Spillovers in learning and behavior: Evidence from a nutritional information campaign in urban slums

Singh, Prakarsh

Amherst College, London School of Economics

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Prakarsh Singh†
Department of Economics, Amherst College

Abstract

This paper provides evidence for spillovers in learning and behavior within urban slums in Chandigarh, India. In an experiment, mothers of children (aged 3-6 years) enrolled in government day-care centers were provided recipe books to lower their price per calorie. Theory suggests that if learning takes place among untreated mothers in the same slum cluster, it may increase or decrease their food expenditure. Results from a difference-in-differences analysis show that nutritional knowledge increases among untreated mothers and there is a corresponding *reduction* in food expenditure. These neighbouring mothers exhibit learning spillovers and a reduction in expenditure regardless of their level of literacy.

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†Email: psingh@amherst.edu. Address: 305 Converse Hall, Amherst College, Amherst MA 01002. Tel: (542)–2271.

1 Introduction

Information dissemination affects knowledge, investments and outcomes and this in turn may have wide-ranging consequences (Reinikka and Svensson, 2005; Banerjee et al., 2010). If change in the information available to a household member changes her level of knowledge and in turn her behavior, then it is vital to understand if this would influence other households. In this paper, I provide empirical evidence on how an informational treatment to an individual shapes the behavior of her neighbors. In particular, I find the presence of positive inter-household spillovers in learning and also on behavior.

The treatment involved specific nutritional information in the form of recipe books custom-designed for mothers living in urban slums in Chandigarh, India where child malnutrition (as per WHO standards) was very high at 35 percent. The information was imparted to mothers who have their children enrolled in day care centers or 'Anganwadis' run by the Government of India. In each of these centers, there is a child care worker whose role includes advising the mother on child nutrition by making home visits[1]. Informational treatment in this context aims to decrease the price per calorie for the mother by giving her a list of economical and nutritious recipes.

Despite the government program having been in place for 35 years and now spanning over 1 million centers, child malnutrition in India is at 37 percent amongst children up to 5 years of age (DHS, 2005). Sen (2005) argues that it is surprising that those at the poverty line do not buy more calories as they could easily afford the calories within their food budget if they had the same food purchasing patterns as those below the poverty line[2]. Mothers seem to lack nutritional knowledge as 65 percent of the mothers interviewed at baseline did not know that the recommended number of meals for children under 6 is 5-6 times a day and their average nutritional quiz score was 25% less than that of the child care worker. However, if spillover effects are important, then targeting a sub-sample of mothers with nutritional information may achieve an increase in knowledge of neighboring mothers as well.

[1]The other main role of the child care worker is to allocate mid-day meals to children in the Anganwadi.

[2]In urban areas of India, there was little change in average calorie consumption between 1983-2005 despite rising per capita incomes with little change in the price of calories relative to other commodities (Deaton and Dreze, 2008). Deaton and Subramanian (1996) calculate that the poor consume slightly less than 1400 calories per day. This is 1000 calories short of the recommended intake. It is important to note that less than 1% of the rural households report lack of food in the state of Punjab, of which Chandigarh is the capital (Deaton and Dreze, 2008).

To identify spillover effects, we compare treated mothers from selected Anganwadis (child day-care centers) to untreated mothers from the remaining Anganwadis in the same cluster both pre and post the informational treatment[3]. Moreover, to account for the natural changes in outcomes over the time period that would have occurred even without the treatment, a comparable set of Anganwadis within the same city (but in a geographically separate block) act as a control group. This also controls for seasonality effects, city-wide shocks to food prices and any other unobservables that would similarly impact all groups. However, there would be two main identifying assumptions in applying the difference-in-differences analysis: first, the treated mothers do not follow differential trends in behavior or knowledge as compared to the untreated mothers in the same slum cluster prior to the treatment. Second, the treated mothers' outcomes do not follow different pre-treatment trends relative to those in the control group. I find that the treated and untreated mothers in the same cluster are ex-ante similar to each other on all observables and also to the control group. However, I cannot check for pre-existing trends in knowledge or behavior[4].

By measuring spillovers, we can evaluate the effectiveness of information campaigns in affecting the health behavior of neighbors. In particular, untreated mothers in the same cluster as treated mothers exhibit changes in (i) nutritional knowledge, (ii) child's dietary intake and (iii) food expenditure. Finally, the paper tests for any spillovers on child health as measured by weight-for-age z-scores.

Theoretically, the impact on food expenditure for the spillover group is ambiguous. The recipe book may increase or decrease food expenditure depending on the direct effect through a fall in price per calorie and indirect effect through a rise in calorie intake. I find that nutritional knowledge increases as measured by a multiple-choice quiz administered on the mothers. Moreover, the increase in nutritional knowledge in the spillover group is limited to questions related directly to the informational treatment and not to out-of-book questions. Corresponding to the increase in nutritional knowledge, we observe a reduction in food expenditure for the spillover group. But there is no effect on reducing child malnutrition. This is not surprising, as there was also no impact on improving health of children whose mothers were directly treated with information (Singh, 2011a). There seems to be no existing research on

[3]For details on how the Anganwadis were selected, please see the Methodology section.

[4]Nevertheless, to test for spillover effects on child weight, the pre-existing linear trends in all the groups can be checked because of recorded weight data prior to baseline. I do not find any evidence of differential trends in weight.

the extent of learning and behavioral externalities in health arising out of a nutritional information campaign.

It is also relevant to test if these effects may be different for differently educated household members. For example, do literate mothers gain more from an informational treatment? It may be the case that literate mothers are able to read the printed information or they have higher retention capacity making them more amenable to receive new information. A priori, it is not clear if there would be any impact of the treatment on child health for mothers who cannot read. For example, neighbors or literate husbands can teach uneducated mothers from the recipe book. I find no evidence of intra-household knowledge transfer from a literate father to a treated illiterate mother. Nevertheless, illiterate mothers do show an increase in their knowledge when treated with the recipe book and there also emerge learning spillovers on untreated illiterate mothers in the same slum. This provides suggestive evidence that illiterate treated mothers may learn by asking neighboring mothers while illiterate untreated mothers may increase nutritional knowledge if their neighbors are treated.

The literature on the impact of informational campaigns is plagued with self-selection issues[5]. Individuals could self-select into network groups based on their characteristics. However, I find the ex-ante observable characteristics of mothers between the different groups to be very similar and it is important to keep in mind that they are all mothers associated with similar Anganwadis in slum areas in the same city. There are almost no issues of self-selection within the treated and untreated groups as compliance among mothers is close to 95 percent and similar across all groups. There may be a bias in measuring spillover effects if social group formation is endogenous (Manski, 1993). However, in my setting, this is not a concern on the extensive margin as the relevant spillover group is geographically separated from the control group and there are no reported migrations between the control clusters and other clusters containing both the treated and untreated Anganwadis. On the intensive margin, within slum clusters, mothers with recipe books may encourage formation of new peer groups but this cannot be addressed in the present study as I study spillovers only on mothers living in the same cluster who send their children to untreated Anganwadis.

This paper is related to three strands of research. First, it relates to the nascent literature on spillover effects in public health. Although, it

[5]For example, Siegel and Biener (2000) and Hsieh et al. (1994) construct treatment and control groups based on recall exposure to media when they study the effect of an anti-smoking media campaign on smoking behavior. This methodology may suffer from a bias if recall exposure is dependent on if a person smokes or not.

is rare to detect presence of an externality in public health interventions, Miguel and Kremer (2004) showed treatment externalities of deworming on child health. Godlonton and Thornton (2011) incentivized individuals for HIV testing and found positive learning spillovers on their neighbors. This is in line with results showing influence on peers to use contraception, menstrual cups and utilizing health services (Speizer et. al., 2001; Oster and Thornton, 2011; Deri, 2005). Chaudhuri (2009) finds positive spillovers of a health education program for mothers and children in Bangladesh on the health of untreated elderly women in the same household. Thus, the current literature focuses either on learning, behavioral or final health outcomes, whereas in this paper, I study all three outcomes[6]. My results confirm inter-household spillovers on knowledge and food expenditure but not on weight and these effects are similar to the effects observed in treated households. A priori, informational spillovers may not always lead to similar behavior[7].

Another strand deals with how individual decisions depend upon the choices of others in the same social network, where these individuals are usually profit-maximizing farmers (Bandiera and Rasul, 2006; Conley and Udry, 2010). Their results are different but do emphasize the importance of social networks in learning[8].

Third, several studies show the complementarity between being educated and benefiting from information campaigns that lead to an increase in the knowledge gap between the informed and the less informed (Tichenor et al., 1970; Kwak, 1999; Nadeau et al., 2008). My results are consistent with these studies as literate mothers seem to gain more knowledge from the informational treatment. However, learning spillovers act to reduce this informational gap between the treated and the untreated in the same cluster.

This paper will not be able to address the minimum number of mothers that should be targeted by the information treatment to attain spillovers to achieve the highest benefit-cost ratio. It can only provide evidence for the existence of spillovers in learning and health outcomes given a specific level of treatment in a specific geographical setting. As spillovers may have scale effects depending on how many mothers in the

[6]Snyder (2007) points out in his review on the impact of informational campaigns that it is not known how successful nutritional campaigns are at changing the intermediate outcome of knowledge.

[7]Although, Duflo and Saez (2003) find positive informational spillovers in a pension scheme, Duflo et al. (2007) show no social learning effects in fertilizer use. Moreover, having peers who have been treated with deworming lowers the personal likelihood of getting dewormed (Kremer and Miguel, 2007).

[8]However, it is not necessary that their results should also hold true within a household as a mother may intrinsically care for her child to be healthy.

slum are being treated, it is clearly not possible to generalize for different intensities of treatment within a geographical area. Similarly, it cannot assess whether information should be imparted by print (newspapers and magazines) or electronic media (radio and television) to maximize spillovers as it considers only one informational treatment in urban slum clusters.

The paper is organized as follows. Section 2 provides the details of the experiment. Section 3 develops a conceptual framework. Section 4 describes the specification and core results. Section 5 reports how spillover effects vary according to mother's literacy. Section 6 concludes.

2 Experiment

2.1 Background

The research project involved performance pay to child care workers and the recipe treatment to mothers in separate geographical blocks. In this paper, I focus on the recipe treatment and the "leftover group" from the informational block, or the spillover group. Figure 1 depicts the locations of the Anganwadis in the recipe treatment, spillover group and control group centers. There are 36, 20 and 36 centers in each group respectively, with the recipe and spillover centers being part of one administrative block and the control being part of another as shown. I assess the extent of informational spillovers between mothers sending their children to different Anganwadis but located within the same slum area.

2.2 Methodology

Matching was resorted to for selecting Anganwadis for both the recipe treatment and the control group. In December 2009, data on malnutrition rates at the Anganwadi-level was collected from the local Health Department. Chandigarh has 370 Anganwadis divided into 3 blocks. All workers were provided a performance-pay incentive in one block (Block 1). A total of 36 centres were selected from Block 3 to receive the recipe book treatment and 36 centres were selected from Block 2 to act as control. These groups were selected by an algorithm that matched the malnutrition averages of centres from Block 2 and 3 to that of Block 1[9]. Similarly, the control group centers were also selected by matching on

[9]The matching was conducted on the average malnutrition rate of Block 1 because all the 73 Anganwadis in this block needed to be assigned the incentive treatment for optimal power.

the average of this block[10]. The matching exercise served two purposes: first, it allowed selection of 36 centers in each group to attain optimal power. Second, it made the selection of the control group comparable to other treatments, as here, the matched and unmatched centers were significantly different in their average malnutrition rates.

It is thus, an empirical question whether those that were left unmatched were significantly different in observables from the matched. If the matched and unmatched centers are ex-ante similar, the spillover effects of the recipe treatment can be inferred from the changes in outcomes in the unmatched group relative to control using difference-in-differences. This interpretation rests on the identification assumption that there are no time varying effects that are correlated with the treatment (common trend assumption). In other words, first, the treated mothers do not follow differential trends in behavior or knowledge as compared to the untreated mothers in the same slum cluster prior to the treatment. Second, the treated mothers' outcomes do not follow different pre-treatment trends relative to those in the control group.

2.3 Implementation

To design the recipe book, ten simple cost-effective recipes were selected from the Government's publicly available book on Nutritious Recipes for Complementary Feeding of Young Children. The recipes use only locally available ingredients and were attractively designed and printed in the vernacular (Hindi). Each recipe was rich in calories and could be easily made at home within a budget of Rs. 4 for 150 gms[11]. The book contained information on ingredients, step-by-step instructions and nutritive value (calories, protein, iron and carotene) for each preparation. Figure A1 in the Appendix illustrates a recipe from the book. Two clear aims of the recipe book were to first, reduce the price per calorie incurred by the mother by increasing her knowledge of nutritious recipes and second, to improve the communication between the mother and the child care worker[12].

It also had information on hygiene and good food habits and high-

[10] The control group was selected from Block 2 because the selected group had less variance in inter-Anganwadi malnutrition than the group from Block 3 and Block 1. This assignment would allow us to test for heterogeneous treatment effects. Block 1 was selected for the incentive treatment because it had the most number of Anganwadis.

[11] This was calculated by the local Nutritionist, Food and Nutrition Board (Rs. 4 = 9 cents).

[12] Apart from the worker being able to use the recipes as a reference point, each page had boxes at the bottom which mothers were asked to tick when they prepared that particular recipe.

lighted food items rich in calories, protein, iron and carotene. At baseline, only 45 percent of the mothers could read but they were given the book even if they could not. Also, 73 percent of the fathers were literate as reported by the mother. The informational environment is such that the workers know that the mothers are getting the book and the mothers also know that the workers are aware of this fact.

In April 2010, a team of nine enumerators weighed children on digital weighing machines and interviewed mothers of these children[13]. Weights were recorded before the mid-day meal and it was ensured that children were not in heavy clothing. The interviews were taken by calling mothers to the Anganwadi at specified times. Enumerators collected information on demographics of the household, diet of the child and mother-worker interaction. A quiz was administered to judge the nutritional knowledge of all the mothers and the worker. The multiple-choice quiz for mothers had 5 questions (worth 13 points because of multiple answers per question) that could be answered by reading the recipe book. The next 4 questions (worth 7 points) were "out-of-book". Mothers in the recipe treatment were provided with the recipe book after they were quizzed, whereas mothers in the spillover or control group did not get the book. Enumerators also noted the previous weight recorded in registers for each child.

A window of 3 months was chosen for the experiment because it is the average time duration between two medical check-ups by the local Health Department. The duration was verified to be sufficient for a grade improvement to occur by doctors at the local office of the Health Department, Government of India.

The second round of the experiment was conducted in July 2010. The children were weighed again and questionnaires re-administered to mothers.

2.4 Compliance and attrition

Table 1 shows the compliance and attrition rates. There were 36 Anganwadis each in the recipe and control groups and the remaining untreated 20 centers from the recipe block formed the spillover group. At baseline and at endline, on average 96 percent of the children weighed also had their mothers quizzed, indicating a high compliance rate. High compliance mitigates the concern that there is a selection bias in certain types of mothers being quizzed and given the recipe book. Moreover, high compliance is observed for all groups addressing the possibility of

[13]Enumerators were trained and supervised by me on the ground throughout the experiment. The weighing machines used in both rounds were re-used for the same set of children for accuracy.

systematic selection of different types of mothers in different groups and strengthening internal validity. A total of 2632 children were weighed twice in the treatment, spillover and control groups. The attrition rate was 13 percent for the children. which is considered normal as children leave the day-care centers for admission in schools or if the family migrates. In Table A1, the observable characteristics of the attrited sample from baseline show insignificant normalized differences relative to control for almost all relevant variables[14]. Also, there is no movement of children between centers (even within the same cluster) as the same set of children for each Anganwadi are covered in the two rounds.

2.5 Summary statistics

Table 2 lists the summary statistics from the recipe, spillover and control groups as well as the normalized differences between them. We find that in the recipe and spillover groups, the average z-score and malnutrition rates are insignificantly different from the control group. Similarly, the average age of a child is about four years and four months and the mother is just over 28 years old. On average, the household income is slightly lower in the recipe and spillover groups relative to the control at around $75 a month[15]. Also, fridge ownership in the recipe and spillover groups is half of that in the control. Close to 75 percent of all mothers are housewives[16]. Close to 70 percent of the households own a mobile phone, but less than 4 percent own a water filter in the recipe treatment. At baseline, the mother's average nutritional knowledge score as measured by a quiz is 12.4 compared to 15 for the Anganwadi workers. The normalized differences show that on the whole, the observable statistics are very similar across all groups barring ownership of fridge[17].

In terms of diet, more than 80 percent of the mothers provide milk and green vegetables at least twice a week to their children. However, more than 50 percent are unable to give their children fruits and only 11 percent give traditional sweets that are rich in calories and less than 10 percent provide non-vegetarian food with a frequency of two times a week. On average, households report spending 52 percent of their income on food.

[14] Only quiz score in the recipe treatment and income in spillover group have significant normalized differences of 0.29 and 0.27 respectively.

[15] Assuming 1$=Rs. 45.

[16] Housewife is a dummy equal to 1 for those mothers who identify themselves as housewives and who do not work outside the home.

[17] The infrastructure in the Anganwadi centres (blackboard, chart, toilet, drinking water, electricity) are very similar across all groups and wages of workers are identical.

3 Conceptual framework

One of the aims of the recipe book was to reduce the price per calorie (p). I assume that the recipe treatment leads to a decrease in p. The mother maximizes her utility, $u = u(h, n)$ where h is the health of her child and n is the consumption of other household items. The health function of the child is $h(q)$ where q is the number of calories her child receives. Assume $\frac{\partial h}{\partial q} = h_q > 0$. She faces a budget constraint: $pq + p_o n \leq m$. Here, p_o is the price and n the quantity of all other goods.

Assume, $u = h^{\alpha} n^{1-\alpha}$, we solve for the maximization problem and find $\frac{\partial q}{\partial p}$ at the optimum. As the total expenditure on calories by a household is $p.q$, the change in expenditure due to a change in p can be expressed as follows after plugging in $\frac{\partial q}{\partial p}$ at the optimum found earlier:

The change in expenditure can be expressed as follows:

$$\triangle E = \underbrace{-\frac{\triangle pm}{p(1 + h^* \frac{(1-\alpha)}{\alpha})}}_{\text{indirect effect}} + \underbrace{q \triangle p}_{\text{direct effect}} \tag{1}$$

where

$$h^* = \frac{h.h_{qq}}{h_q^2}$$

This means that when there is a fall in price per calorie, $\triangle E$ will be positive or negative depending on whether the direct effect is dominated by the indirect effect or not. The indirect effect makes the food expenditure increase as the household finds it cheaper to feed calories, thereby increasing their consumption. The direct effect reduces the food expenditure because the price is reduced per calorie. It is unclear which of the two effects is likely to be stronger in the treatment and spillover groups. One can imagine an extreme case where the indirect effect dominates the direct effect for the recipe group leading to an increase in expenditure, whereas the reverse happens for the spillover group. For this to occur, the recipe book's second aim of improving communication needs to be analyzed further. Assume initially that the recipe book leads to a decline in price per calorie for both the treatment and spillover groups. Note that learning from treated mothers may allow the workers to communicate more effectively with spillover group mothers. However, having the recipe book physically is also likely to be important. This is because the recipe book can be used to monitor and remind the mothers on cooking recipes. The use of the recipe book as a reference by the worker on her home visits makes the mother-worker communication

more effective as found in Singh (2011a). If the recipe book allows the worker to communicate better with the treated mother leading to *more* calorific recipes being cooked, expenditure may actually increase for the recipe treatment and decrease for the spillover group[18]. This happens because the indirect effect dominates the direct effect in equation (2).

4 Empirical specification and results

4.1 Empirical Specification

The baseline regression specification for finding learning and spillover effects on learning is as follows:

$q_{ijt} = \alpha(post)_t + \beta(recipe)_j + \gamma(spillover)_j + \eta(post * recipe)_{jt} + \theta(post * spillover)_{jt} + X_{ijt} + \varepsilon_{ijt}$

q_{ijt} is the quiz score of mother of child i in Anganwadi j at time t. The variable *post* is a dummy that is 0 for baseline and 1 for endline. The variables *recipe* is 1 if the child is in the recipe treatment and 0 otherwise. X_{ijt} encompasses individual and Anganwadi specific controls[19]. The error term is clustered by Anganwadi. The variable *post* accounts for the natural increase in knowledge in 3 months, all seasonal effects on knowledge, regional shocks in levels of information (through for example, radio and print advertisements on health) and any management changes or unobservables that would impact all groups in the same way. β and γ are the baseline differences between the recipe and spillover groups and the control. η and θ are the difference-in-differences estimates for the learning and spillover effects with the underlying common trends assumption.

4.2 Knowledge

Table 3 shows the spillovers on learning of providing the recipe book. Learning is proxied by a quiz score as measured by a 20 point mother's quiz implemented at baseline and endline. The spillover group shows strong learning spillovers. It has an increase in the quiz score which is comparatively smaller compared to the increase in the recipe treatment but still high and significant. This suggests that there was direct learning from the recipe book as well as learning spillovers. The quiz contained two sections: a 13 point section that could be answered by

[18] One possible theoretical channel through which better communication will strengthen the indirect effect may be increasing α for the mother when the worker uses the recipe book as a reference point for training the mother.

[19] It also includes individual dummies for other treatments implemented during the study in another block ($incentive_j$ and $combined_j$) as well as their interactions with *post*. See Singh (2011a) for details of these treatments. This has been done to improve efficiency but makes no difference to our estimates.

reading the recipe book and a general 7 point non-recipe section. It is important to note that the increase in the spillover group is from the recipe score section (as in the direct treatment) giving further impetus to the mechanism that strong informational learning and spillovers took place because of the recipe book. As an additional robustness check, all mothers at endline were asked if they had learnt any new recipes from other mothers in the previous month. I find that 41% and 30% more mothers report learning a new recipe from other mothers in the recipe and spillover group respectively relative to control.

4.3 Diet

In Table 4, the results are from a regression that has the variable food item intake for the child as the dependent variable which is 1 if this item has been consumed at least twice a week on average in the last three months (as reported by the mother). We observe that on average there is no significant impact of the recipe treatment on the consumption of green vegetables or eggs for both the recipe and spillover groups. However, there is a significant increase in porridge consumption in the spillover group indicating spillovers on behavior. This is consistent with learning spillovers and also higher porridge intake in the recipe treatment[20]. There are three potential explanations for the higher porridge coefficient for the spillover group: first, the baseline difference in porridge diet is also higher in the recipe group relative to the spillover group, indicating a catch-up effect. Second, in the spillover group, the proportional increase in porridge consumption is not higher in magnitude relative to the proportional increase in sweets in the recipe treatment (28 percent increase over the baseline for the spillover group compared to a 41 percent increase in sweet consumption for the recipe book even though the latter is insignificantly different from 0). This may suggest different substitution between the different diets in the recipe and spillover groups. The recipe book does contain a recipe for the porridge and it is relatively simple to make, but as six out of the ten recipes can be classified as sweets, it is a little surprising to see no significant increase in the consumption of sweets in the recipe group[21]. Third, the substitution between cheap recipes like porridge and relatively more expensive items like sweets can be illustrated with how diet changes as a child has more

[20]There appears to be a greater difference between the two groups in increasing traditional sweet intake (higher for recipe group) and porridge (higher for spillover group), but these differences are insignificant.

[21]In Singh (2011a), the increase in consumption of sweets only takes place when recipes to mothers are combined with performance-pay incentives to workers as the workers are then more likely to make personalized visits to the homes of the mothers to teach them about specific recipes.

siblings (from Figures in Appendix A2 and A3)[22].

4.4 Food expenditure

We observe in Table 5 that there was a significant reduction in food expenditure in the recipe and spillover groups. The increase in knowledge in the spillover group as well as the recipe treatment lends credibility to this result being at least partly because of the informational transfer from the recipe book. It implies that it is not imitation of their neighbors that is driving the result in the spillover group but strong learning and behavioral spillovers[23].

We also note that the reduction in food expenditure is much greater for the spillover group in magnitude, although the difference is not significant due to coefficients being imprecisely estimated. One reason could be that for the recipe book treatment, there appears to be better communication between the mother and the worker, wherein the worker reminds and monitors mothers with the aid of the recipe book. There is weak evidence for supporting this argument in the sub-section in the Appendix in Table A5. The indirect effect from mother-worker communication should in turn lead to an increase in calorific food (especially traditional desserts), but there appears to be no significant increase in its consumption in the recipe treatment, even though its coefficient is much larger than that in the spillover group. Thus, one reason why the food expenditure decrease is greater for the spillover group is that mothers shift to extremely low-cost food (like porridge) whereas in the treatment group they shift towards recipes with lower price per calorie but relatively higher cost (e.g. sweets).

4.5 Weight

Table 6 illustrates the results for the final health outcomes: weight, grade, z-score and malnutrition status. We find that there are no spillovers on the weight of the child, her malnutrition grade, z-score or the like-

[22] At endline, recipe treatment mothers were asked how many times they cooked each recipe. The responses suggested that the three most popular recipes from the book were Suji Halwa (traditional Indian dessert), Khichdi (Rice-Lentil gruel) and Dalia (Porridge).

[23] One possible explanation for this reduction in food expenditure could be a change in actual market food prices in the treatment block relative to the control group. This would not have anything to do with the treatment. However, I collected data on market prices for major food items (milk, fruits, vegetables, cereals, sweets, chicken) for each cluster at endline and found no significant price differences between slum clusters for any food item. Moreover, the relatively small geographical area with good transport infrastructure in the city would make any price discrepancies between clusters minimal.

lihood of being malnourished. The result is robust to including a vast array of controls. This shows that on average providing recipe books to mothers has no direct impact on the weight of her child or the child of the same slum-dwelling mothers.

The result may be somewhat surprising in the light of an increase in porridge consumption in both groups. However, an increase in the intake of porridge increase does not necessarily imply that the weight should go up. There could be a threshold of energy intake that may be necessary to cross for the weight to increase. When workers were incentivized without mothers receiving the recipe book, there was an increase in the intake of calorific sweets but the weight did not improve (Singh, 2011a). However, it is possible that the weight may go up in the long run, as we do not really know the time it takes for a dietary increase to translate to a significant weight increase. Moreover, there may be other food items that the mother may be substituting with porridge that are not captured in our analysis. Similarly, the weight in the short run in the spillover group does not appear to be correlated with knowledge as is the case with the recipe treatment, where the knowledge increases but the weight does not.

5 Heterogeneity

The heterogeneity specification for finding learning and spillover effects of literate mothers on learning outcomes is as follows:

$q_{ijt} = \alpha(post)_t + \sum_k \delta_k(treatment_k)_j + \rho(literate)_i + \sum_k \eta_k(post * treatment_k)_{jt} + \phi(post * literate)_{it} + \sum_k \theta_k(literate * treatment_k)_{jt} + \sum_k \omega_k(literate * post * treatment_k)_{ijt} + X_{ijt} + \varepsilon_{ijt}$

As usual, *post* is a dummy that is 0 for baseline and 1 for endline. The variable $treatment_k$ are the individual treatment dummies: recipe and spillover[24]. The dummy *treatment* is 1 if the child is in the specific treatment and 0 otherwise. X_{ijt} includes individual and Anganwadi specific controls. To test the hypothesis that the recipe treatment has an impact on knowledge for literate mothers, we need to test if $\eta_1 + \omega_1 = 0$, where $k = 1$ for the recipe treatment.

5.1 Literate mother

It is important to understand how the information spreads to other mothers in the vicinity. Does it depend on whether the mother is literate

[24]Including or excluding the observations from other treatments implemented in the project to a separate block does not make a difference to the interpretation of any of our results. These have been included in the background for improving efficiency but the gains are very minimal and results are extremely robust to only focusing on recipe and spillover groups.

or not? If it does, then the spillovers may suggest that literate mothers share information only with other literate mothers in the slum area or even if they interact with illiterate mothers, these mothers may not be able to retain and apply the information. If it does not, it may mean that information transfer is not restricted to literate mothers. Indeed, this would be of policy relevance, especially because this would imply that printed information can trickle down to even those who cannot read it.

Table 7 provides evidence for the heterogeneous impacts on weight-for-age z-scores, knowledge and food expenditure of a mother being literate. The direct impact in learning appears to be much greater for literate as compared to illiterate mothers. In the spillover group, learning takes place to a similar degree for both literate and illiterate mothers. A literate mother's quiz score is significantly higher relative to an illiterate mother if she is in the recipe treatment but not if she is in the spillover group. This implies that the nutritional knowledge increase happens on average for both literate and illiterate mothers in the spillover group. The sum of the coefficients on Post*Recipe and Mother can read*Post*Recipe is significantly different from 0 for quiz score at the 1 percent significance level. However, informational spillovers on learning of same-slum dwelling mothers are not restricted to them being literate. This suggests that social networking among mothers in the same slum matters and information is transferred through verbal communication. There could be two channels of informational transfer. First, illiterate mothers may ask neighboring literate mothers or their Anganwadi worker to read out recipes. Second, literate mothers may share information with both literate and illiterate mothers. I find some evidence for the first channel to be active as the informational increase in the recipe treatment is 0.82 points for illiterate but 1.78 points for literate mothers in the quiz. Moreover, it appears not to go through the worker but through literate mothers because there is no differential increase in communication between the worker and the illiterate mother receiving the treatment. But, the second channel is clearly demonstrated by an increase in the quiz score of the spillover mothers regardless of them being literate. Another mechanism by which the mothers in the spillover groups may get their information may be through their Anganwadi workers (who talk with workers or mothers from treated Anganwadis). However, I do not observe an increase in the quiz scores of the workers from treated or spillover Anganwadis.

The consistency of the result that having literate mother at home matters for both knowledge and health is in contrast to having a literate father at home as shown in Table A2. There are very small increases in

quiz scores for treated mothers if fathers are literate, which may indicate the presence of transaction costs within a household that prohibit informational transfer either because the literate father does not read to the mother (who also cooks the food) or the illiterate mother does not seek his advice or if there is transfer, then she is unable to retain what she is taught because of lower retentive capacity for information[25]. The latter channel is unlikely given that there appear to be informational spillovers from literate to illiterate mothers within a slum. Moreover, social networks within slum clusters as opposed to fathers seem to be responsible for the 0.82 point increase observed for illiterate treated mothers, further strengthening the first channel in the previous paragraph.

In line with the above results, we find that food expenditure is reduced across the board for literate and illiterate mothers in the spillover group, but there is a premium in the recipe treatment of being literate in reducing expenditure on food. Thus, nutritional information campaigns may have differential direct effects for literate mothers increasing the knowledge gap between the literate and the illiterate in the treated group. As discussed in the Introduction, this is in line with the existing literature on information campaigns. However, spillovers appear to be less heterogeneous in both learning and behavior[26].

A related policy implication is that if the mother can read, she is able to raise the z-score of her child if she gets the recipe book. The direct impact on learning for literate mothers also corresponds to a decrease of about 4.5 percent in the probability of child being categorized as malnourished according to the Anganwadi norms. The coefficients have the same sign but are smaller and insignificant if malnutrition is classified according to WHO Reference (2007). This implies that the children who seem to gain most are those who are mildly malnourished according to the Anganwadis and those whose mothers are literate[27].

[25] In line with this result, there seems to be no complementarity in learning if both the mother and the father can read. If we had also been able to test the father's nutritional knowledge, we would have been able to check if the communication channels are closed from father to mother or vice versa. It was not possible due to budget and time constraints.

[26] As the channel of behavioral change is through diet of the child at home, we can expect that the technology of food production may also have heterogeneous treatment and spillover effects. I test for this in the Appendix using kitchen assets ownership as a proxy for food production technology and find heterogeneity in treatment effects but not for spillovers.

[27] If the weight is between 70-80% of the median weight-for-age, the child is classified as mildly malnourished. The WHO Reference (2007) makes use of z-scores to classify malnutrition.

6 Conclusion

Health interventions often have unintended consequences. Detecting the extent and kind of externalities may be very relevant for shaping public health policy. However, very little is known about the spillovers associated with nutritional information campaigns. I test for spillovers in behavior and learning in the specific context of nutritional information dissemination through recipe books in urban slums. These appears to generate on average no positive spillovers on the malnutrition status of a child in the short run. But, if the policy maker cares about improving general nutritional knowledge and reducing food expenditure for households at the poverty line living in urban slums, the information campaign is effective and there is evidence of strong externalities on learning and behavior for other households within the same slum cluster[28]. In particular, the quiz score of neighboring mothers increases. The increase in the quiz score is significant and is driven by the component of the quiz directly related to the recipe book. There are also spillovers on intake of porridge, which improves without any observable decline in other foods. Thus, this paper provides one of the first pieces of evidence on how spillovers in both learning and behavior can take place of an information campaign. Moreover, the empirical methodology allays concerns of endogeneity as recipe and spillover groups are very similar to the control group.

It was theoretically ambiguous if the food expenditure would increase or decrease after receiving information due to a behavioral change in child's dietary intake by the mother. We find that there is a significant and large decrease in food expenditure in the spillover group. The decrease in food expenditure is equivalent to 29 percent for the mothers in the spillover group. The resulting saving may lead to greater welfare for the family, but the intra-household effects need further probing. This reduction in food expenditure does not seem to have any adverse impact on child health.

Thus, policy makers should not merely judge the effectiveness of nutritional information campaigns by considering the impact it would have on the direct beneficiaries. Spillovers in learning and behavior are likely to be an important source of the effectiveness of such campaigns and the determinants of such spillovers may include both environmental and human factors as well as their interaction. In this paper, I am unable

[28] As spillover effects can be different depending on the intensity of the intervention, the results may not have external validity for other intensity levels. In particular, the intensity that can be calculated as the ratio of total treated mothers to spillover mothers (in slum clusters where at least one centre was in the spillover group) is equal to 608/1001 or 60.7 percent.

to address how, for instance, population density and proximity affect spillovers (due to unavailability of data). However, I do find that being literate does not lead to greater spillovers as the nutritional information is transmitted orally. The spillovers cross the literacy barrier and thus, assist in reducing the informational gap that is exacerbated between the literate and the illiterate as a result of the informational treatment.

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Tables and Figures

Table 1: Compliance and attrition rates

		Recipe	Spillover	Control	Total
Round 1	children weighed	1145	662	1231	3038
	children whose mothers quizzed	1089	608	1207	2904
	% children whose mothers quizzed	**95**	**92**	**98**	**96**
Round 2	children weighed	964	577	1091	2632
	children whose mothers quizzed	908	554	1053	2515
	% children whose mothers quizzed	**94**	**96**	**97**	**96**
	% children weighed again	**84**	**87**	**89**	**87**
	% mothers quizzed again	**83**	**91**	**87**	**87**

Table 2: Summary statistics from the baseline

				Normalized Differences	
VARIABLES	**Recipe**	**Spillover**	**Control**	**Recipe**	**Spillover**
Weight (in kgs)	13.21	13.25	13.29	-0.03	-0.02
	(1.84)	(1.75)	(1.86)		
Grade (according to IAP)	4.17	4.21	4.21	-0.04	0.00
	(0.78)	(0.81)	(0.78)		
z-score (according to WHO, 2007)	-1.7	-1.64	-1.66	-0.04	0.02
	(0.76)	(0.77)	(0.78)		
Malnutrition (according to WHO, 2007)	.36	.33	.33	0.04	0.00
	(.48)	(.47)	(.47)		
Malnutrition (according to IAP)	.62	0.57	.59	0.04	-0.03
	(.49)	(.50)	(.49)		
Quiz score (out of 20)	12.00	11.95	12.55	-0.13	-0.15
	(3.25)	(3.05)	(2.55)		
Age of child (in years)	4.28	4.26	4.27	0.01	-0.01
	(.86)	(.87)	(.83)		
Age of mother (in years)	28.39	28.37	28.53	-0.02	-0.03
	(4.74)	(4.47)	(4.33)		
Number of children	3.02	2.76	2.76	0.14	0.00
	(1.30)	(1.25)	(1.25)		
Income (in Rs.)	3384	3284	3796	-0.18	-0.23
	(1475)	(1420)	(1770)		
Housewife	.71	.79	.78	-0.11	0.02
	(.45)	(.41)	(.41)		
Fridge	.25*	.27*	.45	-0.30	-0.27
	(.43)	(.45)	(.50)		
Mobile	.65	.69	.69	-0.06	0.00
	(.47)	(.46)	(.46)		
Water filter	.03	.04	.09	-0.18	-0.15
	(.18)	(.20)	(.28)		
Literate mother (can read)	.41	.45	.50	-0.13	-0.07
	(.49)	(.50)	(.50)		
Educated worker (till at least A-level)	.54	.60	.65	-0.16	-0.07
	(.50)	(.49)	(.48)		

Notes: Standard deviations in parenthesis. Grades calculated according to IAP (Indian Association of Paediatricians) that is used in Anganwadis have been re-ordered from severely malnourished (1) to Normal (5). Normalized differences are calculated using the formula as in Imbens and Wooldridge (2009) for a scale-free measure of the difference in distributions. A rule of thumb is that when normalized difference exceeds 0.25 in absolute value, linear regression methods tend to be sensitive to the specification (Imbens and Rubin (2007)). * indicates a normalized difference exceeding 0.25.

Table 3: Quiz score and its components

VARIABLES	Quiz Score	Recipe Score	Non-recipe Score	Quizscore Score	Recipe Score	Non-recipe Score
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.041	-0.208	0.249*	0.100	-0.181	0.281**
	(0.291)	(0.200)	(0.130)	(0.293)	(0.211)	(0.127)
Recipe	-0.452	-0.473*	0.021	-0.560	-0.530*	-0.030
	(0.367)	(0.274)	(0.143)	(0.394)	(0.295)	(0.154)
Spillover	-0.570	-0.571**	0.001	-0.677	-0.628**	-0.049
	(0.439)	(0.274)	(0.198)	(0.456)	(0.302)	(0.203)
Post*Recipe	1.283***	1.093***	0.190	1.268***	1.144***	0.124
	(0.402)	(0.293)	(0.165)	(0.423)	(0.312)	(0.165)
Post*Spillover	0.977*	0.870**	0.107	0.905*	0.792**	0.114
	(0.539)	(0.352)	(0.230)	(0.527)	(0.356)	(0.219)
p-value (Post*Recipe-Post*Spillover=0)	0.567	0.535	0.704	0.500	0.341	0.961
Other controls				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 Anganwadi 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. Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post. Other controls include: Age of mother, Proportion kitchen, Proportion nonkitchen, No. of siblings of the child, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Nonkitchen assets are mobile, television, scooter, radio and a flush toilet. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Diet (at least twice a week)

VARIABLES	Green Veg	Egg	Sweet	Porridge	Green Veg	Egg	Sweet	Porridge
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	-0.077	-0.132***	-0.074***	-0.158**	-0.085	-0.135***	-0.077***	-0.166**
	(0.055)	(0.030)	(0.027)	(0.066)	(0.055)	(0.032)	(0.028)	(0.068)
Recipe	0.040	0.067*	0.037	0.157***	0.022	0.051	0.039	0.165***
	(0.050)	(0.040)	(0.032)	(0.051)	(0.046)	(0.045)	(0.036)	(0.050)
Spillover	0.047	0.006	-0.006	0.123*	0.037	-0.003	0.021	0.116*
	(0.059)	(0.038)	(0.036)	(0.067)	(0.058)	(0.045)	(0.041)	(0.070)
Post*Recipe	0.063	0.077*	0.041	0.131*	0.057	0.063	0.052	0.138*
	(0.069)	(0.041)	(0.041)	(0.078)	(0.072)	(0.045)	(0.044)	(0.082)
Post*Spillover	0.040	0.080*	0.012	0.221***	0.041	0.060	0.004	0.206**
	(0.076)	(0.042)	(0.036)	(0.084)	(0.075)	(0.046)	(0.041)	(0.087)
p-value (Post*Recipe-Post*Spillover=0)	0.943	0.457	0.177	0.819	0.951	0.561	0.288	0.338
Other controls					Yes	Yes	Yes	Yes
Constant	0.752***	0.228***	0.128***	0.644***	0.587***	0.469***	0.087	0.608***
	(0.046)	(0.026)	(0.025)	(0.044)	(0.089)	(0.080)	(0.055)	(0.106)
Observations	8882	8882	8882	8882	7376	7376	7376	7376
R-squared	0.021	0.026	0.041	0.046	0.042	0.046	0.065	0.083

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Green Veg, Egg, Sweet and Porridge are dummy variables equal to one when their intake by the child is on average at least twice a week and 0 otherwise based on mother's recall data from the past three months. Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post. Other controls include: Age of mother, Proportion kitchen, Proportion nonkitchen, No. of siblings of the child, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Nonkitchen assets are mobile, television, scooter, radio and a flush toilet. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Food expenditure

VARIABLES	Food exp	Food exp
	(1)	(2)
Post	79.615***	86.226***
	(18.721)	(18.836)
Recipe	-21.111	-20.427
	(23.534)	(26.303)
Spillover	-25.294	-50.438
	(38.160)	(35.059)
Post*Recipe	-66.182**	-74.241***
	(26.884)	(28.320)
Post*Spillover	-111.353***	-120.938***
	(32.976)	(35.040)
p-value (Post*Recipe-Post*Spillover=0)	0.177	0.201
Other controls		Yes
Constant	442.417***	406.558***
	(13.849)	(48.588)
Observations	8759	7286
R-squared	0.055	0.091

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Food expenditure is measured by asking the mother, "On average, what is the weekly expenditure on food for the household?" Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post. Other controls include: Age of mother, Proportion kitchen, Proportion nonkitchen, No. of siblings of the child, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Nonkitchen assets are mobile, television, scooter, radio and a flush toilet.
*** p<0.01, ** p<0.05, * p<0.1.

Table 6: Results on weight, grade, z-score and malnourished status

VARIABLES	Weight	Grade	z-score	Malnourished	Weight	Grade	z-score	Malnourished
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	0.275***	-0.051*	-0.048**	0.036**	0.230***	-0.068**	-0.076***	0.037**
	(0.049)	(0.027)	(0.024)	(0.015)	(0.057)	(0.032)	(0.028)	(0.017)
Recipe	-0.012	-0.010	-0.013	0.021	0.029	0.099**	0.084*	-0.030
	(0.112)	(0.046)	(0.048)	(0.028)	(0.116)	(0.044)	(0.047)	(0.029)
Spillover	-0.012	0.007	0.021	0.006	0.016	0.094*	0.100**	-0.027
	(0.115)	(0.044)	(0.046)	(0.032)	(0.121)	(0.050)	(0.050)	(0.038)
Post*Recipe	-0.017	0.009	-0.003	-0.019	0.045	0.015	0.026	-0.016
	(0.073)	(0.042)	(0.035)	(0.023)	(0.083)	(0.050)	(0.040)	(0.026)
Post*Spillover	-0.120	-0.048	-0.052	0.003	0.010	-0.013	0.013	-0.012
	(0.105)	(0.048)	(0.048)	(0.026)	(0.087)	(0.045)	(0.041)	(0.029)
Other controls					Yes	Yes	Yes	Yes
Constant	13.268***	4.203***	-1.674***	0.327***	11.906***	3.770***	-2.092***	0.525***
	(0.082)	(0.032)	(0.032)	(0.019)	(0.480)	(0.159)	(0.167)	(0.084)
Observations	9328	9328	9328	9328	7218	7218	7218	7218
R-squared	0.009	0.005	0.004	0.005	0.026	0.026	0.033	0.020

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Grades have been ordered from very severely malnourished (1) to normal (5) according to the thresholds used in the Anganwadis. Weight-for-age z-score for each child has been calculated using 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)
Malnourished status is a dummy which takes value 1 if child is malnourished according to WHO classification (if z-score < -2). Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post. Other controls include: Age of mother, Proportion kitchen, Proportion nonkitchen, Household Income, Food expenditure, No. of siblings of the child, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High quiz score mother (if mother's quiz score at baseline was above median), High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Nonkitchen assets are mobile, television, scooter, radio and a flush toilet. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Heterogeneous effects on weight-for-age z-score, quiz score and food expenditure if mother can read

VARIABLES	z-score	z-score	Quiz Score	Quiz Score	Food exp	Food exp
	(1)	(2)	(3)	(4)	(5)	(6)
Post	-0.044	-0.039	0.348	0.505*	73.086***	76.922***
	(0.030)	(0.031)	(0.307)	(0.296)	(20.283)	(21.067)
Recipe	-0.016	0.077	0.091	-0.061	-4.633	-6.287
	(0.045)	(0.048)	(0.421)	(0.467)	(25.783)	(29.809)
Spillover	0.024	0.078	-0.369	-0.532	11.155	-24.019
	(0.052)	(0.057)	(0.440)	(0.500)	(43.925)	(38.791)
Post*Recipe	-0.034	-0.044	0.823*	0.836*	-51.981*	-52.757
	(0.041)	(0.044)	(0.449)	(0.464)	(30.182)	(32.562)
Post*Spillover	-0.109*	-0.062	0.710	0.756	-126.193***	-124.789***
	(0.061)	(0.047)	(0.556)	(0.574)	(37.847)	(41.801)
Mother can read*Post*Recipe	0.080	0.131**	0.962**	0.888*	-45.308	-49.665
	(0.056)	(0.061)	(0.436)	(0.462)	(39.167)	(44.100)
Mother can read*Post*Spillover	0.132*	0.129*	0.386	0.295	6.848	8.205
	(0.078)	(0.073)	(0.398)	(0.401)	(37.682)	(40.736)
p-value of combined effect (Post*Spillover + Mother can read*Post*Spillover=0)	0.719	0.241	0.054	0.055	0.001	0.003
Other controls		Yes		Yes		Yes
Constant	-1.727***	-2.043***	12.085***	12.892***	428.104***	394.058***
	(0.031)	(0.139)	(0.198)	(0.641)	(15.754)	(47.101)
Observations	8692	7375	8445	7335	8385	7286
R-squared	0.011	0.031	0.075	0.088	0.063	0.096

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Weight-for-age z-score for each child has been calculated using the following formula from WHO Reference (2007). Quiz score is out of 20 where recipe and non-recipe scores are out of 13 and 7 respectively. Food expenditure is measured by asking the mother, "On average, what is the weekly expenditure on food for the household?" Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post, Mother can read dummy and its pair-wise interactions with Post as well as all the treatments, and its triple interaction with Post and other treatment dummies (incentive and combined). Other controls include: Age of mother, Proportion kitchen, Proportion nonkitchen, No. of siblings of the child, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Nonkitchen assets are mobile, television, scooter, radio and a flush toilet. *** p<0.01, ** p<0.05, * p<0.1.

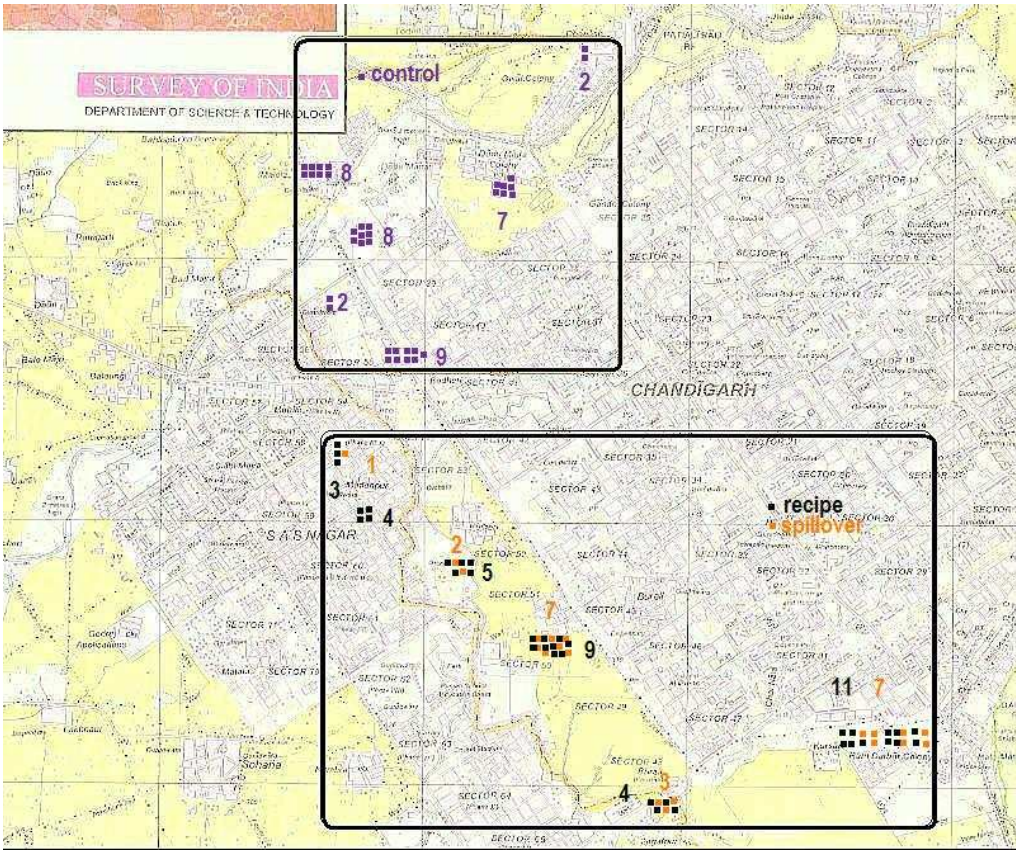

Figure 1: Map of Chandigarh showing location of Anganwadis under treatment, spillover and control groups.

Appendix

Table A1: Summary statistics from the baseline of attrited sample

				Normalized Differences	
VARIABLES	**Recipe**	**Spillover**	**Control**	**Recipe**	**Spillover**
Weight (in kgs)	12.94	13.26	13.49	-0.21	-0.09
	(1.88)	(1.91)	(1.83)		
Grade (according to IAP)	4.04	4.21	4.27	-0.21	-0.05
	(0.83)	(0.85)	(0.75)		
z-score (according to WHO, 2007)	-1.77	-1.56	-1.58	-0.18	0.02
	(0.80)	(0.92)	(0.72)		
Malnutrition (according to WHO, 2007)	.38	.33	.29	0.14	0.06
	(.49)	(.47)	(.45)		
Malnutrition (according to IAP)	.67	.54	.56	0.16	-0.03
	(.47)	(.50)	(.50)		
Quiz score (out of 20)	11.64	11.94	12.74	-0.29	-0.21
	(3.07)	(3.00)	(2.26)		
Age of child (in years)	4.22	4.24	4.21	0.01	0.02
	(.89)	(.90)	(.83)		
Age of mother (in years)	27.29	29.11	27.88	-0.10	0.21
	(4.18)	(4.47)	(3.91)		
Number of siblings	0.55	0.52	0.52	0.02	0.00
	(1.30)	(1.00)	(0.87)		
Income (in Rs.)	3326	3281	4021	-0.25	-0.27
	(1580)	(1628)	(2263)		
Housewife	.53	.63	.49	0.06	0.20
	(.50)	(.48)	(.50)		
Fridge	.23	.23	.35	-0.19	-0.19
	(.42)	(.43)	(.48)		
Mobile	.70	.67	.67	0.05	0.00
	(.46)	(.47)	(.47)		
Water filter	.02	.03	.06	-0.14	-0.10
	(.15)	(.18)	(.24)		
Literate mother (can read)	.37	.37	.48	-0.16	-0.16
	(.48)	(.49)	(.50)		

Notes: Standard deviations in parenthesis. Grades calculated according to IAP (Indian Association of Paediatricians) that is used in Anganwadis have been re-ordered from severely malnourished (1) to Normal (5). Normalized differences are calculated using the formula as in Imbens and Wooldridge (2009) for a scale-free measure of the difference in distributions. A rule of thumb is that when normalized difference exceeds 0.25 in absolute value, linear regression methods tend to be sensitive to the specification (Imbens and Rubin (2007)).

Table A2: Heterogeneous effects on z-score and quiz score if father can read

VARIABLES	z-score	z-score	Quiz Score	Quiz Score
	(1)	(2)	(3)	(4)
Post	-0.060	-0.069*	0.056	0.011
	(0.042)	(0.041)	(0.389)	(0.401)
Recipe	0.060	0.054	0.264	0.025
	(0.070)	(0.064)	(0.553)	(0.568)
Spillover	0.078	0.114	0.052	-0.162
	(0.084)	(0.100)	(0.446)	(0.484)
Post*Recipe	-0.017	-0.002	0.892	0.881
	(0.053)	(0.054)	(0.593)	(0.611)
Post*Spillover	-0.079	-0.016	0.446	0.600
	(0.097)	(0.064)	(0.592)	(0.600)
Father can read*Post*Recipe	0.032	0.023	0.611	0.599
	(0.059)	(0.062)	(0.533)	(0.524)
Father can read*Post*Spillover	0.051	0.021	0.589	0.382
	(0.091)	(0.078)	(0.437)	(0.439)
p-value of combined effect (Post*Spillover + Father can read*Post*Spillover=0)	0.520	0.914	0.050	0.074
Other controls		Yes		Yes
Constant	-1.802***	-1.936***	12.196***	13.441***
	(0.046)	(0.178)	(0.296)	(0.898)
Observations	8792	7385	8557	7345
R-squared	0.010	0.022	0.071	0.087

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Father can read is a dummy equal to 1 if father can read. Weight-for-age z-score for each child has been calculated using the following formula from WHO Reference (2007). Quiz score is out of 20 where recipe and non-recipe scores are out of 13 and 7 respectively. Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post, Father can read dummy and its pair-wise interactions with Post as well as all the treatments, and its triple interaction with Post and other treatment dummies (incentive and combined). Other controls include: Age of mother, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Heterogeneous effects on weight-for-age z-score, quiz score and food expenditure of owning kitchen assets

VARIABLES	z-score	z-score	Quiz Score	Quiz Score	Food exp	Food exp
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.020	0.024	1.034**	0.951*	81.782**	72.427**
	(0.069)	(0.075)	(0.493)	(0.484)	(34.241)	(34.996)
Recipe	0.095	0.118	1.874***	1.748***	90.244**	67.975
	(0.103)	(0.112)	(0.620)	(0.617)	(42.923)	(41.441)
Spillover	0.211*	0.186	0.908	0.767	158.828**	119.014*
	(0.116)	(0.137)	(0.556)	(0.572)	(70.364)	(67.152)
Post*Recipe	-0.151*	-0.138	-0.902	-0.830	-31.485	0.872
	(0.084)	(0.091)	(0.661)	(0.679)	(54.073)	(52.937)
Post*Spillover	-0.182	-0.111	-0.242	0.121	-190.994***	-196.523**
	(0.118)	(0.091)	(0.728)	(0.755)	(69.019)	(75.948)
Proportion kitchen*Post*Recipe	0.302**	0.285*	4.222***	4.126***	-85.365	-157.601*
	(0.143)	(0.157)	(1.020)	(1.001)	(89.337)	(92.694)
Proportion kitchen*Post*Spillover	0.267	0.196	1.802	1.281	141.890	156.967
	(0.172)	(0.152)	(1.249)	(1.275)	(106.691)	(115.071)
Other controls		Yes		Yes		Yes
Constant	-1.971***	-2.032***	11.321***	12.256***	370.622***	353.758***
	(0.086)	(0.192)	(0.423)	(0.904)	(34.643)	(52.184)
Observations	8478	7375	8427	7335	8368	7286
R-squared	0.018	0.028	0.087	0.097	0.088	0.112

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Weight-for-age z-score for each child has been calculated using the following formula from WHO Reference (2007). Quiz score is out of 20 where recipe and non-recipe scores are out of 13 and 7 respectively. Food expenditure is measured by asking the mother, "On average, what is the weekly expenditure on food for the household?" Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post, Proportion kitchen and its pair-wise interactions with Post as well as all the treatments, and its triple interaction with Post and other treatment dummies (incentive and combined). Other controls include: Age of mother, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Heterogeneous effects on weight-for-age z-score, quiz score and food expenditure of owning non-kitchen assets

VARIABLES	z-score	z-score	Quiz Score	Quiz Score	Food exp	Food exp
	(1)	(2)	(3)	(4)	(5)	(6)
Post	-0.055	-0.101**	0.230	-0.131	129.410***	119.175***
	(0.048)	(0.050)	(0.547)	(0.552)	(36.488)	(34.102)
Recipe	0.084	0.084	0.619	0.297	54.992	31.577
	(0.085)	(0.084)	(0.650)	(0.680)	(40.007)	(42.600)
Spillover	-0.058	-0.065	0.372	-0.098	45.322	8.280
	(0.079)	(0.090)	(0.675)	(0.682)	(63.642)	(59.247)
Post*Recipe	-0.014	0.031	0.705	1.169	-110.231**	-70.456
	(0.065)	(0.067)	(0.684)	(0.720)	(49.863)	(47.337)
Post*Spillover	0.011	0.052	0.400	1.109	-160.306**	-157.061**
	(0.082)	(0.064)	(0.759)	(0.782)	(70.329)	(73.946)
Proportion non-kitchen*Post*Recipe	0.040	-0.024	1.174	0.351	68.085	-25.910
	(0.115)	(0.119)	(1.050)	(1.042)	(88.236)	(92.643)
Proportion non-kitchen*Post*Spillover	-0.119	-0.099	1.054	-0.357	66.629	68.151
	(0.136)	(0.127)	(1.323)	(1.250)	(127.237)	(130.335)
Other controls		Yes		Yes		Yes
Constant	-1.872***	-1.948***	11.945***	13.307***	372.172***	374.004***
	(0.058)	(0.179)	(0.501)	(0.986)	(31.288)	(51.734)
Observations	8890	7385	8638	7345	8577	7296
R-squared	0.015	0.027	0.074	0.087	0.064	0.088

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Proportion non-kitchen means proportion of non-kitchen assets owned. Non-kitchen assets are mobile, television, scooter, radio and a flush toilet. Weight-for-age z-score for each child has been calculated using the following formula from WHO Reference (2007). Quiz score is out of 20 where recipe and non-recipe scores are out of 13 and 7 respectively. Food expenditure is measured by asking the mother, "On average, what is the weekly expenditure on food for the household?" Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post, Proportion non-kitchen and its pair-wise interactions with Post as well as all the treatments, and its triple interaction with Post and other treatment dummies (incentive and combined). Other controls include: Age of mother, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. *** p<0.01, ** p<0.05, * p<0.1.

Table A5: Quantity and Content of Social interaction

VARIABLES	**Worker visits** Reported by Mother	**Worker visits** Reported by Worker	**Worker visits** Reported by Mother	**Worker visits** Reported by Worker	**Talked about Diet**	**Talked about Consequences of Malnutrition**	**Talked about Diet**	**Talked about Consequences of Malnutrition**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	-1.989***	-1.086*	-2.125***	-1.234*	-0.014	-0.066	-0.003	-0.083
	(0.476)	(0.655)	(0.514)	(0.677)	(0.018)	(0.049)	(0.013)	(0.051)
Recipe	-2.137***	-1.801**	-2.376***	-2.303***	-0.037*	-0.071	-0.037*	-0.076
	(0.561)	(0.733)	(0.624)	(0.808)	(0.020)	(0.050)	(0.020)	(0.052)
Spillover	-1.827***	-0.043	-2.321***	-1.021	-0.043	-0.059	-0.037	-0.084
	(0.602)	(1.117)	(0.641)	(1.143)	(0.029)	(0.064)	(0.026)	(0.063)
Post*Recipe	2.407***	1.113	2.596***	1.345	0.010	0.099	0.007	0.090
	(0.541)	(0.766)	(0.586)	(0.815)	(0.039)	(0.072)	(0.031)	(0.073)
Post*Spillover	1.757***	0.281	2.183***	0.832	0.023	0.044	-0.018	0.067
	(0.549)	(1.056)	(0.572)	(1.139)	(0.044)	(0.095)	(0.043)	(0.096)
p-value (Post*Recipe-Post*Spillover=0)	0.367	0.084	0.614	0.273	0.807	0.572	0.619	0.812
Other controls			Yes	Yes			Yes	Yes
Constant	5.565***	5.724***	7.132***	7.290***	0.964***	0.839***	0.960***	0.959***
	(0.522)	(0.609)	(1.051)	(1.589)	(0.011)	(0.037)	(0.042)	(0.094)
Observations	8881	9084	7375	7201	8882	8881	7376	7375
R-squared	0.096	0.214	0.115	0.306	0.015	0.018	0.028	0.049

Notes: Robust standard errors in parentheses clustered at the Anganwadi level. Dependent Variables are all dummy variables that take value 1 if the worker talked to the mother in the past 3 months on these topics as reported by the mother. Also included in the regression but not shown are other treatment dummies (incentive and combined) and their interactions with Post. Other controls include: Age of mother, Proportion kitchen, Proportion nonkitchen, No. of siblings of the child, adult members in household, and the following dummy variables: Mother is housewife, Electricity in Anganwadi, Fan in Anganwadi, Blackboard in Anganwadi, Drinking water in Anganwadi, Mother is Hindu, Grandmother at home, High experienced worker (if experience of the worker is more than the median experience), Literate mother (if the mother can read), Literate father, High educated worker (at least till after A-level), Worker is very satisfied with work, Worker is very satisfied with life. Proportion kitchen means proportion of kitchen assets owned. Kitchen assets are fridge, water filter, water tap, cooking gas and pressure cooker. Nonkitchen assets are mobile, television, scooter, radio and a flush toilet. *** p<0.01, ** p<0.05, * p<0.1.

10. BANANA PIE:

Ingredients:

Banana ripe	100g.
Wheat flour	100 g.
Sugar	50 g.
Salt	to taste
Oil	50 ml.

Method of preparation:

1. Add salt and sugar to wheat flour.
2. Mash Banana and mix with flour.
3. Kneed it into a stiff dough.
4. Divide the dough into small balls.
5. Shape each ball into small pies.
6. Heat tawa and grease it with a little oil.
7. Apply oil from sides of pie and cook till golden brown (shallow fry).

Nutritive values per 100 Gms.

Calories	402
Protein	4.4 g.
Iron	1.7 mg.
Carotene	37 microg.

Figure A1

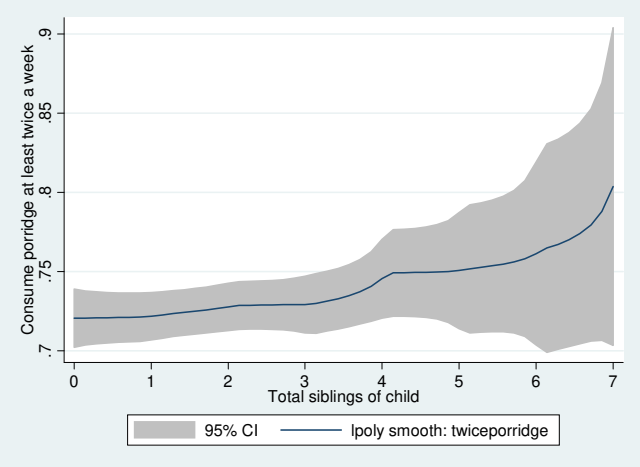

Figure A2: Proportion who consume porridge at least twice a week according to number of siblings

Figure A3: Proportion who consume sweets at least twice a week according to number of siblings