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ABSTRACT

Behavior Change for Early Childhood Nutrition: Effectiveness of Health Worker Training Depends on Maternal Information in a Randomized Control Trial

We carry out a randomized control trial to test for interaction effects between training state-employed caregivers and providing mothers information to improve nutrition of preschool children aged 2-6 in rural India. Salaried caregivers are supposed to provide a mid-day meal and also advise mothers on health and nutrition for their child. Our one-day caregiver training covered basic health and nutrition facts with advice on how to communicate with mothers for behavior change at home. We find that this training was effective only when we provided the mothers with an independent source of nutrition information, and that the combined treatment was effective only among younger caregivers. Results are consistent with behavior change as a costly investment that is more attractive when done earlier in life, and greater response to information that is confirmed and reinforced from multiple sources.

JEL Classification: M53, I12, I38, J38

Keywords: child underweight, child malnutrition, child health, ICDS, Punjab, South Asia

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Introduction and motivation

Child malnutrition is a serious and persistent problem that decreases immunity to disease, educational achievement and labor productivity (Behrman et al. 2004, Alderman and Behrman 2006). Economic development is associated with widespread declines in malnutrition, but children continue to experience high rates of stunting and wasting in many countries, including India (Drèze and Sen 2013). In India, a wide variety of interventions aim to improve nutritional outcomes, including the world's largest child development program known as Integrated Child Development Services (ICDS) that began in 1975 and now serves over 34 million children at about 1.3 million child-care centers.

In this paper we report results from a randomized controlled trial carried out at rural ICDS centers in collaboration with the Punjab government's Social Welfare Department. Our trial was designed to assess the impact of a training program for salaried ICDS workers, and its interaction with direct provision of information to mothers. To test for the interaction between worker training and information to mothers we offered both training alone, and the two in combination, enrolling a total of 2682 mothers and 2980 children across 109 centers in 66 villages. Our relatively large sample size permits additional tests for heterogeneity by age and sex of children, as well as by the ages of workers and mothers.

In rural Punjab as in the rest of India, each ICDS center is staffed by a salaried Anganwadi worker, who is employed to provide day care for about 30 children up to 6 years of age. Health-related services include provision of a mid-day meal and counseling of the children's mothers. The program's effectiveness thus depends on both the skill of caregivers and the responsiveness of mothers. A World Bank report by Gragnolati et al. (2005) found widespread leakage in the provision of ICDS meals and almost no effective communication between caregivers and mothers. More recently, a household survey in 100 Indian districts found that although 96% of villages are served by an ICDS centers, only 50% of the centers provided food on the day of survey and just 19% of mothers reported that caregivers provided any nutrition counselling (Hungama Report, 2011). Poor delivery could explain why Lokshin et al. (2005) and Bredenkamp and Akin (2004) find that children in villages with Anganwadi centers are not less likely to be malnourished or ill than other children. Kapil (2002) argues that there is huge scope for improvement in services because home visits by Anganwadi workers are infrequent. Our study builds particularly on the results of Prinja et. al. (2008) who surveyed 60 Anganwadi centers in Haryana and identified inadequate emphasis on nutritional and health education activities for behavior change, as well as lack of active participation of family members in monitoring the child's nutritional status.

Providing science-based information to mothers about child health and nutrition is widely seen as helpful to combat malnutrition. Behrman and Deolalikar (1987) showed that nutrient intake may not respond to income changes alone, and in recent years programs have focused on supplying either new information or additional foods. For example, Madajewicz et al. (2007) report how information about water quality influences choices in Bangladesh, and Maluccio et. al. (2009) find positive long-run impacts of a nutritional supplement in Guatemala. Even in the United States, supplementary nutrition obtained in schools has been associated with an improvement in child health (Bhattacharya et al., 2006).

Interventions aimed at behavior change through training or information are likely to depend on the degree to which that information is complemented by other actions (Dupas, 2011). The

trial presented in this paper complements other experiments conducted at urban ICDS centers, where Singh (2015) found that distributing nutritional information to mothers led to significant improvements only when the day care workers were incentivized to improve the children's health. Those incentives led workers to conduct more visits to children's homes, which in turn led mothers to use the recipes included in the nutritional information books. The complementarity between motivated workers and informed mothers resulted in lower malnutrition. This result is consistent with incentive schemes that rely on coordination between people, as is often the case for improvements in health (Miller and Babiarz 2013).

In this paper, we test for the impact of giving the same kind of recipe book to mothers as in Singh (2015), along with that of providing a training module for workers designed to improve their nutrition knowledge and help them communicate more effectively with mothers. Our design builds on the large literature regarding the training of health workers to improve both knowledge and communication skills. Henoch et al. (2013) find that confidence in communication improves significantly for trained caregivers and Moleiro et al. (2011) show that even brief training programs may be effective in changing awareness and increasing empathy. Most similarly to our trial, Simoes et al. (1997) evaluate the performance of primary health workers in Ethiopia after a short training course on integrated management of childhood illness. The course focused on assessment, classification, and treatment of sick children (aged 2 months to 5 years) and on counselling of their mothers. Health workers improved communication with mothers over the course of the training.

The training sessions in our trial, like others evaluated in the literature, are very short and low-cost. Newes-Adeyiemail et al. (2004) report that counseling and communication skills of non-physician health providers can change even after a one day of focused training, and Pelto et al. (2004) show that trained providers are more likely to engage in nutrition counseling and to deliver more extensive advice than are untrained providers. Mothers who received advice from trained providers recalled the messages on specific foods, feeding practice, and food preparation recommendations at a higher rate than mothers who did not receive advice. We use these non-experimental results from the existing literature to design a short one-day program and apply it to caregivers in our context, either with or without the provision of nutrition information in recipe books for the mothers in each ICDS center.

Although our primary concern is interaction effects between treatments, we are also interested in heterogeneity of effects by age. There are many reasons why younger workers might be more likely to respond to information. First, behavior change is a costly investment that pays off only over time, and thus is more attractive at a younger age. Second, behaviors become fixed over time and are easier to change in an early attempt. There are also many reasons why younger children might be more responsive to intervention. The fact that growth faltering occurs most often prior to age two has led public health organizations to focus on the first 1000 days - from conception through 24 months. However, Golden (1994) argues that reversal of stunting in later childhood may be possible. A growing body of evidence from Adair (1999), Barham et al. (2013), Crookston et al. (2010), Coly et al. (2006), Outes and Porter (2003), and Prentice et al. (2013) finds that some catch-up can occur at older ages.

In this paper we test for impacts of treatments on the youngest children aged 2-3 years (just after the 1000 days mark) and also among older children aged 3-6 years. This is an important complement to previous studies of worker training that have focused on children under two. Zaman et al. (2008) present results from a cluster-randomized controlled trial that was carried out by distributing a training module regarding feeding practices to health workers who were

taking care of children aged 6 to 24 months with the objective of reducing infant and child malnutrition. The communication skills of trained health workers significantly improved and, especially among children in the age-group of 1 to 2 years, growth faltering diminished. Penny et al. (2005) also find positive effects of an education intervention to caregivers of children under the age of 18 months. However, not all training programs have been so successful. Hamer et al. (2004) show that while nurses in Gambia were trained to identify severe protein-energy malnutrition using WHO training materials, the training did not lead to improvements in terms of under-diagnosis or wrong-diagnosis by nurses.

Conceptual framework

Child health (W) can be thought of as a function of home and day care center inputs, h and c.

$$W=f(h,c) \quad (1)$$

The inputs promote health and include food, care practices and medicine such as oral rehydration salts. The quantity of such inputs at home can depend first, upon the mother's knowledge of the existence of available inputs (k) and second, on her knowledge of the importance of feeding these inputs (i). Thus,

$$h=g(k,i) \quad (2)$$

Both better counseling and monitoring by the worker increase k and i. For example, the worker can increase her home visits to stress the importance of feeding nutritious recipes. However, she could also improve knowledge transfer by making the same number of visits as before.

In this paper, we consider two treatments: (1) training workers, and (2) training workers while also providing recipe books to mothers. We can test if either of these treatments can improve W, which has never been rigorously tested before for the child age group of 2-6 years. Moreover, we can measure the impact of training workers on mothers' knowledge, k. If W improves, but k does not increase, there may be increases in c or i.

Finally, if we find that training workers has the same impact as training workers and providing recipes to mothers, the two treatments may be thought of as perfect substitutes. However, in that case, training-only would obviously be more cost effective for the policy maker.

If the impact of the second treatment is greater than that of the first, we can conclude that training and recipe books are complements in the child's health production function. This is because we know that recipe books on their own have no significant impact on child health, albeit in a different setting (Singh, 2015). Furthermore, it is possible that the complementarity might be heterogeneous depending upon the "type" of worker and mother. For instance, a more motivated worker and mother combination might be able to gain more from the training and recipe treatment. Maternal knowledge and education has been a strong determinant of child health (Guldan et al., Handa, 1999; Sandiford et al., 1995). It will also be possible to understand whether the complementarity results from an increase in k or i. For example, if we do observe trained workers make more visits to mothers who have recipe books, we can check if the mother's knowledge of the existence of available inputs improves or not. If k does not improve, the result is likely driven through a change in mother's knowledge of the importance of feeding

these inputs, i. These channels are important for unpacking the elements of behavioral change at home, which is often described as an important determinant in the fight against child undernutrition.

Context

Our experiment was conducted in rural Punjab, a region long known as India's bread basket and one of its most prosperous states, thanks to fertile soil, irrigation and early dissemination of green revolution seeds and fertilizer in the 1960s. More recently, other states have caught up and Punjab's agricultural output has stagnated, leaving per capita income only slightly higher than the national per capita income (Department of Planning, 2013). As in the rest of India, the ICDS program has not yet succeeded in eliminating malnutrition, and its own website states that out of a total of 1.86 million children between the ages of 0-6 years surveyed in Punjab, 24.27% are classified as malnourished. Some of this is related to incomplete delivery and ineffectiveness of ICDS services, as only 42 percent of the children in the survey register actually receive food on any given day, and Punjab ranked low relative to other Indian states in terms of intended behavioral changes among ICDS beneficiaries (Planning Commission, 2011). Poor performance may be related to poor infrastructure. In Punjab, for example, only 41 percent of ICDS centers have a flush toilet and only a third have functional weighing scales, the average center size is only 236 square feet as opposed to 315 square feet across all of India, and only 17 percent of the centers had updated growth charts for their children whereas the national average was 41 percent (NCAER ICDS survey, 2009).

Regarding worker training and information for mothers, Kular (2014) investigates the conditions of thirty Anganwadis in a rural district of Punjab and finds that workers scored, on average, less than 25 percent on a quiz related to health and nutrition. He notes, "Nutrition and Health education (NHED) is delivered by Anganwadi workers through inter-personal contacts and discussions at Anganwadi centres...[but] workers have inadequate knowledge about NHED component." Bhandari et al. (2004) paired eight communities from Punjab's neighboring state, Haryana, to assign treatment and control. The intervention included a 3-day initial training of health worker as well as monthly home visits by Anganwadi workers for newborns until the age of 12 months and visits once every 3 months until the age of 2 years. Results demonstrated that there was no significant impact on weight gain and only a small increase in linear growth (0.18 SD) between 6 and 12 months.

Methodology

Our trial, undertaken in collaboration with the Punjab government's Social Welfare Department, took place in the rural district of Mohali because department officials were especially keen on improving health indicators there. We selected two blocks within the district, and used a computer algorithm to randomize treatments and control in clusters at the village level to reduce the possibility of information spillovers between workers or mothers at different centers within a cluster. Table 1 shows the total number of clusters and centers allocated to each group and Figure 1 plots the assignment of villages on a satellite map.[1]

[1] Following the cluster randomization procedure, two villages in the second treatment and one from the first treatment were found to have closed. These were then removed from our original sample and are not shown on the map.

The map in Figure 1 illustrates the geographic spread of treatment and control villages. From Table 1, the total number of clusters for all three groups (two treatments and a control) is 76. Power calculations reveal that, with a total number of subjects of about 2000 and intraclass correlation equal to 0.05, this cluster size is sufficient for obtaining a power greater than 0.8 to detect small-sized effects of 0.2 standard deviations (Cohen, 1988).

All workers who were offered the free training session attended. Overall, the 70 workers at 70 centers in 43 villages were given training in one day-long workshops conducted as explained in the next section. They were also handed a set of recipe books in the local language, Punjabi.

All mothers associated with 35 of these centers from 21 villages were also given recipe books (the second treatment) by enumerators after their interview.

<Table 1 and Figure 1 about here>

The baseline survey was conducted in July, 2011, followed by the treatment in August, 2011 and endline in December, 2011. A window of five months was chosen for the experiment because it is the average time between two medical check-ups by the local Health Department. The duration was verified by doctors at the local office of the Health Department, Government of India, to be sufficient for a grade improvement in malnutrition status as measured by the standard ICDS indicator of weight-for-age. At baseline and endline, a team of enumerators (supervised by an assistant and project manager) weighed all children present in the center on a digital weighing machine, interviewed their mothers and the center workers. Previous weights of children (on average two months prior to baseline) were also recorded at baseline from the weight record registers of the workers. These earlier records may have more measurement error than the digital machine recorded weights but are unlikely to be systematically different across the treatment and control groups. Moreover, we will control for infrastructure at each center and qualifications of caregivers, which will help capture any systematic bias in measurement error.

Summary statistics

Table 2 shows the sample size of children and mothers in each arm and round of measurement. All children between the ages of 2 and 6 years present at the surveyed centers were weighed. This translated to close to 2980 children being weighed at baseline with about 27 children being weighed per center in each group. We also have a high compliance rate for mothers, with a total of 2682 mothers being interviewed, a response rate of 90 percent at baseline. At endline too, close to 89 percent of mothers were interviewed for the children weighed at endline. However, 13 percent of children attrited from the sample because they were not present at the center on the day of the survey.

<Table 2 about here>

The summary statistics in Table 3 show that child characteristics, household-level variables, and worker and center observables, are not significantly different between the two treatment groups and the control group at baseline. Weight-for-age malnutrition is defined as weight-for-age z-scores being more than two standard deviations lower than their sex and age-specific mean from a WHO-specified reference population. At baseline, 31 percent of the children were

malnourished (z-score<= -2) and 11 percent severely malnourished (z-scores<= -3). The average child was close to 4 years of age and there were an equal proportion of boys and girls. The mean number of children ever born per family was 1.9. The monthly income of households was on average Rs. 4730 (or approximately $80 per household) in the control group. This corresponds to just below $1 per day, per person. Self-reported food expenditure constituted about half of the total expenditure, which is consistent with other studies on food expenditures of households living in poverty (see Banerjee and Duflo, 2012). The mother was, on average, relatively young at 28 years. About two-thirds of mothers were literate, compared to fathers whose literacy levels are on average 10 percentage points higher. 76 percent of the mothers were housewives, 11 percent worked as housemaids, and 8 percent as laborers. 68 percent of fathers worked as laborers, 11 percent sold eatables, and 7 percent were engaged in handicrafts.

<Table 3 about here>

In other baseline characteristics, among kitchen assets, 53 percent of households owned a refrigerator, 2 percent used a water filter, 87 percent had a water tap, 86 percent owned a pressure cooker, and 73 percent used cooking gas stoves. Among non-kitchen assets, 28 percent of households owned a scooter, 62 percent owned a bicycle, 90 percent owned a television, 83 percent owned a mobile phone and only 6 percent owned a radio. Moreover, only 25 percent had a flush system installed in toilets. As the households were in rural areas, 41 percent owned a cow or a goat and 2 percent owned a chicken.

Centers were observed to be inadequately equipped to provide pre-school education and early childhood development services. Only 28 percent of the centers had functional electricity on the day of the survey and 23 percent of the centers had a blackboard. Similarly, only 24 percent had a toilet. Despite most centers having charts hung up in the classroom, most centers lacked lighting and just half had fans installed despite the maximum average temperature in the month of June being 104 degrees F (40 degrees C). The sample's summary statistics complements the Planning Commission report's (2011) disparaging review of the ICDS centers in Punjab, where they found lack of knowledge among workers, a lack of infrastructure and "missing" beneficiaries. We also asked for the caregiver's satisfaction with different elements of her work on a 7 point Likert scale. In Appendix Table 1, we show that the workers report high levels of satisfaction at baseline for most characteristics (especially, relations with supervisor and job timings), although workers feel dissatisfied by their present salary and potential salary growth.

Worker training and information for mothers

Immediately following the baseline, a local doctor conducted the training workshop over three consecutive days to limit the size of each sitting to fewer than 25 workers. The same format was followed in each of the three sessions and is outlined below. The two components of the session consisted of information on child nutrition and hygiene and on communication effectiveness. These are part of the job requirements for a caregiver in the ICDS system. All workers are supposed to undergo a training session before they start work, however it is unclear how effective such trainings are, due to a lack of any rigorous evaluation. The syllabus for the one month training module for Anganwadi workers is available on the ICDS website. This is the first randomized controlled trial trying to understand the role of health worker training with a focus on health information and communication. The training program was designed with the help of a

local government nutritionist and on the basis of a previous study which pointed towards the importance of behavioral change through better communication between Anganwadi workers and mothers (Gragnolati et al., 2005).

The goals of the training capsule included providing information on significance of hygiene and nutrition of children between 2-6 years of age. After motivating the adverse consequences of malnutrition and poor hygiene, hygienic habits were outlined for the workers with examples. These were teeth cleaning, clipping child's nails, wearing of slippers, washing hands with soap before and after eating, toilet training, drinking clean water, use of spoon for eating, boiling water before cooking, washing fruits and vegetables properly, keeping water and garbage covered and not allowing mosquitoes and fleas to breed in the house by regular cleaning. A group discussion included topics such as: advice to mothers if the child is losing weight, has diarrhea, or weak bones.

For improving nutrition, the workers were asked to teach mothers about giving 5-6 small meals every day, and the concept of balanced meals that includes protein and fat as well as micronutrients from a variety of vegetables and fruits. In order to aid them with specificity of information, a government-approved recipe book was distributed to them that enlisted ten nutritious and economical recipes that could be prepared with locally available ingredients in a few easy-to-follow steps. The recipe book was in Punjabi, the local language, and it provided the nutritional content of each recipe. The first four pages contained simple rules of hygiene, and gave a list of items rich in calories, protein, vitamin A and iron. This nutritional information would also be examined in a quiz conducted on the trained workers at the end of the workshop. Based on Singh (2015), the ten recipes were taken from the Government's publicly available book on Nutritious Recipes for Complementary Feeding of Young Children. Each recipe could be made at home within a budget of Rs. 4 for 150 gms, as calculated by the staff nutritionist of the Food and Nutrition Board, Chandigarh. Each recipe had multiple boxes at the bottom in which mothers were asked to indicate when they prepared that recipe. It also had information on hygiene and good food habits and highlighted food items rich in calories, protein, iron and carotene. The distribution of recipe books also involved discussing four of the recipes in detail. This recipe book was also distributed directly to all mothers in the second treatment. This meant that both the trained workers and the mothers would have the same recipe book in the combined treatment.

Finally, a communication skills handout was distributed to the workers that listed twelve simple rules or best practices for effective communication with mothers. This was designed with the help of the officials at the Social Welfare Department. The workers were asked to read these out aloud. These were as follows:

- Explain to the mother the growth and development of the child
- Keep the discussion positive and it should be in a soft and familiar language
- Show the growth chart of the child to the mother with growth curves and the child's progress
- Ask the mother questions about caring practices, listen to the mother and try to ascertain the cause of the problem
- Praise and compliment the mother for all the child care
- Teach the mothers a recipe from the book by asking her the child's food preferences and available ingredients
- Build confidence in the mother and teach her the significance of health and hygiene at home
- Convince the mother to bring the child regularly to the center for key services

- Explain to the mother and the family that feeding, playing and communicating with children helps them grow and develop well
- Discuss `developmental milestones' of the child with the mother and the family
- Follow up severely malnourished children and make home visits at a convenient time for the mothers
- Reinforce messages by regular home visits

The last section of the workshop asked workers for their feedback and suggestions.

Hypothesis tests

The main regression specification for average effects of treatment on weight-for-age is as follows:

$$\omega_{ijt} = \alpha(post)_t + \beta(training)_j + \gamma(training\ \&\ info)_j + \eta(post * training)_{jt} + \theta(post * training\ \&\ info)_{jt} + X_{ijt} + \varepsilon_{ijt}$$

ω_{ijt} is the weight or health indicator of a child *i* in cluster *j* at time *t*. The variable *post* is a dummy that is 0 for baseline and 1 for endline. The variable *training* is a dummy variable that takes a value of 1 if the child is exposed to a worker who is in the training only treatment and 0 otherwise. Similarly, *training & info* is 1 if the child is in the combined treatment (training to workers and recipe books provision to mothers) and 0 otherwise. Finally, X_{ijt} are child-level, household-level and center-specific controls. The error term is clustered at the village level, which was the level of randomization.

The variable *post* accounts for the natural increase in weight in three months, all seasonal effects on weight that do not vary by village, regional shocks to food prices and any management changes or unobservables that would impact all groups in the same way. β and γ are the baseline differences between the individual treatments and the control. η and θ give us the difference-in-differences estimates for the effect of each treatment. This interpretation rests on the identification assumption that there are no time varying and group-specific effects that are correlated with the treatments (common trend assumption). As the villages were randomly assigned into one of the three groups, we should not expect there to be differential trends amongst the groups.

Although typically not required for the common trends assumption to be checked with randomization, we do carry out a placebo check to corroborate that pre-trends are similar across all groups. For the placebo check, we define *post* = 1 for baseline and 0 for the weight recorded in official registers prior to baseline (on average about two months before). There is likely to be greater measurement error in these prior weights because the official weighing scales are not as precise. However, we do not expect the measurement error to be systematically different across the different groups. Running the above regression with this new definition should allow us to test if there are changes in the difference-in-difference estimates from what we had obtained earlier. We should not observe any significant difference-in-difference estimates with the placebo regression for the common trends assumption to hold.

To check for channels, we can replace the dependent variable with a measure of the quantity or quality of interaction between the workers and the mothers.

Results

In table 4 we test for impacts of treatments on four main outcome variables: weight-for-age z-scores, mothers visit to the center, workers visits to the home, and the sum of mothers and workers visits, all as reported by the mother over the previous month. After controlling for baseline differences, we find only one coefficient to be statistically significant at the 10% level, providing a point estimate of an 0.226 increase in z score for children in the combined treatment group. This impact does not seem to arise from greater mother-worker interaction, but could be due to better food provision and care practices at both the center and at home.

The rest of the paper focuses on disaggregating our sample and evaluating heterogeneity in impacts. As documented in the related literature that motivates this study, we expect gains from the program to be concentrated among children between 2 to 3 years of age, and expect younger workers to be more responsive to the training programs. We also check for heterogeneity by household wealth, although we have no prior hypothesis as to the direction of a wealth effect.

In table 5 we split the impact of treatments on the main outcomes by child age, to test whether weight-for-age responds more among children between 2 to 3 years than among children between 3 to 6 years. We find that the point estimate is indeed almost twice as large for the younger children, with an increase of 0.355 units of z score as opposed to 0.181 for the older children, but the standard errors are large and these coefficients are not individually statistically significant. Other treatment effects remain insignificant, with the only difference by age being a trend increase of 0.132 z-scores of weight-for-age from one round to the next but only for the older children.

Figure 2 provides a non-parametric visualization of these results, showing differences in the change in weight at each age of child between the treatment and control groups. We find that for the training and information treatment there is a negatively sloping line, illustrating that the greatest impacts are for younger children. In the training only treatment there appears to be the greatest impacts on 4 year olds with declining impacts on younger and older children. The control group seems to show an increase in the weight-for-age over time for older children.

In table 6 we split the sample by worker age, to test whether younger workers are more responsive to training. Ages range from 22 to 60 years. To obtain roughly equal sample sizes we divide the sample at its median, which is 37 years. Results reveal that the treatment effect is entirely concentrated among the younger workers, with a 0.322 increase in z score following combined treatment among younger workers and mothers. We also notice that mothers' reported visits to the center are significantly higher when younger workers receive training, whether or not the mother also received information. In other words, the maternal information treatment appears to have increased the efficacy of training and resulting behavior change among the younger workers. In contrast, among the older workers, the only significant change is a trend increase in mothers' visits to the center (significant only at the 10% level), relative to which the trained workers actually had fewer visits. In any case, there was no change in child weight-for-age.

Figure 3 shows changes in child weight by age of worker for each treatment arm, contrasting the control group with training-only and combined training + information. Gradients with respect to worker age are within the 95% confidence interval for control and training-only, but with training + information there is a steep decline in efficacy by worker age. This nonparametric result is consistent with the split-sample test of table 6.

Tables 7 and 8 check for heterogeneous impacts by household wealth, measured first by number of kitchen assets owned from a reference list such as a water tap, water filter, cooking gas, pressure cooker and refrigerator, and then by non-kitchen assets such as mobile phone, radio, television, scooter and a flush toilet. Dividing the sample at the median, which in both cases is about 60% of the asset list, reveals higher point estimates among the richer households for effects of the combined treatment on child weight for age. These are statistically significant only at the p=0.10 level, but the point estimates of 0.261 and 0.306 units of z score are similar to the effectiveness of treatment among the younger workers. The effects seem to be concentrated among richer households as informed mothers are able to employ the specific information communicated to them by trained workers and take corrective action in the form of better nutrition and hygiene.

Table 9 returns to our main results, checking for robustness against non-random attrition using Lee (2009) bounds on estimated treatment effects. This procedure establishes upper and lower bounds by selectively dropping either the largest or the smallest values of the outcome variables (Tauchmann, 2013). We find a confidence interval significantly above zero only among the younger workers, with a lower bound for effectiveness of the worker training + mothers information of 0.307 units of weight-for-age z score.

Discussion and conclusions

This study provides novel evidence about complementarities between salaried caregivers and children's mothers, through a randomized controlled trial of worker training and combined training and maternal education treatments, disaggregated by age of the worker and of the child. We find that on its own, training has no significant impact on children's weight gain, but when we also provide nutritional information to mothers, there are significant improvements among the younger half of workers in our sample. That impact appears to be driven by an increase in the effectiveness of visits, rather than the number of such visits. We find only limited differences in effectiveness by child age, which could be driven by our outcome measure being weight for age, rather than height for age, as weight gain or loss can occur at any age, while linear growth is more age-dependent.

Our results reveal complementarity between worker training and mothers' information, which is in line with Hamer et al. (2004), who found no effects of a training-only treatment. The results are consistent with Zaman et al. (2008) and Penny et al. (2005), which find advantages to helping a population of potential beneficiaries become aware of the implementation of worker training. Most importantly, we find effectiveness only among the younger workers, which is consistent with previous literature on the differential effects of training programs by workers' age such as Felstead (2010), Bertolino et al. (2011) or Thangavelu et al. (2011).

The 2014-15 budget for Punjab allocates $1.2 billion for health expenditures (Department of Planning, 2013), supporting 26,408 Anganwadi workers that care for 434,586 preschool children between the ages of 2-6 years (ICDS, 2014). All of the workers undergo health, nutrition and pre-school training when they begin, but refresher courses are very limited. This study offers the first randomized controlled trial studying the effectiveness of worker training and its interaction with maternal information. The training program costs only about $4 per worker. Its cost effectiveness could be very high relative to other interventions, but the intervention impacts child weight only when accompanied by separate provision of information to mothers, and only among the younger workers. These results underscore the importance of heterogeneity among workers

and complementarities between service provision and the responsiveness of potential beneficiaries, which remain important topics for further research.

References

Adair, L. S., "Filipino children exhibit catch-up growth from age 2 to 12 years", The Journal of Nutrition (1999), 129(6), 1140-1148.

Adhikari, Saroj K., and Caryn Bredenkamp. "Monitoring for Nutrition Results in ICDS: Translating Vision into Action." IDS Bulletin 40, no. 4 (2009): 70--77.

Alderman, Harold, and Jere R. Behrman. "Reducing the Incidence of Low Birth Weight in Low-Income Countries Has Substantial Economic Benefits." The World Bank Research Observer 21, no. 1 (March 20, 2006): 25--48.

Alderman, Harold, John Hoddinott, and Bill Kinsey. "Long Term Consequences of Early Childhood Malnutrition." Oxford Economic Papers 58, no. 3 (July 1, 2006): 450--74. doi:10.1093/oep/gpl008.

Barham, T., K. Macours, & John A. Maluccio. "Boys' Cognitive Skill Formation and Physical Growth: Long-Term Experimental Evidence on Critical Ages for Early Childhood Interventions", American Economic Review (2013),103(3), 467-471.

Bertolino, M., Truxillo, D.M. and F. Fraccaroli. Age as moderator of the relationship of proactive personality with training motivation, perceived career development from training, and training behavioral intentions. J. Organ. Behav. (2011) 32, 248–263.

Bhattacharya, Jayanta, Janet Currie, and Steven J. Haider. "Breakfast of Champions?: The School Breakfast Program and the Nutrition of Children and Families." Journal of Human Resources (June 20, 2006), XLI:445-466;

Behrman, Jere, Harold Alderman, and John Hoddinott. "Malnutrition and Hunger." In Global Crisis, Global Solutions, 2nd ed., 363--420. Cambridge, UK: Cambridge University Press, 2004.

Behrman, Jere R., and Anil B. Deolalikar. "Will Developing Country Nutrition Improve with Income? A Case Study for Rural South India." Journal of Political Economy 95, no. 3 (June 1, 1987): 492--507.

Bhandari, Nita, Sarmila Mazumder, Rajiv Bahl, Jose Martines, Robert E. Black, and Maharaj K. Bhan. "An Educational Intervention to Promote Appropriate Complementary Feeding Practices and Physical Growth in Infants and Young Children in Rural Haryana, India." The Journal of Nutrition 134, no. 9 (September 1, 2004): 2342--48.

Cohen, J. Statistical power analysis for the behavioral sciences (2nd ed.), 1988. Hillsdale, NJ: Lawrence Earlbaum Associates.

Coly, A., J. Milet, A. Diallo, T. Ndiaye, E. Bénéfice, F. Simondon, S. Wade, and K. Simondon, "Preschool stunting, adolescent migration, catch-up growth, and adult height in young Senegalese men and women of rural origin", The Journal of Nutrition (2006), 136.9: 2412-2420.

Crookston, Benjamin T., Mary E. Penny, Stephen C. Alder, Ty T. Dickerson, Ray M. Merrill, Joseph B. Stanford, Christina A. Porucznik, and Kirk A. Dearden, "Children who recover from early stunting and children who are not stunted demonstrate similar levels of cognition", The Journal of Nutrition (2010), 140, no. 11: 1996-2001.

Department of Planning, Government of Punjab. GSDP/NSDP (2004-05) - Statewise Data (2004-05 to 2013-14), 2014. http://pbplanning.gov.in

Department of Statistics, Government of Punjab. "District Wise Geographical Area in Punjab." Census 2011, n.d. http://www.punjabstat.com/

Drèze, Jean. "Universalisation with Quality: ICDS in a Rights Perspective." Economic and Political Weekly 41, no. 34 (August 26, 2006): 3706--15.

Dreze, Jean, and Amartya Sen. An Uncertain Glory: India and Its Contradictions. Princeton University Press, 2013.

Dupas, Pascaline. "Health Behavior in Developing Countries." Annual Review of Economics 3, no. 1 (2011): 425--49.

Evaluation Report on Integrated Child Development Services. Program Evaluation Organization, Planning Commission, March 2011. http://planningcommission.gov.in/reports/peoreport/peo/peo_icds_vol1.pdf.

Felstead, A. Closing the age gap? Age, skills and the experience of work in Great Britain. Ageing Soc. (2010) 30, 1293–1314.

Indiastat. "Funds Released and Expenditure Reported under Integrated Child Development Schemes (ICDS) General SNP and Training in Punjab." Indiastat, 2014. http://www.indiastat.com/

Golden, M. H., "Is complete catch-up possible for stunted malnourished children?", European Journal of Clinical Nutrition (1994), 48, S58-70.

Gragnolati, M., C. Bredenkamp, M. Shekar, M. Das Gupta, and Yi-K. Lee. "India's Undernourished Children: A Call for Reform and Action." World Bank Washington, 2005.

Guldan, Georgia S., Marian F. Zeitlin, Alexa S. Beiser, Charles M. Super, Stanley N. Gershoff, and Sabita Datta. "Maternal Education and Child Feeding Practices in Rural Bangladesh." Social Science & Medicine 36, no. 7 (April 1993): 925--35.

Hamer, C., K. Kvatum, D. Jeffries, and S. Allen. "Detection of Severe Protein-Energy Malnutrition by Nurses in The Gambia." Archives of Disease in Childhood 89, no. 2 (February 1, 2004): 181--84.

Handa, Sudhanshu. "Maternal Education and Child Height." Economic Development and Cultural Change 47, no. 2 (January 1, 1999): 421--39.

"Integrated Child Development Scheme." Directorate of Social Security, Government of Punjab, http://www.pbsocialsecurity.gov.in/html/icds.html.

"Integrated Child Development Services." Ministry of Women and Child Development, Government of India, http://wcd.nic.in/icds/icds.aspx.

"Integrated Child Development Services (ICDS) Scheme." Ministry of Women and Child Development, Government of India, 2011. http://wcd.nic.in/icds.htm.

Kapil, Umesh. "Integrated Child Development Services (ICDS) Scheme: A Program for Holistic Development of Children in India." The Indian Journal of Pediatrics 69, no. 7 (July 1, 2002): 597--601.

Kular, Sarbjit Singh. "A Study on Anganwadi Workers in Rural ICDS Blocks of Punjab." International Journal of Humanities and Social Science Invention 3, no. 9 (September 2014): 1--4.

Kular, Sarbjit Singh. "Evaluation of Nutrition and Health Education Programme of ICDS Scheme in Barnala District of Punjab." Dynamics of Public Administration 31, no. 2 (2014): 234.

Lee, D. (2009). Training, Wages, and Sample Selection: Estimating Sharp Bounds on Treatment Effects. Review of Economic Studies, 76(3), pp.1071-1102.

Madajewicz, Malgosia, Alexander Pfaff, Alexander van Geen, Joseph Graziano, Iftikhar Hussein, Hasina Momotaj, Roksana Sylvi, and Habibul Ahsan. "Can Information Alone Change Behavior? Response to Arsenic Contamination of Groundwater in Bangladesh." Journal of Development Economics 84, no. 2 (November 2007): 731--54.

Maluccio, John A., John Hoddinott, Jere R. Behrman, Reynaldo Martorell, Agnes R. Quisumbing, and Aryeh D. Stein. "The Impact of Improving Nutrition During Early Childhood on Education among Guatemalan Adults." The Economic Journal 119, no. 537 (2009): 734--63.

Martorell, R., Khan, L. K., & Schroeder, D. G., "Reversibility of stunting: epidemiological findings in children from developing countries", European Journal of Clinical Nutrition (1994), 48, S45-57.

Michaelsen, Kim F., Camilla Hoppe, Nanna Roos, Pernille Kaestel, Maria Stougaard, Lotte Lauritzen, Christian Molgaard, Tsinuel Girma, and Henrik Friis. "Choice of Foods and Ingredients for Moderately Malnourished Children 6 Months to 5 Years of Age." Food & Nutrition Bulletin 30, no. 3 (2009): S343.

Miller, G., and K.S. Babiarz, "Pay-for-performance incentives in low-and middle-income country health programs." NBER Working Paper No. 18932 (2013).

Moleiro, Carla, Susana Marques, and Pedro Pacheco. "Cultural Diversity Competencies in Child and Youth Care Services in Portugal: Development of Two Measures and a Brief Training Program." Children and Youth Services Review 33, no. 5 (May 2011): 767--73.

Newes-Adeyi, Gabriella, Deborah L. Helitzer, Debra Roter, and Laura E. Caulfield. "Improving Client--provider Communication: Evaluation of a Training Program for Women, Infants and Children (WIC) Professionals in New York State." Patient Education and Counseling 55, no. 2 (November 1, 2004): 210--17.

Outes, I., & Porter, C., "Catching up from early nutritional deficits? Evidence from rural Ethiopia", Economics & Human Biology (2013), 11(2), 148-163.

Onyango, Adelheid W, Steven A Esrey, and Michael S Kramer. "Continued Breastfeeding and Child Growth in the Second Year of Life: A Prospective Cohort Study in Western Kenya." The Lancet 354, no. 9195 (December 11, 1999): 2041--45.

Pelto, Gretel H., Iná Santos, Helen Gonçalves, Cesar Victora, José Martines, and Jean-Pierre Habicht. "Nutrition Counseling Training Changes Physician Behavior and Improves Caregiver Knowledge Acquisition." The Journal of Nutrition 134, no. 2 (February 1, 2004): 357--62.

Penny, Mary E, Hilary M Creed-Kanashiro, Rebecca C Robert, M Rocio Narro, Laura E Caulfield, and Robert E Black. "Effectiveness of an Educational Intervention Delivered through the Health Services to Improve Nutrition in Young Children: A Cluster-Randomised Controlled Trial." The Lancet 365, no. 9474 (June 3, 2005): 1863--72.

Prentice, A. M., Ward, K. A., Goldberg, G. R., Jarjou, L. M., Moore, S. E., Fulford, A. J., & Prentice, A., "Critical windows for nutritional interventions against stunting", The American Journal of Clinical Nutrition (2013), 97(5), 911.

Prinja, Shankar, Ramesh Verma, and Sunder Lal. "Role of ICDS Program in Delivery of Nutritional Services and Functional Integration between Anganwadi and Health Worker in North India." The Internet Journal of Nutrition and Wellness 5, no. 2 (2008).

Ramachandran, Nira. Persisting Undernutrition in India: Causes, Consequences and Possible Solutions. Springer Science & Business, 2014.

Sandiford, P., J. Cassel, M. Montenegro, and G. Sanchez. "The Impact of Women's Literacy on Child Health and Its Interaction with Access to Health Services." Population Studies 49, no. 1 (March 1, 1995): 5--17.
Sengupta, Paramita, Nina Philip, and A. I. Benjamin. "Epidemiological Correlates of under-Nutrition in under-5 Years Children in an Urban Slum of Ludhiana." Health and Population: Perspectives and Issues 33, no. 1 (2010): 1--9.
Simoes, E. A., T. Desta, T. Tessema, T. Gerbresellassie, M. Dagnew, and S. Gove. "Performance of Health Workers after Training in Integrated Management of Childhood Illness in Gondar, Ethiopia." Bulletin of the World Health Organization 75 Suppl 1 (1997): 43--53.
Singh, P., 2015. Performance Pay and Information: Reducing Child Undernutrition in India. Journal of Economic Behavior & Organization 112, 141–163.
Status Report on ICDS Scheme - Data Tables. India: Ministry of Women and Child Development, 2014 2008. http://wcd.nic.in/icds
Tauchmann, H., 2013. Lee's Treatment Effect Bounds for Non-Random Sample Selection-an Implementation in Stata. SFB 823.
Thangavelu, S.M., Haoming, L., Cheolsung, P., Heng, A.B. and J. Wong. The determinants of training participation in Singapore. Appl. Econ. (2011) 43, 4641–4649.
The Hungama Survey Report 2011. Naandi Foundation. Accessed January 25, 2015. http://www.naandi.org/wp-content/uploads/2013/12/HUNGaMA-Report-One-Pager.pdf.
Udo, C., C. Melin-Johansson, I. Henoch, B. Axelsson, and E. Danielson. "Surgical Nurses' Attitudes towards Caring for Patients Dying of Cancer -- a Pilot Study of an Educational Intervention on Existential Issues." European Journal of Cancer Care 23, no. 4 (2014): 426--40.
Zaman, Shakila, Rifat N. Ashraf, and José Martines. "Training in Complementary Feeding Counselling of Healthcare Workers and Its Influence on Maternal Behaviours and Child Growth: A Cluster-Randomized Controlled Trial in Lahore, Pakistan." Journal of Health, Population, and Nutrition 26, no. 2 (June 2008): 210--22.

TABLES AND FIGURES

Table 1: Number of Centers and Villages by Treatment

	Number of Villages	Number of Centers
Control	23	39
Training	22	35
Training+Info	21	35

Table 2: Compliance and Attrition Rates

		Training	**Training + Info**	**Control**
Round 1	children weighed	955	965	1060
	children whose mothers were quizzed	871	871	940
	% of children whose mothers were quizzed	91%	90%	89%
Round 2	children weighed	807	887	913
	children whose mothers were quizzed	711	767	845
	% of children whose mothers were quizzed	88.10%	86.47%	92.55%
	% of children weighed again	84.50%	91.92%	86.13%
	%mothers quizzed again	81.63%	88.06%	89.89%

Table 3: Summary statistics from the baseline

VARIABLES	Training	Training+Info	Control	Training	Training+Info
Panel A: Children characteristics					
Malnutrition rate	0.245	0.287	0.244	0.00	0.04
	[0.44]	[0.45]	[0.43]	(0.62)	(0.62)
Weight of child	12.79	12.87	12.83	-0.04	0.04
	[2.21]	[2.23]	[2.18]	(3.10)	(3.12)
z-score	-1.336	-1.421	-1.452	0.12	0.03
	[1.07]	[1.05]	[1.03]	(1.49)	(1.47)
Age of child	3.74	3.85	3.81	-0.07	0.04
	[0.95]	[0.96]	[0.99]	(1.37)	(1.38)
Fraction male	0.5	0.52	0.51	-0.01	0.01
	[0.50]	[0.50]	[0.50]	(0.71)	(0.71)
Panel B: Household characteristics					
Monthly income	4982.11	4389.48	4730.41	251.70	-340.93
	[1935.69]	[1922.97]	[1991.08]	(2776.92)	(2768.07)
Weekly Expenditures	831.07	927.30	956.37	-125.30	-29.07
	[394.81]	[534.43]	[508.24]	(643.57)	(737.51)
Food expenditures	448.08	556.58	538.93	-90.85	17.65
	[275.52]	[379.72]	[323.54]	(424.96)	(498.86)
Number of rooms	2.03	2.11	2.35	-0.32	-0.24
	[1.17]	[1.27]	[1.24]	(1.70)	(1.77)
Mother's age	27.67	28.06	28.08	-0.41	-0.02
	[4.01]	[3.88]	[4.52]	(6.04)	(5.96)
Mother can read	0.62	0.65	0.74	-0.12	-0.09
	[0.49]	[0.48]	[0.44]	(0.66)	(0.65)
Father can read	0.75	0.81	0.84	-0.09	-0.03
	[0.43]	[0.39]	[0.37]	(0.57)	(0.54)
Housewife mother	0.51	0.77	0.69	-0.18	0.08
	[0.50]	[0.42]	[0.46]	(0.68)	(0.62)
Panel C: Worker and center characteristics					
Worker's Age	38.11	41.32	40.8	-2.69	0.52
	[7.64]	[8.68]	[8.98]	(11.79)	(12.49)
Educated worker	0.29	0.39	0.17	0.12	0.22
	[0.46]	[0.49]	[0.37]	(0.59)	(0.61)
Proportion kitchen goods	0.54	0.58	0.61	-0.07	-0.03
	[0.25]	[0.23]	[0.26]	(0.36)	(0.35)
Proportion non-kitchen goods	0.61	0.58	0.63	-0.02	-0.05
	[0.22]	[0.20]	[0.22]	(0.31)	(0.30)
Electricity in AWC	0.29	0.35	0.28	0.01	0.07
	[0.45]	[0.48]	[0.45]	(0.64)	(0.66)
Fan in AWC	0.41	0.35	0.53	-0.12	-0.18
	[0.49]	[0.48]	[0.50]	(0.70)	(0.69)
Helper in AWC	1	1	0.97	0.03	0.03
	[0.00]	[0.00]	[0.18]	(0.18)	(0.18)
Chart in AWC	0.82	0.94	0.89	-0.07	0.05
	[0.38]	[0.65]	[0.32]	(0.50)	(0.50)
Blackboard in AWC	0.19	0.32	0.23	-0.04	0.09
	[0.40]	[0.47]	[0.42]	(0.58)	(0.63)
Drinking water in AWC	0.3	0.57	0.36	-0.06	0.21
	[0.46]	[0.50]	[0.48]	(0.66)	(0.69)
Toilet in AWC	0.35	0.25	0.24	0.11	0.01
	[0.48]	[0.43]	[0.43]	(0.64)	(0.61)

Notes: Standard deviations in parentheses.

Table 4: Impact of treatments on main outcomes

	(1)	(2)	(3)	(4)
	z	Mother's visits to center	Worker's visits to home	Total visits
Change in control group	0.0673	0.109	0.0747	0.183
	(0.0637)	(0.332)	(0.368)	(0.661)
Additional change in training	0.0988	0.492	0.530	1.030
	(0.105)	(0.482)	(0.515)	(0.929)
Additional change in training + information	0.226*	-0.495	-0.494	-1.019
	(0.124)	(0.416)	(0.457)	(0.809)
Constant	-1.220***	2.359***	3.188***	5.554***
	(0.0912)	(0.189)	(0.281)	(0.445)
N	4918	4324	4274	4268
R-sq	0.014	0.027	0.019	0.026

Notes: Robust standard errors in parentheses clustered at the village level. Weight-for-age z-score for each child is calculated by the following formula from WHO Reference (2007): (observed weight – median weight-for-age from reference population)/(Std. deviation of weight-for-age from reference population). Mother's visits to center and and worker's visits to the home are the visits in the last month as reported by the mother. Total visits is the sum of the two visits. Regressions also control for baseline differences in dependent variables across treatments. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Impact of treatments on main outcomes by child age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	z	Mother's visits to center	Worker's visits to home	Total visits	z	Mother's visits to center	Worker's visits to home	Total visits
	Child age between 2 and 3 years				Child age between 3 and 7 years			
Change in control group	0.124	-0.0158	0.373	0.359	0.132**	0.160	0.0164	0.174
	(0.126)	(0.513)	(0.564)	(0.997)	(0.0613)	(0.321)	(0.324)	(0.601)
Additional change in training	0.0950	1.006	0.352	1.357	0.0868	0.369	0.555	0.933
	(0.193)	(0.758)	(0.763)	(1.446)	(0.104)	(0.443)	(0.483)	(0.847)
Additional change in training + information	0.355	-0.241	-1.077	-1.356	0.181	-0.590	-0.368	-0.989
	(0.279)	(0.587)	(0.659)	(1.145)	(0.113)	(0.417)	(0.433)	(0.779)
Constant	-0.744***	2.543***	3.189***	5.735***	-1.390***	2.297***	3.187***	5.493***
	(0.143)	(0.273)	(0.402)	(0.656)	(0.0953)	(0.173)	(0.266)	(0.409)
N	1016	890	878	878	3902	3434	3396	3390
R-sq	0.022	0.070	0.041	0.047	0.019	0.023	0.015	0.022

Notes: Robust standard errors in parentheses clustered at the village level. Weight-for-age z-score for each child is calculated by the following formula from WHO Reference (2007): (observed weight – median weight-for-age from reference population)/(Std. deviation of weight-for-age from reference population). Mother's visits to center and worker's visits to the home are the visits in the last month as reported by the mother. Total visits is the sum of the two visits. Regressions also control for baseline differences in dependent variables across treatments. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Impact of treatments on main outcomes by worker's age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	z	Mother's visits to center	Worker's visits to home	Total visits	z	Mother's visits to center	Worker's visits to home	Total visits
	Worker age under 37 years (median)				Worker age above 37 years			
Change in control group	0.108	-0.788	-0.443	-1.239	0.110	0.567*	0.238	0.810
	(0.0696)	(0.520)	(0.540)	(0.997)	(0.0944)	(0.318)	(0.308)	(0.541)
Additional change in training	0.0364	1.591**	1.033	2.639**	0.112	-0.131	0.300	0.170
	(0.133)	(0.693)	(0.711)	(1.286)	(0.159)	(0.497)	(0.537)	(0.953)
Additional change in training + information	0.322**	0.552	0.438	0.930	0.0437	-1.064**	-0.975**	-2.050**
	(0.134)	(0.573)	(0.653)	(1.099)	(0.129)	(0.506)	(0.483)	(0.898)
Constant	-1.253***	2.942***	3.724***	6.677***	-1.244***	2.005***	2.907***	4.916***
	(0.123)	(0.396)	(0.353)	(0.727)	(0.133)	(0.0886)	(0.271)	(0.308)
N	2021	1730	1710	1707	2656	2409	2379	2376
R-sq	0.024	0.056	0.025	0.044	0.010	0.044	0.037	0.045

Notes: Robust standard errors in parentheses clustered at the village level. Weight-for-age z-score for each child is calculated by the following formula from WHO Reference (2007): (observed weight – median weight-for-age from reference population)/(Std. deviation of weight-for-age from reference population). Worker's age has a median of 37 years at baseline and range from 22 to 60 years. Mother's visits to center and worker's visits to the home are the visits in the last month as reported by the mother. Total visits is the sum of the two visits. Regressions also control for baseline differences in dependent variables across treatments. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Impact of treatments on main outcomes by household wealth (by kitchen assets)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	z	Mother's visits to center	Worker's visits to home	Total visits	z	Mother's visits to center	Worker's visits to home	Total visits
	Poor: Own <= 60% of kitchen assets				Rich: Own > 60% of kitchen assets			
Change in control group	0.114	-0.0811	0.0593	-0.00944	0.0401	0.260	0.0906	0.346
	(0.0846)	(0.630)	(0.660)	(1.262)	(0.0903)	(0.320)	(0.300)	(0.548)
Additional change in training	-0.0125	0.126	0.442	0.557	0.171	0.686	0.559	1.254
	(0.144)	(0.670)	(0.809)	(1.408)	(0.130)	(0.563)	(0.506)	(0.991)
Additional change in training + information	0.165	-0.437	-0.441	-0.949	0.261*	-0.592	-0.533	-1.143
	(0.129)	(0.708)	(0.721)	(1.377)	(0.150)	(0.415)	(0.427)	(0.741)
Constant	-1.362***	2.703***	3.323***	6.030***	-1.199***	2.230***	3.137***	5.374***
	(0.114)	(0.398)	(0.430)	(0.806)	(0.101)	(0.152)	(0.263)	(0.369)
N	1512	1329	1302	1301	3035	2834	2815	2810
R-sq	0.010	0.020	0.039	0.036	0.013	0.061	0.020	0.045

Notes: Robust standard errors in parentheses clustered at the village level. Weight-for-age z-score for each child is calculated by the following formula from WHO Reference (2007): (observed weight – median weight-for-age from reference population)/(Std. deviation of weight-for-age from reference population). Kitchen assets are refrigerator, water filter, water tap, cooking gas and pressure cooker. The median household owns 60% of the kitchen assets at baseline. Mother's visits to center and worker's visits to the home are the visits in the last month as reported by the mother. Total visits is the sum of the two visits. Regressions also control for baseline differences in dependent variables across treatments. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Impact of treatments on main outcomes by household wealth (by non-kitchen assets)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	z	Mother's visits to center	Worker's visits to home	Total visits	z	Mother's visits to center	Worker's visits to home	Total visits
	Poor: Own <= 60% of non-kitchen assets				Rich: Own > 60% of non-kitchen assets			
Change in control group	0.268***	0.354	-0.148	0.221	-0.0287	0.135	0.127	0.257
	(0.0488)	(0.483)	(0.520)	(0.981)	(0.0813)	(0.355)	(0.389)	(0.700)
Additional change in training	-0.0825	-0.413	0.291	-0.143	0.194	0.726	0.652	1.387
	(0.128)	(0.594)	(0.707)	(1.273)	(0.121)	(0.552)	(0.555)	(1.024)
Additional change in training + information	0.0583	-0.812	-0.336	-1.188	0.306*	-0.525	-0.538	-1.086
	(0.0896)	(0.586)	(0.607)	(1.157)	(0.154)	(0.437)	(0.496)	(0.846)
Constant	−1.419***	2.384***	3.333***	5.712***	−1.183***	2.335***	3.150***	5.495***
	(0.112)	(0.206)	(0.322)	(0.508)	(0.0972)	(0.203)	(0.303)	(0.474)
N	1202	1084	1062	1061	3188	2946	2924	2919
R-sq	0.020	0.015	0.014	0.014	0.009	0.047	0.025	0.041

Notes: Robust standard errors in parentheses clustered at the village level. Weight-for-age z-score for each child is calculated by the following formula from WHO Reference (2007): (observed weight – median weight-for-age from reference population)/(Std. deviation of weight-for-age from reference population). Non-kitchen assets are mobile, television, scooter, radio and a flush toilet. The median household owns 60% of the non-kitchen assets at baseline. Mother's visits to center and worker's visits to the home are the visits in the last month as reported by the mother. Total visits is the sum of the two visits. Regressions also control for baseline differences in dependent variables across treatments.
*** p<0.01, ** p<0.05, * p<0.1.

Table 9: Lee (2009) treatment effect bounds on Change in child weight for Training + Information

Panel A: All workers

Number of observations = 2025
Number of selected observations = 1800
Effect 95% conf. interval : [-0.1316, 0.7898]

Change in weight	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
All sample						
lower	0.040	0.104	0.38	0.702	-0.164	0.244
upper	0.617	0.105	5.87	0.000	0.411	0.823

Panel B: Younger workers

Number of observations = 910
Number of selected observations = 818
Effect 95% conf. interval : [0.3067, 1.0909]

Change in weight	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Younger workers						
lower	0.568	0.158	3.59	0.000	0.258	0.877
upper	0.821	0.163	5.03	0.000	0.501	1.141

Panel C: Older workers

Number of observations = 1115
Number of selected observations = 982
Effect 95% conf. interval : [-0.6938, 0.7832]

Change in weight	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Older workers						
lower	-0.470	0.136	-3.45	0.001	-0.737	-0.203
upper	0.553	0.140	3.95	0.000	0.279	0.827

FIGURES

Figure 1: Map of Anganwadis in the experiment (source: Google Maps)

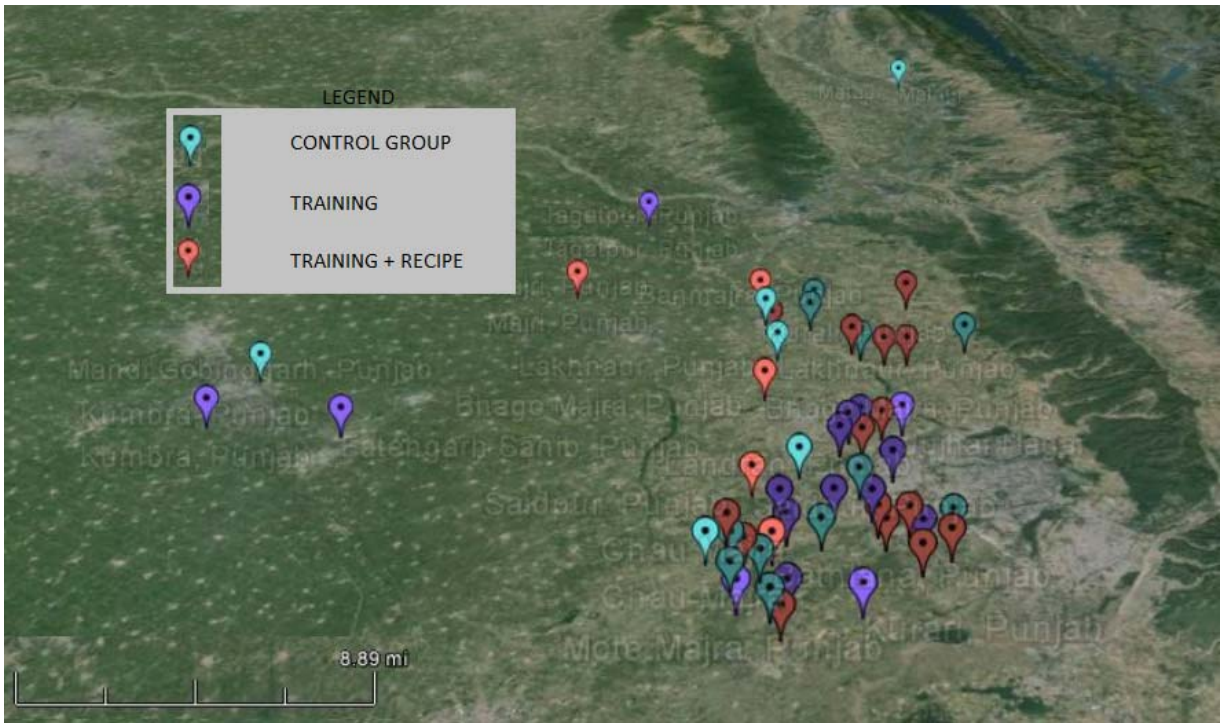

Figure 2. Child age decomposition and changes in weight by treatment and control groups

Figure 3. Worker age decomposition and changes in weight by treatment and control groups

APPENDIX

Appendix Table 1: How satisfied are you with the following work characteristics? (1=min, 7 =max)

	Observations	Average	Std. dev.	Min	Max
Salary growth potential	4579	4.917668	2.435268	1	7
Present salary	4560	3.777632	2.572678	1	7
Relations with supervisor	4604	6.387272	1.526825	1	7
Job security	4588	6.073888	1.686321	1	7
Own capability	4558	6.215226	1.656466	1	7
Own work	4604	6.109036	1.72654	1	7
Job timings	4579	6.572614	1.30585	1	7
Overall job satisfaction	4539	5.789381	1.972746	1	7

Table A2: Mother and Worker knowledge

VARIABLES	Panel A: Mother knowledge			Panel B: Worker knowledge		
	Quiz Score	**Recipe Score**	**Non-recipe Score**	**Quiz Score**	**Recipe Score**	**Non-recipe Score**
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.888	0.212	0.565***	0.543	0.0805	-0.167
	(0.536)	(0.394)	(0.199)	(0.499)	(0.706)	(0.409)
Training	-0.630	-0.620	-0.156	-0.0987	0.0735	-0.0230
	(0.571)	(0.422)	(0.233)	(0.468)	(0.396)	(0.224)
Training+Recipe	-0.352	-0.113	-0.325	0.191	0.167	-0.107
	(0.614)	(0.432)	(0.227)	(0.483)	(0.424)	(0.269)
Post*Training	1.183	1.072	0.301	0.0376	-0.137	0.614
	(0.851)	(0.650)	(0.304)	(0.692)	(0.725)	(0.394)
Post*(Training+Recipe)	0.00809	-0.309	-0.236	-1.032	-0.202	-0.228
	(0.637)	(0.512)	(0.283)	(0.831)	(0.838)	(0.486)
Other controls	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Constant	12.522***	7.501***	5.021***	13.283***	7.993***	5.290***
	(0.205)	(0.140)	(0.096)	(0.652)	(0.498)	(0.260)
Observations	8824	8824	8824	7335	7335	7335
R-squared	0.066	0.079	0.025	0.083	0.101	0.040

Notes: Robust standard errors in parentheses clustered at the village level. Quiz score is out of 20 where recipe and non-recipe scores are out of 13 and 7 respectively. The recipe score accounts for questions related directly to information in the recipe book. Other controls include: Age of mother, Proportion kitchen, Proportion non-kitchen, Household Income, Age of worker, and the following dummy variables: Gender of child, Mother housewife, Mother is Hindu, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read and write), Literate father, Educated worker (at least till A-level), Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Helper in Anganwadi, Weight chart in Anganwadi. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Non-kitchen assets are mobile, television, scooter, radio and a flush toilet. *** p<0.01, ** p<0.05, * p<0.1.