Impact evaluation of school feeding programs in Lao PDR

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Despite the popularity and widespread implementation of school feeding programs, evidence of their impact on school participation and nutritional status is mixed. In this study we evaluate feeding programs in three districts of the Lao People's Democratic Republic. Feeding modalities included on-site feeding, take-home rations, and a combined modality. District-level implementation of the intervention sites and selective take-up presented considerable evaluation challenges. To address these, we use difference-in-difference estimators with propensity-score weighting to construct plausible counterfactuals. We find minimal evidence that school feeding increased enrolment or improved nutritional status. Several robustness checks and possible explanations for null findings are presented.

1 Introduction

School feeding programs, a form of conditional transfer, are promoted as a means to increase educational participation, achievement and cognition, and nutritional status. Despite the attention and resources devoted to school feedings programs, however, prior research on school feeding has been hindered by school-based rather than household-based samples, cross-sectional data, and non-randomized designs (Adelman, Gilligan, & Lehrer, 2008). In 2005, the World Food Programme initiated a three-country study of school feeding programs jointly with the World Bank that was designed to address these shortcomings. Impact evaluations were launched in Burkina Faso, Uganda, and the Lao People's Democratic Republic (Lao PDR). One noteworthy feature of these studies is that they include a comparison of different school feeding modalities (on-site feeding vs. take-home rations) as well as a control group.

This paper reports the results from the study in Lao PDR, which took place in two northern provinces of the country from 2006-2008. The longitudinal study uses a household-based sample and, thus, is better able to assess the nutrition of siblings of students as well as enrolment impacts. To preview our results, we find very little conclusive evidence that school feeding affected enrolment or nutritional status in this population. The evaluation presents several methodological challenges which are discussed in detail below. In an attempt to confirm our null findings, we undertake several additional analyses related to sample attrition, spillover effects, and program take-up and implementation. The study raises some concerns about the potential for school feeding programs where school capacity is limited.

The paper proceeds as follows: we first discuss the theory and prior evidence of school feeding programs, and then introduce our evaluation strategy. Details on the Lao PDR setting

and the school feeding intervention are provided, along with a description of the sample and measures. Results and discussion follow.

2 School feeding and child development: Theory and evidence

Providing food to school children, either during the school day in the form of a snack or in the form of rations to take home, has several goals. First, the transfer is intended to decrease the net cost of schooling and thereby shift parental demand for children's educational participation, leading to improvements in enrolment, attendance, and age at school entry. A second goal is to alleviate short-term hunger during the school day to improve children's concentration and cognitive functioning, leading to better learning and higher achievement. A third goal is to improve children's long-run macro- and micronutritional status through the provision of additional calories and fortified foods, reducing malnutrition and its attendant negative impact on future health and productivity (Adelman, Gilligan, et al., 2008).

Previous empirical work has found mixed evidence for the impact of school feeding (for comprehensive reviews, see Adelman, Gilligan, et al., 2008; Bundy, Burbano, Grosh, Gelli, & Jukes, 2009; Kristjansson et al., 2007). Adelman, Gilligan, et al. (2008) point out that relatively few of the studies in the literature measuring enrollment impacts use a randomized design, perhaps reflecting the popularity of the intervention and the political obstacles to randomization. Thus, their review covers a wider range of approaches to identifying causal impacts including studies that use quasi-experimental methods such as natural or administrative experiments that identify impacts by exploiting a quasi-random component of program eligibility. Studies that investigate impacts on nutrient consumption are more likely to have a randomized design, but

fewer studies that look at anthropometric outcomes employ this approach and virtually no randomized studies look at outcomes of younger family members.

Results are most compelling for school enrolment and attendance, particularly where initial rates of participation are low (Ahmed, 2004; Jacoby, Cueto, & Pollitt, 1996). The effect of school feeding programs on age at first schooling is also of interest given prior work on the importance of timely school entry for future school and labour market success. However, the effect of school feeding on school entry age has not been demonstrated empirically and is identified in reviews as an important evidence gap (Adelman, Gilligan, et al., 2008).

Evidence of impact of school feeding on learning achievement and cognitive function is also hard to find. Studies have shown significant impact in one but not multiple domains, e.g., increased math but not language scores or vice versa (Ahmed, 2004; Kristjansson, et al., 2007; Tan, Lane, & Lassibille, 1999). The mechanisms linking school feeding to achievement are more complex than the school feeding-participation relationship, and are therefore less straightforward to evaluate. School feeding is hypothesized to improve educational achievement through at least three routes: First, school feeding should lead to more time in school, providing more opportunities for learning. Unintended consequences must be factored in, however. For example, if enrolment increases in response to school feeding programs but no additional teachers are hired, classroom crowding may impede effective teaching. For on-site feeding in particular, the provision of a meal during the school day may take away from teaching time (Grantham-McGregor, Chang, & Walker, 1998). A second mechanism is improved cognitive functioning and attention span associated with the alleviation of hunger during the school day. A third mechanism is improved long-term health associated with better nutrition and resistance to infection, which in turn reduces illness-related absences and thereby improves performance.

While micronutrient deficiencies and short-term hunger are fairly easy to address through school feeding, supporting children's long-term growth trajectory may not be. Existing evidence suggests that where there is an effect of school feeding on child growth, it is most likely modest (Grillenberger et al., 2003; Kristjansson, et al., 2007; Powell, Walker, Chang, & Grantham-McGregor, 1998; van Stuijvenberg et al., 1999). Anthropometric studies have confirmed that school-age children may be too old to experience catch-up growth or recover from growth faltering (Behrman, Alderman, & Hoddinott, 2004; Martorell, 1995; Martorell, Khan, & Schroeder, 1994; World Bank, 2006).

How and whether food transfers reach the intended beneficiaries has important implications for effectiveness. School feeding modalities can include on-site feeding (OSF), take-home rations (THR), or both. The impact of the alternative modalities could differ, even if the value of the transfer is comparable. OSF and THR differ in the timing of receipt of the food transfer (daily vs. periodic), conditionality (daily attendance vs. average attendance), and content (OSF may include dairy products, for example). THR do not provide short-term nutritional benefits that can boost concentration and learning effectiveness. THR, however, have the potential to be targeted to a subset of students – say, by poverty or gender – while OSF rarely is targeted within a school.

3 Evaluation Strategy

The idea impact evaluation of alternative school feeding modalities would randomly assign modalities to schools and would also include a control group with no school feeding. In this ideal design, any observed differences in child outcomes could be attributed to the school feeding programs. The design of the present study, however, offers several challenges to the

identification of a suitable counterfactual. First, political and logistical circumstances dictated that school feeding modalities (on-site feeding, take-home rations, or both) could be randomized only at the district level. Second, the control district (receiving no intervention) had to be selected from a neighbouring province, as all other districts in the intervention province were already participating in school feeding. Key socioeconomic and demographic characteristics used to select the control district prior to the baseline survey are shown in Table 1; the control district appears fairly well-matched. However, tests for equality of means of key baseline child, household, school and village characteristics across the four districts (Table 2) reveal significant differences across the districts, particularly in ethnic composition and geography, characteristics which we might expect to be associated with health and nutrition outcomes of children.

A third challenge is selective take up of the intervention. Within the three intervention districts, villages chose whether to participate in the offered school feeding program. This self-selection is likely driven by both observable and unobservable characteristics of villages and village leadership. Comparisons of the health and education outcomes in “take-up” vs. “non-take-up” villages across the three intervention districts suggest that take-up villages had better outcomes at baseline for enrolment and nutrition (Figures 1 and 2). Preliminary analyses also suggested that the village-level predictors of take-up varied substantially across districts (see Table 3). For example, while the proportion of children enrolled in school is positively correlated with take-up when the three intervention districts are pooled (Table 3, first column), the association is clearly strongest in Phongsaly district compared to Khua or Nhot Ou districts.¹ In general, it appears that villages with higher levels of socioeconomic development and more

¹ These multivariate results are consistent with the bivariate associations shown in Figure 1. Odds ratios for take-up regressed on current enrollment in 2006 are 4.32 for Phongsaly ($p < .001$); 1.29 for Khua ($p = 0.456$); and 2.22 for Nhot Ou ($p = .001$).

physical access to roads and river transport were more likely to elect to participate in the school feeding programme. As these villages were likely also better able to implement the school feeding activities successfully, any observed effect of school feeding on health and nutrition outcomes may be biased upward.

Given these challenges, and the availability of pre- and post-intervention data, we used two distinct difference-in-difference (DiD) estimators to construct two plausible counterfactuals. First, the within-district DiD compares the changes in outcomes from baseline to follow-up in take-up villages vs. non-take-up villages in the same district:

$$\Delta^{\text{DiD}} = E[(Y_1^T - Y_0^T) - (Y_1^C - Y_0^C)] \quad (1)$$

where Y_0 and Y_1 denote outcomes at baseline and follow-up respectively, and T and C denote within-district treatment (take-up) and control (non-take-up). At the child level, this is an intent-to-treat analysis (ITT) as we do not account for whether individual children received transfers but only whether they lived in a take-up village or not. Formally, our DiD specification is

$$Y_{ivt} = \beta_0 + \beta_1 * \text{Take-up} * \text{Round2} + \beta_2 * \text{Round2} + \gamma X_{ivt} + \sum \delta_v V_{ivt} + \varepsilon_{ivt} \quad (2)$$

where Y_{ivt} is the outcome for child i in village v at time t , Take-up is the treatment indicator, and Round2 is the follow-up survey, X represents household characteristics and V stands for the set of dummy variables for each village. ε_{it} is the error term which is composed of individual and family unobserved fixed characteristics as well as a stochastic disturbance term, μ_{it} :

$$\varepsilon_{ivt} = \nu_i + \eta_i + \mu_{it} \quad (3)$$

The village fixed effects account for any time invariant community level unobservables including any fixed factors associated with schools. The interaction term of Take-up*Round2 reflects the difference-in-difference and is the coefficient of interest for the impact evaluation. We estimate (2) separately for each of the three intervention districts.

To mitigate potential bias stemming from selective take-up, we use a propensity-score matching technique to trim and weight the observations. We first model the decision to implement the program as a function of village characteristics including the means of household characteristics within the villages. These take-up models allow us to calculate within-district propensity scores, or the probability that a village would participate in the school feeding program. A separate propensity score model was estimated for each of three intervention districts using the same set of baseline covariates (Table 3). We then use the propensity scores to weight the observations in the DiD analysis, such that take-up villages are given a weight of 1, and non-take up villages are given a weight of $(p/1-p)$, where p is the propensity score (Chen, Mu, & Ravallion, 2009; Hirano, Imbens, & Ridder, 2003). We also trim the top and bottom five percentiles of propensity score values. The weighting and trimming serve to balance the observations between take-up and non-take-up villages along observable dimensions. This subsequent matched DiD analysis would yield estimates of the causal impact of school feeding if the matching equation adequately captures the village-level determinants of the take-up decision.

However, we must interpret the within-district propensity-matched results if there are unobservable factors which are also like to affect take-up. A second DiD specification therefore exploits the existence of a control district in our sample and affords an alternative estimate of program impact. In this specification, we include only take-up villages from the intervention districts, and all of the villages in the control district (Ngoi). Propensity-score weights are

recalculated for these district-specific samples, and samples are again trimmed. This specification allows us to compare the intervention villages to the villages in the control district that are most similar but were not eligible for the school feeding program.

While this evaluation approach has obvious drawbacks relative to a randomized design with complete take-up, it also offers advantages over other recent school feeding evaluations. First, the sample of children is based on a household rather than a school sampling frame, meaning that children who are not enrolled in school are included in the analysis. Second, we include children from age 3 to age 14, capturing potential spillover effects for older and younger siblings. Third, the longitudinal design allows for the DiD analysis. Finally, the design includes three treatment arms (OSF only, THR only, and OSF plus THR) and also includes a control district. In addition to the core analyses, several robustness checks and supplemental analyses were also undertaken, the results of which are described below.

4 Setting

This study is set in four districts in northern Lao PDR. Half of all Lao children are stunted and one-third are underweight (UNICEF, 2008). Primary school net enrolment for the country is 84%. Many villages, particularly in remote, mountainous areas, have no schools or have schools with only one or two primary grades. Parents who want their children to continue schooling must send the children to a neighbouring village. If the travel distance is too far to allow for a daily commute, children may board at their school. Boarding usually entails living during the school week in simple dormitory shelters constructed by parents. These “informal boarders” are responsible for preparing their own meals and are considered nutritionally vulnerable.

In this context, the World Food Programme has been operating school feeding programs in Lao PDR since 2002. The program initially targeted 12 districts in three northern provinces. Much of the population in these districts lives in remote mountainous areas with limited access to roads. Enrolment rates, particularly for girls, are low in these areas and household food insecurity is prevalent. The WFP program originally provided a daily snack made from corn-soya blend at school, and additional take-home rations of canned fish and rice for girls and for informal boarders to encourage their enrolment and continued attendance. Take-home rations are meant to be conditional on attending school at least 80% of the time. To participate in the school feeding program, villages were required to convene a school feeding committee, build food storage facilities, provide labour for food preparation and, in some cases, travel to WFP food distribution points to pick up food allocations.

In 2006, WFP expanded the school feeding program to the remaining 7 districts in the targeted provinces. This roll-out provided the opportunity to undertake a longitudinal evaluation of school feeding impact and to compare different school feeding modalities. Three of the new districts in Phongsaly province were selected as intervention sites, and a neighbouring district in Luang Prabang Province was selected as a control site as described above. Due to concerns about possible spillover effects and perceived equity, the World Food Programme and the Lao Ministry of Education determined that implementation of the interventions should be done at the district level and with feeding modality assigned randomly across the three districts in Phongsaly province. Interventions were assigned as follows:

Phongsaly District (Phongsaly Province):	On-site feeding
Khua District (Phongsaly Province):	On-site feeding and take-home rations
Nhot Ou District (Phongsaly Province):	Take-home rations

Ngoi (Luang Prabang District):

Control district

Take-home rations were provided to both girls and boys, with a separate additional ration also provided to informal boarders.

Data for the study come from a longitudinal survey of approximately 4,500 households with school-aged children in rural villages in the four sampled districts of northern Lao PDR. At standard levels of significance (.05) and power (.8), the study size is sufficient to detect a difference in enrollment of five percentage points post-intervention based on baseline attendance data, as well as sufficient enough to detect a change in anthropometric z-scores of approximately 0.3 standard deviations. Eligible households (those with at least one school-aged child, defined as children aged 6-10) were randomly selected using a multiple stage probability sampling scheme. In the first stage, 75 primary sampling units were randomly selected from each district with probability proportional to the population in each village (as listed by the 2005 census). For the most part, primary sampling units were villages. Some large villages comprised two or more PSUs. At the second stage, enumerators and the village head drew up a complete household listing based on the village head's knowledge of child ages. Fifteen households with school aged children were randomly selected from each PSU. In cases where the total number of eligible households was fewer than fifteen, all eligible households were sampled. From a target of 4,500 households, successful interviews were conducted with 4,169 households in 263 villages, a 93% response rate.

After the baseline survey, eligible villages were informed of the rollout of the school feeding program and invited to participate. Consistent with existing policies for school feeding schemes, villages that wanted to participate had to meet minimum participation requirements as described above. All villages that chose to participate and met the participation requirements

were included in the intervention. Participation in sampled villages with existing schools in 2006 was 35/58 (60%) in Phongsaly, 47/63 in Khua (75%), and 34/59 (58%) in Nhot Ou.

A follow-up survey was fielded in the fall of 2008. Where possible, the sampled villages and households from 2006 were located and re-interviewed. A total of 11 villages had moved from their 2006 location (due to the government's village relocation policies), had merged with another village, or could otherwise not be re-interviewed, leading to 119 households lost to follow up. Within recontacted villages, an additional 412 households had left the village or could not otherwise be located and re-interviewed. When possible, replacement households were randomly drawn from a listing of eligible households in the villages with children aged 6-10 who had not been sampled in 2006. A total of 286 replacement households were added to the sample in 2008. Recontact rates therefore are 96% at the village level and 87% at the household level.

An extensive household questionnaire was used to collect information on household composition, assets, livestock, agricultural, shocks, food security, diet diversity, and social capital. The household questionnaire also included detailed education histories and daily activities for children age 6-14 (6-16 in 2008), and diet diversity, anthropometry, and haemoglobin assessments for children age 3-10 (3-12 in 2008). In 2008, modules were added on child health and morbidity and parental perceptions of the school feeding programs. Village and school surveys were also completed by village leaders. For complete details on the survey and fieldwork, see Buttenheim & McLaughlin (2006).

For analyses presented here, we restrict the sample in each year to children ages 3-14 living in villages with schools². The analytic sample includes 10,748 children in 2006 and 9,810 children in 2008. Impact of school feeding is assessed along multiple dimensions: School participation is captured by a dummy variable for currently enrolled in school. Nutritional status is measured by weight-for-age standardized z-scores, calculated from measured weight and reported age using the WHO Child Growth Standards (WHO Multicentre Growth Reference Study Group, 2006); and by an indicator for whether the child is anaemic, based on altitude-adjusted measured haemoglobin (Nestel, 2002). The cut-off for anaemia was 11.0 g/dL for children under 5 years, and 11.5 g/dL for children 5-10 years old.

5 Results

5.1 *Current enrolment*

Current enrolment for children 6-14 by district, survey year and school feeding take-up is shown in Figure 1. Coefficients from probit regressions are expressed as marginal effects. Noteworthy, enrolment at baseline is higher in take-up villages than in non-take-up villages. Moreover, enrolment increases in all districts from 2006-2008, including in the control district of Ngoi. Estimates from the difference-in-difference models (Table 4) confirm that enrolment increases are not larger in take-up villages compared to non-take-up villages within the same district. The first three columns present results from within-district estimates (comparing take-up to non-take-up villages) and the next three columns compare take-up villages in intervention districts to all

² Nineteen villages were excluded based on having no school. An additional village in Khua was excluded because no hemoglobin measures were taken there. The analytic sample includes 58 villages in Phongsaly, 63 villages in Khua, 59 villages in Nhot Ou, and 64 villages in Ngoi.

villages in the control district (Ngoi). We find weak evidence for any impact of school feeding programs on children's enrolment status. There is a marginally significant effect in take-up villages in Phongsaly district (which provided onsite feeding) of five percent when compared with villages in Ngoi. In Nhot Ou district, which provided take-home rations, a significant enrolment boost of seven percent is observed. Stratified models (available from authors) point to younger girls (ages 6-10) driving this result in Phongsaly (with a 15% increase). In Nhot Ou, however, increases are seen for younger boys and older girls (ages 11-14). However, this finding is not supported by a comparable increase in enrolment in Khua District, which offered both on-site meals and take-home rations.

As noted by King and Behrman (2009), impact evaluations are often sensitive to the time period studied. Over a relatively short period children enrolled at baseline are likely to remain so. Thus, we also estimated a single-difference model of current enrolment, restricting the sample only to those children who were of school age at baseline (2006) but were not currently enrolled. This model is estimated only for 2008. Results (Table 5, model 5A) show nine percent higher enrolment in take-up villages in Phongsaly but no significant difference for Ngoi or Nhot Ou. We also investigated effects on attendance using a fairly crude measure of parents' reports of children's absences in the previous term (no direct observations of school attendance records were available). While we observed a slight improvement in attendance, particularly for younger girls in some models, these results (available from authors) were not robust to inclusion of the control district.

Another possible effect of school feeding on enrolment is that children enter school at an earlier age. School feeding programs could encourage timely school entry by changing parental perceptions about the costs and benefits of schooling for young children around the school entry

age. Previous research has shown that starting school at the recommended school entry age is associated with future school success. In our sample, the most common reason offered by parents to explain non-enrolment of children was that the child was “too young” or “too small.” The availability of school meals may shift parent preferences toward sending a child perceived as too young or small to school. If so, we should observe a drop in the age at school entry. On the other hand, if older children who have never attended school also enrol for the first time, the age at school entry may go up. We investigate this in another single-difference estimate of the impact of school feeding on age at school entry (Table 5, model 5B). Four of six specifications show earlier school entry for children in take-up villages, with results most compelling for Phongsaly. Stratified models (not shown) also show a large and significant negative coefficient (younger age at entry) in Phongsaly for younger children in particular.

Taken together, the models presented for school participation do not demonstrate a robust impact of school feeding on school participation across the three intervention districts. It is clear that villages that took up the programs had higher enrolment at baseline, and that the entire region experienced a secular increase in enrolment over the two-year period, consistent with other education-related interventions such as the UNICEF-supported Child Friendly Schools program. The results suggest increased enrolment and earlier age at school entry in Phongsaly and Nhot Ou take-up villages (which offered only one school feeding modalities) compared to Ngoi control villages. However, in Khua district, where both modalities were offered, the results point to null findings.

5.2 Nutritional status

As discussed above, school meals can alleviate short-term hunger, boost micronutrient status, and perhaps provide longer-term nutrition to support child growth. In this study we assess

nutritional status through weight-for-age³, which captures both short- and long-term nutritional status, and anaemia, a measure of micronutrient deficiency. Results for weight-for-age (Table 6) do not provide a consistent picture of the impact of school feeding on child weight. For all children combined, there is a significant positive impact of take-home rations in Nhot Ou (compared to Ngoi controls), on the magnitude of a 0.22 standard deviation in weight-for-age. This is the same district that appeared to have an increase in enrolment associated with the rations. This result is not observed for all sites nor in both estimation methods. Results for anaemia (Table 7) also do not indicate clear improvement in this indicator.

Other recent analyses of school feeding programs in Burkina Faso have found evidence of nutritional spillover effects for younger siblings of beneficiaries (Kazianga, de Walque, & Alderman, 2010). These results cover a somewhat younger cohort than in our sample. While we do observe significant increases in weight-for-age for children 3-5 in 2 of 12 estimates disaggregated by gender, district, and methodology, the majority of the coefficients are not significant.⁴ Similarly, while there are significant results suggesting reductions in anaemia prevalence by 2008 for younger children in Nhot Ou, and for older girls in Khua and Nhot Ou, collectively the nutritional analyses fail to find consistent evidence of positive effect of school feeding on the nutritional status of younger children.

5.3 Additional analyses

Our two difference-in-difference specifications weighted by propensity scores do not yield compelling or consistent evidence of the positive impact of school feeding in this study context. We undertake a set of additional analyses to explore possible sources of null findings.

³ Results for height for age are similar and are available from the authors.

⁴ Disaggregated results are available from the authors.

5.3.1 Selective village and household attrition.

Eleven villages in the 2006 sample had relocated by 2008 and could not be re-interviewed.

Attrition from the village sample by 2008 is significantly associated with the number of households in the village, with larger villages less likely to later relocate (results not shown).

This is consistent with the Government of Laos policy to relocate or combine smaller villages to achieve economies of scale in service provision and agricultural development (Baird & Shoemaker, 2005; Evrard & Goudineau, 2004; World Food Programme, 2005). Six of the 11 relocated villages were in Phongsaly district. Given that these villages were also less likely to take up school feeding (given our estimates of take-up propensity), it is not likely that their attrition is biasing estimates of school feeding downward (in fact, the opposite is probably true).

At the household level, almost 400 sampled households had relocated or could not otherwise be interviewed in 2008. Households in Khua and Nhot Ou were less likely to be lost to follow up relative to Ngoi (results not shown). In addition, households in larger villages, households with more children, and households with higher levels of per capita expenditures were less likely to be lost to follow up. Replacement households had significantly higher per capita expenditures in 2008 than panel households, but not significantly different child nutritional status or odds of current enrolment. The precise implications of this selection bias are not clear. If children with fewer resources benefitted more from school feeding, then our models may slightly underestimate program effects. Some of the relocated children may have benefitted from school feeding programs before they left, or may have moved to villages that also had school feeding programs.

5.3.2 Geographic spillover effects

One possible explanation for our findings of minimal effects of school feeding is that students in non-take-up villages started to attend school in adjacent villages that did have school feeding programs. This would attenuate any observed differences between children in take-up vs. non-take-up villages, as some children in non-take-up villages might experience improvement in enrolment and nutritional status associated with the take-up in adjacent villages. One piece of evidence in support of this spillover effect would be a widening gap in the proportion of “informal” boarders (students who stay at school or travel more than an hour each way to school) in non-take-up vs. take-up villages from 2006 to 2008. Again, we find no evidence of such a gap (results available from authors).

5.3.3 Magnitude and intensity of food transfers in intervention districts

Effects of school feeding may depend on the magnitude and reliability of the food transfer provided. The World Food Programme reports that the OSF ration is intended to provide 100 grams of corn-soya blend and 12.5 grams of sugar each school day, with a target of 83 feedings per term. In the follow-up survey, villages reported the frequency of meals provided in the current term and the number of days that meals had been provided in previous terms (Table 8). While 34/35 (97%) of take-up schools in Phongsaly reported providing OSF meals every day in the current term, only 27/47 (57%) take-up schools in Khua reported providing a meal every day. Indeed, 9 schools listed as participating in school feeding also report never providing a meal in the current term. A second measure of OSF intensity, calculated as the number of days since Fall 2006 that the school reports providing a meal, is also higher in Phongsaly (median = 280) compared to Khua (median = 235), even though schools in Khua enrolled in the school feeding

program earlier than Phongsaly schools. Overall, Phongsaly schools that participated in school feeding reported providing meals on 58% of all possible schools days since Fall 2006, compared to 49% of Khua schools. Together, these results suggest that program implementation difficulties in Khua may have compromised the effectiveness of the program.

The take-home rations for boys and girls in this intervention included 15 kilograms of rice upon enrolment in September, 30 kilograms of rice at the end of the school year in May if attendance was 80% as well as one can of fish each month if attendance was 80% for the month. Informal boarders received an additional four kilograms of rice, two cans of fish and one bag of salt each month if attendance was 80% for the month. Participating villages reported generally similar ration amounts, although the timing of distribution differed from the WFP schedule in many cases.

5.3.4 Conditionality of OSF

In order for OSF and THR program to positively affect school participation, transfers should be conditional on student attendance. There is some evidence that the OSF snack was provided to non-enrolled children: in Phongsaly 10/35 (29%) of take-up schools reported providing the snack to non-enrolled children and in Khua the figure was 20/43 (47%). At the child level, 11% of non-enrolled school-aged children and preschoolers in Phongsaly and 19% of the same population of children in Khua were reported by a parent to have consumed a WFP school snack in the past 24 hours. Given that 7% of children in Ngoi were reported to have had a WFP snack as well (even though there is no WFP school feeding scheme there), these are likely somewhat noisy overestimates, but again may point to program implementation issues, particularly in Khua. The data available do not allow a similar investigation of THR but any leakage would also dilute the enrolment impact.

5.3.5 Other supply side determinants of enrolment

The introduction of several other development and education programs in both the intervention and control districts during the study period presents additional challenges to making causal inferences about school feeding impact. Specifically, other programs that improved the availability or quality of schooling and therefore increased enrolment may have been implemented differentially in the study districts. We added several time-varying measures of school quality to the fixed effect estimates. These regressions indicated that children in villages with schools that gained toilets between 2006 and 2008 were more likely to enrol (results not shown). There was no apparent effect of the school's participation in the UNICEF "Blue Box" hygiene improvement program (which provides interactive games, story cards, songs, posters and other materials with key hygiene messages), but receipt of the Blue Box was negatively associated with children's weight-for-age, more likely reflecting targeting to low-resource schools than impact.

6 Discussion

The goal of this study was to evaluate the impact of school feeding on children's human capital formation in Lao PDR. The evaluation presented several programmatic and methodological challenges, which we have attempted to address through the construction of multiple counterfactuals and robustness checks. We nevertheless find no consistent effect of school feeding on either enrolment or nutritional status. The significant effect on enrolment and age at school entry of take-home rations (in Nhot Ou) and onsite feeding (in Phongsaly) is not observed in Khua, where both OSF and THR were delivered. This makes it difficult to confidently ascribe these improvements to a specific school feeding modality. At the same time, given a range of

other development projects underway in the study area, it is challenging to disentangle the unique contribution of school feeding, if any, to child education and health outcomes.

Additional robustness checks (available from authors) stratified the analyses by age and gender to evaluate whether benefits of school feeding accrued only to certain subgroups. In these analyses, 16% of coefficients showed positive benefits of school feeding for children, 3% showed a negative impact, and fully 81% were not significant, further supporting our finding of little consistent impact.

Previous research has suggested that school feeding programs are most effective in areas with low enrolment and household resource constraints. In our sample, larger and less remote villages with higher baseline enrolment selected into the school feeding programs. We might have seen greater effects if the program had 100% take-up or had been targeted to relatively disadvantaged villages. More consistent implementation might also have produced more compelling effects.

Non-take-up villages in our sample had the opportunity to enumerate reasons for non-participation. The top four reasons elicited in each district among non-take-up villages are presented in Table 9. In all districts and for both feeding modalities, the most common response was that the WFP food delivery point was too far away; another frequent response was lack of access to a road. These hurdles will not be easily overcome in the field as WFP continues its school feeding program expansion in Lao PDR. Problems were also cited with the requirement to build the food storage warehouse and to recruit sufficient village volunteers to run the program. This suggests a threshold level of social capital and social efficacy that is required for villages to participate in school feeding, which may discourage the villages that have the most to gain from participating.

The inconclusive results for Lao PDR should not be taken as evidence that school feeding is not effective when successfully delivered. The larger body of evidence on such programs including companion studies in Burkina Faso (Kazianga, et al., 2010) and Northern Uganda (Adelman, Alderman, Gilligan, & Konde-Lule, 2008; Adelman, Alderman, Gilligan, & Lehrer, 2008; Alderman, Gilligan, & Lehrer, 2008) reveal its potential. In the case of Lao PDR, we have identified several factors, including program design, selective take-up, and implementation, that may well account for inconclusive results. Our results do emphasize the need to think strategically about the role that school feeding programs should play in broader social and educational policies particularly given the unusually high transport costs and limited capacity in rural Laos.

The results point to a dilemma that is recurrent in the history of school feeding—albeit hardly unique to that form of intervention. In her review for USAID Beryl Levinger (1986) concluded that one reason that school feeding did not reach its potential was that programs often faced serious obstacles to implementation. The agency had to decide whether those obstacles were intrinsic or contingent. If the former, then the prudent policy choice would be to shift resources into other types of interventions. However, if the latter, then the agency would be well advised to address the limitations with additional resources. In Levinger’s case, as with these results from Lao PDR, the data at hand could justify either interpretation. Should school feeding schemes continue to be a programmatic priority in Lao PDR, we encourage the relevant governmental and non-governmental agencies to address the contingent factors identified in these analyses. At the same time, continued attention to the best alignment of resources (World Food Programme food supplies) and development goals (school participation and achievement) is critical.

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Figure 1: Unadjusted mean enrolment by district, year and school feeding take-up, children age 6-14, northern Lao PDR, 2006-2008

Figure 2: Unadjusted mean weight-for-age z-score by district, year and school feeding take-up, children age 3-10, northern Lao PDR, 2006-2008.

Table 1: Baseline characteristics of intervention and control districts, school feeding program impact assessment, northern Lao PDR, 2006.

District	Province	Type	No. of households	No. of villages	Poverty rate, rural households	Percent of villages with				Vulnerability*
						complete primary school	incomplete primary school	no primary school	no road access	
Phongsaly	Phongsaly	Intervention	5,682	92	0.36	18%	70%	12%	72%	Very vulnerable
Khua	Phongsaly	Intervention	4,858	113	0.40	10%	80%	11%	73%	Very vulnerable
Nhot Ou	Phongsaly	Intervention	4,514	91	0.32	7%	70%	23%	65%	Very vulnerable
Gnoi	Luang Prabang	Control	6,931	112	0.42	25%	60%	15%	75%	Vulnerable

Source: 2005 Census, Lao PDR; Lao Expenditure and Consumption Survey 2002-03; WFP 2005 Vulnerability Analysis. * Vulnerability score is from the WFP 2005 Vulnerability Analysis.

Table 2: Baseline child, household, and village characteristics by district (treatment group), school-aged children in rural villages in Northern Lao PDR, 2006 (N=5667).

	Phongsaly (OSF)		Khua (OSF & THR)		Nhot Ou (THR)		Ngoi (Control)
<u>Child-level variables</u>							
Child is male	0.52	[0.019]	0.50	[0.020]	0.51	[0.019]	0.51
Age in years	7.86	[0.046]**	7.97	[0.047]	7.87	[0.048]**	7.97
Height in cm.	114.22	[0.545]***	115.55	[0.616]	113.92	[0.628]***	116.03
Weight in kg.	20.13	[0.260]*	20.47	[0.253]	19.38	[0.231]***	20.56
Height-for-age z-score	-2.34	[0.085]	-2.31	[0.093]	-2.47	[0.096]**	-2.23
Weight-for-age z-score	-1.91	[0.080]	-1.94	[0.083]	-2.18	[0.072]***	-1.82
Haemoglobin (g/dL)	11.97	[0.109]**	12.34	[0.099]	12.30	[0.087]	12.19
Child is anaemic	0.33	[0.032]***	0.23	[0.026]	0.23	[0.025]	0.24
Currently enrolled in school	0.71	[0.043]	0.65	[0.048]	0.52	[0.046]***	0.69
Hours spent at school last week	28.60	[1.674]***	25.77	[1.969]***	17.80	[1.720]	19.66
Hours spent on household labour last week	14.24	[1.197]	15.07	[1.095]	14.54	[1.043]	15.49
Diet diversity	4.21	[0.110]***	3.62	[0.114]***	4.00	[0.116]***	3.32
<u>Household-level variables</u>							
Ethnic group = Lao-Tai	0.04	[0.052]***	0.14	[0.059]	0.26	[0.077]	0.20
Ethnic group = Mon-Khmer	0.00	[0.057]***	0.63	[0.082]	0.00	[0.057]***	0.63
Ethnic group = Sino-Tibetan	0.96	[0.030]***	0.24	[0.057]***	0.51	[0.068]***	0.00
Ethnic group = Hmong-Iumien	0.00	[0.050]***	0.00	[0.050]***	0.23	[0.075]	0.16
House walls = brick	0.03	[0.013]	0.02	[0.010]	0.10	[0.022]***	0.02
House walls = wood	0.41	[0.052]	0.65	[0.048]***	0.38	[0.044]	0.39
House walls = bamboo	0.50	[0.048]	0.19	[0.038]***	0.37	[0.043]**	0.46
House walls = missing, other	0.06	[0.028]***	0.14	[0.027]	0.15	[0.034]	0.14
Logged per capita expenditures	11.90	[0.025]	11.84	[0.030]	11.92	[0.021]**	11.87
Months of insufficient rice	2.33	[0.211]***	1.98	[0.243]**	1.29	[0.224]	1.37
Males 0-4 in household	0.45	[0.057]	0.42	[0.061]	0.46	[0.055]	0.46
Females 0-4 in household	0.40	[0.051]	0.36	[0.052]**	0.44	[0.051]	0.48
Males 5-14 in household	1.37	[0.066]	1.40	[0.092]	1.38	[0.072]	1.37
Females 5-14 in household	1.38	[0.072]	1.29	[0.073]	1.34	[0.063]	1.34

(continued from previous page)

Males 15-59 in household	1.45	[0.061]	1.56	[0.067]	1.64	[0.058]***	1.45
Females 15-59 in household	1.44	[0.052]	1.70	[0.085]**	1.62	[0.050]***	1.48
Males 60+ in household	0.11	[0.015]	0.11	[0.017]	0.11	[0.015]	0.09
Females 60+ in household	0.16	[0.018]	0.19	[0.019]***	0.17	[0.019]*	0.14
Years of schooling of household head	3.18	[0.188]	2.52	[0.182]	1.19	[0.225]***	3.82
<u>School/village-level variables</u>							
Elevation of village (km)	1.01	[0.057]***	0.76	[0.063]**	0.92	[0.050]***	0.62
Village has regular market	0.01	[0.049]***	0.16	[0.070]	0.02	[0.050]***	0.17
Net enrolment rate, all children	0.67	[0.042]	0.55	[0.051]**	0.54	[0.050]***	0.67
Net enrolment rate, girls	0.52	[0.058]**	0.56	[0.059]	0.48	[0.055]***	0.64
Exam pass rate, first grade	0.64	[0.041]	0.65	[0.045]	0.66	[0.038]	0.67
Exam pass rate, second grade	0.77	[0.040]	0.84	[0.038]	0.80	[0.043]	0.83
Number of households in village	53.26	[5.575]	50.72	[5.504]*	56.41	[7.766]	60.03
Village has road	0.28	[0.090]	0.40	[0.092]	0.28	[0.090]	0.31
Lowland village	0.72	[0.090]	0.60	[0.092]	0.72	[0.090]	0.69
Upland village	0.03	[0.053]**	0.08	[0.057]	0.15	[0.070]	0.14
Mixed upland/lowland village	0.97	[0.072]***	0.78	[0.086]***	0.69	[0.093]*	0.54

Statistics in brackets are standard errors for the difference between the treatment districts and the control districts, clustered at the village level. * significantly different from control at 10%; ** at 5%, *** at 1%. OSF = On-site feeding. THR = Take-home rations.

Table 3: Coefficients from probit models predicting village-level take-up of school feeding program, northern Lao PDR, 2006.

	All Districts	Within district			Between district (Take-up villages + all control (Ngoi) villages)		
		Phongsaly	Khua	Nhot Ou	Phongsaly	Khua	Nhot Ou
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Altitude (km)	-0.313** [0.148]	-0.476 [0.301]	-0.439* [0.237]	-0.247 [0.411]	0.558*** [0.184]	0.151 [0.180]	0.429** [0.194]
Number of households in village	0.006*** [0.002]	0.001 [0.004]	0.006* [0.003]	0.009* [0.005]	-0.005* [0.002]	-0.002 [0.002]	0.001 [0.002]
Average Household (logged) per capita expenditure	-0.417 [0.301]	0.246 [1.072]	-0.936* [0.512]	-0.957 [0.828]	0.986 [0.627]	0.049 [0.434]	1.507** [0.600]
Average Years of schooling, household head	0.052 [0.032]	0.091 [0.076]	0.034 [0.063]	0.205** [0.101]	0.034 [0.056]	-0.118** [0.053]	-0.206*** [0.063]
Proportion of children enrolled in school (age 6-14)	0.771*** [0.263]	1.834** [0.747]	0.266 [0.391]	0.629 [0.506]	0.124 [0.405]	0.510 [0.354]	-0.136 [0.380]
Hours of chores/household labour per week	0.007 [0.006]	0.019 [0.016]	0.035** [0.014]	-0.010 [0.013]	-0.025** [0.011]	-0.003 [0.009]	-0.011 [0.009]
Height-for-age z-score (age 3-10)	-0.003 [0.138]	-0.698 [0.494]	0.132 [0.192]	-0.227 [0.245]	-0.422 [0.281]	0.314 [0.201]	0.436** [0.195]
Weight-for-age z-score (age 3-10)	-0.196 [0.165]	0.244 [0.465]	-0.100 [0.267]	0.117 [0.323]	0.226 [0.305]	-0.401* [0.241]	-0.660** [0.261]
Child is anaemic (age 3-10)	-0.359* [0.215]	-0.985** [0.401]	-0.510 [0.441]	-0.423 [0.616]	0.439 [0.413]	-0.270 [0.408]	-0.573 [0.517]
Observations	179	58	62	59	97	108	96
Pseudo r ²	0.222	0.472	0.210	0.309	0.319	0.089	0.506

Standard errors in brackets. *** p<0.01, ** p<0.05, *p<0.1

Table 4. Average impact of school feeding programs on current enrolment in school, school-aged children (6-14) in rural villages in Northern Lao PDR, 2006-2008.

	Weighted and Trimmed DiD			Weighted and Trimmed DiD with Control District (Ngoi)		
	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR
All children						
Take-up * 2008	0.001 [0.050]	0.015 [0.046]	0.009 [0.050]	0.048* [0.024]	0.033 [0.027]	0.072*** [0.026]
2008	0.079* [0.044]	0.074* [0.039]	0.192*** [0.042]	0.041*** [0.011]	0.075*** [0.018]	0.107*** [0.016]
Age	0.021** [0.009]	0.030*** [0.006]	0.017*** [0.005]	0.020*** [0.004]	0.020*** [0.004]	0.023*** [0.004]
Child = Male	0.089*** [0.025]	0.078** [0.031]	0.142*** [0.035]	0.052** [0.022]	0.070*** [0.018]	0.134*** [0.025]
Education of household head	0.005 [0.003]	0.008*** [0.003]	0.012*** [0.005]	0.008** [0.003]	0.013*** [0.003]	0.015** [0.006]
Per capita expenditures (log)	0.129*** [0.045]	0.033 [0.041]	0.076 [0.071]	0.077** [0.032]	0.002 [0.024]	0.091*** [0.034]
Observations	3389	3282	3692	5500	6031	5650
Pseudo r2	0.207	0.245	0.189	0.168	0.192	0.188

Standard errors in brackets, clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1. Models are estimated with probit regression and include village fixed effects. Coefficients represent marginal effects (percentage point change in outcome). OSF = On-site feeding. THR = Take-home rations. Dependent variable is current enrolment in school as reported by parent.

Table 5. Additional models of current enrolment in school, children age 6-14, northern Lao PDR, 2006-2008.

	Weighted and Trimmed DiD			Weighted and Trimmed DiD with Control District (Ngoi)		
	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR
Model 5A: 2008 enrolment, children not enrolled in 2006 School feeding predictor: Take-up = 1	0.099 [0.078]	0.063 [0.056]	0.020 [0.094]	0.089** [0.041]	-0.054 [0.051]	0.079 [0.056]
Model 5B: Age at school entry, children entering school after 2006 School feeding predictor: Take-up = 1	-0.379** [0.157]	-0.480** [0.214]	0.215 [0.198]	-0.546*** [0.136]	-0.159 [0.115]	-0.401*** [0.125]

Each row represents results from a different set of models. Sample for model A is 2008 observations of children age 6-14 in 2006 and not enrolled in school. Sample for model B is 2008 observations of children age 3-14 who entered school between 2006 and 2008. All models control for child age, child gender, years of school of household head, and logged per capita expenditures.

Table 6. Average impact of school feeding programs on weight-for-age z-score, school-aged children (3-10) in rural villages in Northern Lao PDR, 2006-2008.

	Weighted and Trimmed DiD			Weighted and Trimmed DiD with Control District (Ngoi)		
	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR
All children						
Take-up * 2008	0.389*	-0.044	0.093	0.018	0.109*	0.218**
	[0.223]	[0.080]	[0.106]	[0.088]	[0.062]	[0.090]
2008	-0.407*	0.168**	0.052	-0.020	-0.000	-0.090
	[0.217]	[0.073]	[0.094]	[0.054]	[0.043]	[0.083]
Age	-0.054***	-0.062***	-0.084***	-0.069***	-0.067***	-0.099***
	[0.012]	[0.016]	[0.015]	[0.014]	[0.011]	[0.016]
Child = Male	-0.167***	-0.108	-0.049	-0.097	-0.076	-0.085
	[0.051]	[0.098]	[0.074]	[0.060]	[0.046]	[0.074]
Education of household head	0.021	-0.011	0.011	0.008	0.001	0.011
	[0.019]	[0.014]	[0.012]	[0.010]	[0.010]	[0.014]
Per capita expenditures (log)	0.205	-0.023	0.047	-0.002	-0.049	-0.010
	[0.203]	[0.102]	[0.234]	[0.208]	[0.082]	[0.183]
Constant	-3.336	-1.844	-1.891	-1.363	-0.034	-0.760
	[2.393]	[1.320]	[2.733]	[2.458]	[0.992]	[2.176]
Observations	2624	2289	2463	4022	4284	3954
r2	0.109	0.182	0.131	0.083	0.157	0.122

Standard errors in brackets, clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1. Models are estimated with linear regression and include village fixed effects. OSF = On-site feeding. THR = Take-home rations. Dependent variable is age- and sex-standardized weight-for-age z-score, calculated from measured weight and reported age using the WHO Child Growth Standards.

Table 7. Average impact of school feeding programs on anaemia, school-aged children (3-10) in rural villages in Northern Lao PDR, 2006-2008.

	Weighted and Trimmed DiD			Weighted and Trimmed DiD with Control District (Ngoi)		
	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR
All children						
Take up * 2008	0.074 [0.080]	0.154 [0.109]	-0.050 [0.035]	-0.035 [0.047]	-0.027 [0.042]	-0.023 [0.042]
2008	-0.153*** [0.054]	-0.119 [0.076]	0.077*** [0.024]	0.004 [0.039]	0.027 [0.035]	0.028 [0.036]
Age	0.005 [0.006]	-0.003 [0.003]	-0.013** [0.006]	-0.001 [0.005]	-0.002 [0.003]	-0.006 [0.004]
Child = Male	0.016 [0.019]	0.022* [0.012]	0.011 [0.030]	0.026 [0.020]	0.035** [0.014]	0.035* [0.019]
Years of education, household head	-0.003 [0.005]	-0.009*** [0.003]	-0.001 [0.006]	-0.003 [0.004]	-0.006* [0.003]	-0.007 [0.005]
Per capita expenditures (log)	-0.038 [0.086]	-0.023 [0.073]	0.074 [0.065]	0.011 [0.053]	0.024 [0.041]	-0.049 [0.045]
Observations	2967	2620	2843	4551	4891	4486
Pseudo r2	0.0781	0.0692	0.0555	0.0775	0.0681	0.0908

Standard errors in brackets, clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1. Models are estimated with probit regression and include village fixed effects. Coefficients represent marginal effects (percentage point change in outcome). OSF = On-site feeding, THR = Take-home rations. Dependent variable is anaemia as determined by measured haemoglobin, altitude-adjusted (cut-offs: 11.0 g/dL for children under 5 years, and 11.5 g/dL for children 5-10 years old).

Table 8. Onsite feeding program intensity by district, schools offering onsite feeding, northern Lao PDR, 2008.

	Phongsaly OSF (N = 35)	Khua OSF/THR (N = 45)
How often do students receive the school snack this term (Fall 2008)?		
Every day	34 (97%)	27 (57%)
Most days	1 (3%)	3 (6%)
Some days	0	2 (4%)
Occasionally	0	2 (4%)
Never	0	9 (19%)
Don't know/no answer	0	2 (9%)
When did OSF start at the school? (Total days of OSF since start)		
Fall 2006	9 (324 days)	24 (241 days)
Spring 2007	17 (253 days)	15 (184 days)
Fall 2007	3 (200 days)	6 (207 days)
Spring 2008	4 (198 days)	0
Fall 2008	3 (42 days)	0
Don't know	1 (40 days)	0
Proportion of all school days (Fall 2006-Fall 2008) when snacks were provided	58%	49%

Table 9. Reasons given* by village leaders for non-take-up of school feeding programs by district, northern Lao PDR, 2008.

	Phongsaly	Khua	Nhot Ou
OSF	<ol style="list-style-type: none"> 1. Food delivery point too far away 2. Not enough volunteers in village 3. Too much trouble to build warehouse 4. No access road to village 	<ol style="list-style-type: none"> 1. Food delivery point too far away 2. District did not deliver food 3. No access road to village 4. Too much trouble to build warehouse 	
THR		<ol style="list-style-type: none"> 1. Food delivery point too far away 2. Not enough volunteers in village 3. District did not deliver food to village 4. No informal borders in this village 	<ol style="list-style-type: none"> 1. Food delivery point too far away 2. Not enough volunteers in village 3. Too much trouble to build warehouse 4. Villagers can't pick up food at district

* Respondents were asked to give three open-ended responses. Responses were subsequently coded by the interviewer. Top four responses identified in each district are shown. OSF = On-site feeding. THR = Take-home rations.

Table A1. Average impact of school feeding programs on school attendance, school-aged children (6-14) currently enrolled in school in rural villages in Northern Lao PDR, 2006-2008.

	Weighted and Trimmed DiD			Weighted and Trimmed DiD with Control District (Ngoi)		
	Phongsaly	Khua	Nhot Ou	Phongsaly	Khua	Nhot Ou
	OSF	OSF/THR	THR	OSF	OSF/THR	THR
All children 6-14	0.043**	0.048	-0.012	-0.059	-0.081	0.004
	[0.019]	[0.072]	[0.049]	[0.037]	[0.061]	[0.054]
All children 6-10	0.072***	0.061	-0.016	-0.039	-0.113	0.014
	[0.018]	[0.080]	[0.064]	[0.069]	[0.092]	[0.080]
All girls 6-10	0.119***	0.073	-0.122	-0.039	-0.113	0.014
	[0.030]	[0.092]	[0.147]	[0.069]	[0.092]	[0.080]

Standard errors in brackets, clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1. Models are estimated with probit regression and include village fixed effects. Coefficients represent marginal effects (percentage point change in outcome). OSF = On-site feeding. THR = Take-home rations. Dependent variable is parent report that child missed fewer than five days of school in the Fall term (vs. 5 or more days).

Table A2. Average impact of school feeding programs current enrollment, school-aged children (6-14) in rural villages in Northern Lao PDR, 2006-2008.

	Weighted and Trimmed DiD			Weighted and Trimmed DiD with Control District (Ngoi)		
	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR	Phongsaly OSF	Khua OSF/THR	Nhot Ou THR
All children						
Take up * 2008	-0.054 [0.054]	0.009 [0.057]	-0.014 [0.042]	0.017 [0.032]	0.014 [0.028]	0.043 [0.032]
2008	0.118** [0.052]	0.070 [0.049]	0.179*** [0.036]	0.059*** [0.015]	0.075*** [0.018]	0.109*** [0.017]
Age	0.022** [0.010]	0.028*** [0.005]	0.016*** [0.004]	0.022*** [0.004]	0.019*** [0.004]	0.021*** [0.004]
Child = Male	0.093*** [0.031]	0.071** [0.032]	0.122*** [0.031]	0.053** [0.024]	0.062*** [0.017]	0.119*** [0.026]
Years of education, household head	0.004 [0.003]	0.004* [0.002]	0.009*** [0.003]	0.007** [0.003]	0.010*** [0.002]	0.010** [0.005]
Per capita expenditures (log)	0.102** [0.042]	0.023 [0.034]	0.057 [0.057]	0.068** [0.034]	0.002 [0.023]	0.064** [0.031]
Observations	3,563	3,381	3,692	5,608	6,130	5,650
r2	0.198	0.271	0.222	0.155	0.221	0.212

Standard errors in brackets, clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1. Coefficients shown are from propensity-score weighted linear probability models and include village fixed effects. OSF = On-site feeding. THR = Take-home rations. Dependent variable is parent report that child is currently enrolled in school.

Table A3. Impact of school feeding programs on current enrolment in school, school-aged children (6-14) in rural villages in Northern Lao PDR, 2006-2008.

	(1)	(2)	(3)	(4)
	Age-sex groups	Age-sex groups trimmed	Age-sex * take up interactions	Age-sex * take up interactions trimmed
Take up * 2008	0.012 [0.009]	0.012 [0.009]	-0.001 [0.037]	-0.011 [0.039]
Takeup * 2008 * Subgroup (ref: Boy 11-14)				
Take up * 2008 * Girl 11-14			-0.046 [0.060]	-0.034 [0.063]
Take up * 2008 * Boy 6-10			0.058 [0.042]	0.054 [0.045]
Take up * 2008 * Girl 6-10			0.020 [0.048]	0.041 [0.047]
Two-way interactions				
2008 * Girl 11-14			0.037 [0.034]	0.031 [0.036]
2008 * Boy 6-10			0.125*** [0.025]	0.130*** [0.026]
2008 * Girl 6-10			0.137*** [0.023]	0.127*** [0.025]
Take up * Girl 11-14			0.043 [0.044]	0.034 [0.047]
Take up * Boy 6-10			-0.026 [0.041]	-0.026 [0.042]
Take up * Girl 6-10			0.046 [0.039]	0.026 [0.041]
Girl 11-14	-0.220*** [0.021]	-0.208*** [0.022]	-0.252*** [0.038]	-0.233*** [0.039]
Boy 6-10	-0.090***	-0.095***	-0.168***	-0.173***

	[0.015]	[0.016]	[0.027]	[0.027]
Girl 6-10	-0.176***	-0.176***	-0.296***	-0.283***
	[0.019]	[0.020]	[0.032]	[0.033]
2008	0.042***	0.042***	-0.060**	-0.057**
	[0.008]	[0.008]	[0.025]	[0.027]
No. of years of schooling of HHH	0.009***	0.010***	0.009***	0.010***
	[0.002]	[0.002]	[0.002]	[0.002]
Per capita expenditures (log)	0.051*	0.046	0.055*	0.051
	[0.028]	[0.029]	[0.030]	[0.031]
Observations	15,593	14,183	15,593	14,183
Pseudo R-squared	0.236	0.226	0.243	0.233

Robust standard errors in brackets. Standard errors in brackets, clustered at the village level. *** p<0.01, ** p<0.05, * p<0.1.

Coefficients shown are from unweighted probit regressions and include village fixed effects. Coefficients represent marginal effects (percentage point change in outcome). All models include the same set of village-levels measured included in models of propensity to take up school feeding (see Table 3 of main paper). “Trimmed” models drop observations with village-level propensity scores above the 95th or below the 5th percentile of propensity scores based on models of village-level take-up of school feeding. Dependent variable is parent report that child is currently enrolled in school.