CROWD-OUT IN SCHOOL-BASED HEALTH INTERVENTIONS: EVIDENCE FROM INDIA'S MIDDAY MEALS PROGRAM

James Berry, Saurabh Mehta, Priya Mukherjee, Hannah Ruebeck, Gauri Kartini Shastry[1]

August 2020

ABSTRACT

Governments often rely on school infrastructure to implement multiple programs targeting child outcomes. How to improve the implementation of these programs is an important, open question. As part of a randomized controlled trial in Odisha, India, we measured the impacts of a nutrition program and a monitoring intervention on the implementation of a pre-existing school-based nutrition program, specifically the Indian government's iron and folic acid supplementation (IFA) program. The new nutrition intervention distributed a micronutrient mix to be added to school meals while the monitoring intervention varied the intensity of monitoring activities. We find that implementing the nutrition intervention crowded out implementation of the government's IFA program, while high intensity monitoring improved it. The net effect is that the high intensity monitoring improved child health, while the micronutrient mix did not. Both crowd-out of the IFA program and sensitivity to monitoring are predominantly found among schools with low managerial capacity.

JEL Codes: O15, I18, H40

Keywords: public service delivery, micronutrient fortification, nutrition programs, monitoring

---

[1] We thank The International Initiative for Impact Evaluation (3ie), the Douglas B. Marshall, Jr. Family Foundation, the International Growth Center, Wellesley College Faculty Research Awards and the Jerome A. Schiff Fellowship for funding this research. Saurabh Bhajibakare, Averi Chakravarty, Kriti Malhotra, Dilip Rabha, and Naveen Sunder provided excellent research assistance. Urmi Bhattacharya, Anna Custers, and Bastien Michel provided excellent research support and management from J-PAL South Asia. We are grateful to Baafra Abeberese, Elizabeth Cascio, and seminar participants at Wellesley College, the Liberal Arts Colleges Development Economics Conference, Advances with Field Experiments Conference, the Eastern Economics Association meetings, the Indian Statistical Institute, and the North East Universities Development Consortium Conference for comments and suggestions.
James Berry: University of Delaware jimberry@udel.edu; Saurabh Mehta: Cornell University, smehta@cornell.edu; Priya Mukherjee: University of Wisconsin-Madison, priya.mukherjee@wisc.edu; Hannah Ruebeck: MIT, hruebeck@mit.edu; Corresponding author: Gauri Kartini Shastry, Wellesley College, 106 Central Street, Wellesley, MA 02481, gshastry@wellesley.edu.

I. Introduction

Governments around the world rely on school infrastructure to implement programs aimed at improving child welfare, some of which are only indirectly related to education. For example, schools in virtually all countries are required to provide students with nutritious meals through school feeding programs. Schools around the world also distribute micronutrient supplementation, deworming treatment, and immunizations to children (Bundy et al. 2018). When schools are tasked with implementing additional programs, it is important to understand how these programs interact with one another. On the one hand, there may be complementarities across programs: for example, micronutrient supplementation may be easier to implement if done alongside school feeding programs (Best et al., 2011). On the other hand, these programs may crowd each other out: schools may not have sufficient managerial capacity to implement additional programs, and new programs could inhibit the implementation of existing programs or interfere with school activities (Vermeersch and Kremer 2005). Crowd-out is generally difficult to study because most evaluations focus on the intervention being evaluated, understandably, with less attention paid to other activities.

We examine interactions between school-implemented programs in the context of India's school meals scheme and a new government-implemented iron and folic acid (IFA) supplementation program, which provided students with weekly iron tablets and biannual deworming tablets. In this paper, we take advantage of rich data on the implementation and outcomes from this pre-existing school nutrition program gathered during the randomized evaluation of a newly implemented program. The new intervention, intending to complement the government's nutrition programs, provided schools with a micronutrient mix (MNM) to be added to school meals. We also varied the intensity with which school meals were monitored to further examine factors influencing the programs' implementation.

Despite relatively consistent implementation of the MNM intervention, we find that the MNM intervention caused a reduction in IFA implementation – students in the MNM schools were *less* likely to report receiving IFA tablets in school regularly. On the other hand, high intensity monitoring improved IFA program implementation: students in the high intensity treatment arm were *more* likely to report receiving IFA tablets in school regularly. Headmaster reports of implementation do not show similar differences, likely because headmasters have an incentive to report that they are complying with government orders.

Child hemoglobin levels offer a more objective outcome and are the final outcome of interest: we find small, statistically insignificant and often negative impacts of the MNM intervention on children's hemoglobin levels. This result is consistent with our finding that the MNM crowded out the IFA distribution, but it could additionally be due to the low MNM dosage levels prescribed by the National Institute of Nutrition.[2] By contrast, increased monitoring of school meals did improve hemoglobin levels, again consistent with improved implementation of the IFA program. Examining heterogeneity across schools, we find that both crowd-out and sensitivity to monitoring are predominantly found among schools with initially low managerial capacity. Taken together, these results highlight the need for policies to take into account managerial capacity constraints in their plans about how and whether to implement additional programs in schools. Increasing top-down monitoring of programs may serve to alleviate these constraints.

This paper relates to a number of literatures. Most broadly, we contribute to the literature on the delivery of publicly provided goods and services in developing countries. A number of studies evaluate different strategies to improve service delivery in a variety of sectors (e.g., Olken 2007; Bjorkman and Svensson 2009; Duflo et. al. 2012; Miller et. al. 2012; Muralidharan et. al. 2016; Rasul and Rogger 2018). Such strategies include the use of technology, financial or non-financial incentives, and either top-down or bottom-up monitoring. Our paper relates specifically to prior work on monitoring service providers:[3] we find that monitoring leads to significant improvements in program implementation, even without explicit stakes. Most closely related to our context, Debnath, Nilayamgode and Sekhri (2020) find that a mobile-based monitoring technology reduces leakage in the school meals program in the Indian state of Bihar.

In addition, our paper draws attention to a specific finding in this literature: the crowding-out of existing programs when new programs are added within the same public infrastructure. Within the

---

[2] We had initially intended to provide 100% of the recommended daily allowance (RDA) for this age group, but the National Institute of Nutrition in India requested a dosage of approximately 50% of RDA, and that we add calcium to the mix (calcium may inhibit the absorption of iron, although usually at higher doses than in our mix).

[3] See Finan, Olken, and Pande (2015) for a review of the literature on monitoring public service providers. The monitoring in this experiment most closely resembles top-down monitoring, even though it was not explicitly linked to higher officials in the government.

context of school meals, Vermeersch and Kremer (2005) find that school meals reduced instruction time. Muralidharan and Sundararaman (2013) find that teacher attendance and teaching activity falls when an extra teacher is introduced at the school.[4] We connect the literatures on public service delivery and crowd-out, documenting that the introduction of the new MNM program crowded out the implementation of the pre-existing IFA program. An additional contribution of our paper is to relate evidence of crowd-out to managerial capacity constraints, linking our paper to the literature on multitasking inspired by the canonical Holmstrom and Milgrom (1991). We highlight the need to evaluate interventions in the broader policy context, rather than in isolation from other public programs, keeping in mind the capacity constraints faced by existing personnel and infrastructure.

Finally, our paper is related to the literature on iron- and micronutrient-supplementation. A major focus area of the nutrition literature is iron supplementation, with studies generally finding that supplementation decreases iron deficiency, across varying locations, populations, baseline rates of deficiency, and intervention methods (Hyder et al. 2007; Hirve et al. 2007; Ahmed et al. 2010; Tee et al. 1999; Gera et al. 2007; Abrams et al. 2008). In the context of India's midday meal program, Krämer, Kumar and Vollmer (2018) evaluate the provision of double-fortified salt — salt fortified with iron and iodine — to schools to be used in midday meals in the Indian state of Bihar. The authors find that the intervention increased hemoglobin levels but did not significantly impact test scores.

Although the MNM did not contain iron, it was designed to help children absorb the iron supplements they were receiving in school through the IFA program and thereby lower iron-deficiency anemia. The intervention was motivated by the literature showing that multi-micronutrient supplementation can be more effective at addressing anemia than iron and folic acid supplementation alone (Ramakrishnan et al. 2004, Best et al. 2011, Ahmed et al. 2010).[5] Despite meaningful take-up, we find no evidence of an effect of the micronutrient mix on hemoglobin levels. This is consistent with our finding on crowd-out of the IFA distribution and suggests that supplementation interventions meant to complement one another may not be successful if

---

[4] Crowd-out can also occur through household responses, e.g. when parents substitute nutrients away from children who receive school meals (Afridi 2010; Jacoby 2002) or when households spend less on education when their schools receive grants (Das et al. 2013).

[5] Fawzi et al. (2007) and Mehta et al. (2011) also find that multi-micronutrient supplementation even without iron and folic acid can improve hemoglobin levels.

managerial capacity constraints hinder the simultaneous implementation of all programs. Alternatively, the lack of impact could also be due to the low dosage required by the National Institute of Nutrition to minimize the risk of harm. This, however, points to limitations in the ability of large-scale distributions advocated by policy makers to provide sufficient nutrition, particularly for the sickest children.[6] Thus, our study echoes the argument for "at scale" testing of interventions (Muralidharan and Niehaus 2017) – while the nutrition literature often uses randomized controlled trials to generate convincing impact estimates, the samples and settings are small enough to allow for sufficient researcher control to ensure high dosage while limiting interference with other programs and minimizing the risk of harm.

We proceed as follows: Section II provides context, first describing the school-based nutrition programs implemented by the government and then describing our interventions. Section III describes the experimental design, including the timeline, sample selection, and data collection. Section IV describes the results. Section V discusses external validity and policy implications. Section VI concludes.

II. Description of nutrition programs

A. India's school-based health interventions

Context: The midday meal program

India's midday meal program mandates that all public schoolchildren in grades 1 through 8 receive nutritious cooked meals in schools. Our study took place in the eastern state of Odisha, in the rural district of Kendujhar. During the period of our study, the midday meal program in Odisha was supervised by the state Department of School and Mass Education, in coordination with district-, block- (administrative unit smaller than a district) and cluster- (administrative unit smaller than block) level officials. In most schools in our sample, either the headmaster or one or more of the

---

[6] While we document a positive impact of our monitoring intervention on hemoglobin levels on average, we find evidence that the impacts are largest for mildly anemic, not moderately anemic children. This result is surprising, since the nutritional literature on iron supplementation consistently finds that those who are most anemic are most likely to respond to treatment (see, e.g., Abrams et al. 2008, Tee et al. 1999). This could be because of lower attendance rates for moderately anemic children (which we also find), but it could also be because of the low levels of micronutrients distributed in one-size-fits-all programs like the IFA program. This conclusion relates closely to that of Banerjee, Barnhardt and Duflo (2018), who study the viability of double-fortified salt as a means to improve anemia levels. Even when provided for free, they find minimal effects on hemoglobin and attribute it to the low levels of iron that can be safely added to food intended for large-scale distribution.

teachers was responsible for purchasing food materials, obtaining cooking fuel and hiring and supervising cooks. In 43 percent of the schools in our sample, members of self-help groups (SHGs) assisted the school staff in acquiring ingredients and cooking the meals.[7] More members of the teaching staff typically helped during lunch to organize the seating of students, distribution of meals, and washing of utensils before classes resumed. While the district was supposed to train those responsible for providing the meals, in only 33 percent of our schools had anyone ever attended a training related to the midday meal program.

Iron and folic acid supplementation program

In 2012, India's Ministry of Health and Family Welfare introduced a national iron supplementation program to reduce the prevalence and severity of anemia among school children. Beginning in January 2013, according to the guidelines distributed by the central government, iron and folic acid supplements, as well as deworming medication, were to be distributed free of charge to all students attending public schools. During the year of our intervention, children aged 5-10 were to receive 45 mg of elemental iron and 400 μg of folic acid once a week at school.[8] One tablet of deworming medication, Albendazole, was also to be administered to each child every six months. Headmasters received the medications and were expected to supervise the provision at school.

In the first year of the IFA program (the year before the MNM intervention), approximately 86% of schools received iron and folic acid tablets, ranging from 49% of schools in one block to 99% in another. In a companion paper (Berry et al. 2020) we use this variation in implementation to estimate the impact of the IFA program in its first year. By the start of the MNM intervention, virtually all schools in our sample had received the tablets. Note that implementation of the IFA program affects the interpretation of the MNM intervention: the comparison is between children whose schools received both iron supplements and multi-micronutrient fortification and children whose schools only received iron supplements.

---

[7] Self-help groups consist of local women (and sometimes men) who save and lend among members of the group.

[8] In the first year of the IFA program, the year *prior* to our intervention, the program was implemented differently. Children in grades 1-5 were to be given 30 mg of elemental iron and 250 μg of folic acid daily for a duration of 100 days. In both years, upper primary school children (those in grades 6 to 8) were to be given a higher dosage (100 mg of elemental iron and 500 μg of folic acid) each week.

B. Experimental interventions

The micronutrient mix program

The micronutrient mix (MNM) program was designed and implemented by the research team in consultation with the government of Odisha and the National Institute of Nutrition. We provided school headmasters and cooks with a multi-micronutrient mix, containing Vitamins A, C, D, B1, B2, B6, B12, Niacin, Zinc, Selenium and Calcium, to be added daily to the midday meal.

Note that the MNM we provided did not include iron or folic acid; we did not want to risk providing the children with too much iron, since the government's IFA program was implemented at the same time. Rather, the MNM was intended to help children absorb iron and complement the IFA distribution. Therefore, our primary outcome variable of interest is children's hemoglobin levels. This was motivated by the nutrition literature demonstrating that multi-micronutrient supplementation is more effective in combating anemia than iron and folic acid supplementation alone (Ramakrishnan et al. 2004, Best et al. 2011).[9] As described in the introduction, we restricted the dosage of the vitamins and minerals in the MNM to approximately 50% of RDA at the request of the National Institute of Nutrition, to avoid over-supplementation.

In order to implement the intervention, we first trained headmasters, cooks, and other staff involved with meal preparation. During these trainings, we covered the health consequences of anemia and other forms of malnutrition, the health benefits of consuming the various vitamins and minerals in the MNM (also noting that they can aid the absorption of iron), and the directions for MNM use. We distributed the mix, plastic sealable jars, and scoops that held 10 grams of the mix. The dosage approved by the National Institute of Nutrition meant that children were to receive 1.5 g of the MNM each day. Since the mix was to be added to the food before it was served to the children, it was necessary to estimate how many children would be eating the meal and multiply this by 1.5 to calculate the number of grams of the mix to add and then divide by 10 to calculate the number of scoops to add. During the training, we practiced calculating this number and found it necessary to involve the headmasters in the addition of the mix since cooks were usually not confident about performing this calculation. We also gave schools laminated fliers that clearly

---

[9] Fawzi et al. (2007) and Mehta et al. (2011) find that multi-micronutrient supplementation even without iron and folic acid can improve hemoglobin levels, although we should note that these studies were conducted in otherwise sick populations with dosages that were greater than the RDA.

described the steps necessary to add the MNM to the food (see Appendix Figure 1). Every month, we contacted schools to enquire whether they needed more of the MNM and, if so, delivered additional packets to the school.

High intensity monitoring

The second intervention involved earlier and more frequent monitoring of school meals during the study period. All schools in the study were visited during meal time on a random day once per month during the last three months of the study, but enumerators also visited the schools in the high intensity monitoring treatment group during the first two months of the intervention. As described in more detail below, this monitoring was fairly intensive, involving detailed observations of meal quality, child attendance, the distribution of food items and quantities to the children, and the amount of food consumed by the children. In addition, enumerators asked the headmasters and cooks about the preparation of the meal and storage of cooking equipment and ingredients, collected a sample of the meal for laboratory testing, and measured the height of three randomly chosen students.

III. Experimental design

A. Timeline

Figure 1 gives the chronology of key activities for the study. The original design was to fortify the school meals with iron. Three hundred seventy-five schools were selected for the study, and an initial baseline survey (Baseline 1) was conducted in these schools between September 2012 and January 2013. However, the plan was halted when the government's IFA program was announced, and the study was revised to evaluate MNM, monitoring, and their interactions with the IFA program. Changing the intervention plan required securing approvals for the new design from a number of government agencies and took approximately 16 months, with final approvals received at the end of September 2014. While waiting for final approval, we conducted a survey measuring the intensity of IFA implementation, as well as a second baseline survey (Baseline 2) in a subset of sample schools during August and September of 2014, early in the 2014-2015 school year. Baseline 2 focused on the three administrative blocks (157 schools) with variation in IFA implementation in the first year in order to evaluate the impact of the government's IFA program on child health (see Berry et al. 2020).

The MNM and high intensity monitoring treatments were launched at the end of November 2014 and continued through April 2015, in 150 schools across 5 blocks. During this period, we also conducted surveys to collect information on student attendance, MNM usage, and IFA tablet distribution. Food samples were collected twice from each of the sample schools. The endline survey was conducted between April and July 2015.

B. School sample

The sample schools in Kendujhar district were selected for the study based on whether they satisfied the following conditions: (i) the school was located within 50 kms from the town of Kendujhar, the capital of the district and (ii) the school was located in one of five blocks: Banspal, Ghatagaon, Jhumpura, Sadar, or Patna. This minimized the fixed costs of dealing with government officials in charge of schools in each block. We began with a sample of 377 primary schools that satisfied these conditions and randomly selected 150 schools in which to conduct the MNM and high intensity monitoring treatments.[10] These schools are primarily rural with a high fraction of students from tribal or scheduled caste communities (approximately 95%). Households are relatively poor – 50% have electricity, 30% own a phone, and 50% of household heads are literate – and children are relatively unhealthy – 44% are underweight and 60% are anemic. In terms of child health, the sample is fairly representative of the state of Odisha, in which 41 percent of children under the age of five are underweight and 65 percent are anemic (International Institute for Population Sciences 2007).

C. Treatment assignment

Out of the 150 schools in the sample, 75 were randomly assigned to receive the MNM, stratified by block and school type (i.e., whether the school only had primary grades 1-5, or also had upper primary grades 6-8). Within each group of 75, half of the schools were randomly assigned to high intensity monitoring.

Table 1 provides the number of schools and students in each group. While the original sample contained 150 schools, 2 schools refused to participate from the beginning of the study, before

---

[10] The original sample of 377 schools was chosen to evaluate provision of fortification to schools as well as centralized school meal delivery operated by the NGO Naandi Foundation. Due to the various delays the project faced, the Naandi Foundation ultimately decided not to participate in the study or provide meals to the study schools.

their treatment status was revealed. Thus, we were left with 75 MNM treatment schools and 73 comparison schools. Out of the 75 schools in the MNM treatment group, 37 were monitored intensely, while 38 were not, and out of the 73 schools that did not receive the MNM, 36 were monitored intensely while 37 were not.

Table 2 shows that the schools in each group are well balanced on a range of covariates measured during our first baseline school survey, right after randomization (top panel of Table 2), or measured during the first month of the intervention (bottom panel of Table 2). Each row shows the mean for the following groups: (i) schools that received neither the MNM treatment nor the high intensity monitoring, (ii) schools that only received the MNM treatment, (iii) schools that only received the high intensity monitoring, and (iv) schools that received both MNM as well as high intensity monitoring. The final column provides the p-value of the F-test of equality across all four groups. No individual covariate is significantly different across all groups.

D. Data

We collected data on a number of outcome variables at various points during the study. Our school-level data includes information on the quality of midday meals, take-up of the micronutrient mix program (including the quantity of vitamin A and zinc in food samples), and the implementation of the IFA program. We also collected child-level data including household demographics; hemoglobin levels; anthropometric measures such as height, weight, and mid-upper arm circumference; cognition; school attendance; and test scores. We describe each survey and the variables of interest below. Figure 1 indicates the timing of these survey modules.

School-level data

Our school-level data collection began with a baseline conducted in late 2012 and early 2013. This survey measured school characteristics and teacher demographic details and qualifications. This baseline information was updated during the first two months of the intervention in late 2014 and early 2015. We carefully monitored take-up of the MNM program throughout the 2014-2015 intervention year. One key measure of take-up is the amount of MNM each school added to midday meals during the school year. We calculate this as the amount of MNM received minus the amount that remained at the end of April 2015, relative to the amount we calculated they would need to serve their students.

In addition, trained enumerators made surprise visits to the study schools to observe the quantity and quality of school meals during the 2014-2015 school year. Schools in the low intensity monitoring treatment arm received these visits during the third, fourth and fifth months of the intervention. Schools in the high intensity monitoring arm received these visits every month (5 visits total). During the third and fifth months of the intervention, enumerators collected samples of the food being served and sent these samples to a laboratory for nutritional analysis. We have data on the amount of vitamin A and zinc in the food sample.[11]

We also carefully monitored implementation of the IFA program. During March-April 2014 (the school year before our intervention) and the first, third, fourth, and fifth months of the intervention, enumerators visited each school to determine whether IFA tablets had been received from the government and how they were being distributed to children. After speaking to the headmaster at each school about the IFA program, our enumerators randomly selected three children to answer additional questions on whether they had received IFA tablets. One student was randomly chosen from each of grades 2, 4, and 5. For each school, we calculate the fraction of those three children that reported receiving tablets regularly and the fraction that report receiving tablets recently.[12]

Child-level data

We randomly chose 15 students in each school for collection of health and education data. These students were chosen from the set of students enrolled in sample schools in grades 1 to 5 who lived with their parents. We excluded children who lived in school hostels due to the difficulty in locating parents to obtain consent. Students were randomly chosen, after stratifying by school and grade. The original baseline survey (Baseline 1) included 3 students per grade in grades 1 to 5 during the 2012-2013 school year. Because of the implementation delays described in Section III.A, children who were in grades 4 and 5 during Baseline 1 had finished primary school by the beginning of the intervention year and were ultimately excluded from the sample. During the 2014-2015 school year, we sampled an additional 3 students per grade in grades 1 and 2 so that the final sample at endline covered grades 1 to 5 during the intervention year. With attrition, there are on average 14 students per school surveyed at endline.

---

[11] We chose to test only these micronutrients for budgetary reasons and because pilot tests of samples of fortified food cooked by our research team and sent to this lab provided the most consistent results for vitamin A and for zinc.

[12] Students were also asked if they swallowed the tablets they received. Almost all students responded that they had.

As described in Section III.A, we conducted a second baseline (Baseline 2) at the beginning of the 2014-2015 school year, in about half of the schools in the original sample. This survey was conducted with 9 children per school. Appendix A describes the sampling procedure for students in Baseline 2.[13]

After obtaining parental consent, enumerators visited schools to measure the selected children's height, weight and hemoglobin levels during the Baseline 1, 2, and Endline surveys. School attendance data were also collected once per month in each of the last three months of the intervention through random, unannounced visits. These checks were made at random times of the day in case children attend school just for the meal and leave immediately after.

Finally, we conducted household surveys at baseline to collect demographic information, household assets, knowledge of anemia, and perceptions of the school's midday meal.

E. Summary statistics

Table 3 checks balance on child health and demographics across each of the experimental treatment groups. Panels A and B focus on child health before the intervention; Panel A includes children who were in the sample at Baseline 1, while Panel B includes children surveyed at Baseline 2. Panels C-F focus on demographics; for children added to the sample during the 2014-15 school year, we fill in demographic information collected at the endline survey if the variable is most likely time-invariant or unrelated to treatment (for example, we fill in the variable for mother's education but not whether the child takes any supplements). The groups are well balanced on most variables, including child health outcomes, household characteristics and demographic information on children, mothers, and heads of household, with a slight imbalance on a few of the 35 variables in the table across the four groups. We cannot rule out that the significant differences exist merely by chance, but our preferred specifications include school or child fixed effects, effectively controlling for these possible differences.

Given that the sample changes over the two years between Baseline 1 and the intervention, as described above, Table 3 focuses on children who were in the sample at endline. Appendix B

---

[13] Recall that at Baseline 2, we only surveyed children in the 3 administrative blocks with variation in IFA implementation. Data from Baseline 2 is primarily used in the companion paper evaluating the IFA program (Berry et al. 2020), but we control for these updated baseline hemoglobin measures in some specifications below.

presents an analysis of attrition for our main outcome variables on child health. We find no significant differences in attrition between the schools that received MNM, schools that received high intensity monitoring, and the control group. However, adding an interaction term between the MNM and high-intensity treatments does reveal some significant differences. Appendix B presents several additional analyses that suggest that differential attrition does not substantially bias our results. We show that attriters have similar baseline characteristics across treatment groups and that our results are robust to accounting for potential differential attrition using Lee (2009) bounds.

IV. Results

A. MNM take-up

Our first outcome of interest is take-up of the MNM by schools in the MNM treatment group. Denoting a measure of take-up in school s in block b measured at time t as y_{sbt}, the basic specification in our analysis is as follows:

$$y_{sbt} = \beta_0 + \beta_1 MNM_{sb} + \beta_2 High_{sb} + \alpha_b + \lambda_t + \varepsilon_{sbt} \qquad (1)$$

where MNM_{sb} is a dummy variable for schools that received the MNM fortification treatment, and $High_{sb}$ is a dummy variable for schools that received higher frequency monitoring visits. All our regressions contain fixed effects for administrative block, α_b. We include month fixed effects, λ_t, since some measures of take-up were collected multiple times during the intervention. Whenever we make use of multiple observations within a school, standard errors are clustered at the school level. In order to account for any differential impact that high intensity monitoring may have had on the MNM treatment, we include a specification that includes an interaction term

$$y_{sbt} = \beta_0 + \beta_1 MNM_{sb} + \beta_2 High_{sb} + \beta_3 (MNM_{sb} * High_{sb}) + \alpha_b + \lambda_t + \varepsilon_{sbt} \qquad (2)$$

For some specifications, we also control for whether the school received IFA tablets during the previous school year to see if experience with nutrition supplements matters for implementation.

We consider multiple measures of take-up. First, we use data on the number of MNM deliveries made to the school, the amount of MNM delivered in kilograms, and the amount of MNM used in kilograms. These results are reported in Table 4. We exclude schools not in the MNM treatment. In addition to block fixed effects, these regressions control for the number of children enrolled in the school at the start of the intervention. Schools assigned to the MNM treatment did take up the mix. The schools that were not monitored intensely received 2.8 deliveries during the study period (the dependent variable mean, presented at the bottom of Columns 1-2). As shown in Columns 3-6, the average school received approximately 0.6 kg of the mix per child enrolled and used almost all of it. This represents more than 58 percent of the amount we estimated they would need based on enrollment. Since schools should be cooking for the number of students present, not enrolled, high absenteeism among children suggests that this measure of take-up is a lower bound. Ninety percent of the schools used at least 25 percent of the amount we estimated they would need. The high intensity monitoring did not affect these measures of take-up.

Second, we study laboratory reports of the amount of vitamin A and zinc present in meal samples collected at each school (Table 5). These measures allow us to compare take-up between the MNM treatment schools and the non-MNM treatment schools as well as across high and low intensity MNM treatment schools. Meals can contain vitamin A and zinc even if they do not contain the mix, so these measures could be considered a measure of meal quality, and not simply take-up of the intervention. However, dependent variable means from the control group indicate very little vitamin A and zinc present in the benchmark samples. We find large, significant increases in the amount of vitamin A and zinc for schools in the MNM treatment. The increase in zinc persists through April, the last month of the intervention; the increase in vitamin A is still significant in April, but it is smaller than in February. We suspect this is due to higher stability of zinc than of vitamin A during storage (Kuong et al. 2016). Appendix C describes additional measures of take-up from the midday meal monitoring visits that support our conclusion that take-up did not decline much over time, as shown in Appendix Table 1. As previously seen in Table 4, high intensity monitoring does not affect the amount of vitamin A or zinc found in the samples – the coefficients are small and of inconsistent sign. The low levels of vitamin A and zinc in the control group samples suggest that spillovers between treatment arms were very unlikely – headmasters in the control schools did not obtain a similar mix to fortify meals.

As noted above, the dosage agreed upon for our intervention would give children approximately 50% of RDA for the micronutrients listed, including vitamin A and zinc. We conduct back-of-the-envelope calculations based on these measures of take-up to get a better sense of how much children in MNM treatment schools received on average. Our midday meal observations document that children receive (and eat) approximately 130 mL of dal or vegetable curry each day, a little bit more than half a cup. We estimate that this weighs about 110 g. Using the range of estimates in Table 5, this means the MNM treatment increased vitamin A intake by 190-376 µg, roughly 30-60% of RDA for this age group, and zinc intake by 2 mg, roughly 20% of RDA for this age group.[14]

B. IFA Implementation

We next report how MNM provision and high intensity monitoring influenced implementation of the government's IFA program. Table 6 estimates the impact of MNM treatment and high intensity monitoring on measures of how well the IFA program was implemented, using equations (1) and (2) above. We focus on three measures of IFA implementation quality: (i) whether the headmaster is able to show the enumerator an IFA tablet (Columns 1-3), (ii) the number of tablets distributed per child in the past week (as reported by the headmaster, Columns 4-6), and (iii) the percent of students who say they get the tablets weekly or more frequently (out of three randomly chosen students spanning different grades, Columns 7-9). The results indicate that neither of our activities affects whether the headmaster has a tablet available to show the enumerator or whether the headmaster reports distributing tablets the past week. However, both of our interventions affect whether students report getting IFA tablets regularly: students in schools that received the MNM treatment are less likely to report getting IFA tablets regularly, while students in the more intensely monitored schools are more likely to report getting IFA tablets regularly. Children were randomly chosen each month, making this outcome difficult for the headmaster to manipulate. In addition, these results are driven by responses later in the school year. The effects are insignificant at the first IFA visit during the intervention (usually in December 2014), when the MNM intervention had just started and many schools in the high intensity treatment arm had yet to receive a meal monitoring visit. By February 2015, however, the effects start to appear – most high intensity schools had received at least 2 and sometimes 3 midday meal visits while low intensity monitoring schools had received at most 1 visit. In fact, in the later part of the year, even headmasters are more likely to report distributing tablets in the highly monitored schools ($p < 0.1$). Note that in Panel B, during the first IFA implementation survey of the intervention year, students in schools that had received IFA tablets in the *prior* year are more likely to report receiving regular medications in

---

[14] We did not directly measure children's blood levels of the nutrients in the MNM for budgetary reasons, given that the ultimate goal of the intervention was to increase hemoglobin levels by improving children's absorption of iron supplements.

school. This difference goes away over time, as all the schools receive IFA tablets during the intervention year. This finding provides a useful check on the reliability of student reports of tablet receipt.

These results suggest that there is some crowding out of IFA implementation by the introduction of the MNM.[15,16] The fact that headmaster-reported measures of IFA implementation do not show this crowd-out is not surprising since headmasters have an incentive to report fully implementing government programs.

C. Child health

Since perfect implementation of the IFA program should improve child health, according to numerous randomized controlled trials in the nutrition literature, we next look to measures of child hemoglobin levels to shed more light on these results. Recall that the nutritional motivation for the MNM intervention was that the vitamins and minerals in the mix would complement the iron from the IFA program (making the iron easier to absorb). However, the crowd-out in implementation that we observe above could mute these effects. High-intensity monitoring could also influence child health through its effects on program implementation.

To estimate the health impacts of the interventions, we use a lagged dependent variable model:

$$y_{1isb} = \beta_0 + \beta_1 MNM_{sb} + \beta_2 High_{sb} + \beta_3 (MNM_{sb} * High_{sb}) + y_{0isb} + \alpha_b + age_{isb} + \varepsilon_{isb} \tag{3}$$

where y_{1isb} is the health outcome of child i in school s in block b at endline, and y_{0isb} is a baseline measure of the outcome variable. We include fixed effects for both block, α_b, and age, age_{isb}.

Table 7 presents the treatment effects on measures of child health. Panel A focuses on a continuous measure of anemia status, hemoglobin levels (in g/dl), while Panel B focuses on a dummy variable

---

[15] There is also some suggestive evidence of crowd-out in the other direction—that is, the IFA program crowding out MNM implementation. The coefficient on whether or not a school received IFA tablets in the previous year is often negative and sometimes marginally significant (only at 15 percent in Table 4 for the amount of MNM delivered to the school but at 10 percent in Appendix Table 1 for whether the MNM could be located in the storeroom).

[16] We also attempted to examine crowd-out on measures of midday meal implementation, such as whether a meal was served and the contents of the meal. However, because our sample had near-universal implementation in the control group by our measures, this analysis is not informative.

for whether a child is anemic.[17] The outcome variables in Panels C and D are BMI-for-age (in z-scores) and height-for-age (in z-scores), respectively.[18] Column 1 includes no other controls while Column 2 includes the lagged dependent variable from Baseline 1. Columns 3-5 include the lagged dependent variables from both Baseline 1 and 2 and dummies for missing observations to allow for the inclusion of all children surveyed at endline. Recall that some children were included in the sample only at endline because they were too young to be enrolled in school during the Baseline 1 survey, two years prior to the intervention.

The results in Table 7 indicate that the MNM treatment had no effect on child health; in fact, the coefficients are often negative although always small and never significant. By contrast, high intensity monitoring increased hemoglobin levels by 0.17-0.24 g/dL and reduced the probability of being anemic by about 6-9 percentage points — a 10-15% decrease relative to the control mean after 5 months.[19] Note that studies have typically detected changes in hemoglobin levels after 2-3 months of consistent supplementation (Gera et al. 2007).

These results are consistent with our evidence on program implementation described above. We showed that schools in the MNM treatment arm distributed the micronutrient mix but found evidence that they were less likely to provide children with the IFA tablets. It seems likely that these effects cancelled each other out, resulting in no improvement in child health. As noted earlier, it is also possible that the MNM mix had no impact due to reduced dosage, in which case the reduction in IFA tablet distribution could either have had no effect on child health or been a spurious result. At the same time, the improvement in child health in schools that received high

---

[17] Hemoglobin level cutoffs used to classify children as anemic are those defined by the WHO at sea level by age group (WHO 2011). For the majority of the sample (ages 5-11), children with hemoglobin below 11.5 g/dL are anemic.

[18] In results available upon request, we replicate Table 7 for school attendance, cognitive ability, and proficiency in reading and mathematics (see Appendix D for descriptions of the data). Neither intervention has statistically significant effects on these outcomes. This is not surprising given the short time horizon, the lack of an effect on child health for the MNM intervention and the fact that no other school characteristics likely changed (such as teacher motivation).

[19] We look to other school-based iron supplementation programs to put the magnitude of this result in context. Krämer, Kumar and Vollmer (2018), using double-fortified salt in school midday meals in Bihar, find that hemoglobin increased by about 0.14 g/dL and the probability of being anemic fell by 9.3 percentage points. Luo et al. (2012) provided iron supplements in school to 4th graders in rural China and find that, on average, hemoglobin increased by 0.23 g/dL after one year. For an alternative comparison, a meta-analysis of 55 efficacy trials concludes that consistent iron supplementation increases children's hemoglobin levels by 0.74 g/dL — 1.1 g/dL for children with baseline hemoglobin levels below 11 g/dL and 0.49 g/dL for children with baseline hemoglobin above 11 g/dL (Gera et al. 2007). One might consider these highly-monitored, randomized placebo-controlled trials an upper bound on the potential effect of school-based distribution.

intensity monitoring is consistent with the improved IFA implementation we document above, especially since MNM take-up did not respond to this increased monitoring. If the impact of high intensity monitoring on IFA tablet distribution reported by students was spurious, it is difficult to explain the improvement in child health. Panels C and D of Table 7 show that the MNM and monitoring treatments had no impact on anthropometric outcomes as we would expect given the nature of the intervention (the duration was not long enough to impact BMI or height). If the improvement in child health in the monitored schools was due to differences unrelated to the IFA or MNM distribution we might have expected to see improvements in these other measures of health.[20] We therefore conclude that the IFA tablet distribution was affected by both the MNM and monitoring interventions.[21]

D. School heterogeneity

In this subsection, we explore possible explanations for why IFA program implementation was affected by the new nutrition intervention and the high intensity monitoring. One possible explanation for the crowd-out is that headmasters were intentionally choosing not to implement one of the nutrition interventions, perhaps out of concern that the children were getting too many supplements, or out of a belief that the two interventions were nutritional substitutes rather than complements. The fact that the crowd-out result in Table 6 is driven by *student* reports of receiving tablets, and not headmaster reports of distributing them, does not support this explanation, but we are not able to rule it out entirely. A related possibility is that headmasters sold the iron tablets since the students are now receiving other micronutrients. The fact that these tablets have very little market value in the region, and that we see no significant difference in the ability of headmasters to produce a tablet to show the enumerator (Columns 1-3 in Table 6) provides some evidence against this hypothesis.

---

[20] In Appendix Tables 2 and 3, we verify that using additional anthropometric outcomes (BMI, weight, height, mid-upper-arm circumference, and weight-for-age z-scores) or a differences-in-differences specification does not affect these conclusions.

[21] Appendix E presents heterogeneity in the child health impacts by baseline hemoglobin status. We find that the positive effect of monitoring on hemoglobin levels is driven by children around the threshold of anemic (around 11.5-12 g/dL), rather than by the children with the lowest levels of hemoglobin. We present evidence suggesting that this effect could be driven in part by higher school attendance among this group: these children are more likely to be present for fortified meals or iron supplementation.

Instead, we argue that the crowd-out is driven by limited resources on the part of headmasters, either in terms of manpower or in terms of managerial capacity. Table 8 estimates regressions similar to those in Column 7 of Table 6 with student reports of tablet receipt as the dependent variable, but for subsets of schools to capture heterogeneous effects according to a school's resource constraints (measured at the beginning of the intervention). We create an index to proxy for a school's managerial capacity with regard to the implementation of the midday meals,[22] and find that both the monitoring impact and the crowd-out are driven by schools with below-median scores on the index. The crowd-out effect is statistically significantly different between above- and below-median managers. We also provide results for several components of the index, and find similar results when *low* managerial capacity is proxied by having fewer than 4 teachers[23] assigned to help run the midday meal, not having an external self-help group manage the meal, or by a school not having a treated water supply (treating a schools' water likely requires effort on the part of the headmaster and could proxy for managerial ability). Note that most coefficients are not statistically different from each other across low and high managerial capacity schools, although the effects are driven by student reports later in the school year (Panel C), where the difference in the crowd-out estimates is starker.

Table 9 presents similar regressions, but with headmaster reports of IFA distribution in the past week as the dependent variable in Panel A and child health measures in Panels B and C. Recall that in Table 6, we showed that there is no statistically significant evidence of crowd-out by headmaster report: headmasters in the MNM treatment are no less likely to report distributing the iron tablets. However, Panel A of Table 9 shows that headmasters in schools with below-median scores on the managerial quality index are *more* likely to report distributing iron tablets in the MNM treatment, in direct conflict to student reports. This suggests that headmasters, particularly those with low managerial capacity, may be misreporting tablet distribution.

---

[22] The components of the index are: having more than four teachers administer the midday meal (which is the median number of teachers), having an external self-help group administer the midday meal, having the school's water treated, having anyone from the school or self-help group attend a midday meal training, having a record of the most recent school management committee meeting, and reporting sufficient funds to administer the midday meal program. For each of these measures, a positive response indicates high managerial capacity and a negative response indicates low managerial capacity. Failing to answer any of these questions is recorded as low managerial capacity. The index is calculated by standardizing each variable with respect to the control group distribution and summing the standardized variables. We obtain qualitatively similar results if we do not standardize the variables and simply sum the binary indicators, though the p-value on the difference between the two groups increases.

[23] Note that the specifications include school size (number of students) as a control variable.

In Panels B and C of Table 9, we use a more objective outcome variable: child health. As discussed above, if children received all the micronutrients intended for them through both programs, they should have higher hemoglobin levels. As shown in Column 1, the impacts of high-intensity monitoring are higher in schools with below-median school management quality, consistent with the results on implementation of the IFA program (Table 8). In addition, there is no evidence of an increase in hemoglobin levels for schools in the MNM treatment among schools with below-median managerial quality, even though these headmasters were more likely to report distributing tablets.[24] Although the differences in impacts between below- and above-median managerial quality are not statistically significant, the analysis of Table 9 supports the validity of student reports of IFA tablet receipt over the headmaster reports and suggests that high intensity monitoring had downstream effects on child health in schools with weaker management quality.

V. Discussion and policy implications

The goal of this research was to study nutrient fortification and supplementation "in the field." While efficacy trials have convincingly demonstrated that fortification and supplementation can improve child health and school attendance, these studies are often highly monitored with compliance rates above 90 percent because researchers closely supervise the delivery and consumption of nutrients. This study, on the other hand, focused on programs that distributed nutrients through existing infrastructure, specifically the Indian midday meal program, with an emphasis on program implementation. This section discusses policy implications of our results.

A. Policy implications from the MNM distribution

The evaluation of the MNM distribution has several policy implications. First, note that while not perfect, take-up was relatively high: according to our records, only 3 schools out of 75 did not use any of the micronutrient mix. As described in Section IV.A, schools used more than 58 percent of the MNM we estimated they would need. The range of take-up measures is similar across both the IFA program run by the government and the MNM program run by the researchers. For example, in 72 percent of midday meal visits, the cook reported adding a powder to the meal, while even in the first year of the IFA program's implementation when only 86 percent of schools received the

---

[24] Appendix Tables 4 and 5 present these heterogeneous results for the individual components of the index.

tablets, 62 percent of children interviewed reported receiving the IFA tablet regularly. These take-up measures bode well for the potential of school-based health programs to improve child health.

That said, the MNM distribution did not actually improve child health, despite previous literature that indicated multi-micronutrient supplementation is more effective than iron supplementation alone. Here we list some possible explanations. First, while we intended the MNM to (biologically) complement the IFA distribution, we show in Section IV.B that it actually crowded out implementation of the IFA program: we observe worse distribution of IFA in MNM schools, and this effect is concentrated among schools with poorer measures of managerial capacity. This raises a policy-relevant concern about running multiple complementary programs through schools with limited resources (either in terms of labor input or managerial capacity). Anecdotal evidence suggests that the headmasters and teachers felt overburdened by these programs. One of the most common concerns about the midday meal reported by school officials during our field visits was that it is takes up the headmasters' as well as teachers' time and mental energy.

Another possible explanation for the lack of an effect on child health is that children in the MNM treatment did not receive enough micronutrients to impact iron absorption. This could be driven by two factors. First, the MNM treatment had less than perfect compliance, about 58% by some measures. Second, the dosage of micronutrients may have been too low. As noted in Section II.B above, at the request of the National Institute of Nutrition (NIN), we halved the originally chosen dosage. The resulting dosage was about half of the recommended daily allowance (RDA) for children of this age, under the assumption that these children would obtain additional micronutrients from other sources. This seems unlikely given the very low concentration of tested micronutrients in the meals provided in control schools (approximately 52-55 µg/100g vitamin A and 5-8 mg/kg zinc, about 10% of RDA each). Thus, the low quantities may not have been sufficient to impact iron absorption. In addition, the NIN requested that we include calcium in the mix, despite there being evidence that calcium may inhibit the absorption of iron. The NIN noted that the levels of calcium in their recommended mix were too low to act as an inhibitor.

The fact that we had to halve the dosage indicates one disadvantage of general fortification or supplementation programs such as the IFA or the MNM distribution: they require a one-size-fits-all-students approach. For safety reasons, micronutrient doses must be limited, but that also means the potential for impact is limited, especially for the sickest children who might also have the lowest school attendance rates (see Banerjee, Barnhardt & Duflo, 2018, for a similar conclusion from a household-based program). A more customized program would allow for supplementation or fortification based on the micronutrient deficiencies a child exhibits, but may be prohibitively expensive to implement since it requires population-wide baseline hemoglobin testing. However, with emerging technologies, point-of-care assessment of nutritional biomarkers and consequent tailoring of intake or supplements may become feasible in the future.

B. Policy Implications from Increased Monitoring

The robust positive impact of high intensity monitoring on child hemoglobin levels is particularly interesting and relevant for policy, and warrants some discussion. We find no evidence that the high intensity monitoring increased take-up of the MNM – high intensity schools did not request or use more of the MNM. Instead, we find evidence that high intensity monitoring improved implementation of the government's IFA program – students in high intensity schools were more likely to report receiving IFA tablets regularly. While our intent was for the monitors to gather information on the quality of midday meals and take-up of the MNM, this intent was not conveyed to the schools. Since schools almost uniformly reported that they distributed the IFA tablets during meals, it is natural that they would have thought that one of the reasons for the unannounced visits at mealtime was to verify the distribution of IFA tablets.

We see two possible explanations for this response: First, the visits could have acted as reminders. However, we find that the effect of monitoring is driven by accumulated visits and not by proximity to the most recent visit (results available upon request), suggesting the visits did not simply act as reminders – but the experiment was not designed to have enough power to differentiate these effects. Second, visits may have acted as encouragement to implement the IFA program, or headmasters may have been concerned about how the information from the visits would be used. Even though enumerators did not provide direct encouragement and there were no explicit stakes associated with the data gathered, headmasters may have interpreted the visits as encouragement or assumed that the information would be shared with government officials. Note that the government does require schools to report their implementation of the IFA program and the midday meal program (but not, obviously, the MNM program) as part of their school health records, which are monitored by government officials at the block, district, and state levels. Therefore, it seems likely that headmasters would be concerned that their self-reported implementation of the government programs may be held to additional scrutiny given the enumerators' visits. If they felt less accountable to the research team than the government (a highly plausible assumption), it makes sense that the monitoring increased IFA implementation and had no effect on the MNM implementation. This mechanism is consistent with the result in Olken (2007), who finds that public service delivery can improve through the threat of government audits, rather than corrective action arising from an audit. Other studies with similarly low-stakes monitoring mechanisms that influence individual behavior include Callen and Long (2015) and Muralidharan et al. (2018).

To understand the policy implications, it is worth thinking more carefully about the additional monitoring visits this study added to the school year. In every school, we conducted an initial training, a school facilities and staffing survey at the beginning of the intervention, four visits to conduct IFA surveys in months 1, 3, 4 and 5, three visits to record attendance in months 3, 4, and 5, and at least three visits to observe the midday meals in months 3, 4 and 5 (some of these visits overlapped to reduce transportation costs). The schools in the high intensity monitoring treatment received two additional monitoring visits to observe midday meals in months 1 and 2. Panel B of Figure 1 illustrates the timeline of survey activities during the intervention.

It may seem surprising that the addition of two monitoring visits on top of a base of around ten other visits of various types had such a substantial effect on headmaster behavior. However, there are a number of factors that may have contributed to the effects we see. First, consider the timing: we observe an impact on compliance with the IFA program as early as February, by which point schools in the high intensity monitoring treatment had received four visits of any type, while the rest had only received two. In addition, the midday meal visits were likely more salient to headmasters than the other visits, possibly because they were 25-71% longer by various measures, such as number of minutes or pieces of information recorded. Another significant difference was timing within the day – midday meal visits were the only visits that occurred during the meal, which is when headmasters reported distributing IFA tablets. Enumerators also collected samples of the meal, which may have made the visit seem more high stakes. Recall that another element of the midday meal monitoring was that enumerators spoke to three randomly chosen students about the meal, made observations about the quantity of food being served to these children, and measured their heights. While enumerators also spoke directly to students during IFA survey visits, it is possible that the likelihood of discrepancies with student reports would have been more salient to the headmaster in the high intensity monitoring treatment schools (where we had spoken to students three times over the first two months of the intervention) than in other schools (where we had spoken to students only once).

VI. Conclusion

We evaluate two interventions aimed at improving implementation and impacts of India's school-based nutrition programs. We show that a program providing MNM to schools actually crowded out implementation of the government's existing IFA program, and that this crowd-out depends on the managerial capacity of the school. Consistent with this crowd-out in implementation of the IFA program, we find no effects of the MNM program on child health. This could also be attributable to the low dosing required by the government, suggesting that school-based programs are less likely to benefit the sickest children due to low micronutrient doses. Nonetheless, the results on take-up, combined with efficacy trials of multi-micronutrient supplementation for children, suggests that school-based multi-micronutrient distribution remains a promising area, provided that sufficient dosing is permitted and that steps are taken to ensure that implementation does not crowd out other nutrition programs.

We also find that the frequent monitoring visits improved implementation of the IFA program, reaffirming that top-down monitoring may be a promising strategy to improve implementation of public health programs. This result contributes to the burgeoning literature on the effectiveness of monitoring visits, even with no explicit stakes attached. Our results suggest that the exact timing of such visits and who the auditors speak to may have significant effects. Still, understanding the impacts of a scaled monitoring program would be an important area for future research. Government audits are famously infrequent in India (Muralidharan et al. 2017). Taking intensity of meal monitoring to scale would require addressing the issues that currently limit effective monitoring.

While schools are a natural setting for implementing social programs for children, it is unclear what the optimal number and types of programs should be, and how to hire and incentivize school officials to implement the programs effectively. Our study has highlighted several important mechanisms that can influence the effectiveness of such programs. As this is an area that is currently understudied in the literature, further research is needed to understand the functioning of similar programs in different contexts, which could lead to broader policy guidance on these issues.

REFERENCES

Abrams, S.A., M. Hettiarachchi, D.C. Hilmers, C. Liyanage, and R. Wickremasinghe. 2008. “The efficacy of micronutrient supplementation in reducing the prevalence of anaemia and deficiencies of zinc and iron among adolescents in Sri Lanka.” *European Journal of Clinical Nutrition* 62 (7): 856

Afridi, F. 2010. “Child welfare programs and child nutrition: Evidence from a mandated school meal program in India.” *Journal of Development Economics* 92(2), 152-165.

Ahmed, F., M.R. Khan, M. Akhtaruzzaman, R. Karim, G. Williams, H. Torlesse, I. D. Hill, N. Dalmiya, C.P. Banu, and B. Nahar. 2010. “Long-term intermittent multiple micronutrient supplementation enhances hemoglobin and micronutrient status more than iron and folic acid supplementation in Bangladeshi rural adolescent girls with nutritional anemia.” *The Journal of Nutrition* 140 (10): 1879–86.

Banerjee, A., S. Barnhardt and E. Duflo. 2018. “Can iron-fortified salt control anemia? Evidence from two experiments in rural Bihar," *Journal of Development Economics*, 133: 127-146.

Banerjee, A., E. Duflo and R. Glennerster. 2011. **“**Is decentralized iron fortification a feasible option to fight anemia among the poorest?” In *Explorations in the Economics of Aging*, Ed. David Wise

Berry, J., S. Mehta, P. Mukherjee, H. Ruebeck, and G.K. Shastry. 2020. “Implementation and Effects of India’s National School-Based Iron Supplementation Program.” Journal of Development Economics, 144(2020).

Best, C., N. Neufingerl, J.M. Del Rosso, C. Transler, T. van den Briel, and S. Osendarp. 2011. “Can multi-micronutrient food fortification improve the micronutrient status, growth, health, and cognition of schoolchildren? A systematic review.” *Nutrition Reviews* 69:186-204.

Bjorkman, M. and J. Svensson. 2009. “Power to the people: Evidence from a randomized field experiment on community-based monitoring in Uganda.” *The Quarterly Journal of Economics* 124 (2): 735–769.

Bold, T., M. Kimenyi, G. Mwabu, A. Ng’ang’a, and J. Sandefur. 2018. “Experimental evidence on scaling up education reforms in Kenya.” *Journal of Public Economics* 168:1-20.

Bundy, D. A. P., N. de Silva, S. Horton, D. T. Jamison, and G. C. Patton 2018. *Optimizing Education Outcomes: High-Return Investments in School Health for Increased Participation and Learning*. Washington, DC: World Bank.

Callen, M. and J. D. Long. 2015. “Institutional corruption and election fraud: Evidence from a field experiment in Afghanistan.” *The American Economic Review* 105(1): 354-381.

Debnath, S., Nilayamgode, M. and S. Sekhri. 2020. “Information Bypass: Using Low-Cost Technological Innovations to Curb Leakages in Welfare Programs,” *Working paper, University of Virginia.*

Das, J., S. Dercon, J. Habyarimana, P. Krishnan, K. Muralidharan, and V. Sundararaman. 2013. “School Inputs, Household Substitution, and Test Scores.” *American Economic Journal: Applied Economics* 5 (2): 29-57.

Duflo, E., R. Hanna, and S.P. Ryan. 2012. "Incentives Work: Getting Teachers to Come to School." *American Economic Review* 102 (4): 1241-1278.

Fawzi, W. W., G. I. Msamanga, R. Kupka, D. Spiegelman, E. Villamor, F. Mugusi, R. Wei, and D. Hunter. 2007. "Multivitamin supplementation improves hematologic status in HIV-infected women and their children in Tanzania." *The American Journal of Clinic Nutrition* 85: 1335-43.

Finan, F., B. Olken and R. Pande. 2015. "The personnel economics of the state." *NBER Working Paper 21825.*

Gera, T., H.P. Sachdev, P. Nestel, and S.S. Sachdev. 2007. "Effect of iron supplementation on haemoglobin response in children: Systematic review of randomised controlled trials." *Journal of Pediatric Gastroenterology and Nutrition* 44 (4): 468–86.

Hirve, S., S. Bhave, A. Bavdekar, S. Naik, A. Pandit, C. Schauer, A. Christofides, Z. Hyder, and S. Zlotkin. 2007. "Low dose sprinkles: An innovative approach to treat iron deficiency Anemia in infants and young children." *Indian Pediatrics* 44 (February).

Hyder, S., M. Ziauddin, F. Haseen, M. Khan, T. Schaetzel, C.S. Jalal, M. Rahman, B. Lönnerdal, V. Mannar, and H. Mehansho. 2007. "A multiple-micronutrient-fortified beverage affects hemoglobin, iron, and vitamin A status and growth in adolescent girls in rural Bangladesh." *The Journal of Nutrition* 137(9): 2147–53.

Holmstrom, B. and P. Milgrom. 1991. "Multitask principal-agent analyses: Incentive contracts, asset ownership, and job design." *Journal of Law, Economics, & Organization* 7 (Special Issue): 24-52.

International Institute for Population Sciences. 2007. National Family Health Survey (NFHS-3), 2005-06: India. Mumbai, India: International Institute for Population Sciences.

Jacoby, H. 2002. "Is there an intrahousehold flypaper effect? Evidence from a school feeding program." *Economic Journal* 112 (476): 196-221.

Kar B.R., Rao S.L., Chandramouli B.A., Thennarasu K. (2004). *NIMHANS Neuropsychological Battery for Children-Manual.* Bangalore: NIMHANS Publication Division

Kar B.R., Rao S.L., Chandramouli B.A. (2008). "Cognitive development in children with chronic protein energy malnutrition." *Behavioral and Brain Functions* 4:31

Krämer, M., S. Kumar and S. Vollmer. 2018. "Impact of delivering iron-fortified salt through a school feeding program on child health, education and cognition: Evidence from a randomized controlled trial in rural India." *Working paper, Sam Houston State University*.

Kuong, K., A. Laillou, C. Chea, C. Chamnan, J. Berger, and F.T. Wieringa. 2016. "Stability of vitamin A, iron and zinc in fortified rice during storage and its impact on future national standards and programs: Case study in Cambodia." *Nutrients*, 8(1): 51.

Lee, D.S. 2009. "Training, wages, and sample selection: Estimating sharp bounds on treatment effects." *The Review of Economic Studies* 76(3): 1071-1102.

Luo, R., Y. Shi, L. Zhang, C. Lui, S. Rozelle, B. Sharbono, A. Yue, Q. Zhao, and R. Martorell. 2012. "Nutrition and educational performance in rural China's elementary schools: Results of a randomized control Ttial in Shaanxi province." *Economic Development and Cultural Change* 60 (4): 735–72.

Mehta, S., F.M. Mugusi, R.J. Bosch, S. Aboud, A. Chatterjee, J.L. Finkelstein, M. Fataki, R. Kisenge, and W.W. Fawzi. 2011. "A randomized trial of multivitamin supplementation in children with tuberculosis in Tanzania." *Nutrition Journal.* 10:120.

Miguel, E. and M. Kremer. 2004. "Worms: identifying impacts on education and health in the presence of treatment externalities." *Econometrica* 72(1): 159-217.

Miller, G., R. Luo, L. Zhang, S. Sylvia, Y. Shi, P. Foo, Q. Zhao, R. Martorell, A. Medina, S. Rozelle and H.F. Farnsworth. 2012. "Effectiveness of provider incentives for anaemia reduction in rural China: a cluster randomised trial." *British Medical Journal* 345:e4809 doi: 10.1136/bmj.e4809

Muralidharan, K., J. Das, A. Holla, and A. Mohpal. 2017. "The fiscal cost of weak governance: Evidence from teacher absence in India," *Journal of Public Economics* 145(C): 116-135.

Muralidharan, K. and P. Niehaus, 2017. "Experimentation at Scale." *Journal of Economic Perspectives* 31(4): 103-124.

Muralidharan, K., P. Niehaus, and S. Sukhtankar, 2016. "Building State Capacity: Evidence from Biometric Smartcards in India." *American Economic Review* 106(10): 2895-2929.

Muralidharan, K., P. Niehaus, and S. Sukhtankar, and J. Weaver. 2018. "Improving last-mile service delivery using phone-based monitoring." *NBER Working Paper No. 25298.*

Muralidharan, K., and V. Sundararaman, 2013, "Contract Teachers: Experimental Evidence from India." NBER Working Paper No. 19440.

Olken, B. 2007. "Monitoring Corruption: Evidence from a Field Experiment in Indonesia." *Journal of Political Economy* 115 (2): 200-249.

Pershad, D. and N. Wig. 1988. *Handbook for PGI memory scale clinical test.* Agra, Uttar Pradesh, India: National Psychological Corporation.

Rasul, I. and D. Rogger. 2018. "Management of Bureaucrats and Public Service Delivery: Evidence from the Nigerian Civil Service." *The Economic Journal* 128: 413-446.

Ramakrishnan U., N. Aburto, G. McCabe, and R. Martorell. 2004. "Multi-micronutrient interventions but not vitamin A or iron interventions alone improve child growth: results of 3 meta-analyses." *Journal of Nutrition* 134: 2592–2602.

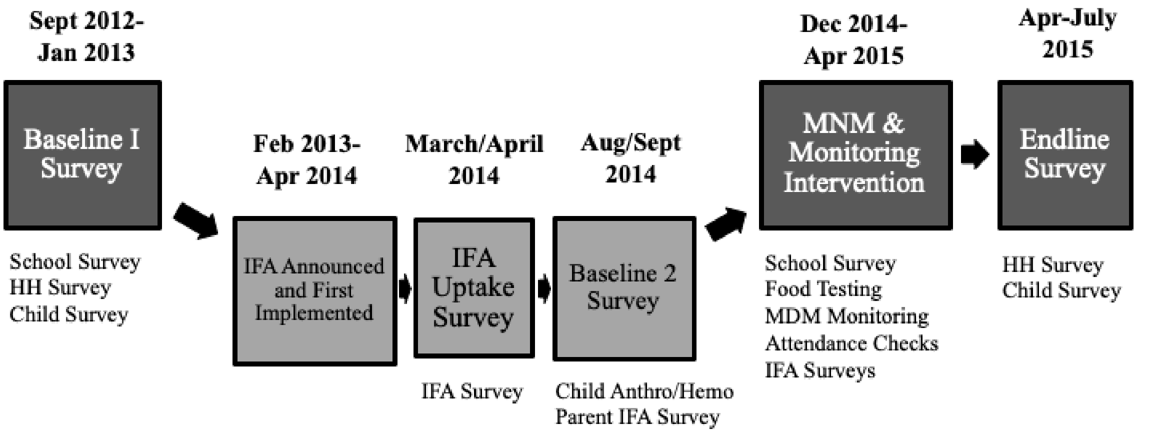
Tee, E.S., M. Kandiah, N. Awin, S. Chong, N. Satgunasingam, L. Kamarudin, S. Milani, A.E. Dugdale, and F.E. Viteri. 1999. "School-administered weekly iron-folate supplements improve hemoglobin and ferritin concentrations in Malaysian adolescent girls." *The American Journal of Clinical Nutrition* 69 (6): 1249–56.

Vermeersch, C. and M. Kremer. 2005 "School meals, educational achievement and school competition: Evidence from a randomized evaluation." *World Bank Policy Research Working Paper Series No. 2523.*

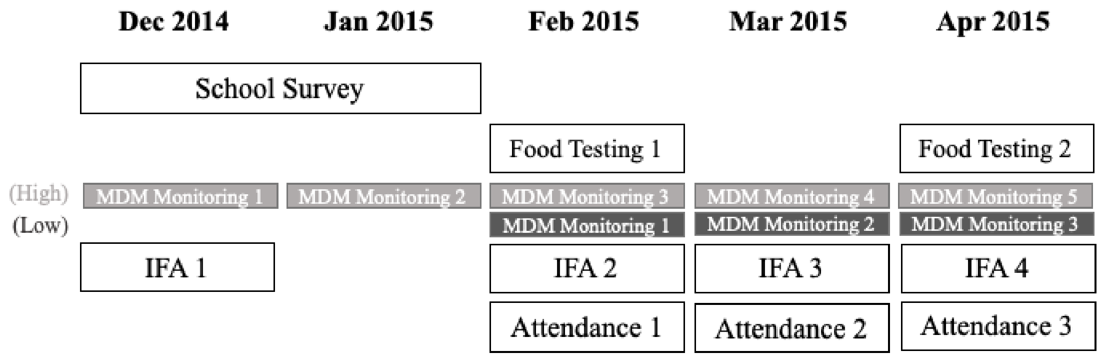
World Health Organization. 2011. "Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity." *Vitamin and Mineral Nutrition Information System.* Geneva, World Health Organization. http://www.who.int/vmnis/indicators/haemoglobin.pdf.

Figure 1: Timeline of key activities

Panel A: Full Overview



Panel B: MNM and High Intensity Monitoring Intervention Activities



Notes: The household survey includes information about household demographics, assets, etc. The child survey includes health outcomes (height, weight, MUAC, hemoglobin level) and education and cognitive ability measures. The school survey includes information on teachers, school assets, infrastructure, and systems, and implementation of existing school programs.

Table 1: Treatment arms

		Monitoring intensity	
		High	**Low**
MNM treatment *Meal provider education and micronutrient mix provision*	Schools:	37	38
	Students Targeted:	3358	3611
	Students Surveyed at Endline:	680	698
Status quo meals	Schools:	36	37
	Students Targeted:	3074	3649
	Students Surveyed at Endline:	672	670

Table 2: Balance across treatments at baseline: School characteristics

	Control	Only MNM	Only high intensity	Both	P-value of all 3 differences
Panel A: At Baseline 1					
Distance to the block headquarters (km)	22.973	22.789	24.861	24.889	0.815
Primary enrollment	85.351	84.868	74.028	74.378	0.686
Secondary enrollment	13.270	10.132	11.361	16.378	0.814
Number of teachers	2.514	2.421	2.472	2.486	0.994
Number of female teachers	2.757	2.868	2.528	2.676	0.641
Number of rooms	4.455	4.444	4.057	3.778	0.516
Percent of schools have a kitchen	0.784	0.833	0.800	0.676	0.462
Percent of schools have at least one latrine	0.838	0.789	0.889	0.865	0.693
Percent of schools have sufficient water	0.778	0.667	0.735	0.622	0.474
Percent of schools with treated water	0.324	0.263	0.286	0.243	0.887
Percent with parent group for MDM	0.394	0.444	0.471	0.343	0.713
Percent with MDM training	0.389	0.324	0.314	0.333	0.918
Percent receiving MDM rice on a regular schedule	0.472	0.486	0.400	0.278 *	0.225
Panel B: Before the intervention					
Received IFA during previous year	0.811	0.842	0.917	0.892	0.540
Panel C: First month of the intervention					
Primary enrollment	86.838	83.526	68.333	73.432	0.466
Secondary enrollment	10.595	10.395	11.278	15.622	0.823
Number of teachers	3.162	3.105	3.250	3.108	0.986
Number of female teachers	3.108	3.711	2.972	3.216	0.248
Number of rooms	4.611	4.514	4.556	4.622	0.995
Percent of schools have a kitchen	0.784	0.886	0.818	0.833	0.688
Percent of schools have at least one latrine	0.917	0.947	0.944	0.944	0.957
Percent of schools have sufficient water	0.706	0.556	0.667	0.706	0.531
Percent of schools with treated water	0.514	0.263 **	0.382	0.270 **	0.091
Percent with parent group for MDM	0.333	0.342	0.343	0.243	0.732
Percent with MDM training	0.559	0.343 *	0.441	0.545	0.232
Percent receiving MDM rice on a regular schedule	0.657	0.684	0.588	0.514	0.448
Received IFA tablets this year	1.000	1.000	1.000	0.973	0.319
Number of tablets distributed per child past week (school report)	0.838	1.105	0.889	0.889	0.621
Percent of students who say they get meds weekly or more frequently (out of 3)	0.417	0.356	0.455	0.480	0.713
Number of schools	37	38	38	37	

*Notes: This table presents balance checks on school characteristics at Baseline 1, across each of the treatment groups. Each row shows the mean for that variable for the following groups: (i) schools that received no treatment, (ii) schools that only received the MNM treatment, (iii) schools that only received the high intensity monitoring, and (iv) schools that received both MNM and high intensity monitoring treatments. Significance levels of the difference with the control group are indicated after each number, with standard errors robust to heteroskedasticity. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively. The final column provides the p-value for the F-test that the differences across all four groups are zero.*

Table 3: Balance across treatments at baseline: Child characteristics

	Control	Only MNM	Only high intensity	Both	P-value of all 3 differences
Panel A: Child health outcomes at Baseline 1					
Hemoglobin	11.097	11.063	11.170	11.027	0.698
z - weight	-1.839	-1.944	-1.811	-1.953	0.442
z - height	-1.351	-1.366	-1.511	-1.397	0.849
MUAC	15.066	15.174	15.180	15.106	0.807
Panel B: Child health outcomes at Baseline 2					
Hemoglobin	11.214	11.330	11.284	11.108	0.790
z - weight	-1.909	-1.778	-1.929	-2.072	0.532
z - height	-1.534	-1.495	-1.678	-1.891	0.291
MUAC	15.606	15.546	15.900	15.770	0.222
Panel C: Child demographics					
Age (Baseline 1)	6.749	6.720	6.995	6.614	0.753
Female dummy	0.475	0.483	0.480	0.499	0.921
Not child of head of household	0.135	0.123	0.136	0.124	0.902
Number of times child had MDM in past week	4.749	4.760	4.847	4.838	0.940
Takes any supplements	0.000	0.003	0.020 **	0.010 *	0.013
Has taken deworming pill in past year	0.128	0.117	0.101	0.122	0.803
Birth order	2.087	2.119	1.999	1.960	0.254
Panel D: Household demographics					
Non scheduled caste/tribe	0.050	0.030	0.072	0.060	0.157
Owns phone	0.422	0.418	0.413	0.415	0.997
Has electricity	0.531	0.505	0.616	0.504	0.115
House is *pucca*	0.117	0.118	0.106	0.112	0.972
Is satisfied with school meals	0.893	0.866	0.871	0.904	0.510
Has heard of anemia	0.094	0.076	0.088	0.067	0.676
Panel E: Mother demographics					
Age (Baseline 1)	31.276	31.206	30.955	30.805	0.858
Is literate	0.413	0.366	0.378	0.402	0.779
Completed primary school	0.027	0.026	0.023	0.019	0.851
Completed middle school	0.029	0.022	0.018	0.037	0.307
Completed high school	0.014	0.006	0.014	0.007	0.498
Not housewife	0.327	0.393	0.380	0.455 **	0.020
Has a job card	0.623	0.686	0.634	0.638	0.506
Panel F: Head of household demographics					
Age (Baseline 1)	38.990	37.646 *	38.990	37.794	0.144
Is literate	0.531	0.588	0.546	0.575	0.547
Completed primary school	0.028	0.038	0.049	0.060 **	0.077
Completed middle school	0.030	0.050	0.055 *	0.052 *	0.146
Completed high school	0.024	0.018	0.025	0.019	0.802
Occupation in sgriculture	0.495	0.479	0.460	0.450	0.730
Has a job card	0.720	0.783	0.738	0.698	0.119

*Notes: This table presents balance checks on demographic characteristics and child health at baseline, across each of the treatment groups for children who have endline data. Recall that not all children were surveyed at Baseline 1. Children that were added to the sample at Baseline 2 are not included in Panel A, and in Panels C-F, values for those children are filled in from the Endline survey if the variable is time-invariant or unrelated to treatment. Each row shows the mean for that variable for the following groups: (i) schools that received no treatment, (ii) schools that only received the MNM treatment, (iii) schools that only received the high intensity monitoring, and (iv) schools that received both MNM and high intensity monitoring treatments. Significance levels of the difference with the control group are indicated after each number, with standard errors clustered by school. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively. The final column provides the p-value for the F-test that the differences across all four groups are zero.*

Table 4: Take-up of MNM by schools

	Number of MNM deliveries		Amount of MNM delivered (kilos)		Amount of MNM used (kilos)	
	(1)	(2)	(3)	(4)	(5)	(6)
High intensity	0.063	0.062	-0.413	-0.392	-0.331	-0.311
	(0.122)	(0.122)	(3.798)	(3.748)	(4.649)	(4.627)
Number of children enrolled	-0.000	-0.000	0.646***	0.648***	0.637***	0.639***
	(0.001)	(0.001)	(0.050)	(0.049)	(0.056)	(0.055)
Received IFA during previous yea		0.119		-9.984		-9.491
		(0.233)		(6.214)		(9.025)
N	73	73	72	72	72	72
R-squared	0.062	0.066	0.909	0.912	0.860	0.863
Dep. var mean, non-high intensity	2.757	2.757	64.324	64.324	58.635	58.635

*Notes: The dependent variables are: (i) the number of MNM deliveries made to the school, (ii) the amount of MNM delivered to the school in kilograms, and (iii) the amount of MNM used in kilograms. All columns include block fixed effects. Robust standard errors are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

Table 5: Take-up of MNM, as seen in micronutrient levels from lab tests of food samples

	February						April					
	Vitamin A			Zinc			Vitamin A			Zinc		
MNM treatment	351.9***	347.4***	345.4***	16.6***	14.5***	14.6***	165.8***	181.9***	181.3***	15.6***	16.6***	16.5***
	(44.8)	(65.4)	(65.5)	(2.8)	(4.2)	(4.2)	(33.4)	(52.7)	(52.2)	(4.4)	(5.8)	(5.9)
High intensity	-5.3	-10.0	-16.2	1.3	-0.8	-0.6	-5.6	10.3	9.3	5.7	6.7	6.5
	(44.6)	(25.4)	(27.8)	(2.8)	(2.1)	(2.3)	(31.7)	(31.2)	(31.4)	(4.5)	(6.1)	(6.1)
MNM treatment * high intensity		9.3	12.7		4.1	4.0		-32.3	-31.4		-2.1	-1.9
		(90.8)	(91.7)		(5.6)	(5.6)		(67.2)	(66.5)		(8.9)	(8.9)
Received IFA during previous year			67.1			-2.5			11.0			1.7
			(77.6)			(5.8)			(57.4)			(5.8)
N	148	148	148	148	148	148	145	145	145	145	145	145
R-squared	0.307	0.307	0.311	0.214	0.217	0.219	0.154	0.156	0.156	0.101	0.101	0.101
Dep. var mean, control group	52.4	52.4	52.4	5.4	5.4	5.4	55.2	55.2	55.2	8.7	8.7	8.7

*Notes: This table presents the results of the effect of the MNM treatment on the micronutrients (namely, vitamin A and zinc) present in school meals, as measured in the laboratory using samples collected by enumerators during February and April of the treatment year. The recommended daily allowances (RDA) for this age group are 7-9 mg of zinc and 400-600 µg of vitamin A. A back-of-the-envelope calculation using estimates of how much food each child was given suggests that vitamin A intake increased by roughly 30-60% of RDA and zinc intake increased by roughly 20% of RDA. All columns include block fixed effects. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

Table 6: Treatment effects on IFA program implementation

Dependent variable:	HM shows enumerator IFA tablet			Number of tablets distributed per child past week (school report)			Percent of students who say they get meds weekly or more frequently (out of 3)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: All months (4 visits each)									
MNM treatment	-0.015	-0.039	-0.015	0.058	0.045	0.059	-0.062**	-0.073	-0.063**
	(0.022)	(0.028)	(0.022)	(0.052)	(0.072)	(0.052)	(0.031)	(0.045)	(0.031)
High intensity	-0.017	-0.042	-0.020	0.043	0.029	0.047	0.083**	0.072*	0.079**
	(0.022)	(0.030)	(0.022)	(0.053)	(0.073)	(0.053)	(0.032)	(0.039)	(0.031)
MNM treatment * high intensity		0.049			0.028			0.021	
		(0.044)			(0.100)			(0.064)	
Received IFA during previous year			0.042			-0.067			0.055
			(0.046)			(0.094)			(0.056)
N	557	557	557	555	555	555	538	538	538
R-squared	0.120	0.122	0.122	0.087	0.087	0.088	0.128	0.128	0.129
p-value of F-test (high & interaction)		0.363	.	.	0.702	.	.	0.035	.
Panel B: December-January (1 visit per school)									
MNM treatment	0.009	-0.007	0.009	0.121	0.253	0.125	-0.043	-0.056	-0.044
	(0.024)	(0.037)	(0.023)	(0.127)	(0.187)	(0.129)	(0.077)	(0.110)	(0.076)
High intensity	0.011	-0.005	0.011	-0.082	0.050	-0.056	0.066	0.053	0.041
	(0.024)	(0.036)	(0.023)	(0.138)	(0.177)	(0.131)	(0.078)	(0.111)	(0.077)
MNM treatment * high intensity		0.033			-0.273			0.028	
		(0.044)			(0.243)			(0.157)	
Received IFA during previous year			-0.001			-0.274			0.297***
			(0.043)			(0.253)			(0.082)
N	145	145	145	145	145	145	134	134	134
R-squared	0.041	0.044	0.041	0.100	0.106	0.109	0.139	0.139	0.174
Panel C: February - May (3 visits per school)									
MNM treatment	-0.024	-0.050	-0.024	0.032	-0.030	0.032	-0.065*	-0.069	-0.064*
	(0.030)	(0.037)	(0.029)	(0.048)	(0.064)	(0.048)	(0.035)	(0.054)	(0.035)
High intensity	-0.029	-0.055	-0.033	0.084*	0.021	0.083*	0.090**	0.086*	0.092**
	(0.029)	(0.041)	(0.029)	(0.049)	(0.069)	(0.050)	(0.036)	(0.045)	(0.036)
MNM treatment * high intensity		0.052			0.124			0.008	
		(0.058)			(0.095)			(0.071)	
Received IFA during previous year			0.056			0.010			-0.027
			(0.063)			(0.086)			(0.063)
N	412	412	412	410	410	410	404	404	404
R-squared	0.139	0.141	0.143	0.150	0.155	0.150	0.064	0.064	0.064

*Notes: This table shows treatment effects on measures of how well the government's IFA program was implemented. We use three measures of IFA implementation quality: (i) whether the headmaster shows enumerator an IFA tablet (Columns 1-3), (ii) the number of tablets distributed per child in the past week, as seen in the school report (Columns 4-6), and (iii) the percent of students who say they get the tablets weekly or more frequently, out of three randomly selected students that were asked the question (Columns 7-9). All columns include block fixed effects and survey month fixed effects. While not always shown in the table, columns 2, 5, and 8 always include the interaction term between the two treatments and columns 3, 6, and 9 always include a control for whether the school received the IFA tablets during the previous school year. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

Table 7: Treatment effects on health outcomes - Lagged dependent variable (LDV) model

Lagged dependent variable from survey:	None	Just Baseline 1	Baseline 1 and Baseline 2 with dummies for missing		
	(1)	(2)	(3)	(4)	(5)
Panel A: Dep var: Hemogloblin (g/dL)					
MNM treatment	-0.044	-0.012	-0.018	0.032	-0.022
	(0.057)	(0.067)	(0.057)	(0.072)	(0.057)
High intensity	0.174***	0.244***	0.179***	0.229***	0.168***
	(0.058)	(0.067)	(0.058)	(0.079)	(0.059)
MNM treatment * high intensity				-0.101	
				(0.114)	
Received IFA during previous year					0.129
					(0.089)
N	1920	1118	1920	1920	1920
R-squared	0.024	0.173	0.129	0.130	0.131
Panel B: Dep var: Anemic					
MNM treatment	-0.000	-0.024	-0.009	-0.023	-0.009
	(0.026)	(0.031)	(0.026)	(0.035)	(0.026)
High intensity	-0.066**	-0.089***	-0.064**	-0.077**	-0.062**
	(0.027)	(0.030)	(0.027)	(0.035)	(0.027)
MNM treatment * high intensity				0.027	
				(0.052)	
Received IFA during previous year					-0.022
					(0.045)
N	1920	1113	1920	1920	1920
R-squared	0.017	0.136	0.089	0.089	0.089
Panel C: Dep var: BMI-for-age (z-score)					
MNM treatment	-0.066	0.036	-0.033	0.017	-0.034
	(0.056)	(0.066)	(0.047)	(0.065)	(0.046)
High intensity	-0.037	-0.005	-0.059	-0.008	-0.063
	(0.055)	(0.066)	(0.045)	(0.067)	(0.045)
MNM treatment * high intensity				-0.101	
				(0.093)	
Received IFA during previous year					0.066
					(0.074)
N	1743	964	1743	1743	1743
R-squared	0.009	0.250	0.204	0.205	0.205
Panel D: Dep var: Height-for-age (z-score)					
MNM treatment	-0.067	-0.049	-0.096	-0.109	-0.091
	(0.078)	(0.085)	(0.068)	(0.093)	(0.067)
High intensity	0.044	-0.059	0.062	0.049	0.080
	(0.078)	(0.083)	(0.068)	(0.102)	(0.070)
MNM treatment * high intensity				0.027	
				(0.135)	
Received IFA during previous year					-0.252**
					(0.115)
N	1869	1069	1869	1869	1869
R-squared	0.048	0.234	0.175	0.175	0.178

*Notes: The dependent variable in each specification is child's hemoglobin in g/dl (Panel A), an indicator for whether a child is anemic (Panel B), child's z-score for BMI for age (panel C), and child's z-score for height for age (Panel D). All columns include block and age fixed effects, in addition to the lagged dependent variable as described in the headers. Standard errors, clustered by school, are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

Table 8: Treatment effects on IFA program implementation (student report) by school characteristics

	Above-median 'school management quality' index			Four or more teachers help out with midday meal			Midday meal managed by a self-help group			School's drinking water is treated		
	No	Yes	P-value of diff	No	Yes	P-value of diff	No	Yes	P-value of diff	No	Yes	P-value of diff
Panel A: All months (4 visits each)												
MNM treatment	-0.114***	0.012	0.047	-0.128***	-0.047	0.190	-0.070*	-0.050	0.776	-0.091**	0.003	0.155
	(0.043)	(0.047)		(0.046)	(0.041)		(0.036)	(0.063)		(0.039)	(0.053)	
High intensity	0.126***	0.028	0.123	0.190***	0.013	0.003	0.095**	0.069	0.720	0.096**	0.060	0.616
	(0.042)	(0.047)		(0.043)	(0.040)		(0.038)	(0.061)		(0.043)	(0.058)	
N	304	234		209	329		364	167		348	182	
R-squared	0.153	0.131		0.144	0.202		0.158	0.126		0.176	0.092	
Panel B: December-January (1 visit per school)												
MNM treatment	-0.118	0.041	0.316	-0.219*	0.012	0.135	0.029	-0.168	0.283	-0.030	-0.006	0.883
	(0.103)	(0.120)		(0.128)	(0.086)		(0.091)	(0.163)		(0.096)	(0.134)	
High intensity	0.190*	-0.090	0.098	0.136	0.028	0.469	0.121	0.035	0.669	0.106	0.036	0.703
	(0.109)	(0.128)		(0.123)	(0.086)		(0.091)	(0.183)		(0.097)	(0.158)	
N	75	59		54	80		91	42		84	48	
R-squared	0.244	0.121		0.286	0.350		0.195	0.156		0.173	0.217	
Panel C: February - May (3 visits per school)												
MNM treatment	-0.110**	0.002	0.112	-0.098	-0.059	0.602	-0.101**	0.001	0.183	-0.114**	0.018	0.076
	(0.046)	(0.053)		(0.061)	(0.044)		(0.043)	(0.064)		(0.045)	(0.059)	
High intensity	0.116**	0.060	0.441	0.215***	0.008	0.005	0.087**	0.090	0.976	0.094*	0.066	0.714
	(0.049)	(0.054)		(0.057)	(0.045)		(0.044)	(0.061)		(0.049)	(0.060)	
N	229	175		155	249		273	125		264	134	
R-squared	0.099	0.055		0.149	0.066		0.066	0.129		0.086	0.055	

*Notes: This table shows treatment effects on measures of how well the IFA program was implemented in different groups of schools. The dependent variable in all regressions is the percent of students who say they get the tablets weekly or more frequently (out of three that were asked). All columns include block fixed effects and survey month fixed effects and a control for total enrollment at the school. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

Table 9: Treatment effects by school characteristics

	Above-median 'school management quality' index		
	No	Yes	P-value of diff
Panel A: Dep var: IFA Implementation (school report)			
MNM treatment	0.149**	-0.071	0.026
	(0.067)	(0.072)	
High intensity	0.026	0.091	0.542
	(0.072)	(0.079)	
N	314	241	
R-squared	0.144	0.063	
Panel B: Dep var: Hemogloblin (g/dL)			
MNM treatment	-0.018	-0.012	0.960
	(0.078)	(0.087)	
High intensity	0.205**	0.147	0.627
	(0.079)	(0.090)	
N	1081	839	
R-squared	0.157	0.122	
Panel C: Dep var: Anemic			
MNM treatment	0.001	-0.024	0.641
	(0.034)	(0.043)	
High intensity	-0.083**	-0.045	0.498
	(0.035)	(0.043)	
N	1081	839	
R-squared	0.107	0.084	

*Notes: This table shows treatment effects on headmaster reports of IFA tablet distribution (Panel A) and child health (Panels B and C) in different groups of schools. All columns include block fixed effects and survey month fixed effects and a control for total enrollment at the school. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*