehensively capturing the effects of SFPs, but the focus is still on education, and health and nutrition (Gelli *et al.* 2014).

30. This section has clearly shown that there is significant variability in the data metrics used by researchers in evaluating the impact of SFPs, which might make between-study comparisons of effect sizes challenging. This variability might exist due to a combination of factors, such as cost considerations for studies, different policy or programme objectives guiding the study designs, and the absence of widely accepted data collection standards and indicator definitions for some of the metrics used in evaluating SFPs. Having a resource repository that can guide researchers designing empirical studies that explore the causal effect of SFPs on outcomes of interest might help to reduce some of the between-study variability in metrics observed.

4. Evidence for the impact of school feeding in critical areas

4.1 EDUCATION

31. Six studies published in six papers (Aurino *et al.* 2019; Chakraborty and Jayaraman 2019; Aurino *et al.* 2018; Kazianga *et al.* 2012; Nga *et al.* 2011; Buttenheim *et al.* 2011) evaluated the impact of SFPs on the educational outcomes of school-age children. Almost all the studies reported on measures of schooling – that is, access to education – but only half the studies investigated the impact on learning and cognitive outcomes. None of the included studies evaluated the effect of SFPs on dropout rate. Table 1 in Appendix D contains details of the effect sizes and significance levels of the estimates reported for education outcomes in the studies.

Schooling: Enrolment

32. Four studies ([2], [5], [11], [14] in Appendix E) investigated the impact of school feeding on enrolment. With intervention durations ranging from one school year to five years, the studies found that the provision of school meals or THR increased enrolment by about 4–11 percentage points (pp), with some significant differences in effect sizes along the lines of social inequalities. Kazianga *et al.* (2012) reported that, after a year of intervention, both in-school meals and THR increased enrolment for Burkina Faso children, and the effect of THR was not significantly different from that of the in-school meals. Aurino *et al.* (2019) found that, although in-school meals led to a 10 pp increase in enrolment among Malian children, the effect was only significant for boys (11.3 pp increase) and not for girls, probably because the opportunity costs of education relative to participation in child labour might be higher for boys than for girls in the study population. In contrast, the authors reported that GFD to households did not significantly impact enrolment, but that the provision of any aid (either school meals or GFD) led to a 12 pp increase in enrolment if there were armed groups in the commune.[13] Buttenheim *et al.* (2011) evaluated a WFP SFP implemented over one to two years in the northern region of Lao People's Democratic Republic (PDR), and found that when offered separately, in-school meals and THR increased enrolment; surprisingly, the combination of both modalities had no significant effect on enrolment.[14] Aurino *et al.* (2018), in a large nationwide two-year RCT in Ghana, did not find a national-level significant effect of school meals on enrolment. Nevertheless, subgroup analysis revealed that enrolment increased for girls, pupils from poor households, and pupils in the northern region of the country (disadvantaged geographical location). It is important to note that Ghana had higher baseline enrolment levels than Burkina Faso, Mali and the northern region of Lao PDR, and this might be responsible for the non-significant effect in the Ghana RCT's full sample.

Schooling: Attendance and absenteeism

33. Three studies ([2], [5], [11] in Appendix E), with a minimum duration of one school year and a maximum of five years, investigated the effect of school feeding on school attendance/absenteeism. Kazianga *et al.* (2012) reported that THR had no significant impact on attendance, but that in-school meals reduced attendance by about 1 day in 20 days among the children that were currently enrolled in school. Further analysis showed that the effect was driven by the subsample of newly enrolled children who would most likely not be enrolled in school in the absence of the intervention. In fact, the authors found that for both onsite school meal provision and THR, the most considerable and statistically significant negative attendance effect was among schoolchildren with no other school-age siblings. This strengthens the assertion that the reduction in attendance was most likely driven by selection into schooling (in intervention sites) of households with a lower value for education who would not have enrolled their children otherwise, probably because they have lower child labour supply. Additional analysis by gender revealed that, for currently enrolled children, both in-school meals and THR did not affect attendance for boys but significantly reduced the number of days that a girl is present at school by about a day. Both Aurino *et al.* (2018) in Ghana and Aurino *et al.* (2019) in Mali found that school meals had no significant effect on absenteeism. However, the Mali study – a five-year study in a conflict setting – further reported that GFD increased absenteeism by about a half school day per week. Analysing by gender, it was discovered that GFD caused boys to miss one full day of school per

[13] In Mali, third-level government administrative units are called communes. Although no particular reason was given for why this was the case, the authors opined that households and individual members living in conflict-affected areas face multidimensional risks and the provision of food assistance might offset some of those risks.

[14] The authors reported significant intervention implementation and measurement challenges that could lead to bias in the results of the Lao PDR evaluation (Buttenheim *et al*. 2011).

week while the effect was not significant for girls. Analysis by conflict intensity showed that the provision of GFD increased absenteeism by 0.8 days per week if armed groups were present in the commune or the village.

Schooling: Grade attainment

34. In the five-year study on Malian schoolchildren in fragile settings conducted by Aurino *et al.* (2019), both boys and girls that received school meals completed 6–7 additional months[15] of education (relative to the matched comparison group), while GFD did not have any impact on grade attainment. The effect is mostly driven by areas indirectly affected by conflict events – that is, villages that suffered from the indirect impact of armed violence despite never experiencing the presence of armed groups within the village or surrounding commune. Among Ghanaian children in a mostly stable setting, the two-year Aurino *et al.* (2018) study reported that school meals increased grade attainment and that, while there were no differences by gender and poverty status, pupils from socially disadvantaged regions that were exposed to the intervention completed more grade levels than their contemporaries who did not receive the school feeding intervention.

Learning

35. Chakraborty and Jayaraman (2019), Aurino *et al.* (2018) and Kazianga *et al.* (2012) assessed the impact of SFPs on learning outcomes. The three studies found that SFPs resulted in a 0.09–0.15 standard deviation (SD) increase in maths scores. Further analysis by sociodemographic variables, such as gender, poverty status and age, revealed that SFPs increased maths scores by up to 0.3 SD. Only the first two studies investigated the impact of school feeding interventions on reading and literacy, and reported that SFPs can cause an increase of up to 0.2 SD in reading/literacy scores.

36. In the study by Kazianga *et al.* (2012) in Burkina Faso, the provision of in-school meals increased maths scores for both boys and girls, but for THR, the increase in maths score was only significant for girls and not for boys. Subgroup analysis by Aurino *et al.* (2018) indicated that, on average, provision of in-school meals resulted in up to twice the increase in maths and literacy scores for girls, poor pupils, younger pupils (6 to 11 years) and schoolchildren from socially disadvantaged regions in Ghana. Chakraborty and Jayaraman (2019), in a quasi-experiment using the Annual Status of Education Report survey data from eight household cross-sections spanning five years, found that non-eligible siblings of the children receiving India's midday meals also recorded increased maths scores. The increase in scores for siblings suggests that the midday meals have a spillover effect, probably due to some kind of partial redistribution of resources within the household. Further analysis by Chakraborty and Jayaraman (2019) suggests that learning increases with the exposure to school meals but at a decreasing rate (for both maths and reading) and that there might be potential complementarities between school meals and teaching- or learning-related classroom inputs, such as teacher attendance, but not with general schooling infrastructure like access to drinking water.

Cognition

37. Three studies provided evidence of the effect of school feeding interventions on cognitive outcomes. Although cognitive development is captured under the education outcome in this review, its multidisciplinary nature, especially as it relates to health, remained salient in the studies reviewed. Studies by Aurino *et al.* (2018) and Nga *et al.* (2011) showed that provision of school meals significantly increased scores for Raven's standardized progressive matrices (SPM)[16] and digit span tests,[17] while the study by Kazianga *et al.* (2012) did not find any significant effect of school feeding interventions on these measures of cognition.

38. In the two-year Aurino *et al.* (2018) study in Ghana, SPM scores increased by 0.13 SD for children that received in-school meals. The increase in SPM was not significant for girls, but scores increased by almost twice for children from poor households or disadvantaged geographical areas, and for younger children (6 to 11 years). Digit span scores also increased by 0.12 SD in children that received school meals with almost twice the effect size for girls, children from poor households, those from disadvantaged areas and younger children. In the four-month Nga *et al.* (2011) study, analysis by baseline anaemia status revealed that the provision of fortified biscuits to anaemic Vietnamese children increased their SPM scores by about twice as much as their counterparts that were not exposed to the meals. The researchers also found that, although receiving school meals significantly increased scores on digit span forwards, it did not significantly increase children's scores on digit span backwards, coding tests

[15] Representing a year of education by 12-month calendar year

[16] Raven's standardized progressive matrices test is a measure of fluid intelligence or problem-solving ability. It is a cognitive function test that measures the ability to develop new insights and information from what is already perceived or known.

[17] "The digit span backward test assesses working memory for auditory information and the digit span forward assesses children's auditory attention span and the ability to focus on auditory information" (Nga *et al.* 2011, page 335).

(subset of intelligence tests that measure visual processing speed and non-verbal short-term memory) and block design tests (subset of intelligence tests that measure motor and spatial visualization skills).

Evidence on school feeding and education from systematic reviews

39. Best *et al.* (2011) reviewed 12 studies (6 clinical controlled trials, 5 RCTs and 1 non-randomized controlled before-and-after study) that evaluated the effect of providing MMN-fortified (minimum of three micronutrients) food on the micronutrient status, growth, health and cognition of school-age children. Of the 12 studies, 11 were conducted in low- and lower-middle income countries, and the interventions were school-based in the same number of studies. Seven of the studies explored the impact of MMN-fortified foods on cognition, compared with unfortified foods; four also investigated the effect on academic performance. The review showed that MMN-fortified foods consistently had a positive impact on cognitive abilities relating to working memory, while the results for other domains of cognition and academic performance were equivocal.

40. Jomaa *et al.* (2011), in a systematic review of the impacts of SFPs on children's health and educational outcomes in developing countries, examined 15 papers including 1 Cochrane review and 12 studies conducted in 7 countries (Bangladesh, Colombia, India, Jamaica, Kenya, Peru and South Africa), published between 1990 and 2009. The review indicated that almost all the modalities of SFPs had a positive impact on enrolment and attendance. However, there were mixed results from the reviewed literature on the effect of SFPs on educational achievement (measured by scores in maths and literacy tests) and cognition. The authors concluded that in low- and lower-middle-income countries, where malnutrition and school dropout rates are known to be high and school enrolment is likely to be low, SFPs can be instrumental in improving schooling and learning outcomes.

41. The most comprehensive systematic review that critically examined the impact of different interventions on access to education and learning outcomes across LMICs (Snilstveit *et al.* 2015) had similar conclusions to that made by Jomaa *et al.* (2011). The review included 238 studies, of which 16 studies (7 randomized trials, 9 quasi-experimental) in 21 different papers evaluated the effect of school feeding interventions on education. The studies reviewed were conducted in 14 countries (Argentina, Burkina Faso, Cambodia, Chile, China, Guyana, India, Jamaica, Kenya, Lao PDR, Peru, Philippines, Senegal and Sri Lanka), targeted at primary schoolchildren, and all included the provision of an in-school feeding intervention. The meta-analysis showed substantial variability in the estimates of the impact of school feeding on schooling and learning outcomes across contexts, and that observed impacts appear larger in contexts with high food insecurity and low baseline school participation. The review also found that SFPs had the potential to improve both school participation and learning outcomes.

4.2 HEALTH AND NUTRITION

42. Out of the 12 studies included in this review, 10 examined the impact of school feeding interventions on health and nutrition outcomes. These 10 studies were published in 13 articles (Adelman *et al.* 2019; Gelli *et al.* 2019; Kuong *et al.* 2019; Perignon *et al.* 2016; De Gier *et al.* 2016; Singh *et al.* 2014; Kazianga *et al.* 2014; Hieu *et al.* 2012; Abizari *et al.* 2012; Buttenheim *et al.* 2011; Nga *et al.* 2011; Nga *et al.* 2009; Osei *et al.* 2010) and focused on outcome areas ranging from micronutrient status at the biochemical level to anthropometric measures of growth.

Micronutrient status (biochemical)

43. Seven studies (in ten publications) investigated the effect of SFPs on micronutrient status (at the biochemical level) and the prevalence of micronutrient deficiency (at the population level). The most common measures reported were iron status and prevalence of anaemia. The study duration ranged from four months to two years, and while some specifically targeted younger children (6–10 years), others targeted all plausibly primary school-age children (6–17 years) to allow for complete assessment in settings where delays in primary schooling, grade repetitions and returned dropouts are not uncommon. Table 2 in Appendix D includes details of the effect sizes and significance levels of the estimates reported for micronutrient status in the studies.

44. **Iron status:** Haemoglobin concentration (in g/litre), plasma/serum ferritin (in µg/litre), body iron (in mg/kg of body weight) and transferrin receptor (in mg/litre) were the four biochemical measures of iron status reported in the included studies. All the five studies in eight articles ([6], [7], [8], [12], [13], [15], [16], [17] in Appendix E) that reported at least one measure of biochemical iron status recorded that the provision of (single-micronutrient or MMN) fortified school meals or snacks significantly improved the biochemical iron status. Hieu *et al.* (2012), in a six-month study examining the effect of the provision of fortified biscuits to Vietnamese schoolchildren in comparison with iron supplementation or non-fortified biscuits (placebo), found that, on average, there was no significant difference between the biochemical iron status of children receiving iron supplementation and those receiving fortified biscuits. Abizari *et al.* (2012) recorded a significant positive effect on all measures of iron status in a seven-

month study of the effect of whole cowpea meal fortified with NaFeEDTA[18] provided as in-school meals to Ghanaian schoolchildren. One of the studies ([16]) examined the impact of school meals with or without deworming and showed that iron status increased with the provision of MMN biscuits to children (with or without) deworming but deworming alone had no impact on the iron status of the schoolchildren. Osei *et al.* (2010) found that, after a year of implementation, community-level micronutrient fortification of school lunch meals had a positive impact on body iron and plasma/serum ferritin but had no significant effect on haemoglobin concentration and transferrin receptors.

45. **Vitamin A and zinc status:** All three studies ([12], [15], [17] in Appendix E) that investigated the impact on vitamin A status of schoolchildren (at the biochemical level) reported that provision of fortified meals increased the plasma/serum retinol (vitamin A) concentration to as high as 0.16µmol/litre. Hieu *et al.* (2012) reported that the vitamin A concentration was significantly higher only for children that were vitamin A-deficient at baseline and that iron supplementation did not have an impact on the vitamin A status. Two studies ([6], [16]) found that the provision of MMN-fortified school meals increased the plasma/serum zinc concentration of schoolchildren by 0.6–1.4µmol/litre on average, while two other studies ([12], [17]) did not find any significant effect.

46. **Folate, vitamin B12 and iodine status:** Two studies ([6], [17] in Appendix E) evaluated the impact of fortified school meals on the biochemical concentration of folate, while one study each did the same for vitamin B12 ([17]) and iodine ([16]). The studies concluded that fortified school meals significantly increased the concentration of serum folate, serum vitamin B12 concentration and urine iodine excretion.

Effect on micronutrient status (prevalence of deficiency)

47. **Anaemia prevalence:** Of the seven studies that assessed the impact of the provision of fortified school meals to schoolchildren, three studies ([1], [12], [16] in Appendix E), with a duration ranging from 4 months to 15 months, found that the meals significantly reduced the prevalence of anaemia by up to 27 pp, while four studies ([7], [13], [14], [17]), implemented over 7 months to 2 years, found no significant effect of the meals on the prevalence of anaemia. Adelman *et al.* (2019) in a 15-month RCT in Uganda found that both in-school meals and THR were equally effective in reducing anaemia prevalence in adolescent girls (10–13 years). Hieu *et al.* (2012) reported that, while the consumption of fortified biscuits reduced the prevalence of anaemia, iron supplementation surprisingly had no significant effect on the prevalence of anaemia. Abizari *et al.* (2012) reported that fortified meals reduced both iron deficiency anaemia (IDA) and iron deficiency (ID), by 47 percent and 30 percent respectively. Similarly, the evidence from Hieu *et al.* (2012) suggests that iron deficiency significantly reduced in those who received daily fortified biscuits or weekly iron supplementation; there was no significant effect on iron deficiency anaemia.

48. **Vitamin A and zinc deficiency:** Two studies each, evaluated the impact of fortified school meals on vitamin A and zinc deficiency. Abizari *et al.* (2012) and Kuong *et al.* (2019) found that the provision of fortified school meals to schoolchildren significantly reduces their odds of having zinc deficiency. For vitamin A deficiency, Kuong *et al.* (2019) reported that fortified rice results in a significantly lower prevalence of marginal vitamin A status, but Nga *et al.* (2009) found that neither provision of fortified biscuits nor deworming had a significant effect on vitamin A deficiency.

49. Of the 12 studies in the systematic review by Best *et al.* (2011), 10 investigated the effect of MMN fortification of foods on the micronutrient status or prevalence of micronutrient deficiencies in school-age children compared with unfortified foods. The review showed that, except for zinc, the provision of MMN fortified foods to school-age children consistently had a positive impact on their micronutrient status. Similarly, the review conducted by Jomaa *et al.* (2011) appears to conclude that school feeding positively impacts on schoolchildren's energy intake and micronutrient status.

Body growth and composition

50. Unlike micronutrient status, where the available evidence is reasonably conclusive on the positive impacts of school feeding interventions, the evidence on the impact of SFPs on body growth and composition is mixed and exhibits marked heterogeneity. Seven of the included studies (published in seven papers) explored the impact of SFPs on body growth and composition using the anthropometric measures recommended by WHO. The most reported outcome measures were the weight-for-age Z-scores (WAZ) and height-for-age Z-scores (HAZ). Other anthropometric indicators reported in the studies include weight-for-height Z-scores (WHZ) and BMI-for-age Z-scores (BAZ). Table 3 in Appendix D includes details on the effect sizes and significance levels of the estimates reported for growth and body composition in the studies.

[18] Sodium iron ethylenediaminetetraacetic acid (NaFeEDTA) is a form of iron fortificant used in the fortification of cereals and legumes.

51. Two studies (Nga et al. 2011; Osei *et al.* 2010) assessed the impact of SFPs on weight and height gains of school-age children and found no significant effect. Gelli *et al.* (2019) found that the provision of school meals for about two years led to a significant increase in HAZ, by up to 0.27 SD, but only in children aged 5–8 years, girls and pupils from poor households, while another study ([6] in Appendix E) found that provision of school meals to schoolchildren for about six months resulted in a 0.64 SD increase in HAZ in children previously exposed to drought but had no significant impact on HAZ in children not affected by drought. Four other studies ([10], [12], [15], [17]), ranging from four months to one year in duration, reported null effect.

52. Only two out of six studies investigating the effect of school feeding intervention on WAZ reported somewhat positive effects. A six-month quasi-experiment ([9]), investigating the effect of the midday meals in Andhra Pradesh state in India, found that in-school meals increased WAZ in young schoolchildren(4–6 years) by 0.60 SD. Further analysis, however, showed that the scores increased significantly only in children affected by drought earlier in life, and mainly in those who had experienced drought within the immediate 13 months before the survey. Kazianga *et al.* (2014) recorded similar positive results among children aged 6–15 years, in an evaluation of two SFPs in Burkina Faso. The researchers found that in-school meals increased WAZ by 0.21 SD, but further analysis showed that the effect was only significant for boys; THR had no significant effect on WAZ in schoolchildren. Conversely, THR increased WAZ in younger siblings by 0.45 SD, while in-school meals had no significant effect on WAZ in younger siblings. The four other studies ([12], [14], [15], [17]) that appraised the impact of SFPs on WAZ in school-age children did not find any significant effect.

53. Three studies ([12], [15], [17]) found that school feeding interventions did not significantly influence WHZ in schoolchildren. Hieu *et al.* (2012) further showed that the provision of weekly iron supplements for six months did not have any effect on WHZ either. One study ([10]) reported that, after a year of intervention, in-school meals did not significantly impact WHZ scores in primary schoolchildren in Burkina Faso, but THR caused an average increase of 0.35 SD in WHZ, although this was significant only for boys and not for girls.[19] Only Gelli *et al.* (2019) estimated the impact of school feeding interventions on BAZ and recorded that the provision of school meals increased BAZ by 0.19 SD, but only in boys aged 5–8 years. Nga *et al.* (2011) attempted to quantify the effect of school feeding interventions on MUAC and skinfold thickness, and found that the provision of fortified meals or deworming had a very small but significant effect of increasing MUAC by 0.07–0.08cm, after four months of intervention. On the other hand, neither fortification nor deworming significantly had an effect on skinfold thickness. Two studies (Nga *et al.* 2011; Osei *et al.* 2010) investigated the impact of school feeding interventions on the prevalence of stunting, wasting and underweight, and found no effect of SFPs on these measures.

Infection and morbidity

54. De Gier *et al.* (2016) and Nga *et al.* (2011) gauged the effect of school feeding interventions on helminthic infestations. Nga *et al.* (2011), in the study of deworming and consumption of MMN-fortified biscuits in rural Vietnamese schoolchildren, found that fortified biscuits alone did not have any significant effect on the odds of having helminthic infestations (Ascaris, Trichuris and hookworm) and that, as expected, deworming reduced the odds of having an Ascaris or Trichuris infection by about a half. Surprisingly, there appeared to be a synergistic effect of fortified biscuits and deworming on worm infestations. For the children not infected with Ascaris at baseline, only 15 percent in the deworming plus fortified biscuits group, compared with 49 percent in the deworming only group, had an Ascaris infection at the end of the intervention – 4 months later. Even for the infected children, those who received deworming and fortified biscuits had a significantly lower parasite load for Ascaris or Trichuris infection compared with those who received fortified biscuits only or deworming only. No difference in the prevalence of hookworm was recorded.[20] In the same vein, the results of the study by De Gier *et al.* (2016) suggest that there might be a significant multiplicative effect of bundling provision of fortified meals or snacks and deworming. The study found that the odds of new hookworm infections increased in children receiving any fortified rice, relative to children receiving regular rice. This is probably because the increased body micronutrient concentration in children receiving fortified rice might promote the rapid growth of hookworms, especially in contexts where the children are repeatedly exposed to a high dosage of hookworm eggs and larvae in the environment. Further analysis showed that the odds of new hookworm infections were almost three times higher for children in schools with a greater than 15 percent hookworm prevalence at baseline.

55. In sum, the provision of fortified meals or snacks to schoolchildren does improve their micronutrient status, biochemically. However, the impact on physical growth and the prevalence of micronutrient deficiencies is

[19] The authors posited that the dynamics of intra-household reallocation of THR might be the reason for the effect being significant for boys and not for girls. The author theorized that families probably redistributed the food resources from THR towards (a) healthier children, and (b) boys, both of whom are also more likely to be enrolled in schools.

[20] The sample size for hookworm parasite estimation was quite small, with significant standard errors. It appears that hookworm infestation might not be common in the context of the study.

inconclusive, probably because of the marked heterogeneity in the contexts, duration, school feeding modality and dietary content of the meals/rations provided in the studies. Few studies also suggest that there might be a significant synergistic effect of bundling SFPs and deworming. None of the included studies evaluated the effect of SBPs on dietary intake, dietary diversity and healthy dietary behaviour.

4.3 HOUSEHOLD ECONOMY AND SOCIAL PROTECTION

56. Six of the included studies (published in seven papers) attempted to evaluate the effect of school feeding on the household economy and social protection using different outcome measures. Evidence generation on the impact of school feeding on household economy and social protection outcomes seems to be an emerging research area and seems to be gaining traction among researchers in recent years; papers on four of the six studies were published within the past two years. Table 4 in Appendix D contains details on the effect sizes and significance levels of the estimates reported for household economy and social protection outcomes in the studies.

57. Aurino *et al.* (2018), Aurino *et al.* (2019) and Kazianga *et al.* (2012) measured the effect of SFPs on children's time use – a measure of child labour. The first study reported that in-school meals did not significantly affect a child's participation in farm or productive work, but reduced the time spent on house chores by about 20 minutes per day for pupils from poor households in Ghana. In a similar vein, comparing two modalities of SFPs in Burkina Faso, Kazianga *et al.* (2012) discovered that, after a year of intervention, THR (conditional on enrolment) decreased children's productive labour participation by 21 percent, while in-school meals had no significant effect. Conversely, Aurino *et al.* (2019) in Mali found that the provision of in-school meals reduced the time spent on farm or productive tasks by almost a month for girls, while GFD increased participation of boys in farm labour and house chores.

58. Singh *et al.* (2014) attempted to measure the impact of school feeding as a social safety net. The researchers found that the provision of in-school feeding resulted in a 0.64 SD increase in HAZ in children affected by drought in the past four years, but there was no significant impact of the meals on children not affected by drought. The impact on catch-up growth measured by HAZ was more salient when heterogeneities by the timing of the drought exposure were analysed. There was an increase in HAZ scores by almost 1 SD for children who were exposed to drought earlier (more than 18 months ago) and no significant effect on those who were exposed more recently (within the last 13 months); a similar trend of increase in WAZ by about 0.5 SD was observed. This paper is one of few providing evidence on the impact of school feeding as a social protection tool in the event of an economic shock.

59. Three studies used the nutritional status, educational outcomes and anaemia prevalence of other household members as proxies to estimate the effect of school feeding on household redistribution or reallocation of resources. Kazianga *et al.* (2014) found that WAZ increased among the younger siblings (under 5 years of age) of THR recipients; Chakraborty and Jayaraman (2019) found that maths and reading scores improved for ineligible children whose siblings received midday meals in India; Adelman *et al.* (2019) found that the prevalence of moderate-to-severe anaemia in adult women and children under 5 years reduced in clusters exposed to school meals interventions (either THR or in-school meals) in Uganda. This evidence suggests that there is probably some redistribution of resources occurring at the household level.

4.4 AGRICULTURE AND LOCAL ECONOMY

60. None of the included studies evaluated the impact of school feeding interventions on agriculture and local economy outcomes. However, the protocol by Gelli *et al.* (2016), which delineates the rationale, design and baseline data analysis of the impact evaluation of the Ghana HGSF pilot, suggests that there is ongoing research in this area. According to the protocol, the researchers will conduct the study in all ten regions in Ghana, using a three-year phased-in cluster RCT design. The study has three arms – a control group where the intervention will not be implemented until after three years; a regular SFP group where it is business as usual with caterers responsible for the procurement and preparation of the school meals; and an HGSF+ group which has the regular SFP plus an additional integrated community-level package aimed at enhancing the impact on poverty and food insecurity. The "plus" component will focus on stimulating the local economy by supporting the school feeding supply chain to purchase food from smallholder farmers and also to include activities geared towards improving the nutritional quality of the school meals. In addition to measuring education, nutrition and health, and household economy outcomes, the researchers planned to measure agriculture and local economy outcomes, such as farm outputs, farm income and price data for commodities. Endogenous complexities in agribusiness and agricultural value chains that affect supply and demand, such as the availability of microfinance or farming inputs for smallholder farmers, soil composition and weather seasonality, the prevalence of cash cropping, and the existence of outside markets, might make it challenging to tease out the impact of SFPs on agriculture and local economy outcomes.

4.5 GENDER AND OTHER SOCIALLY VULNERABLE GROUPS

61. Aside from gender subgroup analysis, which was reported in seven papers from five studies ([1], [2], [3], [4], [5], [10], [11] in Appendix E), the evaluation of impact along the lines of social vulnerabilities, such as poverty status, disability, geography-associated social disadvantage, and fragility, was uncommon in the included studies. Except for Chakraborty and Jayaraman (2019), all the studies found significant gender heterogeneity in the impact of school feeding interventions on educational outcomes, anthropometric measures of health and nutrition, and child labour.

62. The analysis in Adelman *et al.* (2019) was almost exclusively about girls and women and it concluded that SFPs have a significant effect on reducing anaemia prevalence in adolescent girls and other vulnerable household members, such as women aged 18 years or over and children aged 6 to 59 months. Aurino *et al.* (2019) in Mali found that the intensity of conflict in a fragile setting can affect the educational impacts of school feeding interventions. The results of the Ghana HGSF study, as presented by Aurino *et al.* (2018) and Gelli *et al.* (2019), suggest that gender, socioeconomic status and social geography can cause significant heterogeneity in the impact of SFPs; the study found that the school feeding intervention yielded more positive results for girls, poor pupils and pupils resident in the socially disadvantaged northern region of Ghana. Another study explored the impact of providing school meals on the physical growth of children affected by an economic shock (drought) and discovered that children with prior long-term exposure to the shock experienced significant age-standardized height gains compared with those with shorter-term exposure and those who were unaffected by drought (Singh *et al.* 2012).

4.6 COST, COST–BENEFIT AND COST-EFFECTIVENESS ANALYSIS

63. Out of the 12 studies, 5 reported the estimated costs (per child/year) of providing school meals, snacks or THR. The cost of in-school cooked meals ranged from US$10 in India (studies [3] and [9] in Appendix E) to US$41.46 in Burkina Faso ([10], [11]) and US$66 in Ghana ([4], [5]). The cost of THR was estimated at US$51.37 in Burkina Faso ([10], [11]), and fortified biscuits in Vietnam ([12], [15], [16]) at US$16[21] and US$11.95.[22] Chakraborty and Jayaraman (2019) conducted a cost–benefit analysis comparing the educational benefits of the midday meals scheme with the balsakhi (Banerjee *et al.* 2007) and contract teacher (Muralidharan and Sundararaman 2013) interventions. According to the authors' calculations, after two years of programme exposure, each extra dollar spent on the school meals scheme in India caused a 0.013 SD increase in reading scores and a 0.011 SD increase in maths scores. For each dollar spent, the contract teacher cost–benefit estimate is an increase of 0.022 SD and 0.024 SD in reading and maths scores, respectively, while that of the balsakhi programme is 0.027 SD and 0.050 SD increase in reading and maths scores, respectively. Both the balsakhi and contract teacher interventions yielded at least twice as large returns as the midday meals scheme, but the authors rightly cautioned that the benefits of SFPs are not limited to education, and, as such, the cost–benefit analysis for SFPs should not be limited to education alone either.

4.7 SCHOOL FEEDING IN EMERGENCIES

64. Limited rigorous evidence is available on the impact of school feeding interventions in humanitarian settings. From the context descriptions given by the authors, three of the included studies (published in four papers) were clearly implemented in a humanitarian setting. One study was implemented in the camps for internally displaced persons (IDPs) in northern Uganda in 2005–2006, against the backdrop of a protracted civil conflict (18 years) that was beginning to resolve (Adelman *et al.* 2019); the second was implemented during active conflict in Central Mali in 2012–2013 (Aurino *et al.* 2019), while the third was in the Sahel region of Burkina Faso that is prone to severe famine spells (Kazianga *et al.* 2014; Kazianga *et al.* 2012). The Burkina Faso and Uganda studies are RCTs, while the Mali study used a quasi-experimental approach. The studies assessed selected education, health and nutrition, and household economy outcomes.

65. Aurino *et al.* (2019) and Kazianga *et al.* (2012) reported on the impact of school feeding in emergency on education outcomes, and both studies measured enrolment and attendance/absenteeism. Both studies found that school feeding interventions significantly increased enrolment, but that there were mixed and largely heterogenous effects of school feeding on attendance/absenteeism. Aurino *et al.* (2019) evaluated grade attainment, while Kazianga *et al.* (2012) gauged the impact of school feeding on learning and cognition outcomes, in a humanitarian setting. Adelman *et al.* (2019) and Kazianga *et al.* (2014) investigated the impact of school feeding on health and nutrition outcomes in a humanitarian setting. Both studies did not report on a confluence measure of health impact. The first study investigated the impact of school feeding on anaemia prevalence among adolescent girls and other vulnerable members within the household, while the second study examined anthropometric measures.

[21] Estimated from US$0.08 per serving based on 200 school days.
[22] Conversion from Euros using €1 = US$1.18.

66. Three studies attempted to evaluate the impact of school feeding on household economy and social protection outcomes, in humanitarian settings. Kazianga *et al.* (2014) used the nutritional status of other household members as a proxy measure for household reallocation of resources, while Adelman *et al.* (2019) used the anaemia prevalence among other household members in the same way. Both Aurino *et al.* (2019) and Kazianga *et al.* (2012), however, investigated the impact of the SFP on child labour; results are mixed and heterogenous.

5. Conclusions and recommendations for future research and programme design

67. This review has provided insights into what appears to be fairly conclusive body of evidence on the impact of school feeding. At the same time, the review has exposed long standing questions for which there are inconclusive, mixed or no evidence at all. This section will, from the evidence base of the review literature, summarize what is known to work and highlight key questions for a school feeding programme impact evaluation, based on areas where evidence is non-existent, inconclusive or surprising.

68. **Education:** Evidence from the included studies posits, with a high level of confidence, that SFPs do improve enrolment and learning outcomes, especially in contexts where the schooling and learning outcomes are poor at baseline. The literature also suggests that school feeding is one of the very few child-level interventions that has the potential to improve both schooling and learning outcomes. However, the evidence is less conclusive on the impact of school feeding on attendance, and evidence on learning outcomes is not sufficiently standardized across studies. Available recent evidence suggests that the provision of either in-school meals or THR can lead to a reduction in attendance (among currently enrolled children) or not have any effect on attendance. The evidence also suggests that some components of the school health and nutrition package might work in complementarity with school feeding to improve attendance and potentially learning outcomes.

69. *Possible questions:* What is the optimal bundle of school-based programmes which works best to improve schooling and learning outcomes in complementarity with school feeding? Does varying the minimum attendance requirement for THR improve attendance? Does bundling some form of THR with in-school meals have a cost-effective positive impact on schooling and learning outcomes?

70. **Health and nutrition:** The review showed clearly that SFPs where MMN-fortified meals are provided improve the micronutrient status of the recipients and sometimes spill over to their families, especially in the case of THR. However, evidence suggests that provision of fortified school meals without adequate deworming in areas of high helminthic infection prevalence can lead to the unintended effect of increasing worm infestation in schoolchildren, and that the provision of fortified school meals and deworming together could have a synergistic impact on the health and nutritional status of a child.

71. *Possible questions:* What is the impact of combining deworming and school feeding on schoolchildren? What happens when a bundle of school feeding and water, sanitation and hygiene education in schools (WASH-in-school), or other school health and nutrition interventions, is provided? Does the effect vary by the type of school feeding modality – that is, in-school meals versus THR? What is the effect of school feeding on other common measures of child morbidity, such as diarrhoea prevalence? Do SFPs, or particular modalities of SFPs, have an impact on measures of growth?

72. **Household economy and social protection:** The evidence on the impact of school feeding as a social safety net is scarce in the literature, although the available and inferable evidence suggests that school feeding could be a valuable social assistance tool. Evidence also suggests that there is a partial redistribution of household resources as household members of children benefiting from school feeding do better on selected health and nutrition, and education outcomes. There is also mixed evidence on the effect of school feeding on child labour.

73. *Possible questions:* How does school feeding do on improving outcomes for schoolchildren, in comparison with other social safety nets or social assistance programmes, such as conditional cash transfers? How well does SFP "catch" the socially vulnerable? Does the effect as a social safety net vary by modality – that is, in-school meals versus THR? Does the effect of school feeding on child labour vary by modality? Which modality works to reduce child labour in what context? Which modality of school feeding is best suited for which environmental or economic shocks? What changes at the household level happen as a result of school feeding? Who in the household benefits more from the spillover effects of school feeding?

74. **Agriculture and local economy:** There was a dearth of evidence on the impact of school feeding on this area and it is an opportunity for a school-based programming impact evaluation.

75. *Possible questions:* In locations where HGSF is implemented, what is the impact on smallholder farmers, traders and other agribusiness microentrepreneurs? What is the impact of bundling agriculture and livelihoods interventions and school feeding programmes together?

76. **Gender and social vulnerability:** The evidence suggests that there are large gender and other social heterogeneities with respect to the impact of school feeding. Studies found that girls, poor pupils and those from socially disadvantaged backgrounds tend to benefit more from the SFPs. Evidence from longer-term studies, however, did not find gender differences.

77. *Possible questions:* How can targeting criteria for schools be made to effectively target the socially marginalized? Do girls exposed to an SFP marry at a much later date than those not exposed? Does the effect (if any) vary by modality? How does it compare with providing cash transfers? Are gender differences less salient in the longer term – for example, do parents become desensitized to the perceived marginal effect of school meals and revert to the status quo of boy preference?

78. **Other possible questions:** Does varying the timing of in-school meals (e.g. morning versus midday versus afternoon) have any effect on schooling and learning outcomes? Does varying the quantity of THR have an impact on outcomes and, if it does, to what extent? Will using community participatory approaches in designing and implementation affect the outcomes? In what WFP operational and geographical contexts are cooked meals more effective than take-home rations, and vice versa? What is the optimal attendance target for THR?

79. An important finding of this review is that the studies evaluating SFPs significantly varied in design, duration and outcome measures. As a result careful considerations are required when directly comparing effect sizes. Working with research institutions and other partners to develop research standards and guides for SFPs impact evaluation studies might reduce the wide variability observed between studies.

Appendices

5.1 APPENDIX A: LIST OF DATABASES SEARCHED

Database	Database link	Search strategy
1. ClinicalTrials.gov	https://clinicaltrials.gov/ct2/home	Keywords with applied filters – "completed" and age = "birth–17 years"
2. PubMed	https://pubmed.ncbi.nlm.nih.gov/	Keywords with applied filters – results year = 2009 to 2019; article type = "clinical trial", "meta-analysis", "randomized controlled trial", "systematic review"; age = "birth to 18 years"; language = "English"; species = "human"
3. International Standard Randomised Controlled Trial Number (ISRCTN) registry	isrctn.com	Keywords with applied filters – trial status= "completed"
4. AEA (American Economic Association) RCT Registry	https://www.socialscienceregistry.org/	Keywords with no filters
5. International Initiative for Impact Evaluation (3ie) development evidence portal; 3ie Registry for International Development Impact Evaluations (RIDIE)	https://www.3ieimpact.org/evidence-hub/publications; https://ridie.3ieimpact.org/	Keywords with filters for type of publications = "impact evaluations", "scoping papers", "systematic review summaries", "other evaluations", "systematic reviews," "working papers"
6. International Food Policy Research Institute publications	https://www.ifpri.org/publications	Keywords with filters for publication subtypes = "journal article", "discussion paper", "project paper", "miscellaneous" and "working paper" and filter for language = "English"
7. World Food Programme publications	https://www.wfp.org/publications	Keyword (school feeding) with filters for publication type = "Impact Evaluation"
8. Open Knowledge Repository – World Bank publications	https://openknowledge.worldbank.org/discover	Keyword (school feeding) search refined by document language = "en", publication type = "Publications & Research", year = "2009" to "2019"
9. Abdul Latif Jameel Poverty Action Lab (J-PAL) evaluations database	https://www.povertyactionlab.org/evaluations	Keywords search in "search titles" with no additional filters

Database	Database link	Search strategy
10. Innovations for Poverty Action (IPA) database	https://www.poverty-action.org/search-studies	Keywords search in "search terms" with no additional filters
11. ALNAP HELP (Humanitarian Evaluation, Learning and Performance) Library	https://www.alnap.org/help-library	Keyword (school feeding) search with filters resource type = "impact evaluation" + "meta/synthesis evaluation"; from start of 2009-01-01 to end of 2019-12-31
12. EconPapers (RePEc dataset)	https://econpapers.repec.org/scripts/search.pf	Keywords and title search using both keywords with filters restricting to journals and working papers
13. OpenDocs – Institute of Development Studies (IDS) Research Repository	https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/1	Keywords search by "exact phrase" in "monitoring and evaluation" category
14. Resource bank for home grown school feeding http://hgsf-global.org/ (hosted and managed by Partnership for Child Development)	http://hgsf-global.org/en/bank/downloads/search_result[23]	Search for keyword (school feeding), filter date issued to be "[2009 TO 2019]"
15. Embase via the Cochrane Library	https://www.cochranelibrary.com/advanced-search/	Filter source = "Embase" from Cochrane search results
16. Cochrane Library	https://www.cochranelibrary.com/advanced-search/	Title Abstract Keyword search for keywords (school feeding and "school meal); Word variations search included; publication date for reviews and trials between January 2009 and December 2019
17. Manual search of similar articles in PubMed, included systematic reviews and Bundy ***et al.*** (2018)	N/A	N/A

[23] This webpage no longer in existence as at this document was being finalized. However, the archived contents of the page can be accessed via https://web.archive.org/web/20200609160419/http://hgsf-global.org/en/bank/downloads

5.2 APPENDIX B: SUMMARY OF SCHOOL FEEDING INTERVENTION MODALITIES EVALUATED IN INCLUDED STUDIES

	Study	School feeding modality/treatment	Description of modality/treatment	Comparison and method
(1)	Adelman *et al.* (2019)	In-school feeding (cooked meals) Take-home rations (THR)	In-school feeding provided 1,049 kcal of energy, 32.6 g protein and 24.9 g fat per child per school day in the form of porridge made from fortified corn–soya blend given to the children in the morning and beans and maize meal or rice at lunch. The THR provided equivalent energy, fat, protein and micronutrient content but was distributed monthly to an adult female household member conditional on the child fulfilling an 85% school attendance requirement in the previous month. The blend was fortified to meet at least two-thirds of the child's daily vitamin and mineral requirements, including 99% of iron requirements.	No school-based food assistance; however, households (in camps) received fortified general food distribution (GFD) equivalent to 50–75% of the household's caloric needs. (RCT)
(2)	Aurino *et al.* (2019)	In-school feeding General food distribution (GFD)	In-school feeding provided two daily meals: a porridge of super cereal in the morning, and hot lunches of cereals, pulses and vegetable oil, complemented with local condiments. GFD consisted of a household ration of cereals, pulses, vegetable oil and salt, along with fortified super cereal expected to provide 2,100 kcal per person per day.	No food assistance (Quasi-experimental)
(3)	Chakraborty and Jayaraman (2019)	In-school feeding	Depending on the local staple, cooked rice or wheat, mixed with lentils or jaggery, and sometimes supplemented with oil, vegetables, fruits, nuts, eggs or dessert, are served to children at midday every school day.	No school feeding (Quasi-experimental)
(4)	Gelli *et al.* (2019)/Aurino *et al.* (2018)	In-school feeding	Free, hot meals were provided to schoolchildren every school day. Contracted local caterers were in charge of procuring food ingredients from the market, preparing the school meals and serving food to pupils.	No school feeding (RCT)

	Study	School feeding modality/treatment	Description of modality/treatment	Comparison and method
(5)	Kuong *et al.* (2019)/Perignon *et al.* (2016)/De Gier *et al.* (2016)	Fortified rice of different formulations	Three formulations of fortified rice were included in the study: 1. Fortified cold-extruded rice UltraRice original formulation (URO), which contained iron, zinc, vitamin B1 and folic acid; 2. Fortified hot-extruded rice UltraRice new formulation (URN), with all that was in URO + vitamin A, vitamin B3 and vitamin B12; 3. Fortified hot-extruded rice (Nutririce) – with all that was in URN + vitamin B6.	Non-fortified rice (RCT)
(6)	Singh *et al.* (2014)	In-school feeding	A cooked meal containing no less than 300 kcal and including 8–12 g of protein was provided to schoolchildren every school day.	No school meals (Quasi-experimental)
(7)	Kazianga *et al.* (2014, 2012)	In-school feeding Take-home rations (THR)	In the in-school feeding intervention, both boys and girls were served lunch on each school day conditional on attendance. For the THR intervention, however, 10 kg of cereal flour was distributed to girls monthly, provided that 90% attendance requirement was met.	No food assistance (RCT)
(8)	Hieu *et al.* (2012)	Fortified biscuits Non-fortified biscuit + iron supplementation	A serving of the fortified biscuits was a daily ration of five biscuits (approximately 30 g), providing an energy value of about 627 kJ, which was formulated to cover: 50% of the Recommended Nutrient Intake (RNI) of a 9-year-old child for vitamin A, iron, zinc and iodine; 40% of the requirements for copper, vitamin C, thiamin, riboflavin, vitamins B6, B12, E and niacin; 35% of the requirements for magnesium; 20% of the requirements for calcium, vitamin D and folate; and 7% of the requirements for manganese, selenium, potassium, chloride, sodium, fluoride, pantothenic acid, vitamin K and biotin. For the iron supplementation, children weighing less than 20 kg received a 30 mg tablet/week, and those weighing 20 kg or more received a 40 mg tablet/week.	Non-fortified biscuit or iron supplementation (RCT)

	Study	School feeding modality/treatment	Description of modality/treatment	Comparison and method
(9)	Abizari *et al.* (2012)	Cowpea meal fortified with 10mg of iron per meal as sodium iron ethylenediaminetetraacetic acid (NaFeEDTA)	The cooked weight of a single portion of the cooked cowpea meal was approximately 150 g, which was served with around 30 g of sauce made of 16 g groundnut oil, salt, fried onions and chilli, and 12 g of Bungu or false sesame seeds (*Ceratotheca sesamoides*). The total caloric content of the meal was about 430 kcal.	Non-fortified cowpea meal (RCT)
(10)	Buttenheim *et al.* (2011)	In-school meal Take home rations (THR) In-school meal and THR	THR was to be conditional on at least 80% of school attendance and provided to both girls and boys. The THR provides15 kg of rice upon enrolment, 30 kg of rice to the targeted beneficiaries, at the end of the school year, conditional on meeting an 80% minimum attendance requirement. In addition to the rice, one can of fish was given to the beneficiary each month if attendance was 80% or more for that month. For the in-school meal provision, each ration is intended to provide 100 g of corn–soya blend and 12.5 g of sugar daily for each school day, with a target of 83 feeding days per term.	No school meals or THR (Quasi-experimental)
(11)	Nga *et al.* (2011, 2009)	Multi-micronutrient (MMN) fortified biscuit MMN-fortified biscuit + deworming Deworming	One serving of the fortified biscuits consisted of five biscuits and provided 556.5 kJ (133 kcal) of energy. The micronutrient formulation fulfilled ≥50% of Recommended Nutrient Intake (RNI) requirements for children 7–9 years old for iron, zinc, vitamin A and the B vitamins, and 10–40% of the RNI for iodine, vitamins E and K, and other nutrients.	Non-fortified biscuit (RCT)
(12)	Osei *et al.* (2010)	In-school meals + micronutrient premix	The standardized meal menu consisted mainly of rice and dhal or vegetables, aimed at providing each child with at least 1,884 kJ and 12 g protein, per day. The premix was added to this standardized meal.	In-school meals + placebo (RCT)

5.3 APPENDIX C: OUTCOME AREAS AND IMPACT MEASURES REPORTED BY INCLUDED STUDIES

Area	Outcome	Impact measures	# of studies reporting measure
Education (6 studies in 6 publications)	Schooling	Enrolment	4
		Attendance/Absenteeism	3
		Grade attainment	2
		Dropout	0
	Learning	Maths	3
		Reading/Literacy	2
	Cognition	Raven's Standardized/Colored Progressive Matrices	3
		Digit span	3
		Coding	1
		Block design	1
Health and nutrition (10 studies in 13 publications)	Anthropometry and growth	Weight gain	2
		Height gain	2
		Height-for-age Z-scores (HAZ)	6
		Weight-for-age Z-scores (WAZ)	6
		Weight-for-height Z-scores (WHZ)	4
		BMI-for-age Z-scores (BAZ)	1
		Middle upper arm circumference (MUAC)	1
		Skinfold thickness	1
	Micronutrient and health status (biochemical)	Iron status – haemoglobin concentration	5[24]
		Iron status – plasma/serum ferritin	5
		Iron status – body iron	5
		Iron status – transferrin receptor	5
		Zinc status – plasma zinc concentration	4
		Vitamin A status – plasma retinol concentration	3
		Folate status – serum folate concentration	2
		Vitamin status – serum vitamin B12 concentration	1
		Iodine status – urine iodine excretion	1
	Micronutrient deficiency	Anaemia	7
		Iron deficiency anaemia	2
		Iron deficiency	2
		Vitamin A deficiency	2
		Zinc deficiency	2
		Folate deficiency	1
		Iodine deficiency	1
	Nutritional status	Prevalence of underweight	2
		Prevalence of stunting	2
		Prevalence of wasting	1
		Total energy intake/dietary intake	0
		Dietary diversity	0
	Infection	Helminthic infestations	2

[24] Two additional studies did not report the effect of interventions on haemoglobin concentrations, although haemoglobin was measured and anaemia prevalence was reported.

Area	Outcome	Impact measures	# of studies reporting measure
Household economy and social protection (6 studies in 7 publications)	Intra-household reallocation/redistribution of resources	Nutritional status of other HH members (as proxy)	1
		Educational outcomes of siblings (as proxy)	1
		Anaemia prevalence among other HH members (as proxy)	1
		Household dietary diversity	–
		Household food and non-food expenditure	–
	Prevention or mitigation of social and economic risks	Child time use (any task, arm/productive, house chores)	2
		Nutritional status of shock (drought)-affected children	1
Agriculture and local economy		None of the included studies measured agriculture and local economy outcomes	–

5.4 APPENDIX D: TABLES OF EFFECT SIZES AND SIGNIFICANCE LEVELS

Table 1: Effect sizes and significance levels for education outcomes

Author		Aurino *et al.* (2019)	Chakraborty and Jayaraman (2019)	Aurino *et al.* (2018)	Kazianga *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2009; 2011)
Intervention duration		***5 years***	***5 years***	***2 years***	***1 school year***	***1–2 years***	***4 months***
Schoolchildren's age (years)		***7–16***	***6–10***	***5–15***	***6–15***	***6–14***	***6–8***
Impact on:	Enrolment	SM: +10 pp** (+11.2pp^{NS} for girls; +11.3pp** for boys) GFD: +3 pp^{NS} Any food assistance: +5.2pp^{NS} (+12 pp** if AG are in commune)	–	+2.7pp^{NS} (+ 4.2 pp* for girls; + 5.3 pp**for poor pupils; +7.6 pp** for pupils in the disadvantaged northern region)	SM: +3.9 pp** THR: +4.8 pp***	SM: +4.8 pp* THR: +7.2 pp*** SM + THR: +3.3^{NS}	–
	Attendance/ Absenteeism (Conditional on enrolment)	In a 5-day period: SM: -0.05^{NS} days absent GFD: +0.6*** days absent (+0.4^{NS} days absent for girls; +0.9*** days for boys). +0.4** days absent if there are AG in the commune, + 0.8*** if AG are in commune or in the village.	–	+0.04^{NS} days attended school in a 5-day period	In a 20-day period: SM: -0.85** days attended (-0.57^{NS} for boys; -1.12*** for girls) THR: -0.48^{NS} (+0.01^{NS} for boys; -1.09*** for girls)	–	–
	Grade attainment	SM: + 0.5*** additional years of education (+0.6** for girls; +0.5** for boys) GFD: -0.2 years (NS)	–	0.145* additional grade completed (NS by gender or poverty status; + 0.223* for northern pupils)	–	–	–
	Maths scores	–	+9% (0.09 SD) ***	+0.147* SD (+0.242*** for girls; +0.309*** for poor pupils; +0.253* for northern pupils; +0.161** for younger pupils (6 to 11 years))	SM: +9.6% (+11.3%*** for girls; +7.9%* for boys) THR: +8.4%** (+7.3%^{NS} for boys; +9.4 %** for girls)	–	–
	Literacy/Reading scores	–	+18% (0.17 SD) ***	+0.132* SD (+0.205** for girls; +0.233** poor pupils; +0.243** for northern pupils; +0.132* for younger pupils)	–	–	–
	Raven's Progressive Matrices	–	–	+0.129** SD (0.116^{NS} for girls, +0.234*** SD for poor pupils; +0.212** SD for northern pupils; 0.128** SD for younger pupils)	SM: +0.095 SD (NS) THR: +0.101 (NS)	–	FB: +0.86** points (+1.86*** for children that were anaemic at baseline)

Author		Aurino *et al.* (2019)	Chakraborty and Jayaraman (2019)	Aurino *et al.* (2018)	Kazianga *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2009; 2011)
Intervention duration		***5 years***	***5 years***	***2 years***	***1 school year***	***1–2 years***	***4 months***
Schoolchildren's age (years)		***7–16***	***6–10***	***5–15***	***6–15***	***6–14***	***6–8***
							Deworming: -0.18 (NS)
	Digit span	–	–	+0.119* SD (+0.190** SD for girls; +0.269*** SD for poor pupils; +0.253*** SD for northern pupils; +0.113* SD for younger children)	NS^^	–	Digit span (forward) – FB: +0.34*** more items recognized Deworming: +0.07 (NS) Digit span (backwards) – FB: 0.07 (NS) Deworming: -0.03 (NS)
	Coding	–	–	–	–	–	FB: +0.50 (NS) Deworming: +0.54 (NS)
	Block design	–	–	–	–	–	FB: -1.12 (NS) Deworming: 0.54 (NS)

Notes: Stars are included as superscript to indicate the level of significance of the effect size reported: no stars or ^{NS} = Non-significant effect size; * = effect size significant at <10% level; ** = effect size significant at <5% level; *** = effect size significant at <1% level.
Abbreviations: AG – armed groups; CG – control group; GFD – general food distribution; FB – fortified biscuits; FFE – food for education programme; NS – not significant; NS^^ – non-significant effect size was not stated in the article; pp – percentage points; SD – standard deviation; SM – In-school meals; SUP – iron supplementation; THR – take-home rations; TG – treatment group.

Table 2: Effect sizes and significance levels for health and nutrition outcomes (micronutrient status and deficiencies)

	Author	Adelman *et al.* (2019)	Kuong *et al.* (2019); Perignon *et al.* (2016); De Gier *et al.* (2016)	Hieu *et al.* (2012)	Abizari *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2009; 2011)	Osei *et al.* (2010)
Intervention duration		***15 months***	***6 months***	***6 months***	***7 months***	***1–2 years***	***4 months***	***1 school year***
Schoolchildren's age (years)		***6–17***	***6–16***	***6–9***	***5–12***	***6–14***	***6–8***	***6–10***
Impact	Iron status (haemoglobin concentration (in g/litre))	–	+1.2* to 1.8** in children with no baseline inflammation	FB: ≈ +3.0** (+8.0*** for vitamin A-deficient pupils at baseline; +2.0	+3.5***	–	FB: +1.87*** Deworming: +0.50 (NS)	+0.7 (NS)

	Author	Adelman *et al.* (2019)	Kuong *et al.* (2019); Perignon *et al.* (2016); De Gier *et al.* (2016)	Hieu *et al.* (2012)	Abizari *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2009; 2011)	Osei *et al.* (2010)
Intervention duration		*15 months*	*6 months*	*6 months*	*7 months*	*1–2 years*	*4 months*	*1 school year*
Schoolchildren's age (years)		*6–17*	*6–16*	*6–9*	*5–12*	*6–14*	*6–8*	*6–10*
				(NS) for vit A-replete children) SUP: +2.0 (NS)				
	Iron status (plasma/serum ferritin concentration in µg/litre)	–	+8.3*** to 10.7***	FB: +2.5*** SUP: +11.6***	+7.8***	–	FB: +7.5*** Deworming: +2.8 (NS)	+1.9^{NS} (although significant increase from baseline (+6.1**) in TG but not CG)
	Iron status (body iron in mg/kg body weight)	–	-0.06 to +0.11 (NS)	FB: +1.4*** SUP: +1.9***	+1.3***	–	FB: +0.56*** Deworming: +0.18 (NS)	+22.9** µmol/kg
	Iron status (plasma/serum transferrin receptor in mg/litre)	–	+0.66*** to 0.89***	FB: -0.2** SUP: -0.4*	-1.2***	–	FB: -0.139 (NS) Deworming: -0.089 (NS)	-0.1 (NS)
	Vitamin A (plasma/serum retinol concentration in µmol/litre)	–	–	FB: +0.03^{NS} (+0.13** for vitamin A-deficient children at baseline) SUP: +0.05^{NS} (+0.06 (NS) for vitamin A-deficient children at baseline)	–	–	FB: +0.041** Deworming: -0.011 (NS)	+0.1***
	Zinc (plasma/serum zinc concentration in µmol/litre)	–	+0.85*** to 1.4***	FB: +0.1 (NS) SUP: +0.9 (NS)	–	–	FB: +0.61*** Deworming: -0.048 (NS)	-0.1 (NS)
	Folate (serum folate concentration)	–	+2.25ng/mL***	–	–	–	–	+3.2nmol/litre***
	Iodine (urinary iodine excretion in µg/litre)	–	–	–	–	–	+22.49 µmol/litre* Deworming: +11.75 (NS)	–
	Vitamin B12 (serum vitamin B12 concentration in pmol/litre)	–	–	–	–	–	–	Inexplicably reduced in both TG and CG but children in the TG were 59%** less likely to have low serum vitamin B12 than those in the CG

Author		Adelman *et al.* (2019)	Kuong *et al.* (2019); Perignon *et al.* (2016); De Gier *et al.* (2016)	Hieu *et al.* (2012)	Abizari *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2009; 2011)	Osei *et al.* (2010)
Intervention duration		***15 months***	***6 months***	***6 months***	***7 months***	***1–2 years***	***4 months***	***1 school year***
Schoolchildren's age (years)		***6–17***	***6–16***	***6–9***	***5–12***	***6–14***	***6–8***	***6–10***
	Prevalence of anaemia	Any anaemia in adolescent girls (10–13 years): FFE: -26pp***- SM: 27pp*** THR: -24pp** Moderate to severe anaemia in adolescent girls (10–13 years): FFE: -19pp** SM: -21pp** THR: -18pp*	NS^^	FB: -9.4pp*** SUP: -3.0pp (NS)	-2.6% (NS)	SM: -3.5pp (NS) THR: -2.3pp (NS) SM + THR: -2.7pp (NS)	FB: -44% reduced odds of having anaemia Deworming: Adjusted OR – 0.95 (NS)	Adjusted OR: 0.67 (NS)
	Prevalence of iron deficiency anaemia (IDA) and iron deficiency (ID)	–	–	FB: -16.7pp*** (ID); -5.2pp^{NS} (IDA) SUP: -15.6pp***(ID); -3.1pp^{NS} (IDA)	-30%** (ID) -47%** (IDA)	–	–	–
	Vitamin A deficiency (odds ratio)	–	0.20*** to 0.24***	–	–	–	FB: 0.6 (NS) Deworming: 1.01 (NS)	0.57**
	Zinc deficiency (odds ratio)	–	0.16*** to 0.25*** Severe zinc deficiency: 0.28*** to 0.39***	–	–	–	FB: 0.52*** Deworming: 1.07 (NS)	1.2 (NS)
	Folate deficiency (odds ratio)	–	1.59 (NS)	–	–	–	–	0.47**
	Iodine deficiency (odds ratio)	–	–	–	–	–	FB: 0.53*** Deworming: 0.77 (NS)	–
	Helminthic infestation (odds ratio)	–	1.86*** (2.94*** for children in schools with >15% baseline hookworm prevalence)	–	–	–	FB: NS Deworming: 0.42*** to 0.50** for Ascaris and Trichuris infection, respectively	–

Author	Adelman *et al.* (2019)	Kuong *et al.* (2019); Perignon *et al.* (2016); De Gier *et al.* (2016)	Hieu *et al.* (2012)	Abizari *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2009; 2011)	Osei *et al.* (2010)
Intervention duration	***15 months***	***6 months***	***6 months***	***7 months***	***1–2 years***	***4 months***	***1 school year***
Schoolchildren's age (years)	***6–17***	***6–16***	***6–9***	***5–12***	***6–14***	***6–8***	***6–10***
						FB + deworming: -9.9pp** to -12.3pp** in prevalence of Ascaris and Trichuris infection, respectively, compared with deworming only group; -29.0pp** to -24.1pp** compared with control	

Notes: Stars are included as superscript to indicate the level of significance of the effect size reported: no stars or ^{NS} = non-significant effect size; * = effect size significant at <10% level; ** = effect size significant at <5% level; *** = effect size significant at <1% level.

Abbreviations: AG – armed groups; CG – control group; GFD – general food distribution; FB – fortified biscuits; FFE – food for education; NS – not significant; NS^^ – non-significant effect size was not stated in the article; OR – odds ratio; pp – percentage points; SD – standard deviation; SM – in-school meals; SUP – iron supplementation; THR – take-home rations; TG – treatment group.

Table 3: Effect sizes and significance levels for health and nutrition outcomes (growth and body composition)

	Authors	Gelli *et al.* (2019)	Singh *et al.* (2014)	Kazianga *et al.* (2014)	Hieu *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2011)	Osei *et al.* (2010)
Intervention duration		***2 years***	***6 months***	***1 school year***	***6 months***	***1–2 years***	***4 months***	***1 school year***
Schoolchildren's age (years)		***5–15***	***4–6***	***6–15***	***6–9***	***6–14 (analysis is 3–10 years for WAZ and anaemia)***	***6–8***	***6–10***
Impact on:	Height gain (in cm or SD)	–	–	–	–	–	NS^^ (FB nor deworming)	NS^^
	Weight gain (in kg or SD)	–	–	–	–	–	NS^^ (FB nor deworming)	NS^^
	HAZ (in SD)	+0.05^{NS} (+0.12** children 5–8 years; +0.12** for girls; +0.22** for poor children 5-–8 years; +0.22*** for girls 5-–15 years from the north, largely driven by the effect on girls 5–8 years from the north (+0.27***))	+0.27 (NS) +0.98** for pupils exposed to drought earlier in life; +0.64** (drought occurred within 4 years of the survey period); +0.79** (drought within 18+ months of the survey period); -0.14^{NS} (drought within 13 months of the survey period)	Preschool-age children SM: 0.09 (NS) THR: 0.08 (NS) School-age children Not reported	NS^^	–	FB: +0.01 (NS) Deworming: 0.01 (NS)	NS^^
	WAZ (in SD)	–	+0.60*** +0.62*** for drought-affected children; +0.29 (NS) (drought within 4 years of survey period); +0.45* (drought within 18+ months of the survey period): -0.19^{NS} (drought within 13 months of the survey period)	Preschool-age children – SM: +0.03 (NS) THR:+ 0.45*** (+0.43** for boys; +0.44** for girls) School-age children – SM: +0.21** (+0.29** for boys; 0.15^{NS} for girls) THR: +0.13 (NS)	NS^^	SM: +0.02 (NS) THR: +0.22** SM + THR: +0.11*	FB: +0.02 (NS) Deworming: 0.01 (NS)	NS^^
	WHZ (in SD)	–	–	Preschool-age children – SM: 0.10 (NS) THR: +0.35* (+0.48**for	FB: NS^^ SUP: NS^^ +0.19*** increase in FB	–	FB: +0.03 (NS) Deworming: +0.01 (NS)	NS^^

Authors		Gelli *et al.* (2019)	Singh *et al.* (2014)	Kazianga *et al.* (2014)	Hieu *et al.* (2012)	Buttenheim *et al.* (2011)	Nga *et al.* (2011)	Osei *et al.* (2010)
Intervention duration		***2 years***	***6 months***	***1 school year***	***6 months***	***1–2 years***	***4 months***	***1 school year***
Schoolchildren's age (years)		***5–15***	***4–6***	***6–15***	***6–9***	***6–14 (analysis is 3–10 years for WAZ and anaemia)***	***6–8***	***6–10***
				boys; 0.20^{NS} for girls) School-age children – Not reported	group compared with SUP group			
	BAZ (in SD)	+0.08^{NS} (+0.17** in boys 5–8 years)	–	–	–	–	–	–
	MUAC (in cm)	–	–	–	–	–	FB: +0.082** Deworming: +0.072**	–
	Skinfold thickness	–	–	–	–	–	NS^^ (FB nor deworming)	–
	Prevalence of underweight	–	–	–	–	–	NS^^ (FB nor deworming)	NS^^
	Prevalence of stunting	–	–	–	–	–	NS^^ (FB nor deworming)	NS^^
	Prevalence of wasting/thinness	–	–	–	–	–	NS^^ (FB nor deworming)	NS^^

Notes: Stars are included as superscript to indicate the level of significance of the effect size reported: no stars or ^{NS} = non-significant effect size; * = effect size significant at <10% level; ** = effect size significant at <5% level; *** = effect size significant at <1% level.

Abbreviations: AG – armed groups; BAZ – BMI-for-age Z-scores; CG – control group; GFD – general food distribution; FB – fortified biscuits; FFE – food for education; HAZ – height-for-age Z-scores; MUAC – middle upper arm circumference; NS – not significant; NS^^ – non-significant effect size was not stated in the article; pp – percentage points; SD – standard deviation; SM – in-school meals; SUP – iron supplementation; THR – take-home rations; TG – treatment group; WAZ – weight-for-age Z-scores; WHZ – weight-for-height Z-scores.

Table 4: Effect sizes and significance levels for household economy and social protection outcomes

Author(s)		Adelman *et al.* (2019)	Aurino *et al.* (2019)	Chakraborty and Jayaraman (2019)	Aurino *et al.* (2018)	Singh *et al.* (2014)	Kazianga *et al.* (2014; 2012)
Intervention duration		***15 months***	***5 years***	***5 years***	***2 years***	***6 months***	***1 school year***
Schoolchildren's age (years)		***6–17***	***7–16***	***6–10***	***5–15***	***4–6***	***6–15***
Impact on:	Educational and health and nutritional status of other household members (as proxy)	Any anaemia in adult women (≥ 18 years): FFE: -4pp^{NS} SM: -1pp^{NS} — THR: 9pp^{NS} Moderate to severe anaemia in adult women (≥ 18 years): FFE: -10 pp** SM: 7pp* — THR: 13pp** Any anaemia in children (6–59 months): FFE: -7pp^{NS} SM: -9pp^{NS} THR: -6pp^{NS} Moderate to severe anaemia in children (6–59 months): FFE: -18pp* SM: -22pp** THR: -12pp^{NS}	–	+0.08*** (+0.05***) point increase in reading (maths) scores for each additional year of policy exposure for children whose siblings receive midday meals. However, the reading (maths) score only goes up by half the score, for a child with siblings who do not receive free meals in school.	–	–	THR: +0.45*** SD WAZ for younger siblings of treated children SM: - +0.03 (NS)
	Child labour (any task)	–	SM: -9.8pp* for girls; +0.4pp^{NS} for boys; -1.039* months spent for girls GFD: +12.3pp*** in participation (+8.1pp* for girls; +20.0pp*** for boys); +0.976** months spent on work (+8.93^{NS} for girls; +1.537*** months for boys)	–	–	–	SM: +4.2pp^{NS} participation (+1.8pp^{NS} for girls; +6.4pp* boys). In currently enrolled children: + 5.9pp* (+9.2pp** for boys; +1.4pp^{NS} for girls) THR: -2.0pp^{NS} reduction (+1.8pp^{NS} for girls; -6.4pp* for boys). In currently enrolled children: -6.6pp* (-10.7pp** for boys; +0.5pp^{NS} for girls)
	Child labour (productive task/farm chores)	–	SF: -3.5pp (NS) effect on participation but —0.889*** in months spent (-0.975* months for girls; -0.445^{NS} for boys) GFD: Increased participation by 13.3 pp*** for boys	–	-0.153 hours/day (NS)	–	SM: 1.3pp (NS) reduction THR: -10.2pp** (-9.1pp** for boys; -11.5pp** for girls). In currently enrolled: -20.9pp*** (-23.2pp*** for boys; -14.6pp* for girls)

Author(s)		Adelman *et al.* (2019)	Aurino *et al.* (2019)	Chakraborty and Jayaraman (2019)	Aurino *et al.* (2018)	Singh *et al.* (2014)	Kazianga *et al.* (2014; 2012)
Intervention duration		***15 months***	***5 years***	***5 years***	***2 years***	***6 months***	***1 school year***
Schoolchildren's age (years)		***6–17***	***7–16***	***6–10***	***5–15***	***4–6***	***6–15***
	Child labour (house chores)	–	SF: +2.8pp (NS) effect on participation GFD: +8.3pp* in participation for boys and +0.964* months spent	–	-0.279* hours for pupils from poor households; NS for others	–	SM: -0.4pp (NS) THR: +0.2pp (NS)
	Interaction with indicator of economic shock	–	–	–	–	+0.64** SD in HAZ and +0.29^{NS} SD in WAZ for children affected by drought in the past 4 years (+0.79** SD in HAZ and +0.45* SD in WAZ if child experienced drought 18+ months ago; -0.14^{NS} SD in HAZ and -0.19^{NS} SD in WAZ if drought experience was 13 months or less ago)	–

Notes: Stars are included as superscript to indicate the level of significance of the effect size reported: no stars or ^{NS} = non-significant effect size; * = effect size significant at <10% level; ** = effect size significant at <5% level; *** = effect size significant at <1% level.
Abbreviations: AG – armed groups; CG – control group; GFD – general food distribution; FB – fortified biscuits; FFE – food for education; HAZ – height-for-age Z-scores; NS – not significant; NS^^ – non-significant effect size was not stated in the article; pp – percentage points; SD – standard deviations; SM – in-school meals; SUP – iron supplementation; THR – take-home rations; TG – treatment group; WAZ – weight-for-age Z-scores.

5.5 APPENDIX E: ANNOTATED BIBLIOGRAPHY OF INCLUDED STUDIES

	Paper	Study location	Methodology	Summary results	Comments/Notes
	Experimental or quasi-experimental studies				
[1]	"School feeding reduces anemia prevalence in adolescent girls and other vulnerable household members in a cluster randomized controlled trial in Uganda" Adelman *et al.* (2019)	Country: Uganda Coverage: Subnational – two districts in the northern part of the country Context: Schools were in camps for internally displaced persons (IDPs) in areas affected by about 18 years of civil unrest; nearly all the rural households had been residing in the IDP camps for about ten years at the time of the study	Non-blinded cluster randomized controlled trial (RCT) with three arms – onsite at-school meal (SM) provision; take-home rations (THR); and control group receiving no school-based food Duration: 15 months Target: Schoolchildren aged 6–17 years	Both SM and THR reduced the prevalence of anaemia among adolescent girls aged 10–13 years, with no difference in the effect of the two different types of intervention. THR, however, caused a reduction in the prevalence of moderate-to-severe anaemia among adult women (≥18 years), while SM reduced moderate-to-severe anaemia among children aged 6–59 months.	Although conducted in 2005, this is one of the few studies – if not the only study – to investigate the impact of school feeding in an IDP camp population using an RCT. The data analysis focused on subgroups of: direct beneficiaries – adolescent girls (10–13 years); and indirect beneficiaries – adult women ≥18 years and children 6–59 months.
[2]	"School feeding or general food distribution? Quasi-experimental evidence on the educational impacts of emergency food assistance during conflict in Mali" Aurino *et al.* (2019)	Country: Mali Coverage: Subnational – regional level (one region) Context: Low-income sub-Saharan Africa setting with protracted conflict, economic and political fragility and high level of food insecurity. Substantial proportion of the population are children under 15 years and rates of primary school completion and youth literacy are among the lowest worldwide	Quasi-experimental – Difference-in-differences model and propensity score matching was used to estimate the average treatment effect on the treated (ATT), using a panel dataset. Children receiving SM were compared to those that were in households receiving general food distribution (GFD) Duration: Approx. 5 years Target: School-age children 7–16 years	Provision of school meals in the emergency setting significantly increased enrolment and grade attainment (especially for girls), while GFD had no impact on enrolment and attainment and even led to increased absenteeism (mostly for boys). Although the negative effect of GFD on school attendance appeared to be mostly driven by the high rate of absenteeism observed in villages directly affected by conflict.	The study is unique in that it examines the educational impacts of school feeding and GFD provided in a context of conflict, protracted fragility and substantial food insecurity.

	Paper	Study location	Methodology	Summary results	Comments/Notes
[3]	"School feeding and learning achievement: Evidence from India's midday meal program" Chakraborty and Jayaraman (2019)	Country: India Coverage: Nationwide Context: Heterogenous socioeconomic and sociocultural, lower-middle-income development setting with large learning deficit in primary schools and the largest school nutrition programme worldwide	Quasi experimental – Difference-in-differences + fixed effects approach using the exogeneous variation in programme exposure which was jointly determined by the staggered implementation of the Midday Meal Scheme and children's birth cohort, to define treatment and comparison group Duration: 5 years Target: Children aged 6–10 years	Test scores increased in reading and in maths for children that had longer-term exposure (approx. the five-year duration of a primary school) to midday meals compared with those who had less than one year of exposure. The effect on test performance increased in the first three years of exposure and then tapered off in the last two years. There was evidence of complementarities between exposure and teaching-related and learning-related classroom inputs. No significant effects by gender.	The study used eight repeated household cross-sections that are devoted to documenting the status of education among children in rural India. Although a non-experimental evaluation, the study has the largest dataset encountered in the review (about 1.24 million observations) and the longest duration (5 years).
[4]	"A school meals program implemented at scale in Ghana increases height-for-age during mid-childhood in girls and in children from poor households: A cluster randomized trial" Gelli *et al.* (2019)	Country: Ghana Coverage: Nationwide Context: Heterogenous socioeconomic and sociocultural, sub-Saharan Africa development setting	Randomized controlled trial (RCT) with three arms – standard school feeding; home grown school feeding; and control Duration: 2 years Target: Schoolchildren aged 5–15 years	Provision of school meals was effective in slightly increasing linear growth (as measured by height-for-age Z-scores) for girls, younger children (5–8 years) from poor households, and children living in the country's most impoverished geographical areas. The intervention also increased BMI-for-age Z-scores but only in younger boys (5– 8 years).	Girls were not more likely to receive the intervention than boys but children resident in the more impoverished areas (the northern regions) were five times more likely to receive the interventions than those located in other geographical areas.
[5]	*Food for Thought? Experimental evidence on the learning impacts of a large-scale government-led School Feeding Program in Ghana* Aurino *et al.* (2018)			School feeding improved learning and cognition of primary school-age children more especially for the marginalized groups (girls, poor pupils and those from more disadvantaged geographical locations). School feeding had no effect on school attendance but moderate effect on enrolment for the marginalized groups.	Impact reported are probably in the lower bounds of potential effects because of imperfect take-up of school feeding offer and implementation challenges like delayed payment of caterers leading to reduced quantity/quality of food.

	Paper	Study location	Methodology	Summary results	Comments/Notes
[6]	"Multi-micronutrient fortified improved serum zinc and folate concentrations of Cambodian school children: A double-blinded cluster-randomized controlled trial" Kuong *et al.* (2019)	Country: Cambodia Coverage: Subnational – five of seven districts in one of Cambodia's provinces Context: Low-income (as at time of study) Southeast Asia development setting where agriculture is predominant and rice farming is the main occupation and source of income	Double-blinded, cluster-randomized, placebo-controlled trial, with five arms – UltraRice original formulation (URO); UltraRice new formulation (URN); Nutririce; non-fortified rice (placebo); or take-home ration (control) Duration: 6 months Target: Schoolchildren aged 6–16 years	Provision of multiple-micronutrient fortified rice (MMFR) lowered the prevalence of zinc deficiency and also improved the folate status (in the group that received the fortified rice that had folic acid as one of the micronutrients) compared with the placebo group.	The low phytate content of the fortification vehicle – rice – and the low zinc status of the children at baseline might have contributed to the increase in serum zinc concentrations recorded.
[7]	"Impact of multi-micronutrient fortified rice on haemoglobin, iron and vitamin A status of Cambodian schoolchildren: A double-blind cluster-randomized controlled trial" Perignon *et al.* (2016)			The MMFR that contained vitamin A effectively improved the vitamin A status of schoolchildren. The intervention, however, had no significant impact on haemoglobin, iron status and prevalence of anaemia.	Subclinical inflammation status functioned as a significant effect modifier of the intervention on haemoglobin and iron status.
[8]	"Micronutrient-fortified rice can increase hookworm infection risk: A cluster randomized trial" De Gier *et al.* (2016)			Consumption of MMFR significantly increased risk of new hookworm infection especially where baseline prevalence of hookworm infestation was high (>15%).	The study was powered for its primary outcome, which was micronutrient status, and considering the school-level intra-cluster correlation of helminthic infection, the low number of schools per study group will be an important limitation.
[9]	"School meals as a safety net: An evaluation of the Midday Meal Scheme in India" Singh *et al.* (2014)	Country: India Coverage: Subnational – state level Context: Richer (compared with national average), high-performing (primary school enrolment about 97%) state in a lower-middle-income South Asia development setting that was exposed to an environmental shock	Quasi experimental – Instrumental variables (IV) approach using an indicator variable (eligible children born after December 2001) as an exogenous instrument to predict enrolment but not nutrition Duration: ~ 6 months Target: Children aged 4–6 years	Exposure to the Mid-day meal Scheme (MDM) in primary school caused a catch-up growth (as measured by weight-for-age and height-for-age Z-scores) in children who were affected by drought in their early childhood. Suggests that MDM can act as a safety net that compensates for previous or current health shocks, especially for children in areas stricken by food insecurity and/or economic shocks.	The researcher used extensive data from a longitudinal study of a cohort of children living in poverty and born between January 2001 and June 2002 (Young Lives study). First round of data collection was in 2002 and the second round was in 2006–2007 when the cohort was around 4.5 to 6 years old. The India MDM scheme was introduced in the state in 2003 and there was also major shock (drought) in 2002–2003.

	Paper	Study location	Methodology	Summary results	Comments/Notes
[10]	"School feeding programs, intrahousehold allocation and the nutrition of siblings: Evidence from a randomized trial in rural Burkina Faso" Kazianga *et al.* (2014)	Country: Burkina Faso Coverage: Subnational – the Sahel region Context: Low-income sub-Saharan African setting prone to severe food crisis as a result of famine/drought	Randomized controlled trial (RCT) with three arms – school canteens (provision of school meals for both boys and girls); take-home rations (THR – for girls only); and control Duration: 1 school year (approx. 9 months) Target: School-age children aged 6–15 years	Provision of meals in schools increased weight-for-age Z-scores (WAZ) for the gender group more likely to be enrolled in school – boys; THR had no effect on any of the anthropometric measures for school-age children. However, THR increased WAZ for preschool siblings of both genders, and weight-for-height Z-scores of male preschool siblings. Both interventions had no effect on height-for-age Z-scores.	One of the few studies that measured spillover effects of school feeding to younger preschool siblings in the household. The study gives a clear indication that the impact of school feeding might be underestimated if these spillover effects are not considered.
[11]	"Educational and child labour impacts of two food-for-education schemes: Evidence from a randomised trial in rural Burkina Faso" Kazianga *et al.* (2012)			Both school meals and THR increased enrolment rates, led to improvement in maths scores (only for girls) but were not successful in improving attendance. The interventions did not eliminate child labour but THR, in particular, caused a reallocation from farm labour and off-farm productive tasks to household tasks that were more compatible with school hours.	It was surprising that, although targeted at girls, THR increased enrolment rates for both girls and boys. Also, the interventions caused absenteeism to increase in households that were low in child labour supply, while absenteeism decreased for households that had a relatively large child labour supply. This might be an indication that household labour constraints might be a factor in the effectiveness of school feeding interventions on educational and other outcomes.
[12]	"Multi-micronutrient-fortified biscuits decreased the prevalence of anaemia and improved iron status, whereas weekly iron supplementation only improved iron status in Vietnamese school children" Hieu *et al.* (2012)	Country: Vietnam Coverage: Subnational – three communes of two districts Context: Fairly homogeneous socioeconomic and sociocultural, rural, lower-middle-income Southeast Asia development setting, where micronutrient deficiencies are known to be prevalent	Randomized double-blinded placebo-controlled trial with three arms – daily fortified biscuit + weekly placebo iron tablet group; daily non-fortified biscuits + weekly iron tablets or daily non-fortified biscuits + weekly placebo tablet Duration: 6 months Target: Schoolchildren aged 6–9 years in grades 1 to 3	Regular consumption of multi-micronutrient fortified biscuits (MFB) was as effective as the weekly intake of iron supplement in preventing and treating iron deficiency in schoolchildren aged 6–9 years. However, in children that were deficient in vitamin A at baseline, MFB reduced the prevalence of anaemia more than iron supplementation.	All the children were given deworming tablets – Mebendazole – at the start of the trial. Severely underweight or anaemic children and children with mental or congenital anomalies were excluded from the study.

	Paper	Study location	Methodology	Summary results	Comments/Notes
[13]	"Whole cowpea meal fortified with NaFeEDTA reduces iron deficiency among Ghanaian school children in a malaria endemic area" Abizari *et al.* (2012)	Country: Ghana Coverage: Subnational – one district in the northern region Context: Fairly homogeneous sociodemographic, mostly subsistence farming, malaria endemic, sub-Saharan African stable setting	Randomized, double-blinded, controlled trial with two arms – cowpea meal fortified with 10 mg iron/meal as NaFeEDTA or an identical but non-fortified cowpea meal Duration: Approx. 7 months Target: Schoolchildren aged 5–12 years	Consumption of NaFeEDTA-fortified cowpea improved both functional and storage iron status leading to reduced prevalence of iron deficiency and iron deficiency anaemia, but did not lead to a decrease in the prevalence of anaemia.	Mass deworming and malaria testing and treatment were carried out at baseline and 3½ months into the trial. The researchers used the earlier guidance of acceptable daily intake of 2.5 mg EDTA/kg body weight set by the Joint FAO/WHO Expert Committee on Food Additives but the current recommendation by the committee is only 0.2 mg Fe/kg body weight as FeEDTA.
[14]	"Impact evaluation of school feeding programmes in Lao People's Democratic Republic" Buttenheim *et al.* (2011)	Country: Lao People's Democratic Republic Coverage: Subnational – three districts in two provinces in the northern region Context: Low-income (as at time of study) Southeast Asia rural development setting with high poverty rate (>30%), prevalent food insecurity, limited access to road, poor schooling infrastructure and low enrolment rates, particularly for girls	Quasi-experimental – Difference-in-differences model and propensity score matching was used to estimate the average treatment effect on the treated Duration: Approx. 1–2 years (start-up was delayed in some schools) Target: Schoolchildren aged 6–14 years	School feeding did not have any significant detectable effect on enrolment or nutritional status of schoolchildren.	The evaluation faced non-trivial methodological and implementation challenges which might have affected the results. The challenges included: significant differences across the districts (e.g. ethnogeography) which could be endogenous with the outcomes of interest; delayed start-up of the intervention in some sites; non-provision of school meals on a daily basis as planned; provision of food to non-enrolled students; and concurrent implementation of other development projects in the study districts.

	Paper	Study location	Methodology	Summary results	Comments/Notes
[15]	"Decreased parasite load and improved cognitive outcomes caused by deworming and consumption of multi-micronutrient fortified biscuits in rural Vietnamese schoolchildren" Nga *et al.* (2011)	Country: Vietnam Coverage: Subnational – two communes of one province Context: Fairly homogeneous socioeconomic and sociocultural, rural, lower-middle-income Southeast Asia development setting with predominant rice farming as main occupation and income source	Randomized double-blinded placebo-controlled trial with four arms – non-fortified biscuit + placebo deworming; multi-micronutrient-fortified biscuit (MFB) + placebo deworming; non-fortified biscuit + deworming; or MFB + deworming Duration: 4 months Target: Schoolchildren aged 6–8 years	MFB and deworming led to a slight increase in mid upper arm circumference (MUAC) but neither deworming or fortification had any effect on any other anthropometric measures (weight, height, height-for-age Z-scores, weight-for-age Z-scores, or weight-for-height Z-scores). Children who received MFB scored higher on cognitive test scores especially if they were anaemic at baseline. Deworming alone decreased the prevalence of parasite infestations, but providing both MFB and deworming synergistically worked in maintaining the lower prevalence of parasitic infestations.	The relatively short duration of the intervention (4 months) might be one of the possible reasons for the lack of significant effects for physical growth.
[16]	"Multi-micronutrient–fortified biscuits decreased prevalence of anemia and improved micronutrient status and effectiveness of deworming in rural Vietnamese school children" Nga *et al.* (2009)			Provision of MFB (with or without deworming) to children aged 6–8 years reduced the prevalence of anaemia and increased their micronutrient status (as measured by biochemical indicators of haemoglobin, iron, vitamin A, zinc and iodine). Adding deworming to MFB had no additional effect on most of the indicators for micronutrient status, and providing MFB alone did not have any effect on prevalence of helminthic parasitic infestations.	The deworming tablet used was Albendazole. Schools included in the experiments had prior high prevalence of anaemia and parasitic infestations. Children with chronic illnesses, severe anaemia or malnutrition (both undernutrition and overnutrition), congenital illnesses, mental or severe physical disability, or those who had received deworming within six months of the intervention were excluded from the trial.
[17]	"Community-level micronutrient fortification of school lunch meals improved vitamin A, folate, and iron status of schoolchildren in Himalayan villages of India" Osei *et al.* (2010)	Country: India Coverage: Subnational – district level (one district) Context: Hilly agrarian community with heavy subsistence farming, fairly homogenous socioeconomic and sociocultural characteristics with cultural limitations on consumption of animal products, lower-middle-income South Asia development setting	Placebo-controlled, cluster randomized trial single-blind, with two groups – school meals + micronutrient premix or school meals + placebo Duration: 1 school year (8 months) Target: Schoolchildren aged 6–10 years in grades 1 to 4 in public primary schools	At point-of-use fortification of school meals with multi-micronutrient powder was effective in improving the vitamin A, folate and iron status of schoolchildren. The intervention, however, had no effect on the prevalence of anaemia.	There was an ongoing lunch programme in the schools, which provided children received with cooked meals of rice and vegetables (dhal) at school 6 days/week using a standardized menu aimed at providing each child with at least 1,884 kJ/day and 12 g protein/day. The prevalence of helminthic infection was high after intervention, despite the fact that the children were dewormed at the start of the trial.

	Paper	Study location	Methodology	Summary results	Comments/Notes
	Meta-analyses/Systematic reviews				
[18]	*Interventions for improving learning outcomes and access to education in low- and middle-income countries: A systematic review* Snilstveit *et al.* (2015)	Country: Various (Argentina, Burkina Faso, Cambodia, Chile, China, Guyana, India, Jamaica, Kenya, Lao, Peru, Philippines, Senegal, Sri Lanka) Coverage: Global Context: Large heterogeneity in contexts and settings: upper-middle-income to low-income countries; rural to urban study sites; food secure to food insecure areas	Systematic review of 16 experimental and quasi-experimental studies that evaluated feeding programmes or interventions that provided an in-school feeding component Duration (range): 30 days to 24 months Target: Primary schoolchildren	School feeding programmes have the potential to increase enrolment rate, improve attendance, reduce dropouts and improve learning outcomes. However, they are more likely to be effective in contexts with high food insecurity and low existing school participation.	
[19]	"School feeding programs in developing countries: Impacts on children's health and educational outcomes" Jomaa *et al.* (2011)	Country: Various (Bangladesh, Colombia, India, Jamaica, Kenya, Peru and South Africa) Coverage: Global Context: Mainly focused on low-income and lower-middle-income countries; largely heterogenous socioeconomic and sociocultural settings; ranges from food secure to food insecure areas	Systematic review of 15 papers including 1 Cochrane review and 12 studies (randomized controlled trials (RCTs) and non-randomized studies) focused on low-income and lower-middle-income countries Duration (range): not indicated to 23 months Target: Primary schoolchildren	There appears to be consistent evidence demonstrating the impact of school feeding on improving energy intake, nutritional status, school enrolment and school attendance for schoolchildren. There is, however, mixed or no results on other outcomes, especially intermediate or longer-term results, such as the effect of school feeding on growth as measured by weight and height, cognition, or the energy intake of siblings or other vulnerable groups in the household.	

	Paper	Study location	Methodology	Summary results	Comments/Notes
[20]	"Can multi-micronutrient food fortification improve the micronutrient status, growth, health, and cognition of schoolchildren? A systematic review" Best *et al.* (2011)	Country: Various (Australia, Bangladesh, Botswana, India, Indonesia, Morocco, Philippines, South Africa, Tanzania, Thailand and Vietnam) Coverage: Global Context: Mainly focused on low- and lower-middle-income countries; largely heterogenous socioeconomic and sociocultural settings	Systematic review of 12 studies (6 clinical controlled trials, 5 randomized controlled trials (RCTs) and one controlled before-and-after study) that investigated the effect of multi-micronutrient (MMN) fortification of food on at least one of micronutrient status, growth, health or cognition of school-age children Duration (range): 8 weeks to 14 months Target: Schoolchildren 5.5 to 18 years	Provision of MMN-fortified food to schoolchildren consistently improved their micronutrient status and reduced anaemia prevalence. However, the evidence of the effect on growth, morbidity and cognitive outcomes is largely inconclusive.	

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Abbreviations

BAZ	BMI-for-age Z-scores
DCP3	Disease Control Priorities series (third edition)
EPOC	Effective Practice and Organization of Care
GFD	general food distribution
HAZ	height-for-age Z-scores
HGSF	home-grown school feeding
ID	iron deficiency
IDA	iron deficiency anaemia
IDP	internally displaced person
LMICs	low- and middle-income countries
MMN	multiple micronutrient
MUAC	mid-upper arm circumference
NaFeEDTA	Sodium iron ethylenediaminetetraacetic acid
OEV	Office of Evaluation (World Food Programme)
pp	percentage points
RCT	randomized controlled trial
SDG	Sustainable Development Goal
SD	standard deviation
SFP	school feeding programme
SM	in-school meals
SPM	Raven's standardized progressive matrices
THR	take-home rations
WAZ	weight-for-age Z-scores
WFP	World Food Programme
WHO	World Health Organization
WHZ	Weight-for-height Z-scores

Office of Evaluation

World Food Programme

Via Cesare Giulio Viola 68/70
00148 Rome, Italy
T +39 06 65131 wfp.org