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Improving midday meal delivery and encouraging micronutrient fortification among children in India

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Improving midday meal delivery and encouraging micronutrient fortification among children in India

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Summary

Nutrient deficiencies are widespread in developing countries, affecting child health and learning. In India, nutritional deficiencies are especially widespread resulting in efforts by the government to try various strategies to address the issue. We conducted a field experiment across 150 schools in rural India to investigate the effects of a micronutrient fortification intervention introduced in the world's largest school meals program (India's Midday Meal program) on meal quality and child health. Varying the intensity of monitoring visits to schools during meals, we are also able to answer whether, and to what extent, monitoring meals improve these outcomes.

While we find significant and positive effects of the fortification on micronutrients present in meals, we find no detectable effects on hemoglobin levels, anthropometric measures, cognitive ability, school attendance or reading and math proficiency. Increased monitoring of school meals, on the other hand, does improve hemoglobin levels in children. Finally, we explore whether there are any spillover effects of the fortification intervention that was introduced, on both the midday meals program, as well as on another government-run program that provided students in our sample with iron tablets. We find evidence of negative spillovers on how well the iron fortification program was implemented. One possible explanation is crowding out in effort by school officials as a result of the new micronutrient fortification program being introduced in schools. In contrast, increased monitoring of school meals improved the implementation of the iron fortification program, perhaps because iron tablets are distributed during mealtime.

While almost all schools received the tablets from the government's iron fortification program during the year of our intervention, there was variation in how the iron fortification program was implemented across schools during the previous year. Using this variation and panel data on hemoglobin levels, we find some (limited) evidence that the government's iron fortification program was effective, particularly for children who were mildly anemic at baseline. We also find suggestive evidence that the effect diminished over time, once schools ran out of tablets, which may limit the effectiveness of school-based nutrition programs unless they are able to distribute tablets and encourage compliance over the school holidays.

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Abbreviations and acronyms

NFHS-3	National Family Health Survey-3
IFA	Iron and folic acid
MNM	Micronutrient mix
DSME	Department of School and Mass Education
DEO	District Education Officers
NIN	National Institute of Nutrition
NABL	National Accreditation Board for Testing and Calibration Laboratories
SDMU	State Drug Management Unit
MDM	Midday meal

1. Introduction

Nutrient deficiencies are widespread in developing countries, affecting child health and learning. In India nutritional deficiencies are especially widespread. According to the National Family Health Survey-3 (NFHS-3) (IIPS 2007) in 2005–2006, 43% of children under the age of 5 years in India are underweight. Among adults (15–50 years) 36% of women and 34% of men are undernourished. The same report shows that 70% of children under the age of 5 suffer from mild, moderate or severe anemia. In the state of Odisha, where we conducted our study, 41% of children under the age of 5 are underweight and 65% are anemic.

These deficiencies have substantial consequences for productivity, at the individual level (Thomas et al. 2006) and, for economic growth, at the macro-level (Shastry and Weil 2003). Recent work suggests that early childhood health interventions, when proper nutrition is vital for development, may have long-lasting effects (Hoddinott et al. 2008). In response to the high incidence of malnutrition among children, the Supreme Court of India mandated the provision of nutritious midday meals to every primary school student. Unfortunately, the availability and quality of these meals vary greatly due to limited resources, inadequate infrastructure and widespread corruption.[1]

This study proposed to evaluate the efficiency of different strategies to provide micronutrient supplements to schoolchildren through India's midday meals program, with an emphasis on minimizing leakages, using a randomized control evaluation in Keonjhar district in Odisha. One such strategy that we had initially planned to evaluate was centralized meal provision by a non-governmental organization (NGO), wherein resources related to the midday meals would not be given to schools, but directly to the NGO. The NGO would then cook meals for each school in a large, mechanized kitchen in the district headquarters and deliver these to each school during mealtime. This would be in contrast to the status quo decentralized manner in which the midday meals are provided at school: resources (funds and rice) are provided to school officials, who are then responsible for ensuring that nutritious meals are cooked and provided at school during meal time. Unfortunately, the centralized arms of the intervention were never implemented due to extensive delays in the construction of the centralized kitchen, in receiving approvals from multiple government officials (in addition to frequent turnover of these officials) and decisions on the part of our implementing partner. In this report, we focus on the decentralized fortification of school meals (through headmasters and cooks in each school), with variation in the intensity of the monitoring of the school meals.

Another change in the project design was prompted by the (Central) Government of India's new Iron and Folic Acid (IFA) Supplementation Program. We had initially planned to fortify school meals with iron. However, in late 2012 to early 2013, as we completed our baseline survey and prepared to implement the intervention, the Government of India's Ministry of Health and Family Welfare announced the national iron supplementation program for school-going students in all states and union territories. Beginning in January 2013, the IFA program provided iron and folic acid tablets free of

[1] The midday meal tragedy in Bihar (reported in The *New York Times* 7/28/2013) highlights the difficulties in implementing such a large-scale program and the potential for corruption and lack of oversight to have severe consequences.

charge to all children and adolescents attending school. Both the government's IFA program and our study in Keonjhar aimed to address iron deficiency anemia by providing iron-fortified foods or supplements. If both programs were to occur simultaneously, students would receive iron from two different sources, which could lead to the absorption of iron at levels that are greater than the recommended intake levels of iron. If we had tried to circumvent this possibility by reducing the level of iron fortification, we would have been left with insufficient power to detect an effect of our program on our outcomes of interest, including hemoglobin.

Hence, we decided to stop iron fortification. Instead, we decided to fortify the school meals with a micronutrient mix (MNM) of vitamins and micronutrients, which are necessary for the absorption of iron. In a number of studies, multi-micronutrient supplementation has been found to be more effective in correcting health deficiencies like anemia than just iron and folic acid supplementation. Ahmed and others (2010), for example, showed that the provision of multiple micronutrients on a long-term basis to anemic adolescent girls in Bangladesh enhanced hemoglobin levels more than the supply of just iron and folic acid.[2] Other studies have highlighted the health benefits of multi-micronutrient supplementation, over and beyond iron and folic acid supplementation, for pregnant women and lactating mothers (Roberfroid et al. 2008; Roberfroid et al. 2012) and infants (Smuts et al. 2005; Untoro et al. 2005; Hop and Berger 2005). Contrary to popular belief, Fawzi and others (2007) and Mehta and others (2011) find that multi-micronutrient supplementation even without iron and folic acid can improve hemoglobin levels. Using the variation in the implementation of the IFA program, both before and while our revised intervention was underway, we aim to evaluate the effect of iron by itself and the additional effect of multi-micronutrient fortification.

Our results inform micronutrient supplementation policies and school meal policies in India and across the world, potentially improving the wellbeing of millions of disadvantaged children. The Government of India's IFA program highlights the fact that addressing micronutrient deficiencies through schools is a current policy priority. More generally, by shedding light on the implementation of government programs through decentralized institutions such as schools, our study could help inform the design and improve the efficiency of anti-poverty programs.

The study uses stratified cluster randomized control trials in a sample of 148 primary schools, based out of five blocks (administrative unit within a district) in Keonjhar, to answer the following questions:

A. Does fortifying school meals (through the regular system) improve meal quality and health and cognitive outcomes of interest?
B. Does high intensity monitoring improve the take-up of the micronutrient mix, and subsequently improve the health and cognitive outcomes of interest?

Using non-experimental variation in the implementation of the Government's IFA program and in initial hemoglobin levels among school children, in addition to three rounds of health measures – 1) before the IFA program, 2) after the first year of the IFA

[2] By contrast, Ayoya et al. (2008) find no significant difference in hemoglobin between MNM with and without iron among anemic school children in Mali with helminth infections.

program but before our intervention and 3) after our intervention and the second year of the IFA program – we also aim to answer the following questions:

C. Did the Government's IFA program improve health and cognitive outcomes of interest?
D. Did fortifying school meals with multi-micronutrients increase the effect of the Government's IFA program on health and cognitive outcomes of interest?

Sufficient variation in receipt of tablets and implementation of the program during the first year of the government's IFA program allows us to address question C. However, in the second year, all schools received the IFA tablets. Thus, we are unable to separately answer question D and question A. The impact of fortifying school meals with multi-micronutrients that we estimate is contingent on having a government IFA program.

In addition, as mentioned above, we are unable to address the following questions on centralized delivery of fortified meals from the pre-analysis plan that had initially motivated this study for reasons beyond our control:

E. Does fortifying centralized meals improve meal quality and health and cognitive outcomes of interest?
F. How does centralized unfortified meal delivery compare vis-a-vis decentralized unfortified meal delivery on health and cognitive outcomes of interest?
G. How does centralized fortified meal delivery compare vis-a-vis decentralized fortified meal delivery on health and cognitive outcomes of interest?

Section 2 details the research hypothesis and the theory of change. Section 3 provides the context and rationale for sample selection. Section 4 talks about the timeline of the study. Section 5 provides details on the evaluation and data collection. Section 6 discusses the implementation of the interventions. Section 7 describes the results. Section 8 addresses various challenges to internal validity while Section 9 discusses external validity and policy implications.

2. Intervention, theory of change and research hypotheses

2.1 Intervention and hypotheses

Our project focused on addressing widespread micronutrient deficiencies among school-age children through the school system. To this end, we evaluated a number of treatments:

1. **Micronutrient Mix (MNM) Provision**: In the first treatment, we provided school headmasters and cooks with a multi-micronutrient mix, containing vitamins A, D, C, B1, B2, B6, B12, niacin, zinc, selenium and calcium. We conducted rigorous trainings for headmasters, cooks and other staff involved with meal preparation such as self-help group members. During these trainings, we covered the health consequences of anemia and other forms of malnutrition, the health benefits of consuming the MNM and directions for MNM use. We also gave schools pictorial charts that clearly laid out the different steps to be followed to add MNM to the food. We also provided schools with contact details for the staff in our Keonjhar office who were trained to respond to different sorts of queries on MNM use. Every month, schools were contacted to enquire whether they needed more of the MNM and, if so, additional packets were delivered to the school.

2. **High Intensity Monitoring**: In the second treatment, in addition to the training and the delivery of the MNM, school meals were monitored earlier in the program and more frequently.[3] Enumerators visited each school under high intensity monitoring during mealtime on a random day each month for the first two months of the intervention. All schools in the study were visited once per month during the last three months of the treatment. During each visit, enumerators observed meal quality, child attendance, the distribution of food to the children, and how much of the food was consumed by the children. Enumerators also asked the headmasters and cooks about the preparation of the meal and storage of cooking equipment and ingredients and measured the height of three randomly chosen students.
3. **Government IFA Supplementation Program**: Beginning in 2012–2013, the Central Government of India mandated the distribution of iron and folic acid tablets to schoolchildren. While the mandated program involved weekly distribution of iron tablets, the program in Odisha was implemented differently during the first year. Tablets containing iron and folic acid (Ferrous Sulfate Eq. to elemental iron 45mg, folic acid 400mcg) were distributed to school officials in our study district of Keonjhar in 2014–2015 with instructions to give one tablet to each primary school child each day. In the second year, schools were instructed to distribute these tablets weekly instead of daily. In both years, upper primary school children were to be given a higher dosage (Ferrous Sulfate Eq. to elemental iron 100mg, folic acid-0.5 mg) daily in the first year and weekly in the second year.

The primary objective of these interventions is to combat micronutrient deficiencies, most notably anemia, among school-age children using the pre-existing school infrastructure. Improving child health through eliminating micronutrient deficiencies is expected to have the additional benefits of improved cognitive ability, school attendance and educational outcomes. The primary outcomes we consider are hemoglobin levels, anthropometric measures, cognitive ability, school attendance and performance on a test in reading and math. Intermediary outcomes we measure are take-up of the MNM and meal quality.

The specific hypotheses are as follows:

H1. Average meal quality, child health and schooling outcomes will be higher in the schools provided the MNM mix than in the comparison schools receiving the standard meals.

H2. Schools monitored intensively will have higher take-up of the MNM mix, improved meals and better health and schooling outcomes than schools monitored less intensively.

H3. The Government's IFA program will improve child health and schooling outcomes.

H4. The Government's IFA program will improve child health and schooling outcomes more when combined with the MNM provision and high intensity monitoring.

[3] Note that school (or other) officials were not told about the frequency of visits beforehand.

2.2 Theory of change

The interventions aimed to address child health and learning by improving the nutritional content of meals provided in school. In evaluating these impacts, we rely on a number of assumptions. Starting from the input stage of the theory of change, in addition to the training of school staff and the school delivery of MNM mix that we organized, we assume that government officials provided adequate training and instructions on how to distribute the IFA tablets. We verify this when we survey headmasters.

In order for these inputs to turn into high quality meals provided in school, schools must have sufficient fuel, grain and other ingredients in order to produce a nutritious meal. The intervention also assumes that school officials are motivated enough to improve the meals, distribute and monitor the consumption of IFA tablets and perform the calculations necessary to determine how much MNM is added to a meal, based on the number of children in attendance.

An intermediary objective of the project is for children to consume the meals and the IFA tablets and to attend classes during the school day (not just the meal). This assumes children are attending (at least the meal) sufficiently often at baseline in order to increase nutrition. It also assumes that meals are tasty, that the MNM does not alter taste or texture appreciatively and that IFA tablets are not linked to adverse side effects. In order for attendance during class time to increase, either, 1) parents and children value the higher quality meal and there are obstacles to attending the meal but skipping classes, or 2) the children have more energy to attend classes due to the improved meals.

Finally, children will exhibit improved nutritional status and health if they consume sufficient quantities of the MNM or IFA tablets. Previous research suggests that these health outcomes can appear within 5–6 months of increased consumption of micro-nutrients. Gera and others (2007) conducted a meta-analysis of iron supplementation, with the majority of included studies lasting 2–12 months in duration. The meta-analysis finds no relationship between duration of supplementation and impact. Finally, the combination of improved child health and higher school attendance can translate into higher learning, but only if other inputs needed to improve learning outcomes, such as motivated teachers, are present. Neither the supplementation of the meal with the MNM or distributing the IFA tablets should take up valuable class time.

Table 1: Theory of change

	Objectives hierarchy	Indicators	Sources of verification	Assumptions or threats
Impact (goal/overall objective)	Improved child health and learning.	Hemoglobin test, height for age, weight for height, performance on cognitive, math and reading tests	Household survey	Children consume sufficient quantities of the MNM or IFA tablets in order to experience improved health. Other inputs needed to improve learning outcomes are present in schools. Adding the MNM to the meal or distributing IFA tablets does not take up valuable class time.
Outcome (project objective)	Children consume the meals and IFA tablets and attend classes (not just meals) more often. Improved nutritional content of school meals.	Observations of meal consumption and school attendance, perceptions of meal quality from children and parents Vitamin A and Zinc content from food samples taken from school meals	Meal observation survey, school attendance survey, household survey Lab tests of meal samples	Children attend school often enough at baseline to increase nutrition. Meals are tasty and children eat sufficient quantities to increase intake of the micronutrients. IFA tablets do not have side effects. Children and parents value the higher quality meals and IFA tablets OR children have more energy to attend school due to meal improvements.
Outputs	High quality meals provided in school.	Take up of MNM mix, observations of meal quality	Responses to MNM delivery enquiries, meal observation survey (survey of cook, headmaster and children)	Fuel and other ingredients needed to produce nutritious meals are available. School officials are motivated to improve the meals and able to perform any calculations (for example, how much MNM to add relative to number of children).
Inputs (activities)	Supplements (MNM, IFA tablets) provided to school officials. School staff trained in use.	Number of packets of MNM and IFA tablets received by schools; number of school officials trained.	Reports from MNM delivery and trainings Reports from school officials on IFA program implementation (IFA survey)	District officials disseminated adequate instructions for school officials to distribute IFA tablets.

3. Context

The study was based in Keonjhar District in Odisha, since the original implementing partner for the centralized arms, Naandi Foundation, was starting operations in Keonjhar in 2010. This allowed us to randomize the roll out. Keonjhar is one of the poorer districts in the state. A 2008 survey showed that 56 percent of the population in Keonjhar was classified as having a “low-standard of living” (determined by measures such as existence of an electricity connection in the household, access to a toilet facility or an improved source of drinking water, home ownership, agricultural land ownership, etc.). Despite such poverty, school enrollment rates are high in the district – 98% of both boys and girls (ages 6–11) are enrolled in school. This makes it a very good candidate for evaluating the impact of nutrition interventions in school children.

The largest nutrition-based intervention in Keonjhar and in Odisha is the midday meal program, implemented by the Government of Odisha and mandated by the Supreme Court of India. As a part of the program, the schools, under the auspices of the government, cook and provide midday meals to children. The Government of Odisha has set up a State Level Project Management unit under the Department of School and Mass Education (DSME) to implement and manage the midday meal program in government schools, government aided schools and Madrasas. The District Education officers (DEOs) in each of the districts are responsible for drawing and disbursing funds to schools for purchasing ingredients for the midday meals. In addition, the district and block-level education machinery is responsible for supervising the midday meal disbursement. The midday meal program has a weekly menu stipulated by the Government of Odisha. Table 2 lists the menu that was followed in the academic year (2014–2015).

Table 2: Midday meal menu

Day	Menu
Monday	Rice and *Dalma* (local dish in Odisha)
Tuesday	Rice and soya chunks
Wednesday	Rice and egg curry
Thursday	Rice and *Dalma*
Friday	Rice and soya chunks
Saturday	Rice and egg curry

The DSME’s office is committed to ensuring there is awareness about the various facets of midday meals, like providing nutrition, assuring food hygiene and improving attendance of school children. To that end, a midday meal awareness fair is held annually in the state capital, Bhubaneshwar, where all stakeholders involved in the midday meal program in the state are invited to put up displays of their work sharing best practices. The fair is well attended by school children, parents and teachers as well as government officials, bureaucrats and ministers. Implementing and improving midday meal delivery is a priority of the Government of Odisha.

The sample schools and children in Keonjhar district for the study were selected in mid-2012. The selection of schools was done from a list of 750 eligible schools in Keonjhar district where Naandi had not started operations at the time.

The main criterion for a school to be included in the study was whether Naandi's kitchen[4] would be able to deliver meals to the school or not. The schools in the study sample had to satisfy the following conditions:

1) They are located within 50kms from the kitchen;
2) They are located in one of the 5 blocks (i.e., sub-regions within the district) that Naandi had permission to operate in (namely: Banspal, Ghatagaon, Jhumpura, Keonjhar Sadar, Patna); and
3) They are accessible by Naandi's trucks in all seasons

The 377 schools that satisfied these conditions make up our sampling frame. The MNM intervention was evaluated using 150 randomly chosen schools from this list, while the government's IFA program was evaluated using the 157 schools in the 3 more remote blocks: Banspal, Jhumpura and Keonjhar Sadar.

All students in classes 1–5, who are enrolled in the sample schools, but who don't live in school hostels, constituted the student-level sampling frame for the household survey. We excluded children who live in hostels since it was difficult (if not impossible) to locate their families, conduct household surveys and obtain permission from parents to conduct hemoglobin and anthropometric tests.

Thus, our sample is representative of children in Keonjhar schools that have some access to the town and who live with their parents during the school year. As noted above, prevalence of malnutrition and anemia among children under the age of five in Odisha is fairly representative of India: 41% of children in Odisha are underweight versus 43% of children in India and 65% of children in Odisha are anemic (mild, moderate or severe) versus 70% of children in India (IIPS 2007). While the NFHS-3 does not report hemoglobin levels for the schoolage population, data from our baseline survey indicates that approximately 60% of the children in our sample are anemic, a number very similar to the national average. Similarly, 44% of children in our sample are underweight.

4. Timeline

The study went through several changes in the timeline due to delays in construction of the centralized kitchen and the implementation of the Government's IFA program. The delays also forced us to change the intervention design (described above). In addition, there were delays in securing approvals from the Department of School and Mass Education (DSME), Government of Odisha, both for the implementation of the decentralized as well as the centralized arms. Figure 1 gives the chronology of key activities in the study.

[4] The kitchen itself was to be constructed in Keonjhar district's headquarters, Kendujhar.

Figure 1: Timeline of key activities

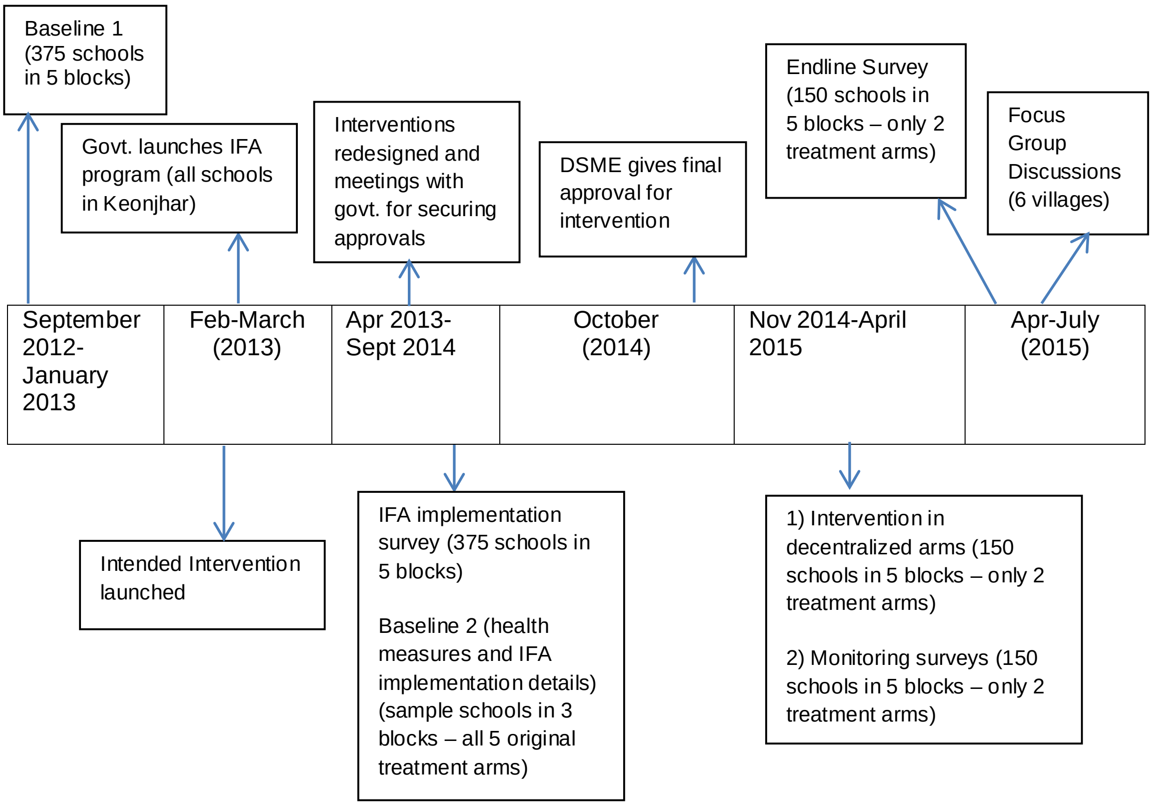


Figure 1 shows that the first baseline survey (baseline 1) was completed by January 2013. The original intervention was launched for less than two months before we had to halt it due to the government's IFA program. Changing the intervention plan required securing approval for the new design from National Institute of Nutrition (NIN), DSME and the Government of Odisha. Starting in April 2013, we set up technical meetings with the various government agencies to discuss and provide clarifications. This process took approximately 16 months. The DSME's office approved the study on July 25, 2014, following which a technical presentation had to be given by the research team. After the presentation there were several rounds of follow-up questions, and final approval was eventually given at the end of September 2014. While waiting for the final approval, we conducted an IFA survey, which collected information on the IFA program's implementation in our study schools, and conducted the second baseline survey (Baseline 2) in a subset of sample schools in order to update anthropometric and hemoglobin measures from the first survey and allow us to evaluate the impact of the government's IFA program on hemoglobin and other health measures.

The intervention was launched in 148 schools (the MNM treatment and the comparison group, both crossed with high intensity monitoring) in November 2014, and was continued through the end of April 2015, with the cooperation of the DSME's office.[5]

[5] As mentioned earlier, the intervention was not implemented in the two centralized arms because Naandi experienced several additional delays in getting permission from the local district authorities to distribute midday meals to new schools for the study, and Naandi ultimately decided not to provide meals to the study schools.

While the original list contained 150 schools, 2 schools refused to cooperate with us from the beginning of the study, before the intervention began. Thus, we were left with 75 MNM treatment schools and 73 comparison schools. During this period we also monitored the school meals and conducted surveys to collect information on student attendance, MNM usage and IFA tablet usage. Food samples were collected twice from each of the sample schools.

The endline survey, which had the same scope as the first baseline survey, was launched in the 148 study schools in April 2015 and was completed in early July 2015. The DSME requested that we conduct focus group discussions with all stakeholders to get a sense of how the intervention worked. The focus group discussions were conducted with school children, their parents and school officials from six sample schools in July 2015 after the completion of the endline survey.

5. Evaluation: design, methods and implementation

5.1 Study design

The design and evaluation of the interventions were conducted by the research team and J-PAL SA, and the project acquired the necessary Institutional Review Board (IRB) approvals from the Institute for Financial Management and Research, India, and Cornell University, USA.

The evaluation of the MNM and high intensity monitoring treatments is a randomized control trial, where the treatment status is randomly assigned to sample schools, allowing us to identify the causal impact of one treatment arm over the other (see Section 2 for the hypotheses the study tests). As mentioned earlier, in addition to the randomized control trial, the project uses non-experimental variation in the implementation of the Government's IFA program to evaluate the impact of the IFA program on child nutrition and cognitive outcomes. To do that we exploit the following sources of variation to identify the impact of the IFA program: 1) time-series variation since we first measured hemoglobin during our baseline survey before the IFA program was implemented; 2) variation across schools within a block in whether sufficient IFA tablets were received from the block-level officials to implement the program; and 3) variation across children in initial hemoglobin status (those not anemic initially are less likely to respond to supplementation).

5.1.1 Sample selection at the school level

As discussed above, the schools in the study sample had to satisfy the following conditions:

1) They are located within 50 kms from the kitchen;
2) They are located in one of the 5 blocks (i.e., sub-regions within the district) that Naandi had permission to operate in (namely: Banspal, Ghatagaon, Jhumpura, Keonjhar Sadar, Patna); and
3) They are accessible by Naandi's trucks in all seasons.

The process by which the schools were located and included in the sample was as follows: first, the research team came up with a list of approximately 750 schools that satisfied conditions (1) and (2). Naandi then sent a team of surveyors to visit each of these schools and came up with a list of 377 schools that also satisfied condition (3).

Our intervention sample comprises 150 randomly chosen schools from this list of 377. Out of these 150, 75 were randomly assigned to receive the MNM while the other 75 did not, stratified by block and school type (i.e., whether the school only has primary grades or also has upper primary grades). Within each of these groups of 75, half the schools were randomly assigned to high intensity monitoring. We stratified on block because block officials play a significant role in the midday meal program: funds and rice to schools for the midday meals are channeled through block offices, and schools are accountable to officials at the block level. Since schools that have classes 6, 7 or 8 (in addition to classes 1–5) are accountable directly to officials at the district headquarters as well as block officials, the stratification was also done by school type: primary (classes 1–5) and primary plus upper primary (classes 1–8).

As noted above, two schools dropped out soon after the study commenced, after treatment statuses had been determined but before the schools could have been aware of them. Thus, 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.

5.1.2 Sample selection at the student level

The sample of schools included in the evaluation of the government's IFA program, on the other hand, includes all 157 schools from the original list of 377 in the three more remote blocks (Banspal, Jhumpura and Keonjhar-Sadar) in our sample. While in the process of obtaining permissions for our revised intervention, we conducted a school survey to gather information on the implementation of the IFA program in its first year. That survey indicated very little variation in tablet receipt in the two less remote blocks in our sample (Ghatagaon and Patna): approximately 97 percent of schools received the tablets. Thus, we focused our efforts during Baseline 2 on the blocks with more variation in IFA tablet receipt in order to evaluate the IFA program. Only 70 percent of schools in those blocks had received the tablets in the first year.

All students in these schools received the treatments (conditional on attending), but conducting household and anthropometric surveys for all children would have been prohibitively expensive (specifically, getting parental permission for hemoglobin tests). Thus, we randomly chose 15 students in each school to survey based on the power calculations described below. These students were chosen from the set of students enrolled in sample schools in classes 1–5 who live with their parents (and not in school hostels). We excluded children in hostels due to the difficulty in locating their parents to obtain permissions. Students were randomly chosen, after stratifying by school and class.

Due to delays in getting approvals and redesigning the study to accommodate the IFA rollout, we had to reduce the sample size of children by 50 percent for Baseline 2. Another complication was that children who were in class 5 during Baseline 1 had graduated from primary school before the 2013–2014 school year, the first year of the IFA program, and the 2014–2015 school year, the year of our intervention. At Baseline 2, we surveyed children who had been enrolled in classes 1–4 during Baseline 1. We also sampled another 3 students who were enrolled in classes 1 and 2 during the 2014–2015 school year. Thus, instead of 15 students per school there are on average 8 children per school for Baseline 2. Recall that at Baseline 2, we only surveyed children in the three administrative blocks with variation in the IFA implementation. Thus, at endline, we surveyed those enrolled in classes 1–3 during Baseline 1 and all those surveyed during Baseline 2. We also sampled additional students enrolled in classes 1 and 2 during the 2014–2015 school year to get a sample of 3 students per class. With some attrition, there are on average 14 students per school surveyed at endline.

5.1.3 Sample selection for focus groups

Finally, we also conducted focus group discussions in six randomly picked schools—two were MNM treatment schools with high MNM take-up, two were MNM treatment schools with low MNM take-up and two were comparison schools, in order to get focus group responses from a variety of perspectives and experiences.

Table 3 lays out the original set of treatment groups and the number of schools and students in each group.

Table 3: Treatment arms

	Treatment	Intended Number of schools	Final Number of Schools	Estimated number of students enrolled in these schools	Number of students surveyed at endline
1A	Centralized provision of fortified school meals	76	0	0	
1B	Centralized provision of non-fortified school meals	76	0	0	
2A	Meal provider education and micronutrient mix provision (MNM treatment)	75	75	6969	989
0	Continuation of current meals	75	73	6723	997
3	High Intensity Monitoring (Cross Randomization across treatments 2A and 0)	75	73 (37 from 2A) (36 from 0)	6432	969

5.2 Data collection

We collected data on a number of outcome variables at various points during the study. For example, we collected extensive data on 1) school infrastructure in meal provision, 2) the implementation of the IFA program, 3) the quality of midday meals and the take-up of the micronutrient mix (including the quantity of vitamin A and zinc in food samples from the meals), 4) child-level outcomes (including hemoglobin levels, anthropometric measures, cognition, school attendance and test scores) and 5) household-level demographic characteristics and information on assets and midday meal perceptions. The timing of these data collection efforts is summarized below:

- **School survey data:** Data on school characteristics and teacher demographic details and qualifications were collected during Baseline I and again during the second month of the intervention.
- **Take-up rates:** Take-up of fortification schemes in itself is an important outcome. The amount of fortified ingredients picked up by the schools per meal served will provide some information about the nutritional value of these meals. This data was collected each month during the intervention.
- **Meal quality:** Trained enumerators made surprise visits to the study schools to observe the quantity and quality of school meals. 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.
- **Testing nutrition content of meals:** During the third and fifth months of the intervention, enumerators took samples of the food being served and sent these samples to a laboratory for nutritional analysis. The amounts of vitamin A and zinc were determined.
- **IFA implementation:** During April–May 2014 and the first, third, fourth and fifth months of the intervention, enumerators visited the schools to inquire about whether IFA tablets had been received from the government and about how well the IFA program was being implemented.
- **School attendance:** Each month, an enumerator made random, unannounced visits to each school in the study to take attendance. These checks are necessary because previous work has shown that attendance taken by the teachers is inaccurate. These checks were made at random times of the day to study whether children attended school just for the meal and leave immediately after.
- **Child health:** Enumerators visited the schools and households to measure the selected children’s height, weight and hemoglobin level during the Baseline 1, 2 and endline surveys. The survey team was careful about obtaining proper permission from each child’s parents before taking any health information.
- **Test scores and cognitive tests:** During the Baseline 1 and endline surveys, students in grades 1–4 were given mathematics and reading tests designed by Pratham, an India-wide NGO that works on child literacy as well as tests of cognitive development. We used two cognitive development tests: 1) a Digit Span Test (Pershad and Wig 1988) where children are asked to repeat sequences of numbers, ranging in length, both forwards and backwards and 2) a Block Tapping Test (Kar et al. 2008) where children are asked to tap the top of four boxes in the same order in which a surveyor taps the boxes or in reverse order. The total number of points possible on these tests is 26 and 10, respectively. Scores on all four tests (Digit Span, Block Tap, Language and Mathematics) are normalized using the control group distribution by grade and survey round (baseline or endline).
- **Household data and health of family members***:* During Baseline 1, enumerators visited the households of the selected children. The survey conducted at this time included consent, demographic details, and sections on

children and women in the household, household assets and perceptions of anemia and of the school's midday meal. The enumerators also conducted cognitive tests on family members and were accompanied by medically trained enumerators, who measured the height, weight and hemoglobin level of the younger siblings of the selected children (siblings in the 3–5 age range), all female siblings and their female guardian. A similar survey was administered at endline, the main difference being that only the height, weight and hemoglobin levels of the selected schoolchild and his or her younger siblings were measured.

Enumerators were trained by the Research Associates and the Regional Survey Manager of J-PAL SA. In addition, 10 percent of the surveys conducted were monitored by senior survey staff via random visits, spot-checks and accompaniments. Issues enumerators faced in the field were discussed and addressed in feedback sessions held daily. In addition, a random 10 percent of the surveys collected were back-checked.

5.2.1 Power calculations

The two primary outcomes of interest in the study are 1) MNM take-up (measured by zinc and vitamin A level in food samples collected) between fortified and un-fortified schools and 2) hemoglobin level between children in fortified and un-fortified schools.

For MNM take-up we calculated a minimum detectable effect of 2.19 mg/kg for zinc and 25.13 mcg/100g for vitamin A. These calculations assume an intra-cluster correlation of 0.2 and a standard deviation of 6.18 mg/kg for zinc and 70.91 mcg/100g for vitamin A.

For hemoglobin levels the MDE (Intention to Treat) is 0.21–0.22 g/dL. With a take-up rate of 50 percent (approximately the take-up rates we experienced during our pilot interventions), we could have detected an effect (Treatment on the Treated) of 0.42–0.43 g/dL. We initially compared our MDE to expected effect sizes we drew from the literature, specifically, from two studies that looked at the impact of providing a micronutrient mix that did not contain iron (Fawzi et al. 2007 and Mehta et al. 2011). The mean effect size across the two studies was 0.62 g/dL, higher than our MDE estimates. Due to the power calculations, we were comfortable with a sample size of 150 schools, 75 in each treatment arm, for the intervention sample.

6. Implementation of the interventions

As described before, the treatment arms that were implemented were those in the decentralized arms (2A, 0 and 3), which we describe in detail in this section. Section 6.4 describes the government's implementation of the IFA program, which was also evaluated by the research team.

6.1 Decentralized fortified treatment arm (2A)

6.1.1 Training of school staff

The micronutrient mix (MNM) was procured by the research team from Hexagon Private Ltd. in accordance with the formula proposed by the National Institute of Nutrition. The district level officials were oriented about the study on November 11, 2014, by a team of four people. This was necessary to ensure participation and support of school officials.

A team of six people from J-PAL SA visited each of 75 MNM treatment schools to conduct training sessions with headmasters/headmistresses, teachers, school cooks and other people involved with the preparation of the school midday meal, such as members of the self-help groups. The trainings for each school happened in the school itself. The trainings started on November 17, 2014, and took three days to complete. During the training the school staff was informed about the following:

a) Rationale about the program:
School staff was informed that the research team of J-PAL SA, with the permission of state authorities, is studying ways in which schools can help their students counter different health disorders by improving the quality and nutrient content of the school meals.
b) Ways to address anemia and other micronutrient deficiencies:
The school staff was informed about the health benefits and food sources of key micronutrients. Table 4 gives the information that was shared with the staff.

Table 4: Information on micronutrients shared with school staff

Name of component	**Health benefits**	**Foods in which these nutrients are found**
Vitamin A	Critical for vision and growth	Carrots, papayas, milk, eggs
Vitamin D	Important for bone growth	Eggs
Vitamin C	Helps absorb iron and thus prevents anemia (a condition in which people feel dizzy and overly tired), helps heal wounds & fight diseases	Lemon, oranges, papaya, dark leafy green vegetables *(saag),* tomatoes, cauliflower
Vitamin B1	Helps the body get energy from food	Dal, nuts, cauliflower
Vitamin B2	Important for growth, helps body to get energy	Milk, eggs, nuts, dark green leafy vegetables (*saag)*
Vitamin B6	Helps fight diseases	Soybean, watermelon, bananas, peanuts
Vitamin B12	Helps growth & prevents anemia	Milk, eggs
Calcium	Vital for keeping bones strong	Milk, Curd, Cheese, Eggs
Niacin	Helps get energy from food, improves blood circulation	Peanuts, eggs, milk, yogurt
Zinc	Helps fight diseases, crucial for physical growth and cognitive development	Almonds, cashews, milk, peas
Selenium	Aids growth, protects against infections, and prevents thyroid-related health problems	Corn, carrots, mushrooms, cabbage

c) Introducing the nature of the fortificant (MNM):
After establishing the benefits of the micronutrients and food sources, the MNM treatment schools were informed that their particular school was chosen through a random lottery to receive the micronutrient mix from J-PAL on a regular basis from November 2014 to April 2015. The school staff was informed that the MNM is a nutritious dry powder and is to be mixed in with the midday meal, which the school should prepare as usual (in accordance with the government stipulated menu). Additionally, they were told that adding the mix to the food should not change its taste, smell or appearance.

d) The manner in which the program's micronutrient mix is to be used:
The school staff was informed that they would be provided with plastic sealed jars and clearly demarcated scoops for storing and measuring quantities of the MNM. They were given instructions on how to store it so that its nutrient content did not depreciate.

School staff were informed that each child should get 1.5 grams of the micronutrient mix each day. They were given step-by-step instruction on how to calculate the amount of the MNM that should be added to the meal on a particular day, based on that day's school attendance, and how to measure out that quantity in scoops. Fliers in the local language (Figure 2) were put up inside the kitchen of each school to remind the school staff responsible for preparing and serving the meal how to add the MNM correctly. Figure 3 gives the English translated version.

Figure 2: Flier in local language put up inside each MNM treatment school's kitchen

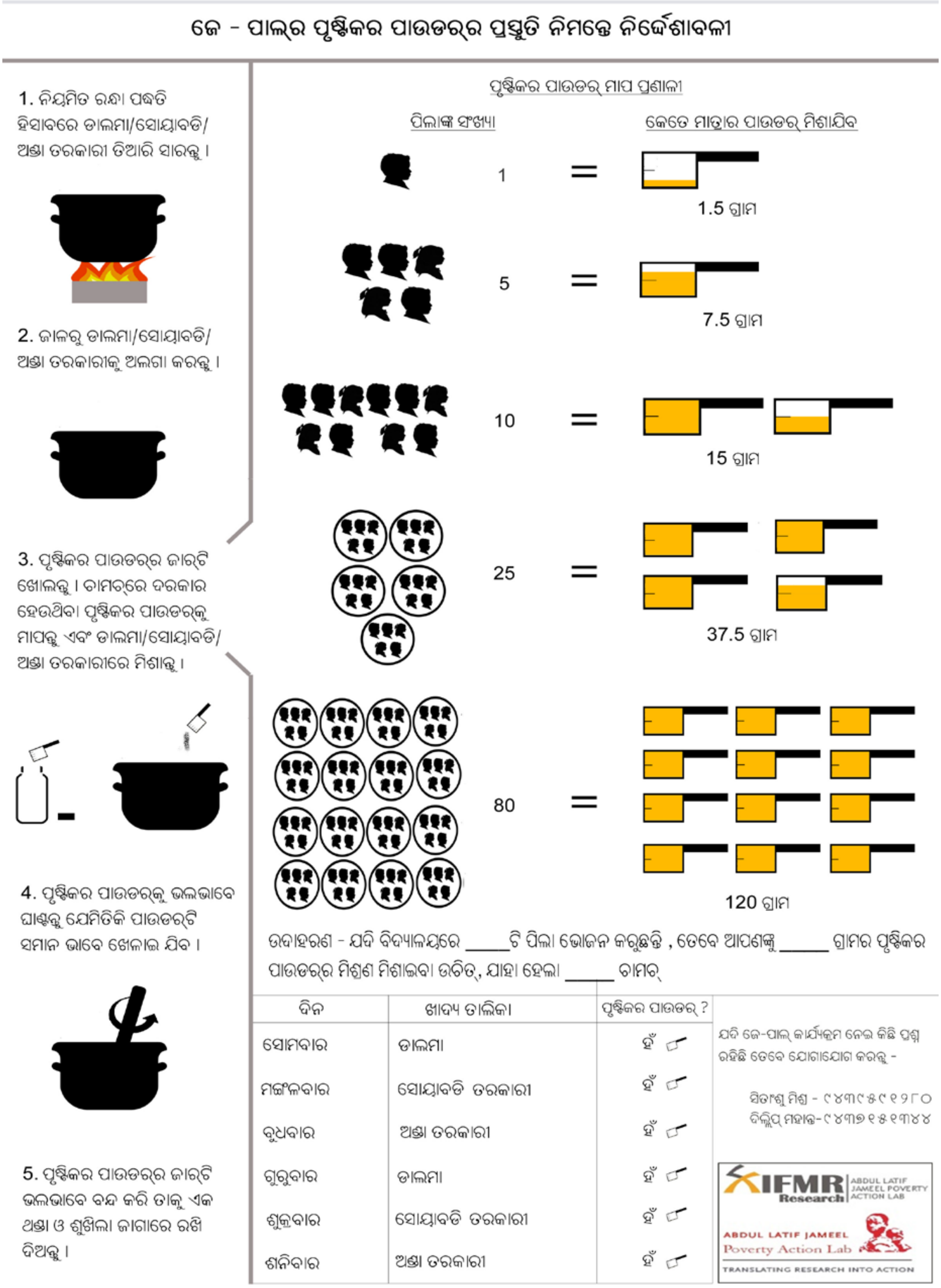
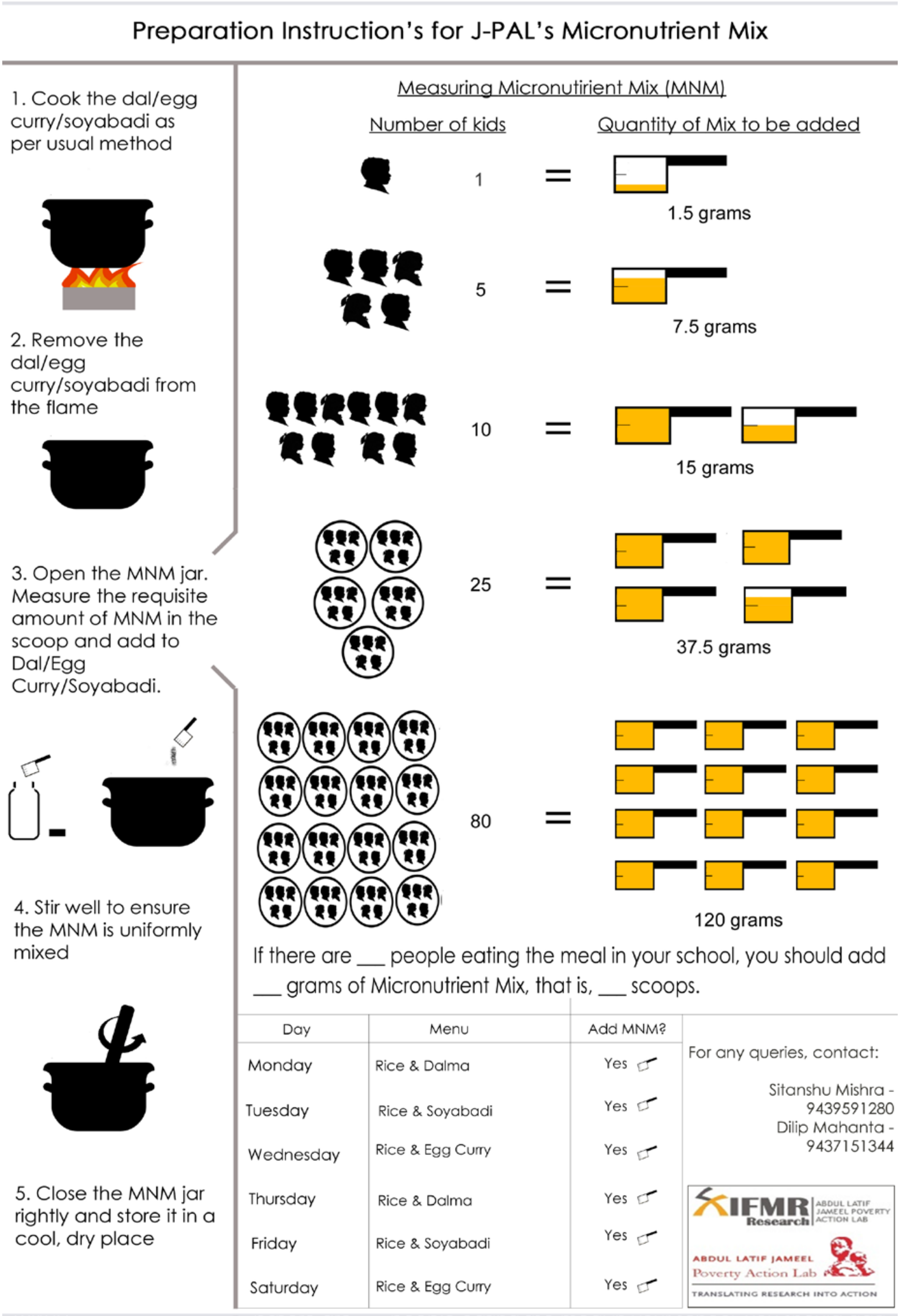


Figure 3: Flier in English language put up inside each MNM treatment school's kitchen



e) How to get the MNM from J-PAL SA:
Right after the training, J-PAL SA staff gave each school enough MNM for four weeks based on current enrollment in the school. The schools were given a phone number to call to order more of the mix and told to be sure to call before their supply was completely exhausted to ensure continuous fortification of midday meals. Headmasters were told that they would be reimbursed at the rate of INR 5 per month to cover their costs of making these calls.

Finally, the school was given the contact information of research personnel at J-PAL SA in case they needed to report any unforeseen issues or serious incidents such as a child falling sick. Fortunately, no such incident was reported.

6.1.2 Progress of MNM delivery

The first delivery of the mix to the 75 MNM treatment schools was made during the training in November 2014. In addition, three more deliveries were conducted during the intervention. Table 5 summarizes the delivery of MNM to schools after training. The initial plan was to deliver MNM only when headmasters ordered it via phone, in order to measure interest and take-up. However, a few weeks after training, we called schools to see if they had exhausted their supply; even though many of the schools were close to exhausting their MNM stock, they had not reached out to us via phone calls. We only received 10 calls requesting additional packets of the MNM. Since we had a number of other measures of take-up, we decided to work to ensure that children received a continuous supply of MNM by calling each school every six weeks to check whether they needed another delivery. If so, we arranged another delivery to replenish them for the next month, based on school attendance and the available stock in the school. Since J-PAL field officers visited schools during the meals for MDM monitoring (see Section 6.3 below), some schools would convey whether they needed MNM packets at those visits and didn't feel the need to call. Since high intensity schools received more MDM visits, using these indications as a measure of take-up would bias the results, therefore we called all schools to ensure uniform treatment. Table 5 summarizes the delivery of MNM made to schools. We planned a maximum of three delivery attempts to each school during the intervention period and the average number of delivery per school was 2.8.

Table 5: Summary of MNM delivery to schools

Number of schools approached for delivery	75
Average number of visits for delivery of MNM per school	2.8
Average amount (kg) of MNM delivered per school in Round 1	3.45
Average amount(kg) of MNM delivered per school in Round 2	3
Amount (kg) of MNM delivered per school in Round 3	3.15

6.2 Control arm (0)

The control arm is simply the continuation of the provision of the usual midday meal by schools. The control schools were given no information on the MNM fortification program, but they were given information on the importance of micronutrients for mental and physical well-being.

A team of seven people from J-PAL SA visited each of the 73 control schools to conduct training sessions with headmasters/headmistresses, teachers, school cooks and other people involved with the preparation of the school midday meals, such as members of the self-help groups. The trainings for each school happened in the school itself. The trainings started on November 17, 2014, and took three days to complete. During the training the school staff was informed about points a) and b) as described in Section 6.1.

6.3 High intensity monitoring (3)

As mentioned above, we conducted unannounced school visits to monitor midday meal quality and MNM take-up in all 148 schools. To estimate if the monitoring affected outcomes of interest like MNM take-up and meal quality, we varied the intensity of the monitoring visits in schools by cross randomizing with the status of fortification. Seventy-five schools received high intensity monitoring which included five visits (one visit per month from December 2014 to April 2015) whereas low intensity monitoring schools were visited only three times during the intervention period (one visit per month during the last three months, February 2015 to April 2015).

The monitoring visit in the schools was made at or just before the time of the midday meal being served. Enumerators were directed to show up after the meal was prepared (and the mix presumably added) but before all the students were served. The field officer spoke to both the headmaster and the cook and also recorded his own observations. For example, field officers were directed to record their observations on whether the midday meal served adhered to the stipulated menu, the ingredients used in cooking, the quality of ingredients used in cooking, the number of servers involved in serving meals to students, the number of students consuming the meals, the cleanliness of the room and the utensils that were used for cooking and whether it appeared that a powder had been mixed in the food.

In addition, the field observer was asked to select three students consuming the meal, from various points in the line of students receiving the meals: the third student receiving a meal, a student in the middle of the line and the third to last student. For each of the three students, the field observer recorded the number of servings of each dish prepared that the student received. In addition, after the meal, the height of the students was recorded using the height chart that is present in the walls of the schools.

On two visits, food samples were also collected from schools with the purpose of testing them for the presence of vitamin A and zinc. Food samples were collected during meal monitoring visits in February 2015 and April 2015. Field observers would reach the schools just before the midday meals were served and collect one scoop (approximately 250 grams) of the cooked item. Proper protocol for hygiene during sample collection, storage and transportation were observed and these samples were sent to an NABL (National Accreditation Board for Testing and Calibration Laboratories) certified laboratory for testing.

Table 6 gives the planned versus actual number of visits in the high and low intensity monitoring schools.

Table 6: Planned versus actual number of visits in high and low intensity monitoring schools

	Control Treatment Arm			MNM Treatment Arm		
	Actual Number of Schools	Planned Number of Visits per school	Actual Number of Visits per school	Actual Number of Schools	Planned Number of Visits per school	Actual Number of Visits per school
High Intensity Monitoring	36	5	4.9	37	5	4.8
Low Intensity Monitoring	37	3	2.9	38	3	2.9

Table 6 shows that in the high intensity monitoring schools the average number of actual visits at 4.9 visits is marginally below the planned number of visits per school. In the low intensity monitoring schools the same is true. The average actual number of visits does not vary much across control and MNM treatment arms. The reason for the variation is that in some cases monitoring visits were unsuccessful in cases where the headmaster was not available in the school at the time of the visit or if the meal was served before the usual lunch hours due to unforeseen reasons.

It is important to remember that none of the information collected at these visits was reported to any block or district officials. The headmasters were told that the information collected was for research purposes, but it would not be surprising if some of them believed the information would be disseminated since J-PAL SA employees had to produce a letter authorizing our work in the school signed by the school officials' direct supervisors at the block level. Thus, while the monitoring visits had very low stakes, they may not have been perceived to be.

6.4 IFA implementation

In this sub-section, we describe how the government's IFA program was implemented. Recall that the research team was not involved with this implementation. Here we describe the official central government policy as well as details regarding the implementation in our sample schools in Keonjhar. According to IFA guidelines distributed by central and state government officials, iron and folic acid supplements and deworming medication are to be distributed free of charge to all students attending school. Children 6–10 years old should receive 30 mg of elemental iron and 250 mg of folic acid daily for 100 days out of a year, under supervision. Students are also supposed to receive tablets to take home with them over school vacations. The IFA guidelines encourage teachers to also take the tablets as role models for students, promoting supplement consumption. One tablet of deworming medication is also to be administered to each child every six months. The central government intended for all teachers and health workers to be trained to notice visible signs of severe anemia so that they could refer those students to local health centers for further treatment. Additionally, the guidelines suggest that teachers conduct monthly nutrition and health education sessions with their students.

In Odisha, the State Drug Management Unit (SDMU) procures iron and folic acid tablets as well as deworming medication at the state level and distributes the medications to each district drug store. There, the Deputy Manager of Reproductive and Child Health prepares lists detailing how many tablets are to be distributed to each block.[6] The District Education Officer (DEO) then instructs the block officials, such as the Block Resource Coordinator, the Cluster Resource Coordinator and the Block Education Officer, to acquire the medications as per the list prepared at the district drug store. Finally, the block officials are expected to supply all schools in the block with the correct number of tablets.

In each school, headmasters are expected to receive the tablets and to provide them to the teacher in charge of IFA implementation. This teacher is instructed to keep a ledger of supply and distribution and is responsible for providing tablets to two adolescent female prefects, who should distribute the iron and folic acid tablets to students. The central and state governments also intend to monitor compliance quite intensively, with IFA implementation information added to the school health records along with information regarding the midday meal program. Every month, the block officials are to monitor school compliance with both programs. A core committee at the district level is also supposed to monitor progress monthly, and a state committee is supposed to meet quarterly. While the central government intends every school to have an IFA committee with the principal, lead teachers, student representatives and a local health worker, the documentation from Odisha does not mention such a committee.

To study the impact of IFA distribution on health outcomes, we conducted an uptake survey to gauge the coverage and implementation of the IFA program in the spring of 2014. This school-level survey asked detailed questions about IFA receipt from the government and distribution of the supplements to students attending school. Approximately 86% of the schools in our 377 school sample received the IFA tablets in the first year, but this hides substantial variation across blocks; two of the blocks have very little variation in implementation—95% and 99% of schools received the tablets—while the other three blocks have substantial variation in implementation: 49%, 62% and 83% of schools in these three blocks received the tablets. Within the schools that received the tablets, there is additional variation in whether or not the school received deworming medication and the number of tablets per student a school reports having received.[7] Table 7 provides summary statistics on these measures of IFA implementation by block.

As part of the school uptake survey, three children per school were randomly selected to answer several questions about the IFA implementation in their school. One student was randomly chosen from class II, class IV and class V. For each school, we calculate the percent of those three children that reported receiving tablets regularly and the percent

[6] The calculations for the number of tablets per block were based on the school health plan for 2012–2013, which included enrollment data. Each block was supposed to receive 100 tablets per child enrolled in grades 1–5. Keonjhar District was responsible for distributing 20.5 million tablets for students in grades 1–5 (Goverment of Odisha 2012).

[7] In schools that did not report the number of tablets received, the measure was replaced by the number of tablets schools reported distributing. Schools report receiving between 0–150 tablets per student and distributing 0–100 tablets per student. The correlation coefficient between these two measures is 0.5403.

that report receiving tablets recently. In the first year of IFA implementation these questions focused on the daily receipt and the previous day's receipt. In the second year of IFA implementation these questions focused on weekly receipt and receipt in the previous seven days, since the policy had changed about how often IFA tablets were to be given to each child. In blocks with variation in IFA implementation, there were substantial differences between school-reported measures and child-reported measures. In schools that reported receiving IFA tablets in the first year, only 58 percent of schools had at least 2 out of 3 children reporting daily distribution. Only 24 percent of schools reporting IFA receipt had at least 2 out of 3 children reporting that they received tablets the day before the survey. We use this variation to estimate the impact of the IFA program in the first year after verifying that the variation appears to be quasi-random, potentially due to when the block officials ran out of tablets.

Table 7: IFA implementation by block

		Blocks with High Variation in IFA			Blocks with Low Variation in IFA	
		Block 1	**Block 2**	**Block 3**	**Block 4**	**Block 5**
SCH	% of schools received IFA	0.49	0.83	0.62	0.95	0.99
SCH	Mean number of IFA tablets received per student (conditional)	15.12	57.47	38.45	65.74	101.27
SCH	Mean % of three kids saying they receive tablets daily	0.19	0.52	0.56	0.80	0.69
SCH	Mean % of three kids saying they receive tablets previous day	0.12	0.23	0.10	0.27	0.39
SCH	% receiving deworming medication	0.42	0.77	0.67	0.93	0.81
SCH	Mean Number of deworming doses per student (conditional)	1.76	2.59	2.10	2.32	2.37
	Number of Schools	43	93	21	117	103

7. Results: impact analysis and results of the key evaluation questions

This section first describes the results from the MNM and high intensity interventions. We first illustrate that the control and treatment groups were balanced on both the outcome variables and household and school characteristics prior to the intervention. We then describe each set of results on the impact of the treatments in our experiment on the outcomes of interest. Finally, we present our results from the evaluation of the government's IFA program that we conducted using quasi-random variation in its implementation in our sample schools.

7.1 Evaluation of MNM and high intensity monitoring

7.1.1 Balance

Table 8 checks balance on household characteristics and child health at baseline, across each of the treatment groups. Each row shows the mean for that variable for the following groups: 1) schools that received neither the MNM treatment nor the high intensity monitoring, 2) schools that only received the MNM treatment, 3) schools that only received the high intensity monitoring and 4) schools that received both MNM as well as high intensity monitoring. The final column provides the p-value of the F-test of all three differences. As shown in Table 8, the groups are well balanced on the child health outcomes of interest in Panel A, with a slight imbalance on a few of the 32 for which balance is checked. We cannot rule out that the significant differences in these cases exist merely by chance, but our preferred specifications include school or child fixed effects, effectively controlling for these possible differences across villages.

We also present a similar balance table on school characteristics that were measured during our baseline school survey. Our sample is well balanced on the variables measured. These results are shown in Table 9, and there are no significant differences on any school characteristics measured.

Table 8: Balance across treatments at baseline: household characteristics

	Control	Only MNM	Only High	Both	p-value of all 3 differences
Child health outcomes					
Hemoglobin	11.107	11.081	11.170	11.000	0.54
z - weight	-1.851	-1.930	-1.810	-1.957	0.49
z - height	-1.367	-1.355	-1.491	-1.420	0.86
MUAC	15.052	15.201	15.167	15.101	0.75
Household-level data					
Non scheduled caste/tribe	0.057	0.045	0.094	0.087	0.23
Owns phone	0.328	0.375	0.346	0.323	0.60
Has electricity	0.517	0.497	0.592	0.480	0.35
House is *pucca*	0.109	0.088	0.097	0.100	0.86
Is satisfied with school meals	0.895	0.868	0.868	0.901	0.53
Has heard of anemia	0.086	0.084	0.087	0.070	0.88
Child demographics					
Age	6.756	6.859	6.984	6.642	0.78
Female dummy	0.486	0.458	0.489	0.510	0.68
Not child of head of household	0.128	0.110	0.134	0.121	0.78
Number of times child had MDM in past week	4.760	4.773	4.820	4.811	0.99
Takes any supplements	0.003	0.003	0.020**	0.007	0.21
Has taken deworming pill in past year	0.126	0.112	0.103	0.119	0.85
Mother demographics					
Age	31.209	31.173	30.867	30.795	0.87
Is literate	0.387	0.357	0.378	0.411	0.86
Completed primary school	0.015	0.025	0.026	0.027	0.71
Completed middle School	0.019	0.014	0.019	0.027	0.81
Completed high School	0.004	0.007	0.008	0.008	0.90
More than high School	0.004	0.022*	0.008	0.015	0.24
Not housewife	0.305	0.355	0.352	0.462**	0.09
Has a job card	0.637	0.734*	0.683	0.663	0.25

	Control	Only MNM	Only High	Both	p-value of all 3 differences
Head of household demographics					
Age	38.990	37.845	38.921	37.950	0.34
Is literate	0.505	0.594*	0.520	0.542	0.26
Completed primary school	0.020	0.044*	0.040	0.047*	0.16
Completed middle school	0.031	0.047	0.050	0.050	0.52
Completed high school	0.014	0.016	0.020	0.020	0.88
More than high school	0.020	0.047*	0.030	0.040	0.33
Occupation in agriculture	0.470	0.478	0.431	0.367*	0.19
Has a job card	0.723	0.783	0.776	0.686	0.07

Notes: This table presents balance checks on household characteristics and child health at baseline, across each of the treatment groups for those who have endline data as well. Each row shows the mean for that variable for the following groups: (1) control group, (2) schools that only received the MNM treatment group, (3) schools that only received the high intensity monitoring group, and (4) the group that received both MNM as well as high intensity monitoring. Significance levels of the difference with the control group are indicated after each number. The final column provides the p-value of the F-test of all three differences.

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: Balance across treatments at baseline: school characteristics

	Control	Only MNM	Only High	Both	p-value of all 3 differences
School-level variables					
Distance to the block headquarters (km)	22.155	22.789	23.383	24.889	0.59
Primary enrollment	64.720	70.763	67.980	63.324	0.80
Secondary enrollment	24.760	24.263	30.313	27.432	0.64
Number of teachers	2.307	2.421	2.600	2.486	0.45
Number of female teachers	2.700	2.868	2.747	2.676	0.90
Number of rooms	3.986	4.444	3.854	3.778	0.47
Percent of schools have a kitchen	0.738	0.833	0.823 *	0.676	0.13
Percent of schools have at least one latrine	0.865	0.789	0.857	0.865	0.77
Percent of schools have sufficient water	0.671	0.667	0.739	0.622	0.43
Percent with parent group for MDM	0.401	0.444	0.466	0.343	0.51
Percent with MDM training	0.368	0.324	0.299	0.333	0.67
Percent receiving MDM rice on a regular schedule					

Notes: This table presents balance checks on school characteristics at baseline, across each of the treatment groups for those who have endline data. Each row shows the mean for that variable for the following groups: (i) control group, (ii) schools that only received the MNM treatment group, (iii) schools that only received the high intensity monitoring group, and (iv) the group that received both MNM as well as high intensity monitoring. The final column provides the p-value of the F-test of all three differences.

*Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

7.1.2 Take-up

Our first outcome of interest is take-up of the MNM mix by schools in the MNM treatment group. Denoting a measure of take-up in school *s* as y_s, the basic specification in our analysis is as follows:

$$y_s = \beta_0 + \beta_1 mnm_s + \beta_2 high_s + \delta controls_s + \nu_s \qquad (7.1.1)$$

In order to account for any differential impact that high intensity monitoring may have had on the MNM treatment, we also include a specification that includes an interaction term

$$y_s = \beta_0 + \beta_1 mnm_s + \beta_2 high_s + \beta_3 mnm_s * high_s + \delta controls_s + \nu_s \qquad (7.1.2)$$

where mnm_s is a dummy for the group that received the MNM fortification treatment, and $high_s$ is a dummy for the group that received the monitoring visits at a higher frequency than the other schools. All our regressions contain fixed effects for administrative block. Table-specific controls are indicated below. For outcomes that were measured at the child level, or whenever we make use of multiple observations within a school, errors have been clustered at the school level. For some specifications, we also control for whether the school received IFA tablets during the previous school year to see if familiarity with nutrition supplements matters for implementation.

We consider two types of take-up measures. First, we have data from our delivery of the MNM to each school, including the number of MNM deliveries made to the school, the amount of MNM delivered to the school in kilograms, and the amount of MNM used in kilograms. Second, we have measures of take-up from the midday meal monitoring visits, including whether the enumerator noticed a powdery addition to the meal, whether the cook reported having added the MNM to the meal and whether the enumerator was able to locate the MNM mix in the storeroom.

The estimates on take-up measured from our delivery records are reported in Table 10. We exclude schools not in the MNM treatment since they did not receive any of the mix. In addition to block fixed effects, these regressions control for the number of children enrolled in the school as of the start of the intervention. Schools assigned to the MNM treatment did take up the mix. The schools that were not monitored intensely received 2.9 deliveries of the mix during the study period (the constant term in Columns 1–2), received approximately 0.6 kg of the mix per child enrolled in the school and used almost all of it. The high intensity monitoring did not affect this take-up.

Table 11 further reports take-up as inferred during the MDM observation visits conducted by our enumerators. These measures allow us to compare take-up between the MNM treatment schools and the non-MNM treatment schools in addition to across high and low intensity MNM treatment schools. We find that being in the MNM treatment group significantly increases 1) the likelihood of our enumerator being able to detect it directly on inspection of the container in which the meal was cooked (Columns 1–3), 2) the likelihood that the cook reports that he/she added the mix (Columns 4–6), as well as 3) the likelihood that the mix was present in the room where food materials are stored (Columns 7–9). High intensity monitoring did not affect take-up of MNM.

Table 10: 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 year		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. The even columns also include a dummy for whether the school received IFA during the previous 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 11: Take-up of MNM, as seen in MDM observations

	Enumerator detected powdery addition in meal			Cook claims he/she added MNM mix			MNM present in store room		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: All Months									
MNM treatment	0.131***	0.131***	0.131***	0.715***	0.646***	0.715***	0.452***	0.412***	0.453***
	(0.023)	(0.037)	(0.023)	(0.035)	(0.064)	(0.035)	(0.033)	(0.054)	(0.032)
High Intensity	-0.007	-0.007	-0.007	0.066*	0.012	0.067*	0.051	0.017	0.058
	(0.022)	(0.012)	(0.023)	(0.040)	(0.023)	(0.040)	(0.041)	(0.020)	(0.041)
MNM treatment * High Intensity		-0.000			0.111			0.066	
		(0.046)			(0.075)			(0.068)	
Received IFA during previous year			0.000			-0.027			-0.114*
			(0.032)			(0.082)			(0.062)
N	554	554	554	536	536	536	532	532	532
R-squared	0.088	0.088	0.088	0.573	0.576	0.573	0.298	0.299	0.303
p-value of F-test (high & interaction)		0.847	.	.	0.238	.	.	0.446	.
Panel B: December to January - High Intensity Schools (2 visits each)									
MNM treatment	0.152***	0.152***	0.152***	0.667***	0.667***	0.668***	0.450***	0.450***	0.449***
	(0.047)	(0.047)	(0.047)	(0.067)	(0.067)	(0.067)	(0.061)	(0.061)	(0.060)
N	139	139	139	133	133	133	131	131	131
R-squared	0.106	0.106	0.107	0.522	0.522	0.523	0.319	0.319	0.348
Panel C: February to March - All Schools (2 visits each)									
MNM treatment	0.095***	0.123***	0.095***	0.751***	0.649***	0.752***	0.482***	0.437***	0.482***
	(0.028)	(0.045)	(0.028)	(0.045)	(0.068)	(0.045)	(0.043)	(0.059)	(0.043)
High Intensity	-0.023	0.006	-0.022	0.075*	-0.026	0.078*	0.058	0.010	0.061
	(0.026)	(0.008)	(0.027)	(0.045)	(0.025)	(0.044)	(0.046)	(0.011)	(0.046)
N	277	277	277	269	269	269	267	267	267
R-squared	0.075	0.080	0.076	0.624	0.635	0.625	0.319	0.322	0.321

	Enumerator detected powdery addition in meal			Cook claims he/she added MNM mix			MNM present in store room		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Panel D: April to May - All Schools (1 visit each)								
MNM treatment	0.181***	0.138**	0.179***	0.679***	0.629***	0.680***	0.401***	0.366***	0.403***
	(0.047)	(0.062)	(0.047)	(0.057)	(0.082)	(0.058)	(0.059)	(0.084)	(0.059)
High Intensity	0.032	-0.009	0.027	0.047	-0.004	0.049	0.028	-0.007	0.037
	(0.046)	(0.018)	(0.047)	(0.056)	(0.026)	(0.057)	(0.060)	(0.030)	(0.062)
N	138	138	138	134	134	134	134	134	134
R-squared	0.156	0.162	0.161	0.577	0.580	0.577	0.325	0.327	0.330

Notes: This table reports take up as inferred during the MDM observation visits conducted by our enumerators. The outcomes measured were (i) the likelihood of our enumerator being able to detect it directly on inspection of the container in which the meal was cooked (Columns 1-3), (ii) the likelihood that the cook self reports that he/she added the mix (Columns 4-6), as well as the (iii) likelihood that the mix was present in the room where food materials are stored (Columns 7-9). All columns include block fixed effects and a control for the school's total enrollment. 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 schoolyear.
*Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

In both Tables 10 and 11, we include a specification where we control for whether the school received the IFA tablets during the previous school year, in an attempt to control for any familiarity the school may have had with such nutrition programs. We find suggestive evidence indicating the opposite, if anything: perhaps crowd out of the MNM program due to previous receipt of the IFA tablets. The results in Table 11 suggest a reduction in the probability that the MNM is present in the store-room (significant at 10 percent). In Table 10, while none of the coefficients on previous receipt are statistically significant at conventional levels, the p-value on the negative impact of receiving IFA tablets during the previous year on the amount of MNM delivered is 0.113. Recall that additional MNM was delivered based on whether the school requested it and how much the school had in stock. We come back to possible spillovers between the two nutrition programs in Section 7.1.5.

7.1.3 Effects on micronutrients in school meals

We expected the MNM treatment to have an effect on one of the main outcomes of interest, nutritional quality of meals being served at schools. As described in previous sections, we measured micronutrients present in meals by collecting food samples at school during meal times and tested these samples at a laboratory for zinc and vitamin A. These measures could also be considered indicative of take-up, except for the fact that meals can contain vitamin A and zinc even if they do not contain the mix.

Table 12 presents the results of the effect of the MNM treatment on the micronutrients present in the meals. Both zinc and vitamin A levels increase significantly for schools in the MNM treatment, with increases of about 160–360 µg/100g for vitamin A and 15–17mg/kg for zinc. Given a median meal size of 120mg of the non-rice dish, these correspond to 30–100 percent of the recommended daily allowance for vitamin A and 23–40 percent of the recommended daily allowance for zinc. We see no detectable differential effects for those schools that were also monitored at a higher frequency or those that received IFA tablets during the previous school year.

Table 12: Treatment effects: micronutrient levels in MDM from lab tests of food samples

	February						April					
Panel B	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	-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	0	9.3	12.7	0	4.1	4	0	-32.3	-31.4	0	-2.1	-1.9
	0	-90.8	-91.7	0	-5.6	-5.6	0	-67.2	-66.5	0	-8.9	-8.9
Received IFA during previous year	0	0	67.1	0	0	-2.5	0	0	11	0	0	1.7
	0	0	-77.6	0	0	-5.8	0	0	-57.4	0	0	-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, zinc and vitamin A) present in school meals, as measured in the laboratory using samples collected by enumerators during February and April. 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.*

7.1.4 Effects on child health, cognitive ability, attendance and learning

The next set of results relates to the health outcomes of the children in our sample schools, our main outcome variable. Our measures of child health are (1) hemoglobin levels, as well as several anthropometric outcomes: (2) weight, (3) height, (4) weight for age z-score, (5) height for age z-score and (6) mid-upper arm circumference.

Tables 13 and 14 present results of the treatment effects on child health outcomes using simple difference and difference in differences (DD) models, respectively. All of the specifications include block and age dummies, and Columns 2 and 3 include a lagged dependent variable from baseline surveys 1 and 2, respectively. Column 4 includes the lagged dependent variables from both baseline surveys and allows for the inclusion of children included in the sample only at endline; this also includes dummies for missing observations. Recall that some children were included in the sample only at endline because they had not been enrolled in school during the Baseline 1 survey, two years prior to the intervention.

The results in both Tables 13 and 14 indicate that the MNM treatment had no effect on hemoglobin, height or mid-upper arm circumference; in fact the coefficients are negative in the simple difference results for hemoglobin, suggesting that this is not simply a matter of power. While Table 13 does suggest that there is a decline in weight and height due to MNM treatment, this finding is not robust to the difference in differences specification as seen in Table 14, which is the preferred specification. All of the results are also robust to including controls for (1) whether the school received IFA tablets in the previous year, (2) the fraction of children surveyed (out of three) that report receiving IFA tablets daily and (3) the fraction of children surveyed (out of three) that report having received IFA tablets on the previous day.

At the same time, both Tables 13 and 14 reveal robust, positive effects of high intensity monitoring on hemoglobin levels, although not on the other anthropometric outcomes. In the next section we discuss interactions between the three interventions that may help explain these findings.

Tables 15 and 16 replicate Tables 13 and 14 for outcomes measuring cognitive ability and proficiency in reading and mathematics. Neither intervention has statistically significant effects on these outcomes. This is not particularly surprising given the lack of an effect on child health for the MNM intervention. Table 17 demonstrates a lack of effect of either intervention on school attendance.

Table 13: Treatment effects on health outcomes: lagged dependent variable mode

Lagged dep var from survey	None	Baseline I	Baseline II	Both with dummies for missing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A: Dep var: hemogloblin (g/dl)				
MNM treatment	-0.042	-0.009	-0.081	-0.017	0.029	0.023	-0.024	0.026
	(0.057)	(0.067)	(0.100)	(0.057)	(0.072)	(0.073)	(0.078)	(0.072)
High intensity	0.170***	0.224***	0.156	0.177***	0.223***	0.211***	0.198**	0.225***
	(0.058)	(0.067)	(0.105)	(0.058)	(0.079)	(0.080)	(0.080)	(0.079)
MNM treatment * High intensity					-0.092	-0.087	-0.037	-0.091
					(0.114)	(0.114)	(0.119)	(0.113)
N	1921	1108	349	1921	1921	1921	1769	1921
R-squared	0.024	0.169	0.173	0.127	0.128	0.129	0.128	0.128
				Panel B: Dep var: weight (kilos)				
MNM treatment	-0.210	0.100	-0.024	-0.162	-0.108	-0.091	-0.151	-0.125
	(0.222)	(0.144)	(0.167)	(0.129)	(0.184)	(0.182)	(0.194)	(0.186)
High Intensity	-0.119	-0.101	0.105	-0.017	0.037	0.070	0.028	0.048
	(0.224)	(0.139)	(0.169)	(0.129)	(0.195)	(0.193)	(0.200)	(0.194)
MNM treatment * High intensity					-0.110	-0.126	-0.115	-0.104
					(0.261)	(0.258)	(0.272)	(0.261)
N	1947	1114	355	1947	1947	1947	1795	1947
R-squared	0.480	0.743	0.891	0.719	0.719	0.720	0.718	0.719
				Panel C: Dep var: height (cm)				
MNM treatment	-0.396	-0.480	-0.589	-0.635*	-0.763	-0.685	-0.849	-0.843*
	(0.462)	(0.464)	(0.745)	(0.369)	(0.500)	(0.479)	(0.520)	(0.493)
High intensity	0.211	-0.097	0.049	0.361	0.231	0.382	0.208	0.278
	(0.466)	(0.452)	(0.738)	(0.377)	(0.551)	(0.534)	(0.561)	(0.543)
MNM treatment * High intensity					0.258	0.179	0.217	0.282
					(0.746)	(0.729)	(0.768)	(0.745)
N	1943	1119	354	1943	1943	1943	1791	1943
R-squared	0.474	0.474	0.692	0.581	0.581	0.583	0.573	0.582

Lagged dep var from survey	None	Baseline I	Baseline II	Both with dummies for missing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel D: mid-upper-arm circumference (cm)								
MNM treatment	-0.128	-0.120	-0.154*	-0.160**	-0.143	-0.139	-0.204*	-0.155
	(0.090)	(0.094)	(0.083)	(0.072)	(0.102)	(0.101)	(0.109)	(0.102)
High intensity	-0.021	-0.071	0.025	-0.061	-0.043	-0.035	-0.078	-0.036
	(0.091)	(0.103)	(0.085)	(0.074)	(0.110)	(0.111)	(0.115)	(0.109)
MNM treatment * High intensity					-0.034	-0.038	0.042	-0.030
					(0.143)	(0.142)	(0.152)	(0.142)
N	1947	1118	355	1947	1947	1947	1795	1947
R-squared	0.316	0.394	0.782	0.483	0.484	0.484	0.482	0.484
Panel E: Weight-for-age (z score)								
MNM treatment	-0.117*	0.028	-0.084	-0.068	0.035	0.038	0.042	0.045
	(0.067)	(0.063)	(0.111)	(0.053)	(0.074)	(0.073)	(0.077)	(0.076)
High intensity	-0.043	-0.113	-0.028	-0.049	0.055	0.061	0.032	0.046
	(0.068)	(0.070)	(0.111)	(0.053)	(0.072)	(0.071)	(0.073)	(0.072)
MNM treatment * High intensity					-0.204**	-0.206**	-0.196*	-0.205**
					(0.103)	(0.102)	(0.106)	(0.103)
N	1161	475	188	1161	1161	1161	1066	1161
R-squared	0.033	0.493	0.481	0.302	0.305	0.305	0.314	0.305
Panel F: Height-for-age (z score)								
MNM treatment	-0.069	-0.045	-0.107	-0.098	-0.115	-0.103	-0.141	-0.124
	(0.078)	(0.086)	(0.149)	(0.067)	(0.092)	(0.089)	(0.096)	(0.092)
High intensity	0.047	-0.053	0.059	0.075	0.058	0.082	0.040	0.064
	(0.078)	(0.084)	(0.151)	(0.067)	(0.100)	(0.099)	(0.102)	(0.100)
MNM treatment * High intensity					0.034	0.021	0.042	0.037
					(0.134)	(0.131)	(0.139)	(0.134)
N	1873	1064	342	1873	1873	1873	1723	1873
R-squared	0.047	0.231	0.198	0.172	0.172	0.175	0.172	0.172

Notes: The dependent variable in each specification is child's hemoglobin in g/dl (panel A), child's weight measured in kg (panel B), child's height in cm (Panel C), mid-upper arm circumference in cm (Panel D), child's z-score for weight for age (Panel E), and child's z-score for height for age (Panel F). All columns include block and age fixed effects, in addition to the lagged dependent variable as described in the headers. Columns 6–9 include measures of IFA receipt during the previous year (a dummy for receiving the IFA tablets in Column 6, the percent of students who say they get IFA tablets regularly in Column 7 and the percent of students who say they got IFA tablets yesterday in Column 8).
Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

Table 14: Treatment effects on health outcomes: difference in difference estimates

				Block fixed effects interacted with midline & endline						
Additional controls								Measures of IFA receipt during previous year interacted with midline and endline		
Fixed effects		School	Child		School	Child	School	School		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Dep var: hemoglobin (g/dl)										
Endline * MNM treatment	0.041	0.020	0.010	0.061	0.040	0.033	0.014	0.036	0.031	0.027
	(0.089)	(0.090)	(0.138)	(0.081)	(0.083)	(0.125)	(0.104)	(0.082)	(0.087)	(0.085)
Endline * High Intensity	0.198**	0.208**	0.223	0.204**	0.215**	0.228*	0.188*	0.196**	0.243***	0.225***
	(0.089)	(0.090)	(0.137)	(0.081)	(0.084)	(0.125)	(0.113)	(0.083)	(0.087)	(0.085)
Endline * High Intensity * MNM treatment							0.052			
							(0.166)			
N	3489	3489	3489	3489	3489	3489	3489	3489	3192	3489
R-squared	0.024	0.099	0.732	0.040	0.109	0.740	0.109	0.110	0.108	0.109
p-value of F-test (high & interaction)		.	.	.	.	.	0.040	.	.	.
Panel B: Dep var: weight (kilos)										
Endline * MNM treatment	0.055	0.043	-0.034	0.042	0.031	-0.040	-0.110	0.037	-0.020	0.020
	(0.181)	(0.190)	(0.214)	(0.175)	(0.180)	(0.211)	(0.244)	(0.180)	(0.187)	(0.188)
Endline * High Intensity	0.010	-0.047	-0.109	-0.048	-0.115	-0.153	-0.258	-0.082	-0.198	-0.100
	(0.179)	(0.188)	(0.215)	(0.173)	(0.181)	(0.208)	(0.274)	(0.189)	(0.192)	(0.183)
Endline * High Intensity * MNM treatment							0.283			
							(0.357)			
N	3511	3511	3511	3511	3511	3511	3511	3511	3215	3511
R-squared	0.504	0.565	0.945	0.508	0.567	0.945	0.568	0.568	0.572	0.568

				Block fixed effects interacted with midline & endline						
Additional controls								Measures of IFA receipt during previous year interacted with midline and endline		
Fixed effects		School	Child		School	Child	School	School		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel C: height (cm)										
Endline * MNM treatment	-0.468	-0.409	-0.795	-0.469	-0.404	-0.798	-0.619	-0.386	-0.462	-0.497
	(0.522)	(0.548)	(0.733)	(0.514)	(0.537)	(0.750)	(0.625)	(0.532)	(0.555)	(0.526)
Endline * High Intensity	1.049**	0.808	0.198	1.044**	0.782	0.225	0.564	0.891	0.557	0.865
	(0.529)	(0.557)	(0.717)	(0.526)	(0.556)	(0.691)	(0.847)	(0.560)	(0.581)	(0.554)
Endline * High Intensity * MNM treatment							0.432			
							(1.069)			
N	3511	3511	3511	3511	3511	3511	3511	3511	3215	3511
R-squared	0.460	0.512	0.894	0.466	0.514	0.895	0.514	0.514	0.511	0.514
Panel D: mid-upper-arm circumference (cm)										
Endline * MNM treatment	-0.131	-0.131	-0.171	-0.140	-0.141	-0.175	-0.216	-0.140	-0.183*	-0.154*
	(0.090)	(0.094)	(0.135)	(0.089)	(0.091)	(0.134)	(0.148)	(0.091)	(0.098)	(0.090)
Endline * High Intensity	-0.065	-0.048	-0.082	-0.079	-0.069	-0.086	-0.144	-0.060	-0.053	-0.057
	(0.092)	(0.095)	(0.137)	(0.094)	(0.098)	(0.145)	(0.124)	(0.100)	(0.108)	(0.096)
Endline * High intensity * MNM treatment							0.149			
							(0.186)			
N	3515	3515	3515	3515	3515	3515	3515	3515	3219	3515
R-squared	0.315	0.388	0.865	0.323	0.392	0.866	0.392	0.392	0.388	0.392
Panel E: Weight-for-age (z score)										
Endline * MNM treatment	-0.009	-0.009	0.008	-0.007	-0.005	0.009	0.083	-0.004	0.007	0.006
	(0.075)	(0.078)	(0.078)	(0.075)	(0.077)	(0.069)	(0.111)	(0.077)	(0.081)	(0.080)
Endline * High intensity	-0.008	-0.007	-0.061	-0.023	-0.021	-0.077	0.069	-0.015	-0.043	-0.030
	(0.075)	(0.079)	(0.079)	(0.075)	(0.079)	(0.068)	(0.108)	(0.080)	(0.085)	(0.078)

				Block fixed effects interacted with midline & endline						
Additional controls								Measures of IFA receipt during previous year interacted with midline and endline		
Fixed effects		School	Child		School	Child	School	School		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Endline * High intensity * MNM treatment							-0.177			
							(0.155)			
N	2471	2471	2471	2471	2471	2471	2471	2471	2255	2471
R-squared	0.015	0.141	0.959	0.021	0.147	0.960	0.148	0.147	0.156	0.148
				Panel F: Height-for-age (z score)						
Endline * MNM treatment	-0.060	-0.054	-0.142	-0.061	-0.053	-0.141	-0.050	-0.050	-0.057	-0.069
	(0.092)	(0.097)	(0.128)	(0.091)	(0.095)	(0.132)	(0.110)	(0.095)	(0.099)	(0.093)
Endline * High intensity	0.213**	0.168*	0.048	0.213**	0.165*	0.058	0.168	0.181*	0.130	0.181*
	(0.093)	(0.098)	(0.123)	(0.093)	(0.098)	(0.119)	(0.149)	(0.099)	(0.104)	(0.098)
Endline * High intensity * MNM treatment							-0.006			
							(0.190)			
N	3432	3432	3432	3432	3432	3432	3432	3432	3138	3432
R-squared	0.032	0.126	0.807	0.044	0.130	0.807	0.130	0.130	0.133	0.130

Notes: The dependent variable in each specification is child's hemoglobin in g/dl (panel A), child's weight measured in kg (panel B), child's height in cm (Panel C), mid-upper arm circumference in cm (Panel D), child's z-score for weight for age (Panel E), and child's z-score for height for age (Panel F). All columns include age fixed effects, in addition to the controls and fixed effects indicated in the headers. Columns 9–11 include measures of IFA receipt during the previous year (a dummy for receiving the IFA tablets in Column 9, the percent of students who say they get IFA tablets regularly in Column 10 and the percent of students who say they got IFA tablets yesterday in Column 11).
Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

Table 15: Treatment effects on other outcomes: lagged dependent variable model

Lagged dep var from survey	None	Baseline I	Baseline I with dummy for missing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Panel A: Dep var: Normalized Digit Span score				
MNM treatment	-0.083	0.003	-0.056	-0.053	-0.044	-0.115	-0.055
	(0.071)	(0.060)	(0.059)	(0.077)	(0.075)	(0.073)	(0.078)
High Intensity	-0.026	0.060	0.005	0.008	0.024	-0.009	0.009
	(0.070)	(0.059)	(0.058)	(0.077)	(0.076)	(0.078)	(0.078)
MNM treatment * High Intensity				-0.007	-0.018	0.062	-0.006
				(0.115)	(0.113)	(0.113)	(0.115)
N	1637	1064	1637	1637	1637	1530	1637
R-squared	0.112	0.371	0.268	0.268	0.270	0.263	0.268
			Panel B: Dep var: Normalized Block Tap score				
MNM treatment	-0.068	0.010	-0.047	-0.020	-0.011	-0.045	-0.044
	(0.057)	(0.056)	(0.053)	(0.078)	(0.077)	(0.073)	(0.076)
High Intensity	-0.062	0.006	-0.059	-0.031	-0.016	-0.029	-0.016
	(0.060)	(0.057)	(0.056)	(0.079)	(0.079)	(0.076)	(0.076)
MNM treatment * High Intensity				-0.054	-0.065	-0.015	-0.047
				(0.107)	(0.106)	(0.103)	(0.105)
N	1637	1064	1637	1637	1637	1530	1637
R-squared	0.093	0.236	0.179	0.180	0.182	0.188	0.183
			Panel C: Normalized Language test score				
MNM treatment	-0.036	-0.039	-0.011	0.052	0.066	0.019	0.055
	(0.077)	(0.083)	(0.072)	(0.089)	(0.090)	(0.087)	(0.089)
High Intensity	-0.017	-0.028	-0.001	0.063	0.083	0.055	0.060
	(0.077)	(0.081)	(0.071)	(0.097)	(0.098)	(0.101)	(0.100)
MNM treatment * High Intensity				-0.127	-0.145	-0.078	-0.127
				(0.140)	(0.139)	(0.138)	(0.140)

Lagged dep var from survey	None	Baseline I	Baseline I with dummy for missing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
N	1218	580	1218	1218	1218	1141	1218
R-squared	0.084	0.312	0.163	0.164	0.167	0.171	0.164
			Panel D: Normalized Mathematics test score				
MNM treatment	-0.044	0.026	-0.028	0.006	0.015	-0.030	0.002
	(0.069)	(0.068)	(0.062)	(0.082)	(0.081)	(0.084)	(0.082)
High Intensity	-0.045	0.006	-0.033	0.002	0.016	-0.006	0.007
	(0.069)	(0.068)	(0.063)	(0.082)	(0.082)	(0.085)	(0.085)
MNM treatment * High Intensity				-0.070	-0.082	-0.023	-0.070
				(0.125)	(0.123)	(0.125)	(0.125)
N	1293	709	1293	1293	1293	1213	1293
R-squared	0.109	0.332	0.187	0.188	0.190	0.187	0.188

Notes: The dependent variable in each specification is normalized digit span score (panel A), normalized block tap score (panel B), normalized language test score (Panel C), and normalized mathematics test score (Panel D). All columns include block and class fixed effects, in addition to the lagged dependent variable as described in the headers. Columns 5–7 include measures of IFA receipt during the previous year (a dummy for receiving the IFA tablets in Column 5, the percent of students who say they get meds regularly in Column 6 and the percent of students who say they got meds yesterday in Column 7).

Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

Table 16: Treatment effects on other outcomes: difference in difference estimates

				Block fixed effects interacted with endline							
Additional controls									Measures of IFA receipt during previous year interacted with midline and endline		
Fixed effects		School	Child		School	Child	School	Child	School		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A: Dep var: Normalized Digit Span score											
Endline * MNM treatment	0.018	0.009	0.044	-0.006	-0.019	0.037	-0.092	-0.061	-0.017	-0.034	-0.019
	(0.067)	(0.071)	(0.107)	(0.068)	(0.068)	(0.109)	(0.097)	(0.152)	(0.067)	(0.068)	(0.070)
Endline * High Intensity	0.055	0.045	0.086	0.078	0.062	0.098	-0.012	0.000	0.070	0.046	0.062
	(0.067)	(0.070)	(0.106)	(0.071)	(0.072)	(0.116)	(0.109)	(0.162)	(0.070)	(0.074)	(0.073)
Endline * High Intensity * MNM treatment							0.146	0.197			
							(0.135)	(0.213)			
N	2779	2779	2779	2779	2779	2779	2779	2779	2779	2592	2779
R-squared	0.061	0.254	0.842	0.143	0.289	0.862	0.290	0.863	0.290	0.285	0.289
Panel B: Dep var: Normalized Block Tap score											
Endline * MNM treatment	0.044	0.035	0.065	0.016	0.003	0.041	-0.033	-0.076	0.006	0.014	0.001
	(0.080)	(0.082)	(0.129)	(0.078)	(0.079)	(0.129)	(0.108)	(0.172)	(0.079)	(0.081)	(0.080)
Endline * High Intensity	-0.044	-0.069	-0.000	-0.064	-0.100	-0.054	-0.135	-0.171	-0.085	-0.102	-0.098
	(0.080)	(0.082)	(0.127)	(0.075)	(0.075)	(0.127)	(0.109)	(0.191)	(0.075)	(0.074)	(0.078)
Endline * High Intensity * MNM treatment							0.071	0.236			
							(0.163)	(0.261)			
N	2779	2779	2779	2779	2779	2779	2779	2779	2779	2592	2779
R-squared	0.061	0.185	0.791	0.132	0.230	0.815	0.230	0.816	0.230	0.229	0.230
Panel C: Normalized Language test score											
Endline * MNM treatment	0.122	0.049	0.047	0.139	0.035	0.033	0.031	0.083	0.039	0.063	0.033
	(0.114)	(0.113)	(0.205)	(0.108)	(0.108)	(0.202)	(0.149)	(0.298)	(0.109)	(0.111)	(0.105)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Additional controls				Block fixed effects interacted with endline					Measures of IFA receipt during previous year interacted with midline and endline		
Fixed effects		School	Child		School	Child	School	Child	School		
Endline * High Intensity	0.000	-0.002	-0.016	0.051	0.032	0.018	0.028	0.074	0.039	-0.002	0.033
	(0.113)	(0.112)	(0.204)	(0.109)	(0.108)	(0.201)	(0.174)	(0.305)	(0.108)	(0.108)	(0.112)
Endline * High Intensity * MNM treatment							0.007	-0.109			
							(0.226)	(0.412)			
N	1869	1869	1869	1869	1869	1869	1869	1869	1869	1744	1869
R-squared	0.052	0.312	0.849	0.102	0.318	0.853	0.318	0.853	0.319	0.320	0.318
					Panel D: Normalized Mathematics test score						
Endline * MNM treatment	0.029	0.012	0.088	0.023	-0.011	0.070	-0.048	0.075	-0.008	0.011	-0.023
	(0.110)	(0.110)	(0.184)	(0.098)	(0.101)	(0.163)	(0.140)	(0.236)	(0.100)	(0.103)	(0.096)
Endline * High Intensity	-0.028	-0.044	-0.016	0.032	0.014	0.054	-0.024	0.059	0.023	-0.013	0.029
	(0.110)	(0.110)	(0.184)	(0.097)	(0.100)	(0.164)	(0.150)	(0.236)	(0.100)	(0.104)	(0.105)
Endline * High Intensity * MNM treatment							0.077	-0.010			
							(0.201)	(0.320)			
N	2050	2050	2050	2050	2050	2050	2050	2050	2050	1910	2050
R-squared	0.051	0.290	0.820	0.121	0.306	0.835	0.306	0.835	0.306	0.303	0.306

*Notes: Notes: The dependent variable in each specification is normalized digit span score (panel A), normalized block tap score (panel B), normalized language test score (Panel C), and normalized mathematics test score (Panel D). All columns include class fixed effects, in addition to the controls and fixed effects indicated in the headers. Columns 9-11 include measures of IFA receipt during the previous year (a dummy for receiving the IFA tablets in Column 9, the percent of students who say they get IFA tablets regularly in Column 10 and the percent of students who say they got IFA tablets yesterday in Column 11). Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

Table 17: Treatment effects on attendance: school level

	Fraction Attending			Total Attendance		
	(1)	(2)	(3)	(4)	(5)	(6)
MNM treatment	-0.024	-0.014	-0.016	-3.061*	-2.067	-2.127
	(0.025)	(0.034)	(0.034)	(1.824)	(2.883)	(2.892)
High Intensity	-0.005	0.006	0.001	-1.606	-0.615	-0.746
	(0.024)	(0.037)	(0.037)	(1.683)	(2.692)	(2.743)
MNM treatment * High Intensity		-0.021	-0.018		-1.979	-1.908
		(0.049)	(0.048)		(3.648)	(3.666)
Total enrollment	0.001*	0.001*	0.000*	0.759***	0.759***	0.758***
	(0.000)	(0.000)	(0.000)	(0.057)	(0.057)	(0.057)
Attendance measured before lunch	-0.022	-0.022	-0.021	-2.156	-2.152	-2.127
	(0.017)	(0.017)	(0.017)	(1.311)	(1.311)	(1.320)
Received IFA during previous year			0.045			1.169
			(0.047)			(3.045)
N	392	392	392	392	392	392
R-squared	0.133	0.134	0.137	0.841	0.841	0.841

Notes: This table shows treatment effects on school attendance, as measured by fraction of total enrollment (Cols 1-3) and total attendance (Cols 4-6).
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.

7.1.5 Interactions between MNM, high intensity monitoring and IFA program

In interpreting the results described above, it is important to consider how the three interventions—MNM provision, high intensity monitoring and the IFA program—may have overlapped. It is easy to imagine complementary effects if high intensity monitoring gives headmasters additional incentives to implement the MNM distribution or the IFA program more consistently. At the same time, the MNM treatment was a new program introduced in the treatment schools, on top of the existing midday meals program as well as the IFA program. Since the adding on of one additional program at the school level increases the workload of the school staff, it is plausible that this might lead to negative effects on how well other programs are implemented at school.

We first consider the positive effects of the high intensity monitoring in this light. There are a few explanations. First, it could be that these schools implemented the MNM fortification better. Our results on take-up discussed above suggest this is not the case. High intensity schools were not more likely to take-up the intervention or have more nutritious meals. The results in Tables 13 and 14 indicate no difference in the effect of high intensity schools that also received the MNM mix and those that did not.

A second explanation is that the high intensity monitoring may have led schools to implement the IFA program better. Table 18 shows treatment effects on measures of how well the IFA program was implemented. We focus on four measures of IFA implementation quality: (1) whether the headmaster shows the enumerator an IFA tablet, (2) the number of tablets distributed per child in the past week (as seen in the school report), (3) the percent of students who say they get the tablets weekly or more frequently (out of three randomly chosen students spanning different grades) and (4) whether at least 2 out of 3 students asked say they get the tablets at least weekly. High intensity monitoring has a positive effect on the implementation of the IFA program. Students in these schools are more likely to report getting the IFA tablets regularly. Interestingly, these results are driven only by student-reported outcomes, which would be more difficult for the principal to manipulate (since the children were randomly chosen each month). In addition, these results are driven by responses later in the year: at the first IFA visit during the intervention (usually in December 2014), many schools in the high intensity treatment arm had yet to receive a meal monitoring visit. There is little difference between the schools randomly assigned to receive more monitoring in the future. By February 2015, however, the effects start to show up: 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.

At the same time, schools receiving the MNM treatment seem to do worse on these IFA implementation outcomes. Students are less likely to report having received the IFA tablets regularly and the headmaster is less likely to be able to produce the IFA tablets to show the enumerator. Thus, these results suggest that there is some crowding out of IFA by the introduction of the MNM mix. As discussed above, there is some suggestive evidence of crowd out in the other direction in Tables 10 and 11: receiving IFA tablets during the previous year may reduce take-up of the MNM, although the coefficients tend to be significant only at 10% or 15%.

Table 18: Spillover effects on IFA programs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	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)			At least 2 out of 3 students asked say they get meds weekly or more frequently		
	Panel A: All Months (4 visits each)											
MNM treatment	-0.023	-0.047*	-0.024	0.052	0.039	0.053	-0.059*	-0.070	-0.060*	-0.067*	-0.088*	-0.067*
	(0.022)	(0.028)	(0.022)	(0.051)	(0.071)	(0.051)	(0.032)	(0.046)	(0.032)	(0.036)	(0.053)	(0.036)
High Intensity	-0.012	-0.036	-0.016	0.045	0.031	0.048	0.085***	0.074*	0.081**	0.085**	0.063	0.080**
	(0.022)	(0.029)	(0.022)	(0.052)	(0.071)	(0.052)	(0.032)	(0.040)	(0.032)	(0.037)	(0.045)	(0.036)
MNM treatment * High Intensity		0.049			0.027			0.022			0.044	
		(0.043)			(0.098)			(0.065)			(0.073)	
Received IFA during previous year			0.062			-0.053			0.052			0.073
			(0.047)			(0.091)			(0.060)			(0.076)
N	557	557	557	555	555	555	538	538	538	538	538	538
R-squared	0.113	0.115	0.118	0.088	0.089	0.089	0.112	0.112	0.113	0.094	0.095	0.096
p-value of F-test (high & interaction)		0.428	.	.	0.678	.	.	0.034	.	.	0.071	.
	Panel B: December-January (1 visit per school)											
MNM treatment	-0.017	-0.032	-0.018	0.103	0.232	0.106	-0.024	-0.037	-0.024	-0.016	-0.028	-0.015
	(0.024)	(0.044)	(0.024)	(0.127)	(0.184)	(0.128)	(0.077)	(0.108)	(0.076)	(0.082)	(0.113)	(0.081)
High Intensity	0.039*	0.024	0.033*	-0.069	0.063	-0.048	0.038	0.024	0.023	0.041	0.028	0.023
	(0.022)	(0.024)	(0.020)	(0.140)	(0.180)	(0.134)	(0.079)	(0.111)	(0.078)	(0.084)	(0.119)	(0.083)
MNM treatment * High Intensity		0.032			-0.268			0.027			0.026	
		(0.042)			(0.242)			(0.156)			(0.165)	
Received IFA during previous year			0.080			-0.255			0.208**			0.242**
			(0.073)			(0.260)			(0.101)			(0.117)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	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)			At least 2 out of 3 students asked say they get meds weekly or more frequently		
N	145	145	145	145	145	145	134	134	134	134	134	134
R-squared	0.062	0.065	0.089	0.098	0.104	0.106	0.146	0.146	0.163	0.135	0.135	0.155
Panel C: February - May (3 visits per school)												
MNM treatment	-0.026	-0.052	-0.026	0.036	-0.025	0.036	-0.072**	-0.076	-0.071**	-0.085**	-0.105*	-0.085**
	(0.030)	(0.038)	(0.029)	(0.049)	(0.064)	(0.049)	(0.036)	(0.054)	(0.036)	(0.041)	(0.062)	(0.041)
High Intensity	-0.032	-0.058	-0.035	0.083*	0.020	0.083*	0.090**	0.085*	0.092**	0.089**	0.069	0.090**
	(0.029)	(0.040)	(0.029)	(0.048)	(0.067)	(0.049)	(0.036)	(0.045)	(0.036)	(0.041)	(0.049)	(0.040)
MNM treatment * High Intensity		0.052			0.124			0.010			0.041	
		(0.058)			(0.094)			(0.071)			(0.082)	
Received IFA during previous year			0.057			0.009			-0.024			-0.006
			(0.063)			(0.086)			(0.064)			(0.080)
N	412	412	412	410	410	410	404	404	404	404	404	404
R-squared	0.132	0.134	0.135	0.159	0.163	0.159	0.064	0.064	0.064	0.059	0.059	0.059

Notes: This table shows treatment effects on measures of how well the IFA program was implemented. We focus on four measures of IFA implementation quality: (i) whether HM shows enumerator IFA tablet, (ii) the number of tablets distributed per child in the past week (as seen in the school report), (iii) the percent of students who say they get the tablets weekly or more frequently (out of three that were asked), and (iv) whether at least 2 out of 3 students asked say they get the tablets at least weekly. All columns include block fixed effects and survey round fixed effects. While not always shown in the table, columns 2, 5, 8, 11, and 14always include the interaction term between the two treatments and columns 3, 6, 9, and 12 always include a control for whether the school received the IFA tablets during the previous schoolyear.

*Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

Finally, we explore whether high intensity monitoring or the MNM introduction in schools affected the quality of the school meals. We consider several measures of meal quality based on variables measured in our MDM monitoring surveys. These include: (1) whether a meal was served, (2) whether vegetables had been added to the meal, (3) whether any children received second helpings of rice and of the non-rice dish (egg curry, or dalma or soybean curry), and (4) the number of adults served. Table 19 reports these results. While there are significant impacts on whether a meal was served or vegetables were added, we refrain from concluding too much from these variables given the lack of variation; in 100 percent of visits to control group schools a meal was served and vegetables were added. While we see some effects on the number of adults who are served, we see no corresponding impact on the amount of food children receive.

Table 19: Treatment effects on the quality of midday meals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Was a meal served?			Were vegetables added to the meal?			Any children received 2nd helpings of ...						Number of adults served		
							Rice			Curry					
Panel A: All Months (5 visits each for High Intensity Schools, 3 visits each for Low Intensity Schools)															
MNM treatment	-0.021*	-0.036**	-0.021*	0.011	-0.009	0.011	0.016	0.021	0.016	0.008	0.006	0.008	0.141*	0.077	0.140*
	(0.012)	(0.017)	(0.011)	(0.008)	(0.009)	(0.008)	(0.045)	(0.065)	(0.045)	(0.035)	(0.054)	(0.035)	(0.083)	(0.163)	(0.082)
High Intensity	-0.012	-0.024**	-0.013	-0.016	-0.033**	-0.016	0.003	0.007	0.005	0.021	0.019	0.020	-0.215**	-0.267*	-0.223**
	(0.014)	(0.012)	(0.014)	(0.011)	(0.015)	(0.011)	(0.047)	(0.063)	(0.049)	(0.037)	(0.049)	(0.037)	(0.100)	(0.148)	(0.100)
MNM treatment * High Intensity		0.024			0.032**			-0.008			0.004			0.103	
		(0.023)			(0.014)			(0.090)			(0.070)			(0.186)	
Received IFA during previous year			0.026			0.000			-0.023			0.021			0.127
			(0.030)			(0.017)			(0.090)			(0.055)			(0.169)
N	581	581	581	568	568	568	565	565	565	561	561	561	567	567	567
R-squared	0.030	0.031	0.032	0.027	0.034	0.027	0.075	0.075	0.076	0.073	0.073	0.073	0.051	0.051	0.052
p-value of F-test (high & interaction)		0.123	.	.	0.065	.	.	0.993	.	.	0.849	.	.	0.100	.
Dep. var mean, control group	1.000	1.000	1.000	1.000	1.000	1.000	0.219	0.219	0.219	0.155	0.155	0.155	0.472	0.472	0.472
Panel B: Dec-Jan (only High Intensity Schools, 2 visits each)															
MNM treatment	0.025	0.025	0.025	.	.	.	-0.002	-0.002	-0.004	0.025	0.025	0.028	0.357*	0.357*	0.360*
	(0.017)	(0.017)	(0.017)	.	.	.	(0.084)	(0.084)	(0.083)	(0.072)	(0.072)	(0.070)	(0.185)	(0.185)	(0.186)
N	145	145	145	.	.	.	141	141	141	139	139	139	143	143	143
R-squared	0.072	0.072	0.073	.	.	.	0.121	0.121	0.124	0.103	0.103	0.115	0.099	0.099	0.102

Panel C: Feb-May (All Schools, 3 visits each)

MNM treatment	-0.036***	-0.035**	-0.036***	0.014	-0.010	0.014	0.022	0.024	0.022	0.001	0.006	0.002	0.064	0.068	0.064
	(0.013)	(0.017)	(0.013)	(0.010)	(0.009)	(0.010)	(0.045)	(0.064)	(0.045)	(0.035)	(0.053)	(0.035)	(0.096)	(0.160)	(0.096)
High Intensity	-0.013	-0.012	-0.016	-0.017	-0.041**	-0.017	0.003	0.005	0.003	0.023	0.028	0.024	-0.199**	-0.196	-0.203**
	(0.014)	(0.010)	(0.014)	(0.011)	(0.019)	(0.012)	(0.047)	(0.064)	(0.048)	(0.036)	(0.050)	(0.036)	(0.099)	(0.150)	(0.099)
N	436	436	436	425	425	425	424	424	424	422	422	422	424	424	424
R-squared	0.039	0.039	0.046	0.030	0.042	0.030	0.049	0.049	0.049	0.047	0.047	0.047	0.067	0.067	0.067

Notes: This table presents treatment effects of the MNM introduction in schools and increased monitoring affected multiple measures of quality of the school meals. We consider several measures of meal quality based on variables measured in our MDM monitoring surveys. These include: (i) whether a a meal served, (ii) whether vegetables had been added to the meal, (iii) whether any children received 2nd helpings of rice, and of the non-rice dish (egg curry, or dalma, or soybean curry), (iii) the number of children served, and (iv) the number of adults served. All columns include block fixed effects, survey month fixed effects and a control for the school's total enrollment. While not always shown in the table, columns 2,5, 8, 11, 14, and 17 always include the interaction term between the two treatments and columns 3, 6, 9, 12, 15, and 18 always include a control for whether the school received the IFA tablets during the previous schoolyear.

*Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

7.2 Evaluating the government's IFA program

We present our analysis of the government's IFA program in this subsection. We argue that the program's implementation in our study schools was quasi-random and start by detailing our empirical strategy below.

7.2.1 Empirical strategy

The core of our strategy to identify the impact of the IFA program is a difference in difference model, comparing the change in hemoglobin levels for children who experienced the program relative to students who did not, or children who experienced a more intense implementation compared to children with a weaker implementation. This specification takes the form:

$$\mathrm{Hb}_{ist} = \beta_0 + \beta_1 \mathrm{IFA}_s + \beta_2 \mathrm{post}_t + \beta_3 (\mathrm{IFA}_s \,\mathrm{x}\, \mathrm{post}_t) + \varepsilon_{ist} \qquad (7.2.1)$$

where Hb_{ist} is the hemoglobin level of child *i* in school *s* at time *t*, IFA_s is a marker of IFA implementation, and post_t is an indicator for whether hemoglobin measurement was taken after IFA implementation. Additional control variables include the distance from a school to block headquarters, whether or not a school has a kitchen, the percent of parents satisfied with implementation of the school lunch program, the percent of families per school employed in housework outside the home and the percent of families per school in a non-disadvantaged caste. In the preferred specification with school fixed effects, these control variables are interacted with the post indicator. Additional specifications include an indicator for whether or not a school received deworming medication from the government, an interaction of that indicator with post and an interaction to capture the joint effect of IFA receipt and deworming receipt. In order to infer that β_3 is the causal effect of the IFA, we assume that the health indicators of students in both IFA and non-IFA schools would have been on the same trend in the absence of the program. Understanding the pattern of distribution of IFA tablets to schools will support the validity of this assumption if distribution is not related to any observable characteristic that would suggest differential trends in child health.

Next, we estimate heterogeneous effects by comparing the difference in β_3 when Equation 7.2.1 is estimated separately for students at different points in the distribution of hemoglobin levels at baseline. The results of this estimation further support the validity of the identifying assumptions, since any differential trends across schools correlated with IFA implementation would also have to differ by baseline hemoglobin level to bias the results.

Recall that our main source of data on IFA implementation in the first year was a school-level survey conducted in April–May 2014. Our preferred measure of IFA receipt is simply whether or not the school received the tablets from their block-level officials. As described above there is substantial variation in coverage in some administrative blocks, measured by IFA tablet receipt, deworming tablet receipt and the number of tablets received per school.

7.2.2 Quasi-random variation in the IFA program's implementation

Understanding the implementation patterns of the IFA in its first year is key to helping ensure that future waves of the IFA provide iron and folic acid tablets to every child in every school. In addition, variation in IFA implementation across schools allows for the analysis of the effect of the program using a difference in differences strategy, comparing the changes in hemoglobin levels for students who experienced the program and those who did not. As noted above, using this variation would be problematic if it was correlated with differential trends in child outcomes irrespective of the IFA implementation. The main concern is that implementation is correlated either directly with trends in anemia prevalence or with trends in some other predictor that also affects hemoglobin levels. In this subsection, we describe the variation in IFA implementation and provide a number of checks to support the assumption of parallel trends.

To understand where this variation may be coming from, it is important to note that there are many potential avenues for leakage within the delivery system: in order for the program to have any chance of improving the iron status of children, the iron and folic acid supplements need to be transported from the state headquarters to each individual child. Recall the complicated distribution process of tablets from the central government to students described in detail above. Given that only 70 percent of study schools in the three more remote blocks received tablets from their block officials, there are either leakages within the first three stages of the chain of distribution (from the state to district, district to block and block to schools) or an insufficient supply of tablets at the top.

It seems natural to expect that variation in implementation across schools is correlated with trends in household demographic characteristics and levels of corruption, both of which might have an independent effect on child health (and, thereby, biasing our strategy). While we do not have data to study trends prior to the beginning of the intervention, we can look at differences at baseline. We first show that, indeed, the variation in IFA implementation across blocks does match patterns of household demographics and school resource allocation implied by high levels of inefficiency. However, we also show that the pattern of distribution within block in the three blocks with high variation in IFA implementation is not correlated with potential confounders; it appears to be quasi-random, driven perhaps by when tablets were received at the block level and when the block officials ran out of tablets.

Table 20 shows that the two blocks with over 95 percent IFA implementation are different from the three blocks with more variation in IFA implementation on a range of measures. More than half of the observable characteristics (measured at the school-level) differ, statistically, between the two types of blocks.[8] High implementation blocks are more advantaged across a range of demographic variables, have parents that are more involved in implementation of the school lunch program and are more likely to receive rice for that meal on a regular schedule from the government (although this last difference is not statistically significant). These differences suggest that, at some point in the tablet distribution schedule between the state and the block, the less remote/more advantaged blocks systematically received more tablets. At the same time, these blocks also have slightly higher anemia rates among children.

However, the main concern for the strategy described above is whether or not schools within the high-variation blocks received IFA tablets systematically or quasi-randomly. Within these three blocks, there are two possible explanations for why some schools

[8] Table 20 tests 37 observable demographics; 21 are significantly different at the 5% level and 4 more at the 10% level.

report receiving tablets and others do not that could be particularly worrisome. First, this variation could be non-randomly influenced by the block officials, if any unobservable characteristics are correlated with whether the block official gave the school the right number of tablets. For example, block officials could choose to focus on certain types of schools. Second, this variation could be non-randomly influenced by the schools, if unobservable characteristics are correlated with (a) how schools implement the IFA program or (b) how schools respond to the IFA survey. Our preferred measure of IFA implementation (whether or not the school received the tablets from the block official) helps minimize omitted variable bias from (a) since receipt of tablets does not rely on a school's ability to implement a program, but school characteristics may still be correlated with how schools respond to the question about IFA receipt on the IFA survey. However, further analysis supports none of these sources of bias (block- or school-induced).[9]

[9] There are several ways in which the block officials could decide to distribute tablets non-randomly. The official could choose to first visit schools closer to the block headquarters, or schools that are closer to each other. More rural schools would then be systematically less likely to receive tablets. The official could also target schools that he thinks need the tablets most or schools that have more advantaged children, both of which would be based on his evaluation of the demographics of each village. Finally, the official could also choose to distribute tablets to schools with which he has a better relationship, or which he thinks will be most effective in implementing the program. Since the block official also distributes the supplies for the MDM program, he could choose to distribute the tablets first to schools that he views as 'good implementers' (based on their implementation of the MDM program), which he therefore thinks will use the tablets most effectively. This could lead to bias if being a 'good implementer' is correlated with the probability of reporting getting IFA tablets.

Table 20: Comparison of high-variation and low-variation blocks

		High IFA variation	Low IFA variation	P-Value
	Panel A: Demographic Characteristics	**Blocks 1-3**	**Blocks 4-5**	
School-reported (SCH)	Distance to the block headquarters (km)	21.31	24.17	**0.0218**
	Primary enrollment	75.21	60.15	**0.0004**
	Secondary enrollment	30.09	24.99	0.2082
	Number of teachers	2.53	2.40	0.4332
	% of schools have a kitchen	0.73	0.81	**0.0984**
	% of schools have at least one latrine	0.85	0.86	0.8817
	% of schools have sufficient water	0.74	0.66	**0.0770**
Household-reported, aggregated to school level (HH)	Mean % of students are female	0.50	0.51	0.5813
	Mean % of families in a non-disadvantaged caste	0.04	0.10	**0.0000**
	Mean % of village adults in agricultural work	0.19	0.20	0.5387
	Mean % of village adults work in own home	0.25	0.23	**0.0325**
	Mean % of village adults work in others' homes	0.26	0.18	**0.0000**
	Mean % of village adults work as laborers	0.16	0.27	**0.0000**
	Mean % of village adults with no formal schooling	0.57	0.46	**0.0000**
	Mean % of village adults who own a phone	0.31	0.39	**0.0000**
	Mean % of families that live in high-quality housing	0.09	0.13	**0.0096**
	Mean % of families with electricity	0.52	0.55	0.2621
	Panel B: Implementer Variables			
SCH	% with parent group for MDM	0.12	0.63	**0.0000**
	% with MDM training	0.58	0.15	**0.0000**
	% receiving MDM rice on a regular schedule	0.38	0.46	0.1458
HH	Mean number of MDM per week	4.76	4.64	**0.0839**
	Mean % of parents satisfied with MDM	0.90	0.87	**0.0025**
	Panel C: Anthropometric Measures at Baseline			
Child-level measures aggregated to school level and averaged	Mean % of students with anemia	0.57	0.63	**0.0002**
	Mean % with mild anemia	0.23	0.24	0.4324
	Mean % with moderate anemia	0.33	0.38	**0.0007**
	Mean % with severe anemia	0.01	0.01	0.5127
	Mean child Hb level	11.20	11.04	**0.0003**
	Mean student BMI	13.68	13.55	**0.0909**
	Mean student weight	18.30	18.11	0.2002
	Mean BMI, girls	13.54	13.41	0.1900
	Mean BMI, boys	13.81	13.67	**0.0447**
	Panel D: IFA Implementation Variables			
SCH	% of schools received IFA	0.71	0.97	**0.0000**
	Mean number of IFA tablets received per student (conditional)	49.92	82.10	**0.0000**
	Mean % of 3 kids saying they receive tablets daily	0.44	0.75	**0.0000**
	Mean % of 3 kids saying they received tablets the previous day	0.18	0.33	**0.0007**
	% received deworming medication	0.66	0.88	**0.0000**
	Mean number of deworming doses per student (conditional)	2.42	2.34	0.7478
	Number of schools	157	220	

Note: P-value tests the difference in the two means, unconditional on block. Bolded p-values are significant at the 10% level.

Finally, these systematic distribution patterns would only introduce bias if they were correlated with hemoglobin level trends in children. In addition to showing that there is little evidence to support these systematic distribution patterns, we also show that IFA receipt is not predicted by students' anemia status or hemoglobin levels and that observable characteristics of schools are not correlated with the percent of students that are anemic in each school.

To test these hypotheses for non-random tablet distribution (either block-induced or school-induced) we first check for differences between schools that received tablets and schools that did not and then examine the ability of these measures to predict IFA receipt. To test the hypotheses for block-induced non-random distribution, we use the school's distance to the block headquarters and a range of demographic measures about each school.[10] Finally, given data constraints it is impossible to fully untangle whether a block official targeted schools with a high ability to implement a government program or whether headmasters that are better implementers were better at reporting tablet receipt; we simply observe the ability of a school to implement a government program through their success at implementing the MDM. Similar to IFA distribution, supplies for the MDM are distributed by the block officials to each school. For each school, we observe the (parent-reported) mean number of lunches provided per week and the percent of parents who are satisfied with the implementation of the MDM. Further, we observe whether or not a school uses a self-help group to provide the MDM, whether or not anyone from the school attended government MDM training, and whether or not a school gets regular scheduled visits from the block officials to deliver the rice for the MDM. This final measure is the only one that contains information about block level decision-making; the rest simply measure the school's effectiveness at implementing the MDM.

As seen in Table 21, there is no significant difference in mean distance to the block headquarters among schools that got IFA tablets and those that did not within the three blocks with high variation in IFA implementation. Furthermore, over the range of observed demographics and measures of IFA implementation, there are few observable differences between schools that received IFA tablets and schools that did not. Out of all the observable demographic variables that the block officials likely knew, there are only three significant differences between these two types of schools: the percent of the population in a disadvantaged caste, the percent of villagers who report working in their own home not for pay and the percent of villagers who report working in others' homes for pay.

In addition, there are no significant differences between schools that received tablets and those that did not that correspond to a school's ability to implement the MDM, as measured by the markers described above. We conclude that block officials were not systematically targeting schools that they thought would most successfully implement the program, since schools that got tablets are not measurably better implementers.

[10] These measures include school-reported proxies for socioeconomic status, e.g. whether or not the school has a kitchen or sufficient water, and a range of household-reported proxies for socioeconomic status aggregated to the school level, e.g. the percent of families in agricultural work, the percent of families who own a phone or the percent of families living in high- or low-quality housing.

Table 21: Comparison of IFA, non-IFA schools in high-variation blocks

		Blocks with high IFA variation		
	Panel A: Demographic Characteristics	Got IFA	No IFA	P-Value
School-reported (SCH)	Distance to the block headquarters (km)	20.59	23.02	0.1355
	Primary enrollment	75.02	75.67	0.9330
	Secondary enrollment	29.73	30.96	0.8691
	Number of teachers	2.61	2.33	0.3328
	% of schools have a kitchen	0.77	0.64	0.1085
	% of schools have at least one latrine	0.86	0.83	0.5644
	% of schools have sufficient water	0.76	0.69	0.3584
Household-reported, aggregated to school level (HH)	Mean % of students are female	0.50	0.50	0.6869
	Mean % of families in a non-disadvantaged caste	0.03	0.06	**0.0320**
	Mean % of village adults in agricultural work	0.20	0.18	0.2398
	Mean % of village adults work in own home	0.27	0.22	**0.0112**
	Mean % of village adults work in others' homes	0.25	0.30	**0.0057**
	Mean % of village adults work as laborers	0.15	0.18	0.1367
	Mean % of village adults with no formal schooling	0.56	0.60	0.3012
	Mean % of village adults who own a phone	0.30	0.33	0.4004
	Mean % of families that live in high-quality housing	0.09	0.11	0.2287
	Mean % of families with electricity	0.52	0.51	0.7547
	Panel B: Implementer Variables			
SCH	% with parent group for MDM	0.10	0.16	0.3282
	% with MDM training	0.61	0.51	0.2771
	% receiving MDM rice on a regular schedule	0.36	0.43	0.3551
HH	Mean number of MDM per week	4.81	4.63	0.1019
	Mean % of parents satisfied with MDM	0.90	0.90	0.7568
	Panel C: Anthropometric Measures at Baseline			
Child-level measures aggregated to school level and averaged	Mean % of students with anemia	0.56	0.58	0.5765
	Mean % with mild anemia	0.23	0.23	0.8608
	Mean % with moderate anemia	0.32	0.35	0.3013
	Mean % with severe anemia	0.01	0.00	**0.0210**
	Mean child Hb level	11.21	11.19	0.7580
	Mean student BMI	13.65	13.74	0.6224
	Mean student weight	18.33	18.21	0.6273
	Mean BMI, girls	13.51	13.60	0.6679
	Mean BMI, boys	13.77	13.90	0.3175
	Number of schools	111	46	

Note: P-value tests the difference in the two means, unconditional on block. Bolded p-values are significant at the 10% level.

Furthermore, none of these variables overall are predictive of IFA receipt in a regression of IFA receipt on varying sets of demographic and school variables. Columns (1) and (2) of Table 22 regress IFA receipt on distance to the block headquarters and a host of observable demographic characteristics and MDM implementation variables (with and without block fixed effects). None of these observable characteristics significantly predict IFA receipt either across or within blocks in the three blocks with high variation in IFA implementation. However, this result may be caused by the smaller sample size due to missing data (n=124 schools). To account for this, the remaining columns consider subsets of the variables included in the first two columns. There are only two robustly significant predictors: the percent of villagers employed in housework outside the home and the percent of families in a non-disadvantaged caste. Given the number of variables tested, this is approximately the number we would expect to see significant by chance (at the 10 percent level). Overall, these regressions suggest that the block officials did not systematically target schools based on their observation of differences between schools or village populations.

If, however, the tablets were disproportionately given to more disadvantaged schools within these three blocks (as mildly suggested in Tables 21 and 22), the estimated effects of the IFA could be biased in either direction, depending on how the trend in hemoglobin levels would have differed for advantaged and disadvantaged children in the absence of the IFA. If advantaged children would have been on a faster trend (and were less likely to get tablets) than disadvantaged children, the results presented here are conservative estimates of the effect of the IFA. More of a concern, if advantaged children would have been on a slower trend (because they are less anemic) then these results overestimate the effect of the IFA. However, in this sample, anemia and poverty are not strongly correlated, which suggests non-differential trends. Furthermore, controlling for whether a student is advantaged or disadvantaged does slightly increase the point estimate of the effect of the IFA, suggesting that the first scenario is more likely.

Table 22: Predictors of IFA receipt in high-variation blocks

	Dependent Variable: Received IFA Indicator											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All observed characteristics		**Demographic characteristics**		**Demographic characteristics**		**Sig. Predictors from Cols 1-6**		**Cols 7-8 + Implementer Variables**		**Final control variables**	
Distance to the block hq (km)	-0.004	-0.002	-0.003	-0.003	-0.003	0.006	--	--	--	--	-0.000	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.011)	--	--	--	--	(0.004)	(0.004)
Mean % of pop in non-disadvantaged caste	-0.909*	-0.745	-1.074**	-0.907*	-1.352**	-1.086	-1.061**	-0.853*	-0.929*	-0.710	-0.887**	-0.778*
	(0.532)	(0.524)	(0.517)	(0.504)	(0.659)	(1.062)	(0.475)	(0.458)	(0.492)	(0.473)	(0.440)	(0.420)
% of students are female	-0.066	-0.149	-0.012	-0.094	-0.320	1.926	--	--	--	--	--	--
	(0.475)	(0.464)	(0.470)	(0.456)	(0.430)	(1.162)	--	--	--	--	--	--
Primary enrollment	-0.001	-0.001	-0.001	-0.001	-0.002	0.004	--	--	--	--	--	--
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	--	--	--	--	--	--
Secondary enrollment	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	--	--	--	--	--	--
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	--	--	--	--	--	--
Number of teachers	0.062	0.049	0.055	0.046	0.061	-0.027	--	--	--	--	--	--
	(0.048)	(0.048)	(0.047)	(0.047)	(0.060)	(0.085)	--	--	--	--	--	--
% has a kitchen	0.034	-0.033	0.052	-0.022	0.254*	-0.149	--	--	--	--	0.086	-0.074
	(0.109)	(0.109)	(0.107)	(0.106)	(0.137)	(0.177)	--	--	--	--	(0.093)	(0.096)
% has at least one latrine	0.163	0.083	0.167	0.096	0.345**	-0.105	0.138	0.058	0.142	0.049	--	--
	(0.127)	(0.127)	(0.125)	(0.124)	(0.154)	(0.218)	(0.115)	(0.113)	(0.116)	(0.114)	--	--
% has sufficient water	0.043	0.066	0.037	0.047	-0.060	0.164	--	--	--	--	--	--
	(0.103)	(0.100)	(0.100)	(0.097)	(0.099)	(0.188)	--	--	--	--	--	--
Mean % of village adults in agricultural work	-1.415	-0.949	-1.532*	-1.198	-1.312*	-0.852	-0.919	-1.064	-0.820	-0.899	--	--
	(0.888)	(0.877)	(0.863)	(0.840)	(0.719)	(3.020)	(0.703)	(0.678)	(0.720)	(0.689)	--	--
Mean % of village adults work in own home	-0.318	-0.070	-0.435	-0.032	0.542	1.470	--	--	--	--	--	--
	(0.727)	(0.726)	(0.710)	(0.711)	(0.625)		--	--	--	--	--	--
Mean % of village adults work in others' homes	-0.982	-0.689	-1.133*	-0.715	-0.418	0.008	-0.822**	-0.735**	-0.840**	-0.731**	-0.843**	-0.551*
	(0.646)	(0.638)	(0.627)	(0.624)	(0.552)	(2.272)	(0.361)	(0.347)	(0.364)	(0.350)	(0.337)	(0.329)
Mean % of village adults work as laborers	-1.385*	-0.738	-1.570**	-0.910	-1.540**	0.530	-1.050*	-0.755	-0.972	-0.572	--	--
	(0.785)	(0.795)	(0.760)	(0.765)	(0.679)	(2.568)	(0.582)	(0.569)	(0.606)	(0.593)	--	--
% of villagers with no formal schooling	-0.385	0.026	-0.381	0.037	-0.034	-1.286	-0.561	-0.096	-0.529	-0.145	--	--

	(0.468)	(0.498)	(0.450)	(0.477)	(0.421)	(1.003)	(0.412)	(0.437)	(0.433)	(0.445)	--	--
% of villagers who own a phone	-0.357	-0.430	-0.475	-0.504	0.222	-1.910**	-0.448	-0.463	-0.413	-0.420	--	--
	(0.366)	(0.359)	(0.357)	(0.347)	(0.319)	(0.812)	(0.340)	(0.326)	(0.342)	(0.328)	--	--
% of villagers who live in high-quality housing	-0.903	-0.534	-0.896	-0.532	-0.715	-1.695	--	--	--	--	--	--
	(0.623)	(0.620)	(0.614)	(0.606)	(0.612)	(1.315)	--	--	--	--	--	--
% of villagers who live in low-quality housing	-0.196	-0.169	-0.253	-0.173	0.503	-2.168**	0.196	0.181	0.204	0.202	--	--
	(0.430)	(0.424)	(0.425)	(0.415)	(0.389)	(1.055)	(0.303)	(0.298)	(0.304)	(0.298)	--	--
% of villagers with electricity	0.086	0.099	0.050	0.081	0.100	-0.160	--	--	--	--	--	--
	(0.159)	(0.155)	(0.156)	(0.151)	(0.168)	(0.279)	--	--	--	--	--	--
Mean number of MDM per week	0.040	0.030	--	--	--	--	--	--	0.052	0.032	--	--
	(0.067)	(0.066)	--	--	--	--	--	--	(0.063)	(0.061)	--	--
Mean % of parents satisfied with MDM	0.290	0.598	--	--	--	--	--	--	0.298	0.602	0.444	0.856*
	(0.508)	(0.507)	--	--	--	--	--	--	(0.476)	(0.461)	(0.456)	(0.441)
% with parent group for MDM	-0.170	-0.061	--	--	--	--	--	--	--	--	--	--
	(0.130)	(0.134)	--	--	--	--	--	--	--	--	--	--
% with MDM training	0.095	0.047	--	--	--	--	--	--	--	--	--	--
	(0.092)	(0.090)	--	--	--	--	--	--	--	--	--	--
% receiving MDM rice on a regular schedule	-0.056	0.037	--	--	--	--	--	--	--	--	--	--
	(0.094)	(0.099)										
Constant	1.518	0.467	2.173***	1.294	0.660	2.334	1.531***	1.025**	0.943	0.263	0.531	-0.047
	(1.002)	(1.042)	(0.817)	(0.839)	(0.740)	(2.567)	(0.469)	(0.485)	(0.722)	(0.713)	(0.460)	(0.455)
Blocks	No Block F.E.	Block F.E.	No Block F.E.	Block F.E.	Block 2	Blocks 1 and 3	No Block F.E.	Block F.E.	No Block F.E.	Block F.E.	No Block F.E.	Block F.E.
N	124	124	124	124	76	48	124	124	124	124	124	124
R-squared	0.212	0.273	0.183	0.252	0.392	0.397	0.145	0.231	0.155	0.246	0.096	0.213

Note: Standard errors in parentheses. The dependent variable is the indicator for receiving IFA tablets in every column. Columns 1 and 2 include every observable characteristic of each school; the remaining columns restrict to particular subsets of observable characteristics. Columns 3 and 4 only include demographic characteristics (at both the school and household level, see Table 1,3, or 4 for a description of which are reported by the household and aggregated to the school level and which are reported by the school). Columns 5 and 6 repeat the analysis for demographic characteristics but separate schools by block (blocks 1 and 3 are combined due to the small number of schools in each block). Columns 7 and 8 restrict the independent variables to those that are significant in any of the previous columns. Columns 9 and 10 repeat columns 7 and 8 but add indicators of implementing ability of each school. Finally, Columns 11 and 12 include the final control variables used in the main analysis of the paper. These include a proxy for each of the three possible ways in which BEOs could have distributed tablets systematically (for full discussion of these decision-making processes see Section 4B) as well as the two robustly significant variables in the previous columns. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

The preferred differences-in-differences result is reported in Table 23 with and without a set of control variables that proxy for the different decision-making processes that could influence block officials. These control variables include: distance to the block headquarters, percent of parents satisfied with the school lunch program (i.e. implementing ability), percent of families in a non-disadvantaged caste and percent of families engaged in housework (village demographic indicators of socio-economic status), and whether or not a school has a kitchen (a school demographic indicator of socio-economic status).

Table 23: Overall effect of the IFA

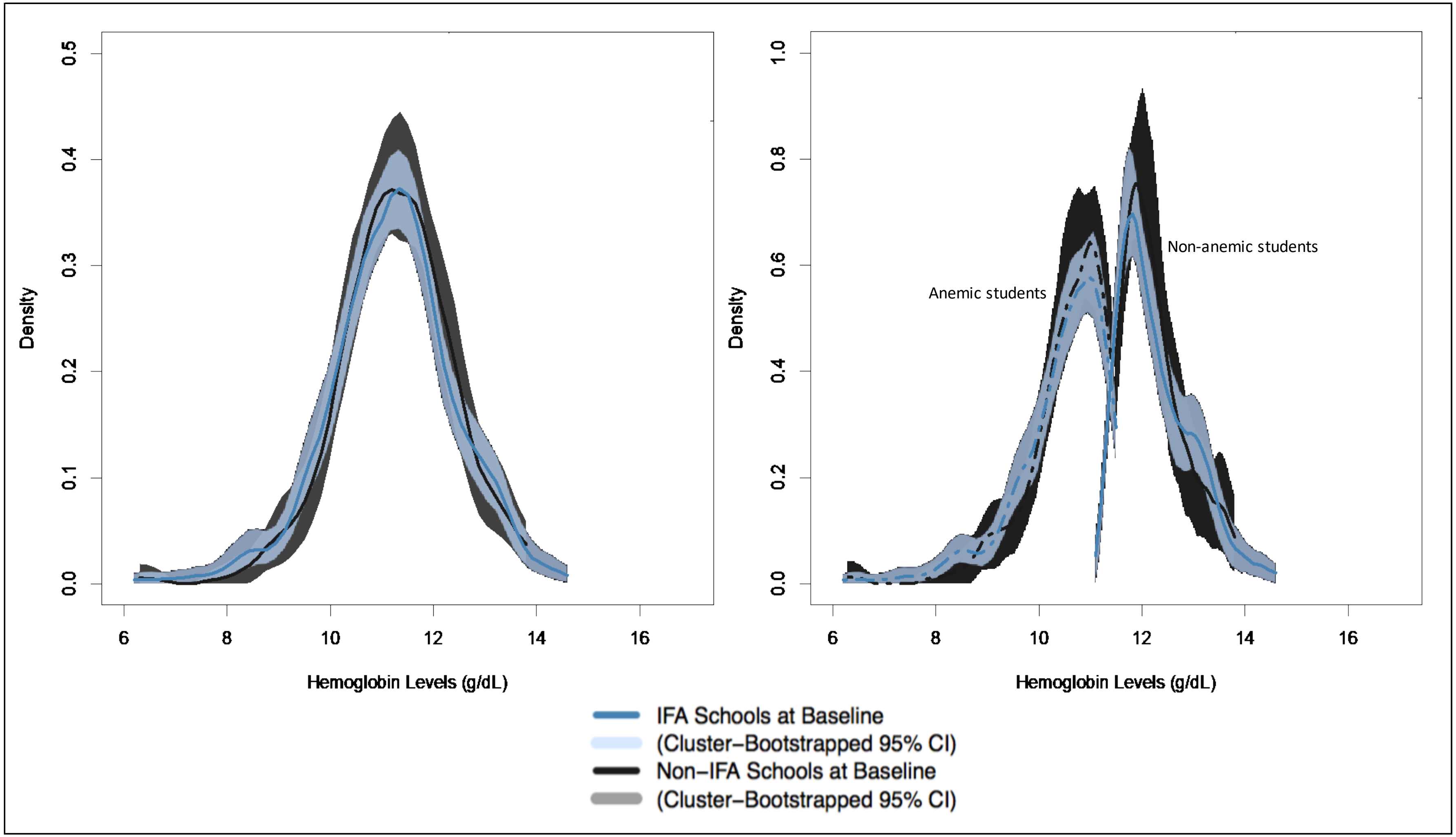
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Children's hemoglobin levels					
IFA*Post	-0.047	0.053	0.199	0.280	0.283	0.307
	(0.141)	(0.165)	(0.150)	(0.178)	(0.202)	(0.202)
Deworming*Post	--	--	-0.345**	-0.329**	-0.210	-0.286
	--	--	(0.140)	(0.152)	(0.254)	(0.315)
IFA*Deworming*Post	--	--	--	--	-0.205	-0.066
	--	--	--	--	(0.304)	(0.354)
N	1459	1413	1459	1413	1459	1413
School fixed effects?	No	Yes	No	Yes	No	Yes
Added controls?	No	Yes	No	Yes	No	Yes

Note: The dependent variable is child's hemoglobin level measured in g/dL. IFA is a dummy variable that is one if a school reported receiving IFA tablets and zero otherwise. All regressions include an indicator for whether hemoglobin measurement was taken after IFA implementation and the other relevant main effects of each interaction term. "Added controls" include the following variables interacted with "post": distance to block headquarters, whether or not a school has a kitchen, the percent of parents satisfied with MDM implementation, the percent of families employed in housework outside the home, and the percent of families in a non-disadvantaged caste. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

Finally, and perhaps most importantly, there is no evidence that schools receiving tablets had students that were disproportionately more or less anemic. Overall within the three blocks with high variation in implementation rates, as well as within each block, there is no statistical difference in the prevalence of anemia, mild anemia or moderate anemia between schools that received the IFA tablets from the government and schools that did not (Table 21, Panel C). Additionally, there is no difference in the mean hemoglobin level or in standard nutritional markers like weight and height. Figure 4 plots the kernel densities of students' hemoglobin levels in schools that did and did not get IFA tablets and shows that the distribution of hemoglobin levels at baseline among study children is quite similar in both types of schools, for both anemic and non-anemic children.

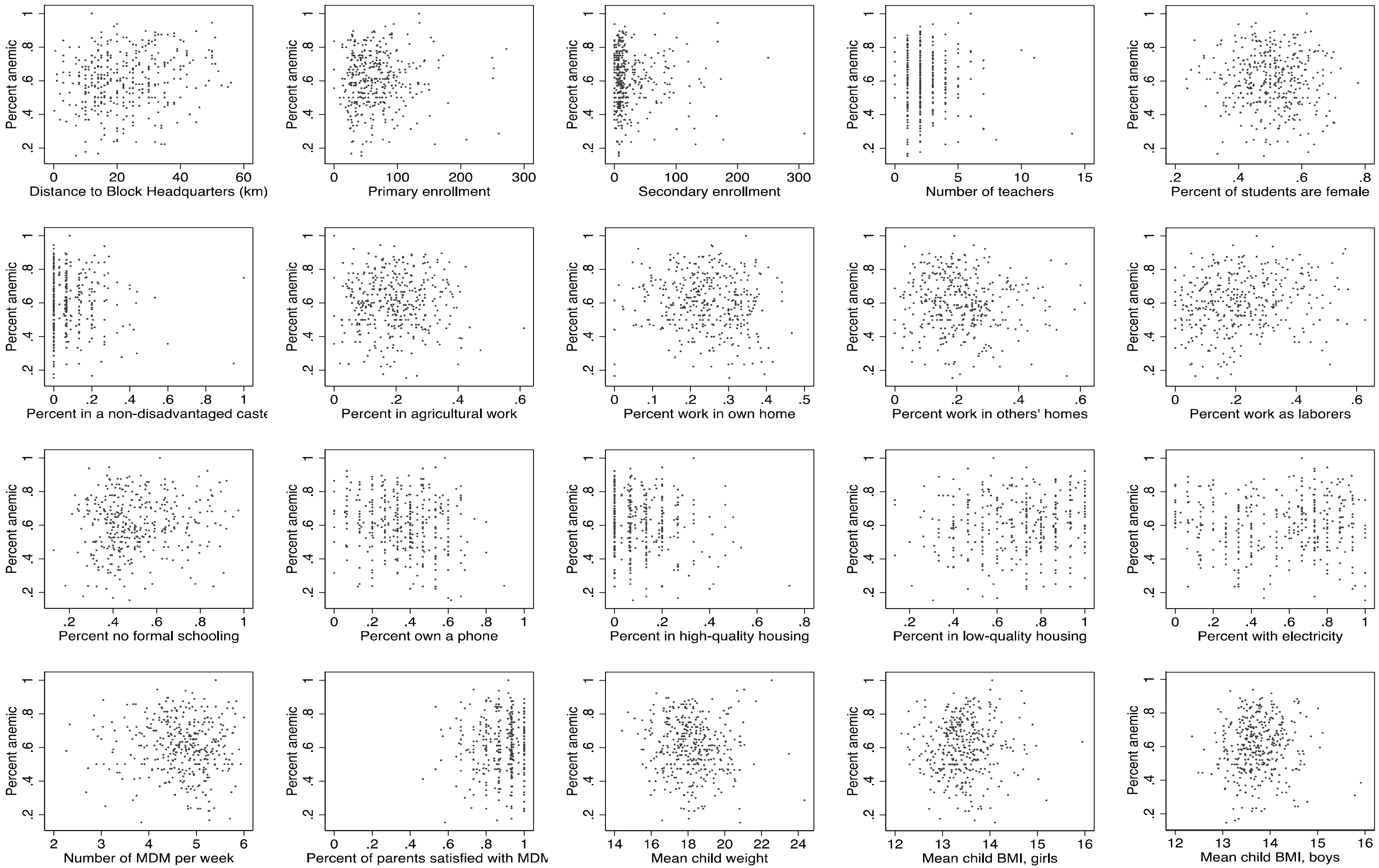
Additionally, there are several reasons, founded in the data, to think that the block officials in each of the blocks without enough tablets for everyone distributed tablets quasi-randomly and not systematically. Note that tablets were more likely to go to schools with a higher population of students in a disadvantaged caste (Tables 21 and 22), which would imply the block officials may have been attempting to target needier students. However, anemia rates in each village are not correlated with any observable demographic characteristic (Figure 4): a block official could not target students who needed the iron supplements more, even if he wanted to. This is consistent with the literature that shows that in contexts with such widespread anemia and poverty, it is difficult to identify those most in need of iron supplementation without actually measuring iron deficiency (WHO 2015). Further, in this sample, only 11 percent of parents know what the health condition called ‘anemia’ is (after implementation of the IFA). This suggests that even fewer adults are aware of the use of iron supplements to treat the micronutrient deficiency, and thus that there is no market for iron supplements, even if an official wanted to sell them. Overall, this suggests that the block official would distribute all of the provided tablets to schools and that he would do so in a way unrelated to underlying trends in children’s hemoglobin levels.

Figure 4: Distribution of child hemoglobin levels at baseline in IFA and non-IFA schools



Note: Kernel density plots of child hemoglobin levels at baseline with cluster-bootstrapped 95 percent confidence intervals. Each plot compares the distribution of hemoglobin levels in IFA and non-IFA schools

Figure 5: Observable demographic characteristics at school level are uncorrelated with anemia prevalence.



Note: Each graph plots the percent of students per school who are anemic versus some observable demographic characteristic. Anemia prevalence is not correlated with any observable school characteristics.

In addition, school headmasters reported whether or not they had already run out of tablets (ran out, did not run out, or uncertain) at the time of the school uptake survey. In the sample of schools in blocks with high variation in IFA implementation that did receive tablets (111 schools), 39 schools report running out of tablets, 25 report still having tablets to distribute and the remaining 47 are uncertain. Schools that report having already run out of tablets at the time of the school survey appear very similar to schools that do not run out on the same range of characteristics described above, suggesting that both the timing of tablet distribution and the number of tablets provided per student are also likely not systematically determined by the block officials and, rather, were largely determined by chance.[11] These facts together with the descriptive analysis above, support the quasi-random distribution of tablets within each block.

Conditional on school receipt of IFA tablets, there is reason to believe that the IFA has the potential to have a positive effect on student hemoglobin levels: surveys of randomly selected students confirm that students were receiving tablets in schools and swallowing the tablets upon receipt. In the summer of 2014 (after the second year of the IFA had commenced), 76 percent of students surveyed reported receiving tablets in schools. Conditional on tablet receipt from the school, over 99 percent of students reported swallowing the tablet. While this high compliance rate (relative to compliance rates reported in programmatic evaluations) may have been influenced by interviewer scrutiny, it may also stem from student experience participating in the MDM and the fact that students often took their supplements with the school meal.

7.2.3 Impact of IFA program

Table 23 presents results from specification (7.2.1), the DD analysis estimating the effectiveness of the IFA in raising student hemoglobin levels. The dependent variable is a child's hemoglobin level and the key independent variable is an indicator for whether or not the school reported receiving IFA tablets from the government.[12] For this and all subsequent tables, the even-numbered columns include school fixed effects and the additional control variables interacted with the "post" indicator, as described in Section 7.2.2; Columns 3–6 additionally control for the receipt of deworming medication from the government. The point estimates indicate that attending a school that reported receiving IFA tablets increases children's hemoglobin levels by 0.280–0.307 g/dL, once we control for receipt of deworming medication, fixed effects and the list of control variables described above. While not statistically significant at conventional levels, the p-values are suggestively close (0.118 and 0.130) for these two estimates. This effect is of the expected magnitude for combined anemic and non-anemic students in a real-world iron supplementation program.[13] Unexpectedly, there is a negative and significant effect of

[11] Two key differences are that schools that ran out of tablets for primary school children have much larger average secondary school enrollment (and perhaps they redistributed tablets designated for primary students to secondary students) and are also much less likely to receive their rice for the school lunch program on a regular schedule (indicating less frequent contact with the block officials). See Appendix Table A1 for the full range of statistics.
[12] Results are qualitatively similar when the independent variable is measure of the number of tablets received per student. This measure is noisy due to inconsistent reporting on the part of schools and therefore not our preferred measure.
[13] In the study most similar to this one in both supplementation program and empirical design, Luo et al. (2012) find the overall effect of school-based iron supplementation to be 0.23 g/dL for 4th graders in rural China.

attending a school that received deworming medication. This effect is no longer significant when estimated separately for schools that did or did not get IFA tablets (Columns 5 and 6).[14] Finally, the simultaneous receipt of both deworming medication and IFA tablets may reduce the effect of the iron supplementation tablets, but the relevant coefficient is not statistically significantly different from zero.[15]

Next, we show heterogeneous effects of the IFA with respect to initial anemia status that are consistent with a causal interpretation of the DD specification. This supports the identification strategy because if the DD results were driven by differential trends instead of the IFA, we would have no reason to expect the results to be bigger for anemic students than non-anemic students. We divide the sample by baseline anemia status: non-anemic students (hemoglobin concentration over 12.5 g/dL at baseline), borderline anemic students (hemoglobin concentration between 11.5 and 12.5 g/dL at baseline), mildly anemic students (hemoglobin concentration between 11 and 11.5 g/dL at baseline) and moderately anemic students (hemoglobin concentration between 8 and 11 g/dL at baseline).[16] Note that "mild" anemia is a misnomer in that the negative effects of iron deficiency are already substantial by the time any level of anemia is diagnosed (WHO 2011). Similarly, borderline-anemic students are likely to be suffering from many of the negative effects of iron deficiency as well. The majority of the children in this sample are mildly or moderately anemic. Informed by previous highly-monitored trials of iron supplementation, we expect the effect of the IFA to be largest for more anemic students and smallest for the non-anemic students (Gera et al. 2007).

Table 24 presents the results from this heterogeneous effects model and illustrates that this expectation largely holds, providing additional support for the identification strategy. Focusing on the estimates that include school fixed effects, the IFA has an insignificant effect on the students with the highest baseline hemoglobin levels that fluctuates in sign between models. The effect is larger and positive across all specifications for non-anemic borderline-anemic students (0.09–0.37 g/dL with controls) but still insignificant. The largest and only statistically significant effect of the IFA occurs for mildly anemic students: the IFA causes a significant increase in hemoglobin levels of 0.49–0.84 g/dL with the inclusion of school fixed effects and control variables including deworming receipt. This effect is about twice as large as the overall effect for all students reported in

[14] The negative effect of attending a school that received deworming medication could be a consequence of selection as well. As seen in Appendix Table A2, any differences in schools that got deworming medication indicate that those schools were more advantaged, even with these three blocks, and potentially on different trends.

[15] Appendix Table A3 presents results for this DD analysis with height and weight as the outcome variables. Existing literature shows no effect of iron supplementation on height and mixed, inconclusive effects on weight (Low et al. 2013; Vucic et al. 2013). Table A3 shows that the IFA had no effect on height and a small but significant effect on weight. In this context, iron supplementation could increase weight by reducing lethargy and increasing school attendance, thereby increasing weight if students receive more nutritional school lunches. Unfortunately, we do not have data on children's attendance in the first year. There is also the possibility that the IFA program affected implementation of the MDM delivery, potentially causing the gain in weight. Unfortunately, we do not have data on MDM implementation during the first year of the IFA program.

[16] These hemoglobin cutoffs are as defined by WHO standards at sea level and apply to the majority of the sample (5–11 year olds). Students outside this age range are classified by alternate age-appropriate cutoffs.

Table 23 and is large enough to shift these children from being classified as mildly anemic to only borderline anemic.

Table 24: Heterogeneous effect of the IFA by anemia level at baseline

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Children's hemoglobin levels					
Panel A: Non-Anemic and Non-Borderline Anemic Students (Hb>=12.5 g/dL at baseline)						
IFA*Post	-0.387	-0.101	-0.118	0.141	0.214	0.192
	(0.257)	(0.284)	(0.284)	(0.368)	(0.362)	(0.379)
Deworming*Post	--	--	-0.356	-0.318	0.106	-0.221
	--	--	(0.284)	(0.347)	(0.435)	(0.788)
IFA*Deworming*Post	--	--	--	--	-0.743	-0.147
	--	--	--	--	(0.558)	(0.934)
N	196	186	196	186	196	186
Panel B: Non-Anemic Borderline-Anemic Students (11.5 <= Hb < 12.5 g/dL at baseline)						
IFA*Post	0.034	0.114	0.090	0.187	0.353	0.375
	(0.176)	(0.182)	(0.188)	(0.210)	(0.305)	(0.303)
Deworming*Post	--	--	-0.087	-0.115	0.214	0.117
	--	--	(0.190)	(0.193)	(0.250)	(0.280)
IFA*Deworming*Post	--	--	--	--	-0.518^	-0.389
	--	--	--	--	(0.358)	(0.379)
N	420	410	420	410	420	410
Panel C: Mildly Anemic Students (11 <= Hb < 11.5 g/dL at baseline)						
IFA*Post	0.028	0.307*	0.243	0.499**	0.496*	0.842***
	(0.173)	(0.177)	(0.225)	(0.231)	(0.299)	(0.305)
Deworming*Post	--	--	-0.015	-0.432***	-0.011	0.225
	--	--	(0.032)	(0.142)	(0.064)	(0.300)
IFA*Deworming*Post	--	--	--	--	-0.532	-0.753*
	--	--	--	--	(0.440)	(0.455)
N	280	272	280	272	280	272
Panel D: Moderately Anemic Students (8 <= Hb < 11 g/dL at baseline)						
IFA*Post	-0.003	0.066	0.218	0.277	0.180	0.248
	(0.169)	(0.185)	(0.242)	(0.243)	(0.326)	(0.317)
Deworming*Post	--	--	-0.288	-0.290	-0.371	-0.357
	--	--	(0.238)	(0.234)	(0.315)	(0.337)
IFA*Deworming*Post	--	--	--	--	0.114	0.093
	--	--	--	--	(0.436)	(0.452)
N	539	521	539	521	539	521
School fixed effects?	No	Yes	No	Yes	No	Yes
Added controls?	No	Yes	No	Yes	No	Yes

Note: Receiving IFA is a dummy variable that is one if a school reported receiving IFA tablets and zero otherwise. The dependent variable is a child's hemoglobin levels, measured in g/dL. All regressions include an indicator for whether hemoglobin measurement was taken after IFA implementation and the other relevant main effects of each interaction term. Anemia levels are defined by the WHO standards at sea level. "Added controls" include the following school-level variables interacted with 'post': distance to block headquarters, the percent of parents satisfied with MDM, whether a school has a kitchen, the percent of families employed in housework outside the home, and the percent of students in a non-disadvantaged caste. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

Finally, the effect of the IFA for moderately anemic students ranges from 0.218–0.248 g/dL with the inclusion of controls for deworming receipt and is insignificant. While the finding that the effect on moderately anemic students is smaller than the effect on mildly anemic students seems surprising, there are at least three possible related explanations. First, the most anemic students may not have received enough iron through the IFA to build up sufficient iron stores, for example, because of more infrequent school attendance due to the negative effects of anemia (such as increased lethargy). Second, note that moderately anemic students are the only subgroup to have a positive (but insignificant) point estimate of the interaction effect of iron supplementation and deworming. This indicates that the most anemic students may have also been those with the highest worm loads. Both of these hypotheses imply that these children would therefore have experienced smaller immediate effects of iron supplementation as well as the most dramatic falls in hemoglobin levels when they ceased receiving iron supplements. On the other hand, students who were mildly anemic at baseline are likely less susceptible to timing discrepancies if they were more able to build up sufficient iron stores over the course of their supplementation. Since hemoglobin measurement was done over the summer vacation, it is possible the measureable effect for mildly anemic students persisted while the effect for moderately anemic students did not. The third explanation relates to the micronutrient mix treatment: the most anemic students are likely to be more severely deficient in other vitamins and micronutrients, perhaps affecting their ability to absorb the iron in the supplements.

These results imply that school-based iron supplementation programs may not be sufficient to reduce the most severe cases of anemia (affecting one-third of children in this sample), but they may be most effective in improving the hemoglobin levels of borderline or mildly anemic students and therefore preventing them from developing more severe levels of anemia. A main disadvantage of using the school system to distribute tablets is that the program only reaches kids who attend school frequently. These results are likely to generalize to other school-based nutrition programs, which would face many of the same constraints.

In our third set of results, we examine the heterogeneous effects for students whose schools report running out of tablets ahead of the school survey. Recall that schools reported whether they had run out of tablets, whether they still had tablets or whether they did not know if they had run out approximately two to four months before hemoglobin was measured. It is likely the impact of supplementation had fallen for children in schools that had run out of tablets. Table 25 presents the results, which support the hypothesis that students with more recent iron supplementation are driving the measurable effect of the IFA described above. In schools that still had tablets to distribute at the time of the school survey (the omitted category), the IFA increased children's hemoglobin levels by 0.414 g/dL (p-value 0.106). Students in schools that reported uncertainty regarding whether or not they had run out of tablets experienced an IFA effect of similar magnitude. However, the effect for students in schools that ran out of tablets at least two to four months before hemoglobin measurement was smaller by 0.311 g/dL (p-value 0.116). Thus, they still experienced a positive effect of the IFA but the effect was diminished by the time of hemoglobin measurement (and is not statistically significant). Note that the p-value from the F-test of all three IFA interactions presented at the bottom of the table rejects the null hypothesis that all three coefficients are zero at more conventional significance levels.

Table 25: Heterogeneous effect of the IFA students receiving tablets more recently

	(1)	(2)	(3)	(4)
	Dependent variable: Children's hemoglobin levels			
IFA*Post	0.006	0.128	0.303	0.414
	(0.206)	(0.226)	(0.234)	(0.254)
IFA*Post*UncertainTabletStatus	0.130	0.045	0.091	0.008
	(0.196)	(0.201)	(0.198)	(0.205)
IFA*Post*RanOutOfTablets	-0.288	-0.259	-0.334*	-0.311
	(0.201)	(0.196)	(0.198)	(0.197)
Deworming*Post	--	--	-0.370**	-0.363**
	--	--	(0.154)	(0.159)
N	1459	1413	1459	1413
P-value (F-test of 3 coefficients):	0.059	0.210	0.020	0.058
P-value (IFA*Post + IFA*Post*RanOut =0)	0.091	0.470	0.861	0.595
School fixed effects?	No	Yes	No	Yes
Added controls?	No	Yes	No	Yes

Note: The dependent variable is child's hemoglobin level measured in g/dL. IFA is a dummy variable that is 1 if a school reported receiving IFA tablets and 0 otherwise. Uncertain Tablet Status is a dummy variable that is a 1 if the school reported not knowing if they had run out of tablets and Ran Out of Tablets is a dummy variable that is a 1 if the school reported running out of tablets. All regressions include an indicator for whether hemoglobin measurement was taken after IFA implementation and the other relevant main effects of each interaction term. "Added controls" include the following variables interacted with "post": distance to block headquarters, whether or not a school has a kitchen, the percent of parents satisfied with MDM implementation, the percent of families employed in housework outside the home, and the percent of families in a non-disadvantaged caste. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

8. Discussion: challenges to internal validity

In this section, we discuss potential concerns with respect to internal validity, leaving external validity to the following section. The evaluation of the IFA treatment depends critically on the parallel trends assumption, which we discuss at length in the description of the empirical strategy above and for which we provide substantial support. In this subsection, we focus on internal validity with respect to the randomized controlled evaluation of the micronutrient mix provision and high intensity monitoring.

8.1 Spillovers between treatment groups

First, we consider contamination of the MNM provision. While we did not deliver the mix to any schools in the comparison group, it is possible that they obtained a similar mix to add to their meal, perhaps inspired by the information on anemia provided to all schools at the onset of the intervention. We find very little evidence that this happened, based on the food test results and the midday meal observations. Vitamin A content in the meals taken from schools with neither intervention were 52 µg/100g of food in February 2015 and barely changed by April 2015 (55 µg/100g). Schools that received the MNM provided food with levels of vitamin A that were seven times the food provided in schools that did not receive the MNM. Considering the observation of midday meal provision, the cook reported adding a powder to the meal only twice out of more than 400 visits to schools that did not receive the MNM. Similarly, the enumerator noted a powdery addition in the meal only twice out of more than 400 observations. None of the schools are repeated among these four observations suggesting that these are due to human or measurement error and not due to contamination. Note, in addition, that high intensity schools were not more likely to request and receive more of the mix (Table 10) and not more likely to serve food with higher vitamin A or zinc content (Table 12)—regardless of whether they received the mix or not—suggesting that contamination was unlikely.

8.2 Attrition

Another concern is overall as well as differential attrition (across treatment groups) of our sample. Table 26 provides an analysis of attrition for our main outcome variables on child health. This analysis is complicated by the fact that more than 2 years had passed between our Baseline 1 survey and the endline survey and the fact that we only surveyed a subset of the respondents at the time of the Baseline 2 survey. We focus on children who were surveyed at Baseline 1 and still in primary school during the year of the intervention (those in classes 1–3 at baseline) in Columns 1–6; additionally, we include children in the MNM intervention sample who were surveyed at Baseline II in Columns 7–12. In our implementation of the survey, we went to great lengths to visit children at both home and at school (after getting the necessary permissions from the parents) and conduct multiple visits if we were initially unable to find the child. Attrition is therefore quite minimal at only 9 percent. Column 1 in Table 26 indicates that whether the child attended a school that received the MNM or a school that was monitored intensely does not affect the probability of attrition. In Column 2, we add an interaction term between the two treatments. While the coefficients become significant, Columns 3–6 show that the composition of those who attrited is not significantly different across groups. Baseline hemoglobin levels do not affect probability of attrition, and this does not differ by treatment group (Columns 3–4, 9–10). Similarly, class at baseline does not affect probability of attrition, and this does not differ by treatment group (Column 5–6, 11–12).

8.3 Potential Hawthorne effects

We next turn to the possibility of Hawthorne effects. It is possible that the MNM use occurred partly due to the novelty of the MNM distribution itself, and that use might decline as this novelty wears off. There is some indication in the results that proper usage of the MNM fell off towards the end of the school year. Specifically, the increase in vitamin A content of school meals, relative to comparison schools, was almost twice as big in February 2015, only 2–3 months after the intervention started, than in April, the last month of the intervention. The amount of zinc in the school meals did not fall, however, and neither did the measures of take-up from the meal observations. The novelty of additional monitoring visits may wear off, especially once headmasters realize that there are no significant (monetary or career) stakes for them. We leave exploration of this question to future work.

Table 26: Analysis of differential attrition

Dep variable:	Attrited From Baseline I						Attrited From Baseline I or Baseline II					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
MNM treatment	-0.016	-0.055**	0.267	0.040	0.005	-0.006	-0.004	-0.028	0.198	0.350	0.004	-0.002
	(0.016)	(0.022)	(0.193)	(0.317)	(0.044)	(0.068)	(0.019)	(0.027)	(0.201)	(0.324)	(0.040)	(0.060)
High Intensity	-0.011	-0.049**	0.122	-0.093	-0.040	-0.050	-0.021	-0.044*	-0.161	-0.006	-0.037	-0.042
	(0.016)	(0.023)	(0.192)	(0.328)	(0.044)	(0.067)	(0.019)	(0.026)	(0.201)	(0.336)	(0.040)	(0.058)
MNM treatment * High Intensity		0.076**		0.409		0.019		0.047		-0.301		0.009
		(0.031)		(0.388)		(0.089)		(0.038)		(0.399)		(0.081)
Baseline hemoglobin level			0.022	0.012					0.017	0.026		
			(0.020)	(0.027)					(0.021)	(0.027)		
MNM treatment * baseline hemoglobin level			-0.012	0.004					0.013	-0.003		
			(0.017)	(0.030)					(0.018)	(0.031)		
High Intensity * baseline hemoglobin level			-0.026	-0.008					-0.018	-0.034		
			(0.017)	(0.029)					(0.018)	(0.029)		
MNM treatment * High Intensity * baseline hemoglobin level				-0.031						0.031		
				(0.035)						(0.036)		
Class in school as of baseline					0.004	0.010					0.004	0.012
					(0.020)	(0.024)					(0.018)	(0.021)
MNM treatment * class at baseline					0.016	0.003					0.016	0.001
					(0.021)	(0.030)					(0.019)	(0.027)
High Intensity * class at baseline					-0.010	-0.023					-0.009	-0.023
					(0.021)	(0.031)					(0.019)	(0.029)
MNM treatment * High Intensity						0.027						0.031

Dep variable:	Attrited From Baseline I						Attrited From Baseline I or Baseline II					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
* class at baseline						(0.041)						(0.039)
Constant	0.103***	0.123***	-0.135	-0.011	0.093**	0.100*	0.154***	0.166***	-0.034	-0.123	0.086**	0.089**
	(0.015)	(0.018)	(0.227)	(0.302)	(0.044)	(0.054)	(0.016)	(0.018)	(0.228)	(0.296)	(0.037)	(0.045)
N	1241	1241	1232	1232	1239	1239	1481	1481	1471	1471	1380	1380
R-squared	0.001	0.006	0.004	0.009	0.002	0.007	0.001	0.002	0.005	0.006	0.002	0.006
p-value from F-test of all regressors	0.544	0.074	0.461	0.144	0.757	0.340	0.545	0.401	0.241	0.233	0.722	0.305

Notes: This table presents an analysis of attrition for our main outcome variables on child health. Columns 1-6 study attrition from Baseline I while Columns 7-12 study attrition from either Baseline I or Baseline II. While column 2 suggests differential attrition by treatment arm, columns 3-6 show that the composition of those who attrited is not significantly different across groups. Baseline hemoglobin levels do not affect probability of attrition, and this does not differ by treatment group (Columns 3-4, 9-10). Similarly, class at baseline does not affect probability of attrition, and this does not differ by treatment group (Column 5-6, 11-12).

*Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.*

9. Specific findings for policy and practice

From the beginning of this study, our intent was to study iron supplementation or fortification "in the field." While efficacy trials have convincingly demonstrated that iron supplementation and fortification can improve child health and school attendance, these studies are often highly controlled with compliance rates above 95 percent because researchers closely monitor the delivery and consumption of iron supplements. Our intent was to evaluate the efficacy of a program that distributed iron through existing infrastructure, specifically the Indian midday meal program. While the IFA program announced by the Indian Ministry of Health and Family Welfare interfered with our specific plans, it nicely highlighted the policy relevance of the study.

In the end, we were able to evaluate three policy-relevant interventions: 1) the government's as is IFA program, 2) the provision of MNM to randomly chosen schools and 3) high intensity monitoring of midday meals, each with related but separate policy implications. We start with some general considerations with respect to external validity and policy implications and then discuss each intervention in separate subsections.

A number of elements about the study and the setting need to be considered when extrapolating from these results to other settings. First, the MNM provision and high intensity monitoring were organized by the research staff, with the intention of comparison with Naandi's centralized meal delivery. After the decentralized treatments began, Naandi made the decision not to continue with the study and extend meal service to the sample schools. Thus, while our results regarding the responses by schools may be applicable to schools in other settings, it is important to note that the impacts of these interventions are conditional on consistent delivery of the MNM and actual visits by monitors. The analysis of IFA implementation provides some insight in this area; variation in the receipt of IFA tablets during the first year is likely due to incorrect estimates of the number of tablets each block needed because the blocks ran out of tablets. In the second year, this appears to have been resolved. Almost all schools received the IFA tablets within a few months of the start of the school year. This suggests that taking MNM provision to scale would be possible. At the same time, the impact of high intensity monitoring requires that enumerators actually visit the schools and that these visits are unannounced. Government audits are famously infrequent in India. Taking intensity of meal monitoring to scale would require addressing the issues that currently limit frequent monitoring.

Another important element that might affect the generalizability of this study is the fact that school meals in Odisha are relatively consistent. Out of 732 unannounced visits to schools, only 12 times (1.6%) was a meal not served. This bodes well for a possible effect of fortification but may make it less easy to generalize the effects to a setting where school meals themselves might be inconsistent.

Finally, we also conducted qualitative interviews with school staff, parents and children to get their feedback on each of the health interventions at school. A summary of the main learnings from this exercise is provided in Appendix B.

9.1 Policy implications from IFA evaluation

The evaluation of the IFA program suggests that a school-based iron supplementation program has potential to improve hemoglobin levels and reduce anemia prevalence for school-aged children in districts similar to Keonjhar District but with some caveats. First, implementation of the program, while not perfect, did not appear to be plagued by systematic distribution by corrupt officials within each block. The main barrier to total coverage of the program seemed to be the misallocation of tablets to states or districts, and the program could be more effective in reaching its goals if this was corrected. In the second year of the program, 100 percent of schools in our sample reported receiving tablets from the government. Of the schools that had received tablets in the first year, more than half of them received more tablets in the second year than they did in the year before. Finally, over 95 percent of schools in all 5 blocks received deworming medication in the second year. Overall, these data suggest that the administrative wrinkles were quickly and effectively ironed out of the IFA program, and that it therefore stands to have a substantial impact on the prevalence of iron deficiency and anemia in its second (and subsequent) year(s).

However, there are still limitations facing the IFA program and other school-based programs. The policy had larger measurable effects for students who received tablets closer to the time that their hemoglobin levels were measured. This suggests that in the intervening time between rounds of supplementation in school, children's hemoglobin levels may fall. This could occur whenever schools run out of tablets or more systematically when students are out of school for long periods of time (e.g. the summer holiday). There are two obvious solutions, although they may be difficult to implement: 1) ensure that schools receive enough tablets and 2) provide students with tablets to take home over school vacations. While out-of-school tablet provision and student compliance may work differently than in-school provision and compliance, students would be less likely to experience falls in hemoglobin levels over the summer months.

Recall that the largest effects of the IFA program were concentrated among anemic or borderline anemic (i.e. iron deficient) children, suggesting that it could be particularly effective in reducing iron deficiency among children who are not yet presenting visible signs of moderate or severe anemia. At the same time, the IFA program was less effective in improving the hemoglobin levels of moderately anemic students. It is possible that the IFA program is not intensive enough to fully treat students who already present such high degrees of iron deficiency, or that it does not reach those students as effectively because they are less likely to regularly attend school.

It is also plausible that the relatively small (overall) effects of the IFA found here may be rooted in the delay between supplementation in schools and the measurement of children's hemoglobin levels, therefore understating the actual effectiveness of the program. This is not unexpected, given the life cycle of a red blood cell and the low levels of iron naturally present in most Indian diets. Our results also indicate that the policy was successful in getting tablets to children but was limited by the undersupply of tablets in particular administrative blocks and certain schools. Furthermore, these findings suggest that school-based programs like the IFA, while successful, may not be wholly effective in persistently reducing the prevalence of anemia and iron deficiency if children are not consistently receiving iron tablets, for example during summer vacations.

Overall, the results reported here suggest that the IFA affected children's hemoglobin levels in schools that reported receiving tablets from the government, particularly for children who received tablets most recently and those who had lower hemoglobin levels at the onset of the program. Given that a large number of children had likely gone without iron supplements for several months at the time of hemoglobin measurement, the point estimates reported here are relatively large. While most of the estimates of the impact of the IFA program are not statistically significant at conventional levels, it is likely the case that the evaluation lacks adequate power. This is suggested by the large standard errors (accompanying large point estimates).

One persistent puzzle in the results is the potential negative effect of deworming on hemoglobin levels and the insignificant interaction between deworming and iron supplementation. While data constraints limit the further evaluation of these effects in this study, the phenomenon should be further studied in real-world programs that implement both biannual deworming regimens and weekly or daily iron supplementation in schools.

9.2 Policy implications from MNM distribution

The evaluation of the MNM distribution has some related policy implications. First, take-up was relatively high. Three out of 75 schools did not use any of the micronutrient mix, indicated in the records on how much MNM was delivered and how much was collected at the end of the intervention. On average, schools used more than 58% of the amount we estimated they would use based on the number of students enrolled 90% of the schools used at least 40% of the amount we estimated they would need. One contribution of this study is the evaluation of nutrition programs run by different entities. The range of take-up measures is similar across both the nutrition program run by the government and the program run by researchers. For example, in 72% of midday meal visits, the cook reported adding a powder to the meal, while 62% of children interviewed reported receiving the IFA tablet regularly, and 86% of schools reported receiving IFA tablets. In conjunction with the evaluation of the IFA program, 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 measures of child health, despite previous literature that indicated multi-micronutrient supplementation is more effective than just iron supplementation. One likely reason for the lack of an effect of MNM provision on child health outcomes could be the low dosage of micronutrients provided. In order to obtain approval from the National Institute of Nutrition, we had to halve the dosage suggested by the nutrition expert on the principal investigating team. The resulting dosage was well below 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). Thus, the low quantities may not have been sufficient to impact iron absorption. We hope future work evaluates an MNM supplementation with higher dosage.

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 because it requires a one-size-fits-all-students approach. A more customized program would allow for supplementation or fortification based on the micronutrient deficiencies a child exhibits, but it may be prohibitively expensive to implement. As indicated by the IFA results, programs that target the general population are most likely to improve well-being for mildly malnourished children and perhaps reduce the probability that children develop mild forms of malnutrition, but it may not be sufficient for children with more severe deficiencies.

9.2.1 Spillovers

One last policy implication has to do with the negative spillovers of the MNM program on implementation of the IFA distribution. As seen in Table 18, students in MNM treatment schools are less likely to report receiving IFA tablets regularly than students in the comparison schools. Thus, the MNM treatment appears to crowd out the distribution of IFA tablets, perhaps because headmasters and teachers are overburdened, as they appear to be from anecdotal evidence.[17] Note that these negative spillovers are not as evident in the survey responses reported by the school officials, who could potentially get confused between the two programs. There is no other reason to think the students would report getting IFA tablets less frequently, besides crowding out of different school programs. An important policy implication is that giving additional responsibilities to school officials may lead to declines in the quality of teaching or implementation of other programs.

An unexplored area in the broad literature on service delivery is that of crowd out and negative spillovers in the implementation of concurrently run programs. The literature has, up to now, largely focused on evaluating ways to increase effort by service providers or public officials. However, the potential negative effect on the quality of service delivery in contexts where service providers may be overburdened has remained largely understudied. Our study is, to our knowledge, one of the first to measure the cost (to already existing programs), of adding on additional programs within existing public infrastructure. In much of the developing world, schools remain the primary avenue for government programs to reach children of school-going age. However, nutritional and other programs are being added on through schools, without matching increases in infrastructural and personnel capacities at these schools. We believe our results provide a starting point to explore such issues in program implementation.

9.3 Policy implications from high intensity monitoring

Finally, the robust positive impact of high intensity monitoring on child hemoglobin levels (Tables 13 and 14) is particularly interesting and relevant for policy, especially in the absence of an interaction effect with the MNM treatment. 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 (Table 10) and did not have more midday meal visits where enumerators noted a powdery addition to the meal or cooks reported the addition

[17] One of the most common concerns about the midday meal reported by the school officials during our field visits was that it is takes up the headmasters' as well as teachers' time and mental energy.

of the mix (Table 11). At the same time, the impact of high intensity monitoring on the quality of the meals provided was not particularly large and unlikely to affect hemoglobin levels (Table 19).

A likely explanation for the effect of the high intensity monitoring can be seen in Table 18: students in high intensity schools were more likely to report receiving IFA tablets regularly. While this could be seen as a spillover effect, it is likely that it was a direct monitoring effect. Since almost all schools reported that the IFA tablets were distributed during the midday meal, it would be natural for school officials to suspect that one of the reasons for visiting during the meals was to monitor the IFA distribution.

To understand the policy implications, it is worth thinking about the number of visits this study added to the school year (on top of the regular visits the district- or block-education officers [DEO or BEOs] and other officials might conduct). In every school, we conducted an initial training at the onset of the intervention, a school facilities and staffing survey at the beginning of the intervention, 4 visits to conduct IFA surveys in months 1, 3, 4 and 5, and at least 3 visits to observe the midday meals in months 3, 4 and 5. The schools in the high intensity monitoring treatment received 2 additional visits to observe midday meals in months 1 and 2. It is puzzling that the addition of 2 visits on top of a base of 9 had such a substantial effect on the propensity of schools to distribute IFA tablets.

One significant difference in the midday meal visits relative to the other type of visits was timing; they were the only visits that occurred during the meal. As noted above, mealtime visits may have been seen as monitoring the IFA distribution. Note that the tablets were to be distributed weekly, making the stakes of such a monitoring visit particularly low; it would have been easy for the headmaster to report that this week's tablet would be given the next day or had been given the previous day. However, this strategy would not help explain discrepancies with the student reports of tablet receipt. While enumerators spoke to randomly chosen students during both the IFA visits and midday meal observations, it is likely 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 spoke to students three times over the first two months of the intervention) than in other schools (where we had spoken to students only once).

Thus, this study contributes to the burgeoning literature on top-down monitoring and the effectiveness of monitoring visits, even with no stakes attached. Even more specifically, the results suggest that the exact timing of such visits and who the auditors speak to may have significant effects. Another important contribution of our study is the finding that adding on an increasing number of programs in schools may have negative spillovers on other programs if school officials already feel overburdened. While schools are a natural setting for implementing a number of social programs for children, it is unclear what the optimal number and types of programs there should be and how to hire and incentivize school officials to implement the programs effectively. This is an area that is currently understudied in the literature and warrants further research.

To conclude, this study finds evidence supporting the effectiveness of a government program to distribute iron supplements in schools and the effectiveness of frequent monitoring visits at improving implementation of such public health programs. While we do not find evidence that the MNM distribution improved child health, this part of the intervention was not optimized to find an effect, given the short time period within one school year and the restrictions necessary to provide the same intervention to all students. However, the fact that we find strong take-up rates of the micronutrient mix, and significantly higher amounts of micronutrients in meals, combined with efficacy trials demonstrating the effect of multi-micronutrient supplementation, suggests that multi-micronutrient distribution is still a promising area and should be studied further.

Appendix A: Tables

Table A1: Comparison of schools that ran out of tablets to those that did not

		Blocks with high IFA variation			
	Panel A: Demographic characteristics	Did not run out	Ran out	Uncertain	P-Value
School-reported (SCH)	Distance to the block headquarters (km)	18.21	18.56	23.49	**0.0132**
	Primary enrollment	77.48	88.92	62.17	**0.0115**
	Secondary enrollment	23.48	50.97	15.43	**0.0005**
	Number of teachers	2.56	3.15	2.19	**0.0270**
	% of schools have a kitchen	0.76	0.82	0.74	0.7063
	% of schools have at least one latrine	0.92	0.84	0.85	0.6325
	% of schools have sufficient water	0.83	0.79	0.70	0.4480
Household-reported, aggregated to school level (HH)	Mean % of students are female	0.51	0.52	0.49	0.2814
	Mean % of families in a non-disadvantaged caste	0.03	0.05	0.02	0.2927
	Mean % of village adults in agricultural work	0.15	0.19	0.23	**0.0020**
	Mean % of village adults work in own home	0.26	0.27	0.26	0.8171
	Mean % of village adults work in others' homes	0.25	0.24	0.25	0.9121
	Mean % of village adults work as laborers	0.19	0.16	0.13	0.1014
	Mean % of village adults with no formal schooling	0.64	0.55	0.54	**0.0442**
	Mean % of village adults who own a phone	0.28	0.30	0.32	0.6020
	Mean % of families that live in high-quality housing	0.09	0.08	0.09	0.9090
	Mean % of families that live in low-quality housing	0.80	0.79	0.73	0.1441
	Mean % of families with electricity	0.50	0.54	0.52	0.8735
	Panel B: Implementer Variables				
SCH	% with parent group for MDM	0.00	0.17	0.10	0.1324
	% with MDM training	0.50	0.63	0.65	0.4478
	% receiving MDM rice on a regular schedule	0.58	0.22	0.35	**0.0129**
HH	Mean number of MDM per week	4.72	4.87	4.81	0.5724
	Mean % of parents satisfied with MDM	0.92	0.90	0.89	0.3251
	Panel C: Anthropometric Measures at Baseline				
Child-level measures aggregated to school level and averaged	Mean % of students with anemia	0.59	0.54	0.57	0.3850
	Mean % with mild anemia	0.24	0.23	0.23	0.8318
	Mean % with moderate anemia	0.34	0.29	0.33	0.3065
	Mean % with severe anemia	0.01	0.01	0.01	0.7241
	Mean child Hb level	11.17	11.31	11.15	0.1882
	Mean student BMI	13.60	13.54	13.78	0.5894
	Mean BMI, anemic students	13.52	13.59	13.68	0.7782
	Mean BMI, nonanemic students	13.62	13.55	13.95	0.4484
	Mean student weight	18.26	18.32	18.38	0.9448
	Mean weight, anemic students	17.36	18.10	17.71	0.3497
	Mean weight, nonanemic students	19.35	19.16	19.35	0.9162
	Mean BMI, girls	13.43	13.47	13.59	0.8722
	Mean BMI, boys	13.74	13.63	13.89	0.4017

Note: P-value corresponds to F-test of the null hypothesis that the three means are the same.

Table A2: Comparison of deworming, non-deworming schools in high-variation blocks

		Blocks with high IFA variation		
	Panel A: Demographic Characteristics	Got Deworming	No Deworming	P-Value
School-reported (SCH)	Distance to the block headquarters (km)	20.96	21.98	0.5166
	Primary enrollment	72.60	80.34	0.3015
	Secondary enrollment	29.29	31.66	0.7406
	Number of teachers	2.65	2.28	0.1923
	% of schools have a kitchen	0.78	0.63	**0.0472**
	% of schools have at least one latrine	0.84	0.87	0.7339
	% of schools have sufficient water	0.79	0.65	**0.0526**
Household-reported, aggregated to school level (HH)	Mean % of students are female	0.50	0.50	0.7213
	Mean % of families in a non-disadvantaged caste	0.04	0.05	0.3280
	Mean % of village adults in agricultural work	0.20	0.17	**0.0361**
	Mean % of village adults work in own home	0.27	0.22	**0.0012**
	Mean % of village adults work in others' homes	0.24	0.30	**0.0021**
	Mean % of village adults work as laborers	0.15	0.20	**0.0064**
	Mean % of village adults with no formal schooling	0.55	0.62	**0.0293**
	Mean % of village adults who own a phone	0.32	0.30	0.7103
	Mean % of families that live in high-quality housing	0.09	0.10	0.8925
	Mean % of families with electricity	0.53	0.50	0.5995
	Panel B: Implementer Variables			
SCH	% with parent group for MDM	0.10	0.16	0.3031
	% with MDM training	0.63	0.48	**0.0747**
	% receiving MDM rice on a regular schedule	0.35	0.43	0.3116
HH	Mean number of MDM per week	4.80	4.68	0.2889
	Mean % of parents satisfied with MDM	0.90	0.90	0.6906
	Panel C: Anthropometric Measures at Baseline			
Child-level measures aggregated to school level and averaged	Mean % of students with anemia	0.56	0.59	0.2095
	Mean % with mild anemia	0.22	0.24	0.2567
	Mean % with moderate anemia	0.32	0.34	0.5464
	Mean % with severe anemia	0.01	0.01	0.7747
	Mean child Hb level	11.23	11.15	0.2898
	Mean student BMI	13.70	13.64	0.7182
	Mean student weight	18.31	18.29	0.9313
	Mean BMI, girls	13.56	13.50	0.7534
	Mean BMI, boys	13.80	13.81	0.9343

Note: P-value tests the difference in the two means, unconditional on block. Bolded p-values are significant at the 10% level.

Table A3: Overall effect of the IFA on height and weight

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Dependent variable: Children's height					
IFA*Post	0.705	0.620	-0.622	-0.868	-1.902	-2.190
	(0.813)	(0.832)	(1.465)	(1.461)	(2.444)	(2.529)
Deworming*Post	--	--	1.860	2.152	0.010	0.106
	--	--	(1.626)	(1.751)	(0.811)	(1.195)
IFA*Deworming*Post	--	--	--	--	2.921	3.178
	--	--	--	--	(2.605)	(2.966)
N	1460	1414	1460	1414	1460	1414
Panel B:	Dependent variable: Children's weight					
IFA*Post	0.564***	0.528***	0.987***	0.980***	1.359***	1.427***
	(0.174)	(0.201)	(0.310)	(0.331)	(0.497)	(0.530)
Deworming*Post	--	--	-0.594*	-0.655*	-0.046	0.041
	--	--	(0.328)	(0.351)	(0.281)	(0.299)
IFA*Deworming*Post	--	--	--	--	-0.859^	-1.078*
	--	--	--	--	(0.556)	(0.619)
N	1462	1416	1462	1416	1462	1416
School fixed effects?	No	Yes	No	Yes	No	Yes
Added controls?	No	Yes	No	Yes	No	Yes

Note: The dependent variable is child's height measured in cm (panel A) and child's weight measured in kg (panel B). IFA is a dummy variable that is 1 if a school reported receiving IFA tablets and 0 otherwise. All regressions include an indicator for whether hemoglobin measurement was taken after IFA implementation and other relevant main effects of each interaction term. "Added controls" include the following variables interacted with "post": distance to block headquarters, whether or not a school has a kitchen, the percent of parents satisfied with MDM implementation, the percent of families employed in housework outside the home, and the percent of families in a non-disadvantaged caste. Standard errors clustered by school are in parentheses. Significance at the 0.10, 0.05, and 0.01 levels indicated by *, **, and ***, respectively.

Appendix B: Qualitative report from focus group discussions

Introduction

We conducted a small qualitative study after the endline to assess the acceptance of the MNM among all stakeholders of the midday meal in Keonjhar district. This included the students/ children, parents, headmasters, teachers and cooks (if possible).

We conducted focus group discussions (FGDs) with two kinds of stakeholders

a) In schools: we held brief discussions with the teachers, headmasters and, if possible, the cooks.
b) In villages: we held brief discussions with parents and children.

1. Sampling

To have a representative and diverse sample, we picked two high MNM take-up schools, and two low take-up schools from the decentralized fortified arm. Schools with MNM take-up less than 50 percent were classified as low take-up schools and those with MNM take-up of more than 75 percent were categorized as high take-up schools. In addition we picked two schools from the control, six schools in total.

2. Field plan for focus group discussions

We sent out invitations for the focus group discussion four days in advance to schools, as well as parents of the children. The focus group discussion was conducted in the regional language, Oriya, by one moderator and one note-taker. We did not record the information in order to ensure IRB compliance.

We sent out the invitations on June 26–27, 2015, to schools and selected parents. We trained the moderator and the note-takers on these dates as well. The discussions were structured around a few questions about the MDM program, IFA program, and the J-PAL MNM program for schools in the treatment group. The FGDs were conducted July 1, 2015, onwards and lasted for a week up until July 7, 2015. The discussion with school faculty (headmasters, teachers, MDM in-charge, cook) were held in the respective schools; the discussion with parents and children were usually held at the *anganwadi* of that village, or in a common concrete area of the village depending on the convenience of the parents.

3. Summary of the teacher and headmaster discussions

Overall, the schools seemed to perceive the MDM program as beneficial. However, the school administrators expressed a need for a higher MDM budget so that better quality ingredients could be procured. They also expressed a preference for better quality rice than what was delivered from the government. Some administrators indicated a preference for more centralized provision of meals. The headmasters and teachers expressed a desire to devote more time to teaching than managing the MDM, except in one case where meal provision was being managed by a self-help group and the headmaster expressed a preference for it to be managed by the school instead. There is demand for cooking fuel as well.

Overall the headmasters and the teachers believed the micronutrient mix was good for the nutritional development of the children. The administrators were willing to support the program if continued in the future, indicating that the program was well received. Mostly they indicated no change in taste or color due to the addition of the micronutrient mix powder. However there were instances where some children expressed a dislike for how the meals smelled after the mix was added.

In terms of the IFA program, most of the headmasters and teachers were aware of the government program and seemed to be providing these tablets to the children. However, they noted that some children throw these tablets away.

4. Summary of the students and parent discussions

Overall, the parents seemed to be aware about the midday meals program. However, in very rare cases were parents able to verify the quality of meals provided in schools; those who did check, suggested that better quality rice, more oil and larger quantities of vegetables be used for midday meals. They expressed a desire for meat, milk and fruits to be added to the midday meals and said that there should be some effort to ensure that meals aren't contaminated (for example, with insects). In terms of the quantity of the meals, parents often felt that it was insufficient and that the children did not get a second serving and came home hungry. Most parents were not aware of the IFA program and confused the iron tablets with deworming tablets. Parents found it hard to conclude whether it has any impact on child's health.

Most children said they like eggs and dalma the most; some children pointed out that the meals were sufficient in quantity, and, that on request, they could also get a second serving for meals, contrary to what most parents stated.

In schools where MNM was provided, there were a few cases where children and parents did mention that meals seem to have a slight smell due to the mix. However, overall, most children did not notice a difference in the smell, color or taste of the meal. Except in one case, it seems that the MNM was well received by the parents and children.

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