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Costs, and cost-outcome of school feeding programmes and feeding programmes for young children. Evidence and recommendations

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ABSTRACT

Our objectives for this study were to provide updated, realistic data on the costs and cost-outcomes of school feeding in Low and Middle Income Countries. We also aimed to identify factors that may influence effectiveness and therefore, cost effectiveness of the interventions. To do this, we combined data on effect sizes for physical and psychosocial outcomes from two Cochrane systematic reviews with new data on the costs of school feeding. We simulated the costs of preschool feeding based on the school feeding costs. We found that he average for low- and middle-income countries combined was US$72, with large variations across countries. We also found a wide variation in costs for different outcomes. We suggest several ways in which effectiveness may be improved and cost-per outcome lowered for both programmes.

1. Introduction

Worldwide, an estimated 795 million people were chronically undernourished between 2012 and 2014; the vast majority of them in low and middle-income countries (LMIC) (FAO, 2014). Although this figure represents a decrease of 200 million from 1990 levels there is still much work to be done. Reflecting this, the Open Working Group on Sustainable Development Goals has proposed 'ending hunger and achieving food security' as a major goal for the post-2015 Development Agenda (United Nations, 2014).

Many of those affected by undernutrition are children; in 2015, worldwide, 159 million children were stunted and 50 million children were wasted (GROUP U-W-WB, 2015). In 2011, undernutrition was responsible for 45% of all deaths for children under five years of age (Black et al., 2013). Throughout childhood, undernutrition and micronutrient deficiencies contribute to higher risk of infection and chronic disease in adulthood (Barker, 2001; Prentice and Moore, 2005). They can also impair psychomotor and cognitive development (Walker et al., 2007; Scrimshaw, 1998; Worobey and Worobey, 1999; Meeks Gardner et al., 1995a). Hunger and undernutrition have important consequences for school-aged children as well. In 2012, the World Food Program estimated that, across the world, 67 million school-aged children did not even attend school (Programme, 2012). Another 66 million children went to school hungry; hunger can impair attention and motivation; undernutrition at this age can impair cognitive abilities (Bryan et al., 2004), and school performance (Programme, 2012; Bryan et al., 2004; Meeks Gardner et al., 1995b). Moreover, short-term hunger can adversely affect attention and interest (Read et al., 1973); missing breakfast is particularly problematic for those children who are most undernourished (Pollitt, 1995; Bundy et al., 2013).

Interventions during early childhood and the school years to reduce undernutrition can maximize developmental, educational potential and educational attainment. They can also enhance lifelong health and well-being. Effective interventions to improve child nutrition can contribute to several proposed post-2015 goals: 'end hunger, achieve food security', 'ensure healthy lives and promote

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well-being for all' and 'ensure inclusive and quality education for all '(page 6) (Goals OWGotGAfSD, 2014). However, in order to realize these goals, decision makers need to be able to identify which of these interventions are effective and why; they also need evidence on their costs, cost per outcome and cost-effectiveness.

1.1. The interventions

School feeding and feeding programmes for young children are common responses to child under-nutrition and its sequelae. School feeding programmes, in particular, are widespread. Global estimates show that approximately 370 million children received school feeding in 2012 (Programme, 2013). Recent survey data suggests that every country in the world is providing some form of food to its school children; though coverage is weakest where the needs are greatest (Programme, 2013).

Supplementary feeding programmes for disadvantaged young children provide energy and nutrients through food or beverage to children to ameliorate or prevent undernutrition (Beaton and Ghassemi, 1982). Programme goals include: prevention or amelioration of growth failure, improved survival, lower morbidity, promotion of normal cognitive and behavioural development and increasing enrolment and attendance at school (Beaton and Ghassemi, 1982; Beaton, 1993a).

School-feeding programmes are designed to support the education of children living in poverty and food insecurity through two main pathways. The first involves increased access to and participation in school (e.g. enrolment, attendance, drop-out) (Kazianga et al., 2008). The second pathway involves increased learning ability (e.g. attention, cognition) through improved intake of macro- and micronutrients (Adelman et al., 2008; Greenhalgh et al., 2007). The impact of the school-feeding in each of the above areas occurs through a number of complex mechanisms, detailed analysis of which is beyond the scope of this paper and discussed elsewhere (Greenhalgh et al., 2007).

Scaling-up and consolidating these interventions requires considerable resources and a steady flow of funds: across low-income countries, school-feeding programmes, on average, cost about US$50 per child per year (Gelli et al., 2011a). Therefore, it is essential to undertake a careful assessment of benefits and trade-offs of these interventions (Alderman, 2011). Key to this assessment is an understanding of the cost-effectiveness of alternative implementation approaches.

Despite the fact that these programmes are both well established as part of development aid, there is a dearth of knowledge on their costs and cost-effectiveness. This is partly due to the methodological complexity required in the aggregation of simultaneous, multiple outcomes of school feeding. In the absence of cost-effectiveness data, evidence on the costs per unit outcome can provide important insights for policymakers. To our knowledge, however, only one study in the literature exists on the cost outcomes of school feeding (Galloway et al., 2009a) and none exist for pre-school feeding. Our previous study (Galloway et al., 2009a) combined data from our earlier systematic review of school feeding (Kristjansson et al., 2007a) with data on school-feeding costs from four low-income countries. This study found that school feeding costs per child per year were on average US$40 (ranging from US$28 to US$63) per child per year. The cost per extra day of attendance was less than US$10 per child, while the cost per extra kilogram of weight ranged from US$38 to US$252. Costs for cognitive and learning outcomes were also variable.

1.2. Objectives

Our objectives for this paper were (1) to provide new and more robust estimates on the costs per unit outcome of school feeding in LMIC by combining new data from two systematic reviews with data from a newer, more comprehensive costing study covering 62 countries (Gelli et al., 2011b), (2) to provide a preliminary estimate of some cost-outcomes for preschool feeding and (3) to provide some insight from our process findings into factors that may influence effectiveness and therefore, cost effectiveness.

2. Methods

2.1. Systematic reviews

We used outcome data from two previous systematic reviews; a review of school feeding programmes (Kristjansson et al., 2007b), updated in 2015 (Kristjansson et al., 2015a) and a review of feeding programmes for children aged three months to five years (Kristjansson et al., 2015b) (hereafter referred to as preschool feeding, although it included infants as well). We followed the procedures outlined by the Cochrane Collaboration (Higgins et al., 2011), one of the world's leading producers of systematic reviews. To better understand how context and implementation affected results, we conducted process evaluations, including realist reviews (Pawson et al., 2005).

Although both reviews included studies from across the world, we used only data from Low and Middle Income Countries for this paper. Thirteen of the 25 school feeding studies and 29 of the 32 preschool meal studies were from LMIC and therefore included in our cost per outcome analyses.

The school meal programmes comprised breakfast, lunch or snacks delivered in the school setting. The school meals/snacks comprised local vegetables and grains, pre-prepared biscuits, and/or milk; a few included meat. Participants ranged in age from 6 to 19 years.

The preschool meal programmes were delivered in preschools/daycares (9 studies) or delivered to the children's homes (20 studies). A variety of foods were used including: locally produced fruit, vegetables and cereals as well as fortified biscuits, milk, and Ready to Use Therapeutic Foods. On average, the school meal programmes provided 401 kcal per day (range 90–680) while the preschool meal programmes provided an average of 397 kcal per day (range 89–784).

2.2. Calculating costs

Herein, we briefly summarize the methodology for calculating costs in the present paper. We based our estimates on analyses done by Gelli and Daryanani (2013) because they were standardized to a fixed caloric ration and 200 day school year across 62 LMIC. Gelli's data (Gelli and Daryanani, 2013) were collected from several sources, including previously published World Food Programme (WFP) data, reports from government ministries, grey literature, and published reviews. Programme expenditures were collected across all supply chain activities alongside data on number of feeding days and planned kilocalories, and cost per child estimates were then standardized. Where relevant, programme costs were also adjusted to account for school-level costs using scaling parameters from previous studies (Gelli et al., 2011a). All data were validated by WFP country offices. Cost data were reported as cost per child per school. All estimates were converted to US dollars using an internet-based currency converter set to a fixed reference date of 1 June 2008.

For the purposes of this paper, in order to make the cost-outcome data as realistic as possible, we re-standardized the cost estimates from the 2013 paper (Gelli and Daryanani, 2013) to the average kcal given in studies in the two systematic reviews (401 kcals for school feeding and 397 kcal for pre-school feeding) (Gelli et al., 2011a; Galloway et al., 2009a).

Table 1
Cost per outcome of school and preschool feeding.

		RCTs		CBA	
		Preschool feeding	School feeding	Preschool feeding	School feeding
Height – per cm gain	Median	54	No sig. effect (NS)	No sig. effect (NS)	43
	Average	76	NS	NS	59
Height – per SD gain	Median	121	NS	NS	56
	Average	171	NS	NS	76
Weight – per kg gain	Median	121	103	121	100
	Average	171	141	171	137
Weight – per SD gain	Median	73	167	126	114
	Average	103	228	178	155
Point in cognitive dev.	Median	Mixed findings	176	No data	Not significant
	Average	Mixed	241	No data	NS
S.D. gain in psychomotor dev.	Median	81	Not applicable (NA)	No data	Not applicable (NA)
	Average	114	NA	No data	NA
Day of attendance	Median	Not applicable (NA)	4–8	Not applicable (NA)	Mixed effects
	Average	NA	6–10	NA	Mixed effects
Gain in math Achievement (point on the WRAT)	Median	NA	34	Not applicable (NA)	
	Average	NA	46	NA	
Gain in math S.D.					97
					132

Due to the paucity of data on the costs of supplemental feeding for young children, we used cost data from the school meals programmes as an approximation for preschool costs, recognizing that this had several limitations.

2.3. Calculating cost per outcome

The outcome data from the two systematic reviews were combined with our re-standardized cost data to calculate cost per outcome in LMIC for school feeding and preliminary estimates for preschool feeding. Cost per outcome was estimated by dividing the average costs of school feeding per child per 200-day school year by the average gain (e.g. kg of weight, cm of height, SD in math performance) per 200 day school year.[1] Average gain per calendar year was used for the preschool studies. Where possible, we calculated cost per standard deviation as well as that for one unit change.

3. Results

3.1. Outcomes: comparison of selected findings from the school and preschool reviews

Our meta-analyses of RCTs in the preschool and school feeding reviews found small, positive effects on weight (0.24 and 0.37 kg. per year/school year respectively).[2] For height, meta-analyses of the RCTs found small but significant effects on height for preschool feeding (0.54 cm per year) but not for school feeding. There were small effects in the meta-analysis of the CBAs.

We found positive effects of feeding on some aspects of psychosocial functioning in both reviews. For example, our combined analysis of two preschool studies found significant positive effects for psychomotor development, another study reported positive results, but no significance and one study reported non-significant differences. For cognitive development, findings from three preschool studies were mixed; findings from the combined analysis of two studies in the school meals review were positive but non-significant. We found that school feeding had a significant positive effect on attendance; effects in the RCTs ranged from 4 to 7 days a year. School feeding also had significant effects on math performance in two RCTs and two CBAs.

3.2. Costs of school feeding

We found that in low- and middle-income countries (LMIC), the average and median costs of school feeding standardized to 401 kcals combined were US$41 and US$ 30 respectively ($n = 62$), with large variations across countries. The costs ranged from a minimum of under US$10 (India) to a maximum of US$270 (Botswana). The average programme costs of US$41 and median costs of US$29 (min. = 8.6, max. = 270) per child per year.

3.3. Costs per outcome

The costs per outcome for school- and preschool feeding are summarized in Table 1. Where possible, we present costs for both a one-unit change as well as those for a one standard deviation change.

For both school feeding and preschool feeding, the median cost for an additional kg of weight was high (median of $121 per year in the preschool feeding RCTs; median of $103 USD per year in the school feeding RCTs). The cost for an additional centimetre of height was also high; in the preschool programmes the median cost was $54 for RCTs (cost per SD = $121). In the school feeding programmes, results for the RCTs were non-significant; while for the CBAs, the cost per cm gain was $ 43. The estimated cost per added day of attendance in the school feeding programmes was quite low; the median was $4 to $8 in the RCTs. For math performance, calculations based on one RCT found that a one point gain on the Wide Range Achievement Test was $34. The cost per standard deviation in math achievement was $97 in two CBAs.

3.4. Process findings

Our process evaluations identified several things that may impact on the effectiveness of these feeding programmes. Factors that were found in both the school and preschool reviews are discussed first, followed by a short discussion of factors that are unique to each programme.

First, there is some evidence that feeding programmes work best for children who are more undernourished. Second, palatability and cultural acceptability of the food are important; locally based ingredients may help to ensure this. Third, oversight is key;

[1] We adjusted the outcome numbers to a 200-day school year by calculating effect per month and then multiplying by 10 months.

[2] Please note that outcome data in both reviews is on treated children rather then on intention to treat.

supervisors need to ensure that the child received and consumed the supplement in addition to their usual diet. In both reviews, we found that the target child didn't always receive the full benefit of the supplement due to substitution (child gets less food at home because he was fed at school) or ration sharing within families. This effect was observed in both reviews and for all types of feeding but seems to be a bigger concern in those preschool feeding programmes that deliver food to children's homes. Finally, well-organized and efficient distribution systems are vital in order to ensure that food actually reaches the schools, children and families.

Factors that seem to be unique to the school meals review were: organization of the schools and classrooms and development of the intervention with a local team.

Factors that were identified only in to the preschool review included caregiver trust, nutritional knowledge and level of stress/distraction.

4. Discussion

Child undernutrition remains one of the most pressing global health issues today. It is therefore important to learn which interventions work and which don't work and why; it is also important to be able to compare their costs and cost-effectiveness.

This paper begins to address the gap in cost-effectiveness studies of school feeding programmes by combining the latest data on the effectiveness of interventions with a comprehensive analysis of costs to provide updated evidence on the cost per outcome of school feeding. In addition, by simulating the costs of pre-school feeding, we did a preliminary exploration of comparisons on costs per outcome of the two interventions targeting children at different stages in the lifecycle. In the absence of rigorous methods that enable the cost-effectiveness comparisons of interventions with multiple, simultaneous effects on a range of different outcomes, costs per outcome data such as that included in this paper provide a benchmark and an important first step for meaningful comparisons.

The cost-outcome data herein can be used in future work comparing the costs and cost-outcomes of different interventions. It is not intended that these cost data be used to compare the costs of different outcomes, as we have not considered the relative value of each outcome.

4.1. Effectiveness

We found that both preschool and school feeding had some impact on weight gain. Preschool feeding had a small significant effect on height in the RCTs while our meta-analysis of the school feeding RCTs found a non-significant effect. We might expect a greater height gain in the preschool programmes as this is a period of more rapid growth (Beaton, 1993b). However, average height gain in the preschool programmes (ages 3 months to 5 years) was rather small; we suspect that this may have been due to problems with implementation.

Both reviews found effectiveness for several psychosocial outcomes, including attendance, psychomotor development and math performance. Powell (Powell et al., 1998) noted that the effect on math achievement found in their study ($b = 0.71$) was equal to a third of a years' gain.

The effect sizes for height and weight in both reviews are similar to those found in a systematic review on deworming (Taylor-Robinson et al., 2012)[3] while the effects of preschool feeding on haemoglobin were similar to those of iron supplementation (Das et al., 2013). The effects of preschool feeding on psychomotor (small to moderate) and cognitive (non-significant) development are also in line with those from a systematic review of iron supplementation (Szajewska et al., 2010).

4.2. Discussion: cost-outcomes

The cost-outcomes in this study were fairly high, but have some variability across different outcomes, even when standardized using an average of the kilocalories per day provided by preschool and school feeding. In this analysis, the cost/outcomes for school feeding were generally lower than the comparable figures reported in our previous work (Galloway et al., 2009b). There may be several reasons for this. First, the cost data in this study includes many more countries (62 low- and middle-income countries) than in the Galloway study (four), therefore it is likely more representative. Second, we have added new data for several outcomes. Third, in the Galloway paper, we standardized the cost to that of a 700 kcal meal while in the present paper, the cost was standardized to the average kcal actually provided. The finding that school feeding and preschool feeding can have positive impacts on attendance and some aspects of school achievement suggests the opportunity to prioritize outcomes related to psychosocial health and school participation, rather than focussing on gains in height and weight when designing and researching interventions.

As noted above, the effect sizes for height and weight were generally small in both reviews; as a result, the cost-outcomes were rather high. Effect sizes for psychosocial health ranged from small to moderate and the cost-outcomes ranged from low (attendance) to high (cost per SD for math in the CBAs). We believe that both programmes could be more effective as our process evaluations showed implementation problems in some of the included studies, including low energy provision, poor supervision, ration sharing among families and substitution. We also noted that studies that were well implemented seemed to have better outcomes, but this will have to be verified in future work.

4.3. Limitations

This cost-outcome analysis has several limitations. First, the comparison of the cost-outcomes of school and pre-school feeding programmes is limited by a lack of data on the costs of pre-school feeding interventions. We used school feeding costs as the best available proxy, but this is far from ideal. It is possible that preschool feeding may be more expensive than school feeding because many of the meals are home delivered. Second, we found limited overlap in outcome data across the two interventions. Third, in order to assess benefits and trade-offs of different feeding programmes, it is important to understand how different feeding implementation models compare to each other and to other interventions with similar aims and objectives. Yet, we were only able to estimate costs per outcome and were not able to aggregate costs for multiple outcomes. This is problematic as both interventions are complex, with several goals and implementation configurations (Gelli et al., 2012) Furthermore, their benefits cover several domains of growth, behaviour and learning, The lack of valid methodologies to estimate overall impact across different outcomes has presented a barrier to such an assessment.

5. Conclusion

Both school and preschool feeding had some important effects, but we believe that on average, they can be doing better. It is important to ensure high implementation quality and caregiver

[3] Effects on weight are somewhat smaller than those found in studies that screened before deworming but larger than those found in studies with no screening.

support. On the basis of our process findings, we can suggest some actions that may help both school and supplementary feeding programmes for young children to be more effective and cost-effective.

- The poorest children or areas should be targeted.
- The distribution and intake of school and preschool feeding programmes should be closely supervised and supply chains closely monitored.
- Feeding programmes should build family capacity around nutrition and around the necessity to give the most undernourished child in the family more food.
- Food should be palatable and culturally acceptable to children and their parents.
- In general, a moderate to high proportion of the dietary reference intake (DRI) for energy and key micronutrients is desirable. Having said this, we recognize that in some low-income countries, overweight may be a concern, so we suggest that caloric density should be carefully considered in light of the context.

Our paper begins to address the evidence gap on the opportunities for supporting child growth and development post-infancy, and throughout the continuum from early childhood to adolescence. However, there is much work to be done so that interventions that benefit school children and/or young children can be truly compared. Aggregation of costs and benefits across different intervention modalities and various outcomes is an important challenge for evaluators (Pawson et al., 2005) and this remains an active research area.

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