If only I knew: experimental evidence on the impact of nutrition information on behavior in rural Bihar

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Abstract

India accounts for one-third of global stunting and has extremely high rates of maternal and child anemia and underweight. Undernutrition indicators have been slow to improve over the last decade despite novel programmatic innovations introduced in the hope of accelerating progress. One such little-tested innovation is that of using women's self-help groups (SHGs) - savings and credit groups of 15-20 women - to effect change in health and nutrition outcomes. We use a randomized controlled design and primary survey data on more than 2000 households from the eastern state of Bihar to analyse the impact on diet quality and anthropometry of a health and nutrition pilot delivered through the SHG platform. Using multiple rounds of survey data, we find that the pilot had small but significant impacts on women and children's dietary diversity but no impact on women's BMI. The main impact on children's diets came from a significant increase in the proportion consuming pulses, vitamin-A rich fruits and vegetables, other fruits and vegetables, and dairy. We identify several potential pathways through which the intervention might have worked and investigate each of these separately. Our analysis suggests that the main channel through which the intervention worked was improving awareness of quality of diets, however, conditional on exposure, resource constraints and social norms around child diets remain significant barriers to further progress. To the extent that SHGs are able to address these constraints, they could emerge as a powerful platform for effecting change in maternal and child health and nutrition status.

1 Introduction

Improving maternal and child undernutrition is an important, yet complex, development challenge. This is particularly true in the case of India, where maternal and child health and nutrition indicators remain poor despite considerable improvements over the last decade. The country's large population burden, combined with its high rates of child stunting and maternal and child anaemia and underweight, means that India contributes greatly to the global prevalence of malnutrition.

Improving nutrition is important not only because of the intrinsic value of a well-nourished population, but also because it is instrumental in enhancing several economic outcomes (Alderman, Behrman, and Hoddinott 2007). In efficiency-wage models, better nutrition is linked to greater earning potential through its impact on worker productivity – healthier workers can work better and longer, this in turn can lead to higher earnings, thus perpetuating a virtuous cycle (Straus and Thomas 1998). Alderman, Behrman, and Hoddinott (2007) argue that nutrition, cognition and education are linked in three broad ways. First, undernourished children may receive fewer investments in education because caregivers view this investment as having a low return. Second, malnourished children may enter school late which may reduce the total amount of schooling and hence, lifetime earnings. Third, malnutrition may affect cognitive development directly and reduce the capacity to learn. There exists a vicious cycle of poverty and undernutrition – loss in productivity either due to poor physical stature or recurrent illness, loss in earnings due to poor cognition and learning; and increased health care costs. The link between economic growth and malnutrition is tenuous, especially in low- and middle-income countries (Vollmer et al. 2014), and even if growth does cause improvements in nutritional status, it can often be at a pace that is too slow. This means that we need to look beyond macroeconomic growth to explore both the factors that determine undernutrition, and the nutrition-specific interventions that can accelerate change.

Improving nutrition is complex because it is affected by multiple factors at different levels; immediate factors such as dietary intake and morbidity, underlying factors such as household food security, care giving and the home environment, and basic factors such as the households' resources and capacity and the larger socioeconomic and political context (UNICEF 2015). While the complexity of these factors and their interplay is well understood from a theoretical perspective, there is little evidence on the barriers to adoption on recommended practices for improved nutrition. Is it knowledge? Is it resources? Is it the mother's ability to exert agency over the use of existing resources? Or is it some combination of these (and other) factors?

To provide a partial answer to these questions, we study an intervention that combines an explicit health and nutrition objective with a platform that has the added potential to affect several underlying determinants of nutrition. This intervention, implemented in the eastern state of Bihar in India, was delivered through a Bihar-specific rural poverty and livelihoods program, JEEViKA. Bihar is an especially important test case, as it exhibits some of the highest rates of malnutrition in the country combined with some of the lowest per capita incomes (NFHS 4 2015-16, Economic Survey 2016-17). In 2015-16, 48.3 percent of children under five in Bihar were stunted (all-India average 38.4), 30.4 % of women were underweight (all-India average 22.9) and 60.3 percent of women were anaemic (all-India average 53.1). These poor nutrition outcomes are exacerbated by the low levels of underlying and immediate determinants of maternal and child nutrition, especially related to the status of women – Bihar performs very poorly on women's education, women's agency and decision-making, experiences of domestic violence and women's access to bank or savings accounts.

Supported by the Bihar Rural Livelihoods Promotion Society (BRLPS) and the World Bank, JEEViKA helps organize women from impoverished households into self-help groups (SHGs), groups of 15-20 women who come together once a week to deposit small amounts of money into a common account from which members can take loans in times of need. The pilot intervention we evaluate in this paper - the JEEViKA Multisectoral Convergence pilot, or JEEViKA-MC - used the existing SHG platform to deliver a set of health and nutrition interventions. Introduced in a small geography in 2016 and continued till 2018, the JEEViKA-MC pilot consisted of two components. The first component, that of *behaviour change communication*, or BCC, provided information on a range of behaviours covering the period from pregnancy to delivery to postnatal care. The second component, the *convergence* component, was designed to improve access to and utilization of certain government services by increasing coordination between the SHGs and their federations and service providers, and by improving awareness of these services among the women members of the SHGs and their federations.

SHGs are primarily savings and credit groups aimed at improving women's financial empowerment; however, the group-based approach has been shown to have significant impacts on women's social, political and psychological empowerment as well (Brody et al. 2016). In recent years, SHG-based intervention programs have begun to adopt a more multisectoral approach, adding on components such as the transfer of assets, provision of agriculture and livelihood extension services and an increased emphasis on skills development. One such additional thematic area is that of health and nutrition. That SHGs have the potential to improve nutrition outcomes is undeniable – very few other platforms can compete with their reach or their ability to target multiple pathways simultaneously. This makes SHGs a particularly important vehicle in the case of nutrition in India, where not only is the problem of malnutrition widespread and pernicious, many of the factors affecting maternal and child nutrition - such as women's empowerment, awareness of health and nutrition behavior, household income and food security, use of health and nutrition services, among others – are poor, and could potentially be addressed through the formation and strengthening of these groups.

At the time the JEEViKA-MC pilot was designed, direct evidence on the impact of women’s group programs on health and nutrition outcomes was limited. A recent evidence review documenting the impact of women’s groups programs on maternal and child nutrition outcomes in South Asia concluded that although women’s groups have great potential, the evidence base is thin, and few studies examine pathways to impact (Kumar et al. 2018). Group-based programs that do not specifically incorporate nutrition interventions can still trigger other pathways, especially improved household income, consumption, livelihood-related training or technology, and women’s empowerment (Kumar and Quisumbing 2011; Miller et al. 2014; De and Sarker 2011; Saha et al. 2013; Prennushi and Gupta 2014; Deininger and Liu 2009, 2012, 2013; Datta 2015; Hoffman et al. 2017; Desai and Joshi 2014; Khanna, Kocchar and Palaniswamy 2015; Pandey, Gupta and Gupta 2019). In the context of Nepal, Saville et al. (2018) show that combining a participatory learning and action (PLA) approach with food transfers leads to improvement in certain health and nutrition practices. In India, micro-finance group-based programs integrated with health services improved rates of institutional delivery, colostrum feeding, toilet ownership (Saha et al. 2015), and early initiation of breastfeeding and complementary feeding at 6 months (Johnson et al. 2014). The addition of BCC to PLA-based approaches resulted in significant improvements in women and children’s dietary diversity scores but did not lead to significant changes in maternal BMI or underweight (Harris-Fry et al. 2016; Harris-Fry et al. 2018; Nair et al. 2017). Several studies evaluating BCC delivered either through PLA or community groups reported improvements in health and nutrition knowledge, and infant and young child feeding practices (IYCF) (Kumar et al. 2008; Roy et al. 2013; Acharya et al. 2015; Younes et al. 2015).

To the best of our knowledge, only two studies have evaluated the impact of the JEEViKA program on household and other outcomes, and neither of these studied the direct impact on health or nutrition indicators. Datta (2015) uses retrospective data and a propensity score matching technique to show that participation in JEEViKA groups has a significant impact on women’s empowerment and food security and leads to improved financial outcomes such as increased savings, a reduction in high-cost debt, and more productive use of loans. Hoffman et al. (2017) uses a randomized controlled trial design to show that SHG members substitute away from costly informal credit towards SHG loans leading to a significant decline in the cost of borrowing.

The first component of the JEEViKA-MC pilot, the integration of BCC, builds on a now well-established understanding within the field of health and nutrition of the importance of information in changing behavior (see Lamstein et al (2014) and Kennedy et al (2018) for systematic reviews of the literature; also, Bhutta et al. 2013; Fabrizio, Liere and Pelto 2014; Hoddinott et al. 2017; Olney et al (2015) and Ahmed et al (2016). When combined with cash or in-kind (food) transfers, well designed and regularly implemented BCC can have large and significant impacts on quality of diets and on child stunting, even over relatively short intervention periods (Ahmed et al 2016). What is interesting is that, even when *not* combined with other transfers, health and nutrition BCC can impact outcomes directly (Jalan and Somanathan, 2008; Madajewicz et al. 2007; Dupas 2011; Haider et al. 2000; Bhutta et al. 2011; Morrow et al. 1999; Galasso and Umapathi 2009; Alderman 2007; Linnemayr and Alderman 2011). In a nutrition information experiment in Malawi that is perhaps closest to ours in design, Fitzsimons et al (2016) show that the provision of information without any accompanying cash or in-kind transfers can affect household food consumption and child nutrition. However, can information alone impact health and nutrition outcomes in a context as resource-constrained such as our study area in Bihar? This is the key question we set out to answer.

Our paper adds to the literature in several ways. First, it provides evidence on the effectiveness of group-based approaches in delivering BCC interventions. Second, it does so in the context of a large country-wide SHG model, the National Rural Livelihood Mission under JEEViKA, and hence demonstrates impact under scale. Third, it looks at women's outcomes – specifically women's BMI and dietary diversity – outcomes that have not received a great deal of attention previously. Fourth, it investigates potential pathways through which the observed impacts might have occurred. Fifth, in using a rigorous experimental design, it circumvents many of the methodological problems with the existing literature which could have been responsible for the wide range of previous impact estimates (Mansuri and Rao, 2012).

We find that the JEEViKA-MC pilot had no impact on women's body mass index or their likelihood of being underweight. However, it did have positive and statistically significant (albeit small) impact on the dietary diversity of women and children. We use data from our evaluation surveys to explore several hypothesized pathways to impact and conclude that the crucial barrier to the adoption of behavior is indeed exposure to information. Our quantitative findings, combined with a mixed-methods process evaluation study, suggest several challenges associated with integrating a robust behaviour change intervention into an evolving large-scale state-run program. We discuss these in our conclusions.

The rest of the paper is organized as follows. Section 2 describes the contextual background and provides information on the intervention. Section 3 describes our methods, and section 4 presents our results. Section 5 explores some possible mechanisms through which the program might have had an impact, and section 6 concludes.

2 Background and intervention

2.1 Background

This study was implemented in 3 blocks of Saharsa district of Bihar, a district in the north-east of the state, close to the border with Nepal (Figure 1). Saharsa is one of the poorest districts in Bihar; it also performs particularly poorly on health and nutrition indicators, being at or above the state average in wasting and underweight among children under 5 years, anaemia among women, and underweight among women (NFHS 4 2015-16).

The three intervention blocks – Saur Bazaar, Sonbarsa Raj and Pattarghat - were purposively selected for the implementation of the JEEViKA-MC pilot because they were among the first blocks to receive the JEEViKA intervention, and hence had some of the oldest SHGs. For the purpose of the evaluation, the Gram Panchayat (GP) was chosen as the unit of randomization, as it was this unit that both minimized the possibility of contamination of the comparison arm with the treatment, as well as provided adequate power to detect changes in our primary outcomes. Out of the total number of Gram Panchayats (GPs) in these three blocks, 24 GPs that had mature SHGs (i.e. formed in or before 2011) and where no other confounding health interventions were being implemented were selected for the evaluation. These 24 GPs were allocated to treatment or comparison groups using simple random sampling.

2.2 Description of the intervention

The core set of JEEViKA interventions include organizing rural women into SHGs, providing them with training (both on group functioning, as well as on financial literacy, agriculture and livelihoods), federating SHGs into Village Organizations (VOs) of 12-20 SHGs and Cluster-Level Federations (CLFs) of 25-30 VOs, and linking SHGs and their federations to banks. SHGs and their federations are also provided lines of credit and access to funds with pre-determined rates of interest and terms of repayment. Some examples of the funds that JEEViKA provides are the Food Security Fund (FSF), a loan of INR 1,00,000 provided to VOs at a 0% rate of interest to allow members to purchase food items such as pulses and cereals in bulk, and the Health Risk Fund (HRF), a loan of INR 50,000 provided to VOs at a 1% rate of interest, used to defray health expenses of SHG members and their families. Detailed individual- and SHG-level records of amounts deposited, and loans taken or repaid are maintained by a cadre of paid female workers known as Community Mobilizers (CMs), with each CM supporting 10-12 SHGs. The core set of JEEViKA interventions, combined with the social capital conferred by virtue of the group structure, are intended to improve livelihoods, household savings and income, women's financial independence, and their empowerment and agency.

The JEEViKA-MC pilot intervention being evaluated in this paper was specifically designed to improve both the demand for and the utilization of quality health and nutrition services. It consisted of two additional components to be layered onto the core set of interventions, each of which is described below.

Component 1: Behaviour change communication

In all GPs including the 12 control GPs, CMs continued to provide their traditional record-keeping services for all SHGs part of the JEEViKA program. In addition, in the 12 GPs that were part of our evaluation, CMs were tasked with providing intensive BCC on maternal and child nutrition and health, water, sanitation, and hygiene behaviors at bi-monthly SHG meetings. The BCC focused especially on households with women of reproductive age and young children, and covered a range of topics including maternal, infant, and young child feeding practices, diets during pregnancy, the importance of antenatal and postnatal care, government entitlement schemes, increased use of the FSF (to achieve food security) and the HRF (to cover health-related costs), the adoption of kitchen gardens, and the importance of safe water, sanitation, and hygiene practices. In addition to the sessions with the CM, this component also included the screening of a series of six videos developed by Digital Green which reinforced several of the messages in the BCC content.

Component 2: Convergence and coordination

This component was aimed at strengthening the supply of services to meet the anticipated increased demand induced through greater household awareness as a result of the BCC and consisted of measures to improve VO awareness of government entitlement schemes, as well as increase the coordination between the VOs and various village- and block-level service providers. This part of the intervention morphed considerably over the study period: First, it consisted of the formation of convergence and coordination committees at different levels aimed at coordination between government departments and JEEViKA workers to ensure service delivery, then, the strengthening of existing platforms under the Ministry of Women and Child Development's Integrated Child Development Services (ICDS) program, and finally, of home visits to pregnant and lactating mothers by volunteer workers who would provide advice on child feeding and care and connect the mothers to health and ICDS frontline workers.

2.3 Study design

A cluster-randomized controlled trial was used to assess the impact of the intervention on the two primary outcomes of the evaluation: women's BMI and child dietary diversity. Based on power calculations, it was estimated that a sample of 2400 households would give us between 80 and 90% power to detect an effect size of .23 in women's BMI. Therefore, 5 villages were selected from each GP, and 20 households per village were selected at random from the full list of eligible households. Households having a woman with a child aged 6-24 months at the time of the baseline and at least one person who was a member of a JEEViKA SHG were eligible for our baseline survey, conducted in May 2015. The mother of the child aged 6-24 months was the primary respondent to the household survey (Figure 1). The 6-24-month-old child at baseline was the 'index child'. In addition, if the primary respondent had a child aged 6-24 months at endline, information on the youngest of those children was also collected; this child will be referred to as the 'youngest child'.

The intervention began as soon as the baseline survey was over and continued until October 2018 for a total of slightly under 2.5 years of implementation. At the end of the implementation period, an endline survey of the same set of households was conducted, yielding two rounds of panel data. The slight delay in the endline survey resulted in a seasonality shift, which can influence agricultural outputs and incomes, disease environments, and food availability. However, the comparison with the comparison arm households and over time still permits a meaningful assessment of the impact of this pilot.

Data collection was sub-contracted to Oxford Policy Management (OPM) who hired a team of more than 90 enumerators. These enumerators received intensive two-week training on both paper and tablet versions of the tools. OPM was not involved with the implementation of the program in any way. The household surveys collected information on health and nutrition knowledge and practices (especially the trial and adoption of practices recommended in the BCC material), household socio-economics and demographics, and exposure to and utilization of JEEViKA platforms, among other modules. Anthropometric data was collected from the mother and young children. Household data was supplemented with village-level information on facilities and livelihoods.[1]

In addition to households, we also conducted other interviews. The first was with the CM, the JEEViKA cadre responsible for the delivery of the BCC. All CMs in the study areas were interviewed; at endline, some of the CMs from baseline had been transferred or left their jobs, so the exact individuals do not always tally at both survey time points. The second set of interviews was with long-term residents of the community who were able to answer questions about facilities, sources of employment and so on for that village.

3 Methods

The impact estimates on the primary outcomes were based on intent-to-treat (ITT) impact estimates. We estimated the ITT effects using the analysis of covariance (ANCOVA) estimator. This estimator is operationalized using least squares by estimating the following regression equation for the base model:

$$Y_{i1} = \alpha + \beta Y_{i0} + \delta T_i + \varepsilon_i,$$

and estimating the following regression equation for the fully specified model:

$$Y_{i1} = \alpha + \beta Y_{i0} + \delta T_i + \sum_{j=1}^{J} \gamma_j \, x_{ij0} + \varepsilon_i.$$

[1] Ethical approval for the study was obtained from IFPRI's internal IRB as well as from a local IRB firm, Sigma. For this purpose, final translated questionnaires and the consent form were submitted for review by the committee and were deemed acceptable within the IRB guidelines. In addition, this study was registered at 3ie's Registry for International Development Impact Evaluations with the study ID: RIDIE-STUDY-ID-57b237eb214e4 and can be accessed here https://ridie.org/index.php?r=study/detailView&id=451.

Here, Y_{i1} is the outcome indicator measured at endline, Y_{i0} is the outcome indicator measured at baseline and T_i is the indicator for being in the treatment group; x_{ij0} is a vector of baseline characteristics (to control for baseline imbalance and other important contextual indicators- for example, the mother's variables for all child level analysis); and, ε_i is the idiosyncratic error term.

For some outcomes, most notably all outcomes for the youngest child, there were no baseline outcomes to control for. In these cases, the specification remains the same as given above, with the omission of the term Y_{i0}.

The regression specifications account for survey design (adjusted standard errors for clustering at gram panchayat level and assuming heteroskedasticity), with block-level fixed effects. In addition, we present p-values adjusted for a small number of clusters using the wild bootstrap method, implemented in STATA 15 with the command *boottest* (Roodman et al. 2019).

3.1 Outcomes

The two primary outcomes for the evaluation were women's BMI and dietary diversity among children ages 6-24 months. Since our index child was 6-24 months at baseline, they were between 3 and 4.5 years at endline, and hence no longer in the age range for which minimum dietary diversity is calculated. For the set of index children, therefore, we present results only on the number of food groups consumed. For youngest children, we report results on the proportion attaining minimum dietary diversity as well as the number of food groups consumed. These results for youngest children are necessarily an estimate of the single-difference, but we provide some descriptive results to allow the reader to compare these children to the similarly aged index children from baseline as well. In addition to these primary outcomes, we also present results on the percentage of women who achieved minimum dietary diversity (MDD), defined as consuming 5 out of 10 food groups as well as the number of food groups consumed by them.

To assess the impact of the pilot on knowledge, we score the CM and respondent women on a knowledge test based on the BCC material. Each question is given a score of 1 if the respondent provides any correct answer, and 0 otherwise. Scores on each subsection and on the knowledge test as a whole are then standardized out of a hundred to aid interpretation of the estimates. The knowledge section on child feeding included questions on the appropriate age to feed a child a range of different foods, while the section on dietary diversity and home cultivation asked about the benefits of various types of foods (for example, green leafy vegetables, vitamin-A rich fruits and vegetables), the components of a tri-coloured meal, and the vegetables and fruits that can be grown in the kitchen garden at different times of the year.

To assess the impact of the pilot on household food security, we administer the Household Food Insecurity Access Scale (HFIAS), developed and validated by the Food and Agriculture Organization (FAO). This scale is a series of nine questions about the experience of different aspects of food insecurity. If anyone in the household experienced one of those aspects in the month prior to the survey, follow-up questions were asked about the frequency of occurrence. These questions are then used to calculate both an overall food insecurity scale score (ranging from 0 to 27, a higher score indicating greater food insecurity) and indicators for three separate HFIAS domains—anxiety and uncertainty, insufficient food quality, and insufficient food quantity.

4 Results

4.1 Achieved sample and attrition

We collected information on 2246 households at baseline, 1164 in the treatment arm and 1082 in the comparison arm (Table 1). Of 2246 households, 2,119 of these (those with baseline respondent women available) were re-interviewed, for an attrition rate of only 5.65 percent overall. From amongst the 2246 women at baseline, 1881 had index children who were followed up at endline. The attrition among index children was slightly higher than that of women, at 16.25 percent overall. This was due to child not being alive, missing data on date of birth and endline back estimation of age. In addition to the index child, if the mother had given birth to one or more children since baseline, information was collected for the youngest of those children between the ages of 6 and 24 months at endline. There were 805 such youngest children in total.

Since the household survey was a panel, Table 1 also presents the attrition rate by treatment arm. Households in the comparison arm were slightly less likely to attrit (5.4 percent) than households in the treatment group (5.8 percent) but these differences were not statistically significant. A similar pattern of attrition was observed among the index children, with the index children more likely to be found in the comparison arm as compared to the treatment group. We also observed some differences in attrition rates by block. Although low attrition rates rarely affect estimation results in the literature (de Brauw and Harigaya 2007), we took steps to ensure that results at the household level were not biased by non-random attrition. First, we examined baseline descriptive statistics on households by endline attrition status. Next, we estimated a probit model for whether households were interviewed at endline based on characteristics that looked like they might be important from the descriptive statistics. Third, we developed attrition weights based on the probit models (Wooldridge 2002) and use those weights to ensure that our results are not affected by any bias caused by attrition. Further details on these checks can be found in the Appendix A.

4.2 Descriptive statistics and baseline balance across arms

Table 2 presents baseline characteristics of the respondent women and their households by treatment arm, along with unadjusted tests of difference. The average respondent woman was 25 years old, had two or more children and less than 3 years of education. More than 70 percent of the women were housewives; among those who were employed, agricultural and non-agricultural labour were the main occupations. An average household has seven members and was predominantly from other backward classes or scheduled caste groups. More than 70 percent had access to electricity, however, an average household owned only 6 assets out of a possible total of 25.

As can be seen from the last column, the samples were well balanced at baseline. Those baseline covariates unbalanced at 10 percent are: household size, no. female household members, head of the household belongs to a general caste, household has electricity, household floor is made of improved material, respondent woman's husband is household head, highest number of years of schooling in the household (female) and respondent woman is an agricultural laborer. The full list of covariates includes all those covariates unbalanced at 10 percent, and, in addition, the number of assets owned by the household, caste of household head, household head is Muslim, 10 dummies for household demographic composition, any female household member has bank account, respondent woman's age, and dummies for respondent woman being a non-agricultural day laborer or a housewife. We control for both the set of unbalanced covariates and the full set of covariates in our regression specifications.

In the regressions using CM's knowledge as an outcome, the partial specification included number of children, being an SHG member and length of SHG membership (in years). The full specification included all these along with number of years of schooling, years of experience as CM, religion dummies, caste dummies, age (in years), engaged in other income generating activities and marital status.

4.3 Impact estimates

This section presents the estimates of the impact of JEEViKA-MC intervention on the outcomes described in section 3.1 Outcomes. Since all impact tables in this paper will follow the same format, it is worth explaining the structure of the tables here. For each outcome, only the coefficient on the treatment indicator from three different model specifications is reported. The first is the unadjusted base specification, i.e., the coefficient on the treatment indicator without controlling for any additional characteristics. The second and third each add a set of covariates; column 2 (the 'partial specification') adds those baseline covariates that were unbalanced at the 10 percent level, column 3 (the 'full specification') controls for all relevant baseline characteristics. Both clustered and wild bootstrapped estimated p-values have been reported for each specification. The baseline mean of the outcome variable in the comparison arm is provided in each table to aid interpretation. For those outcomes measured only at endline (i.e. where there is no corresponding baseline outcome value) the endline mean in the comparison arm is reported as the benchmark for reference instead.

4.3.1 Women's BMI

At baseline, average BMI among all women in the sample was 19.07 (± 2.3) and there were no significant differences across the two arms. Some improvement was observed over time. Overall, the proportion of women who were of normal weight increased from 53 percent at baseline to 58 percent at endline; at the same time, the proportion who were underweight declined from 44 percent to 37 percent (). Kernel density plots show that the distribution of women's BMI was almost identical across the two arms at both time points, and there was negligible movement over time (Figure 4).

As expected from the overlap in the kernel density plots, we find no impact of the JEEViKA-MC intervention on women's BMI or on the likelihood of women being underweight. These findings are robust to the specification employed (Table 3). The lack of movement in women's BMI could, however, be a result of the relatively short intervention period.

4.3.1 Dietary diversity for women

Overtime, between baseline and endline, the proportion of women attaining MDD in the comparison arm did not move much, however, the proportion in the treatment arm showed an impressive increase of almost two-thirds to 47 percent at endline (Figure 5). Our endline impact estimates corroborate the descriptive findings, showing a 10.3 percentage point increase in the likelihood of a woman's achieving MDD (column 3), which represents a 30 percent increase over the baseline comparison levels (Table 4). This is a substantial improvement over the course of the intervention period of just around two and a half years.

To investigate the dietary diversity findings further, we looked at the proportion of women consuming each of the individual food groups. At baseline, the consumption of various food groups was balanced across arms. All women reported consuming starchy staples (grains, roots, and tubers), depending on cereal calories as a primary source of energy (Figure 6). In the regression framework, the impact estimates in the full specification showed improvement in number of food groups women consumed by 0.3 food groups (Table 4), a significant 7.8 percent increase over the baseline comparison group mean. As can be seen from Figure 6, this increase in diverse diets comes mainly from consumption of pulses, dairy, other fruits, and other vegetables. Improvement in the consumption of flesh foods or eggs and nuts and seeds was minimal, and of dark green leafy vegetables declined in both arms. Although 77 percent of the women reported that they are not vegetarians, a much smaller proportion reported actually eating flesh foods in the 24 hours recall period. This suggests that resource constraints may be more salient for these households than lack of information about these foods.

4.3.2 Dietary diversity for index child

The average number of food groups consumed by index children at baseline was low at 2.45 (± 1.46) out of a possible 7, and only around 26 percent of these children attained minimum dietary diversity, which is defined as eating 4 distinct food groups over a 24-hour period. At baseline, a reasonably high proportion of children consumed grains (78 percent overall) and dairy (61 percent overall), but consumption of other food groups – especially flesh foods, eggs, fruits and vegetables and pulses - was low (Figure 7). By endline, consumption had improved in every single food group, though in many cases the treatment and comparison arms showed similar improvements.

We find a positive and significant (albeit small) impact of the intervention on index child dietary diversity (Table 5). In the fully specified model of column 3, we see a small significant increase of 0.17 food groups, amounting to a 7 percent increase over the mean of the baseline comparison arm. When disaggregated by the individual food groups as in Figure 5, we see that this change in the total number of food groups consumed was driven largely by improvements in the consumption of pulses (both arms), vitamin A-rich fruits and vegetables (only treatment arm), other fruits and vegetables (only treatment arm), and dairy (both arms). The consumption of flesh foods and eggs barely moved across survey rounds, and less than 15% of the sample reported eating these foods. This suggest that there continues to be room for further improvement in diet diversity.

While the general improvement in dietary diversity from baseline to endline can be attributed at least in part to the index child being 2.5 years older and hence eating a greater variety of foods, the differences between children in the treatment and comparison arms provide strong evidence that the intervention had a role in improving diets for the index child.

4.3.3 Dietary diversity for youngest child

The results on dietary diversity among the youngest children in the household are qualitatively similar to those of index children and women. Reported dietary diversity among youngest children at endline was much better than that of index children of the same age group at baseline. 58.3 percent of the youngest children achieved minimum dietary diversity at endline (61.9 in the treatment arm, 54.5 in the comparison arm), a large improvement over the 22.6 percent of index children at baseline. This improvement over time cannot be attributed solely to the treatment, as even in the comparison arm, the mean number of food groups being consumed by the youngest children at endline is higher than the number of food groups consumed by the index children of similar age at baseline (3.41 versus 2.23). This could be a result of a secular trend in the improvement of diets, or the impact of seasonality, given that the baseline and endline surveys were conducted at different times of the year.

In the regression specifications, we find a positive and significant impact of the pilot on the number of food groups consumed by the youngest children (Table 6). In the full specification of column 3 for this outcome, we find an increase of 0.3 food groups, an 8.4 percent increase over the comparison arm mean. As seen in Figure 8, though, treatment areas were slightly better off in consumption of all 7 food groups as compared to comparison areas, the main impact came from consumption of vitamin A-rich fruits and vegetables, other fruits and vegetables, dairy, and pulses. However, there was no corresponding increase in the probability of achieving minimum dietary diversity in any specification for the outcome (Table 6, columns 1-3).

4.4 Robustness of impact on dietary patterns

Since diverse diets are a recommended behavior under the JEEViKA-MC pilot, it is possible that self-reported diets are subject to social desirability biases. We corrected for this using the individual score on a social desirability index in our regression models (Appendix B, Table B1-Table B3). This 5-question index includes questions like – "Are you always courteous, even to people who are disagreeable/not pleasant?", When you make a mistake, are you always willing to admit it? – and can be scored from 0-3. The individual score on this scale was then included in the model as an additional covariate. We found hardly any impact of social desirability on the point estimates or their significance. The results of this are available in the Appendix B.

5 Mechanisms

In the previous section, we presented evidence that the JEEViKA-MC pilot interventions improved child dietary diversity for both the index and youngest child but had no impact on women's BMI or the prevalence of underweight among women. There are several hypothesized channels through which the observed impacts might have occurred. The first relates to improvements in household food security and production. There are two ways in which the pilot interventions might have improved food security and relaxed budget constraints, allowing household resources to be invested in quality of the diet instead. The first of these was through the promotion of the FSF, used to purchase of food grains and other items at wholesale prices and at low rates of interest. This fund, while available in all areas, was specifically promoted in the treatment GPs as part of the intervention, and it is possible that this led to a greater proportion of treatment households utilizing it. The second was the promotion of kitchen gardens for production of fruits and vegetables. Again, kitchen gardens were part of the standard set of JEEViKA interventions, however, under the pilot, additional focus was given to providing practical advice on how to set these gardens up, and how to ensure that there was a steady stream of fruits and vegetables throughout the year.

The second channel through which the pilot could have improved diet quality is through improved household knowledge of health and nutrition, especially of diets, encouraging a shift in resource allocation even in the absence of an increase in resources. To test this, we investigate the impact of the pilot on knowledge and awareness of both the CMs and the respondent women.

We examine each of these channels in turn.

5.1 Improvements in overall household food security

We look at three sets of outcomes related to household food security. First, we examine whether households in the treatment arm were more likely to have received food from the FSF. Second, we look at household utilization of kitchen gardens. Third, we looked at the impact of the treatment on indicators of household food insecurity, which could have resulted from either use of FSF or of kitchen gardens (or indeed, other factors).

We find a positive and significant impact of the intervention on utilization of FSF by household for food procurement, with an 11 pp increase in the likelihood of someone in the household using FSF, which is a sizeable 17.7 percent increase over the mean in the comparison arm in the fully specified model for the outcome (Table 7). It would appear from this that the households in the treatment arm are indeed more likely to have benefitted from the purchase of food via the FSF.

On kitchen garden-related outcomes, our impact estimates show a 13-percentage point increase in the likelihood that anyone in the household ever had a kitchen garden, which is a sizeable 26 percent increase over the comparison arm mean, and an 8.2 percentage point increase in the likelihood that the household currently has a kitchen garden, which is a 12 percent increase over the comparison arm mean in the fully specified model for each outcome (Table 8). Finally, we also observe a 7.8 pp increase in the likelihood that the household's current kitchen garden is cultivated year-round, which is a sizeable 19 percent increase over the endline comparison mean levels.

Given that the pilot appears to have increased use of the FSF and of kitchen gardens, the next question is whether the pilot also had a direct impact on household food security, a key immediate determinant of health outcomes. We find no impact of the pilot on the experience of food insecurity by the households in the treatment arm in any HFIAS domain regardless of the specification employed (Table 9). The impact estimates for the overall score are negative, indicating an improvement in household food security status, however they are not statistically significant in any specification. This suggests that while a greater proportion of households in the treatment arm began using the FSF to purchase food, this purchase of food was not sufficient to have reduced some of the constraints on household budgets, in particular, it was unable to significantly ease households' experience of food insecurity.

5.2 Improvements in knowledge around dietary diversity and the cultivation of fruits and vegetables in kitchen garden

The second channel which could have caused the improved diet quality was greater exposure to BCC messages on dietary diversity and related interventions. Improved knowledge could have resulted in more efficient use of existing household resources, manifested in improved diet quality. We use several methods to investigate this. First, we examine exposure to some key messages based on the BCC content. Conditional on the respondent woman being exposed to the message, we look at their trial and adoption of the specific behavior being recommended. Second, we administer a knowledge module to CMs and to respondent women that tests knowledge of the content of the BCC material.

Figure 9 presents exposure, trial, and adoption of key messages related to diet diversity and kitchen gardens. For each of these messages, we asked whether women had heard the message, whether they had ever tried the recommended behavior, and if yes, whether they were still practising it. The height of the bars is the average proportion who responded yes to the questions from among the women in the comparison arm, while the dot is the same for women in the treatment arm. The messages were – "Household members should eat tri-colored food" (i.e. a plate with foods of three different colours), 'Children aged 6 months to 2 years should eat tri-colored food' and 'One should grow vegetables in a kitchen garden'. We find that rates of exposure, trial, and adoption are all higher in the treatment arm as compared to the comparison arm, but that exposure was still quite low, with fewer than 50% of the women in the treatment arm having heard these messages. This suggests that the key barrier to behavior change is exposure; once the woman is exposed to the message, trial rates are quite high, but a low proportion of women are exposed, leading to low trial rates overall. However, even among those women who try the recommended behavior at least once, longer-term adoption remains low, indicating other barriers exist.

We find that the pilot intervention was able to effect small but significant improvements in key knowledge indicators related to reported dietary diversity and kitchen garden cultivation. For the CM, we see no impact of the pilot on kitchen garden knowledge score, however, we do see a large 26.8 pp increase in knowledge score on child feeding and a 9.5 pp increase in knowledge of dietary diversity in fully specified model of each indicator (Table 10). Even though overall CM knowledge is high (as can be seen from the comparison arm mean), these are still fairly large effects, ranging from 10.7 to 43.3 percent.

Increases in CM knowledge were also reflected in improved respondent women knowledge. Table 11 shows that the pilot interventions resulted in an increase in respondent woman knowledge scores of 6.6

percent, 4.9 percent and 2.3 percent endline comparison mean scores for the fully specified models in knowledge domains of child feeding, dietary diversity and kitchen gardens, respectively.

6 Discussion and conclusion

Our paper used primary data and a cluster-randomized controlled trial design to evaluate the impact on health and nutrition outcomes of the JEEViKA-MC pilot intervention layered onto an existing women's SHG platform. The intervention had two components – one that provided information on health and nutrition practices, and one that served to increase coordination between service providers and beneficiaries – and implementation ran for a total of slightly over two years. Analysis of two rounds of survey data suggest that the JEEViKA-MC pilot had small but significant impacts on reported dietary diversity for both women or children, but no impact on anthropometric outcomes for women. The intervention appears to have worked through anticipated pathways, delivering higher exposure to key messages on nutrition through the self-help group platform, and contributing to improved knowledge about nutrition and improvement of some practices among women covered by the pilot program.

The health and nutrition BCC component of the pilot seemed to have worked relatively well. We find positive impacts on knowledge of health, hygiene and nutrition practices among women in the treatment arm. We also find positive change in several practices, such as dietary diversity (among women and children), and select child feeding practices. Women in the treatment arm were significantly more likely to use the Food Security Fund to purchase food, and we also find a small positive impact on cultivating a kitchen garden.

Despite the improvement in some of the key underlying determinants mentioned above, we find no impact on anthropometric outcomes for women or children. This implies improvements in dietary diversity and greater uptake of the food security fund did not ultimately lead to improvements in anthropometric outcomes and household food security. One possible explanation is that the duration of the pilot was too short to reasonably expect impact on anthropometric measures, which are a result of many interrelated factors. The second possible explanation is that, despite improvements, the quantity and quality of food being consumed was not enough to reduce the prevalence of underweight among women or children.

A closer look at the diets of children reveals that the impact on dietary diversity came primarily from higher consumption of vitamin A-rich fruits and vegetables in the treatment groups, and not from animal-source foods. The consumption of eggs and flesh foods (e.g., meat, fish, or chicken) was very low even at endline, despite families self-identifying as non-vegetarian. Improvements in reported dietary diversity for women came primarily from pulses, fruits, and dairy, and from a protective effect of the intervention on consumption of green leafy vegetables. Gaps still remain, with more than 50 percent of women not meeting minimum dietary diversity even in the treatment arm, suggesting that more effort is needed to close barriers to consumption, and to improve dietary diversity and consumption of iron-rich foods in this setting. We did not collect information on quantities of different foods consumed, an important factor in enabling changes in anthropometric outcomes.

The findings of our evaluation are largely consistent with what other such studies have found. The literature indicates that although several studies found an impact of group-based interventions on dietary diversity either for mothers or for children, very few studies found an impact on anthropometric outcomes. The magnitude of the impact of the pilot intervention tested in our study is somewhat lower than in the most recent study from India (Nair et al. 2017), likely due to more diluted implementation in this programmatic context.

In addition to group-based interventions, our overall findings are in line with findings from a recent review of agriculture-nutrition program evaluations (Ruel, Quisumbing and Balagamwala 2018), which reiterated the positive impacts of agricultural interventions on diet diversity, as well as more limited impacts on anthropometric outcomes. Our findings are also in line with findings from evaluations of other large-scale behavior change interventions implemented by the global initiative, Alive & Thrive. Taken together, these various studies suggest that although improvements in dietary diversity can be achieved through diverse efforts to support behavior change, this may not be translating into sustained daily consumption of foods that promote linear growth. Trials that included food or cash supplements in Bangladesh (Ahmed et al. 2016) with behavior change efforts were more successful in supporting improvements in child growth outcomes.

By providing evidence on the integration of health and nutrition objectives into an at-scale savings-credit and livelihoods program, our study has the potential to influence policy. The reach of the NRLM program is vast and set to increase further over the next decade; if this platform can be harnessed effectively to deliver results on nutrition then this will greatly accelerate India's progress on this front. Our results suggest that provision of information is not enough, especially in resource-constrained contexts. The power of information is in improving the efficiency of resource-allocation. This needs to be combined with other financial or livelihoods-related interventions that increase the size of the pool of resources; when thus combined, the delivery of BCC through this platform could be transformational.

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Figures

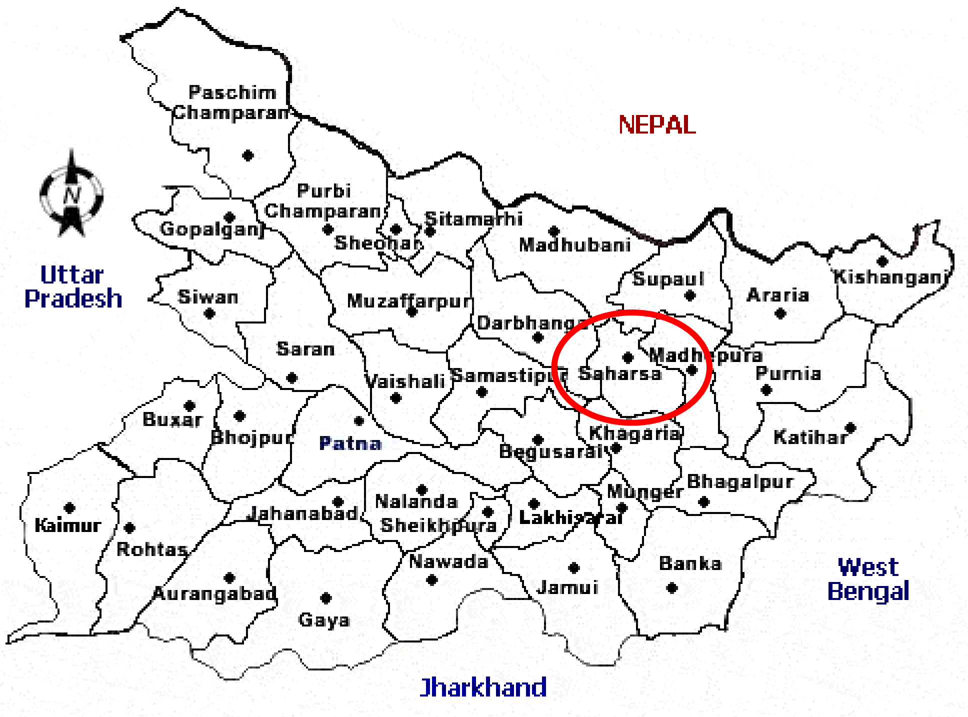

Figure 1: Map of the districts of Bihar

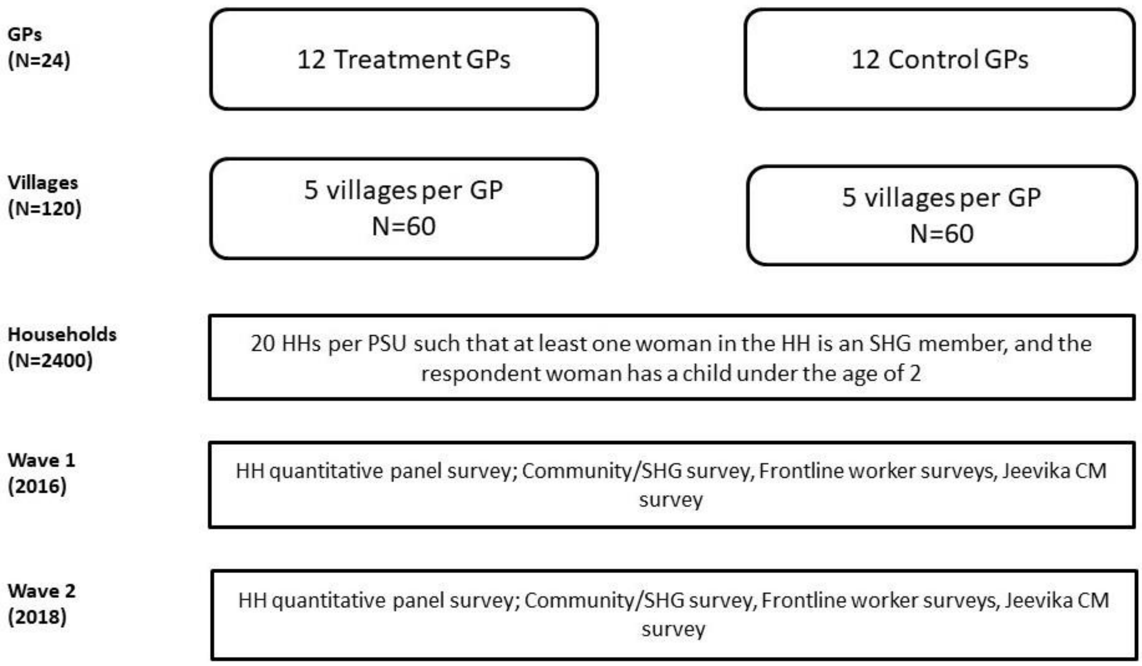

Figure 2: Planned study design

Note: Study sampling might have deviated slightly from the schema above for reasons such as unavailability of households satisfying the sampling criteria within a village or fewer than five villages per GP.

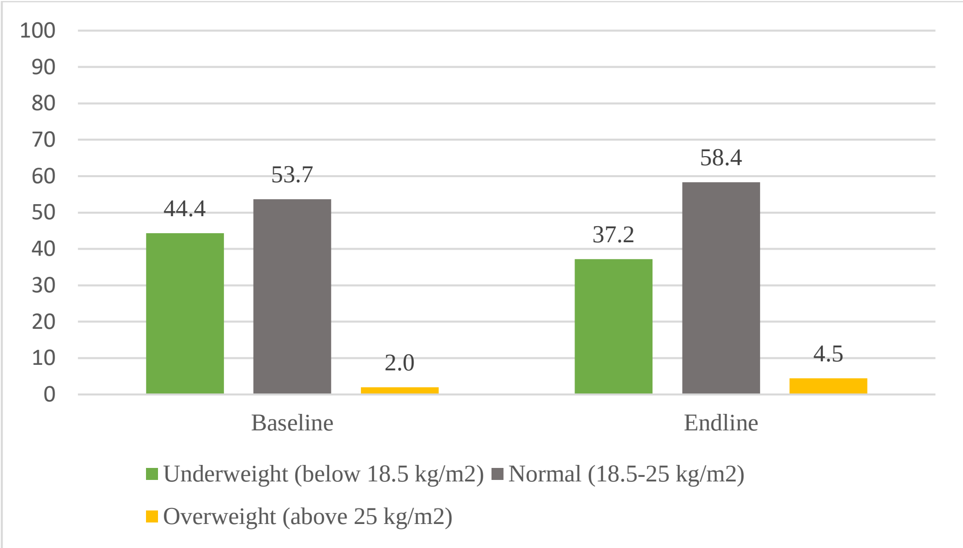

Figure 3:Distribution of women by BMI categories: underweight, normal and overweight at baseline and endline

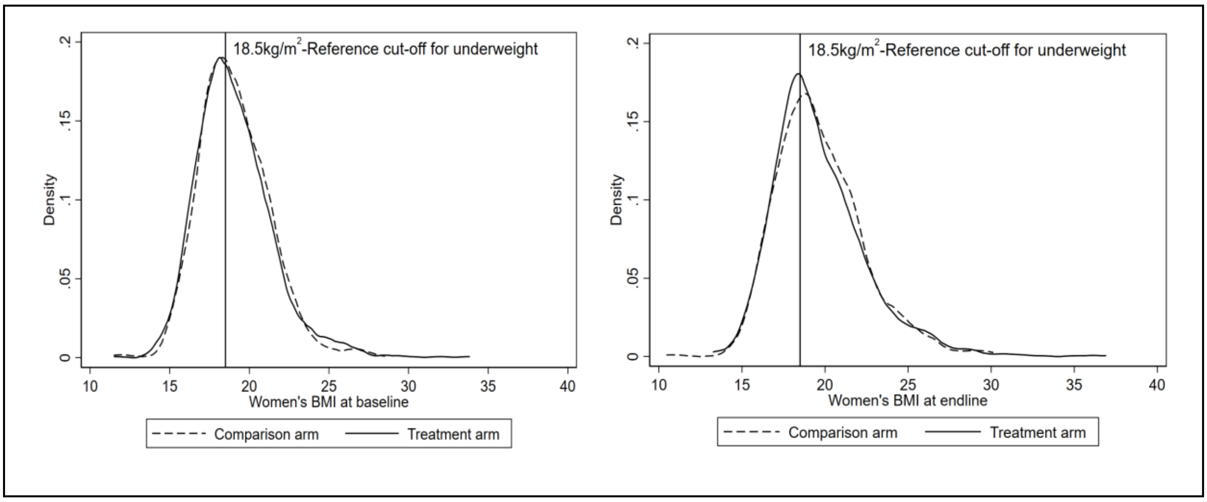

Figure 4: Kernel densities at baseline and endline, by arm

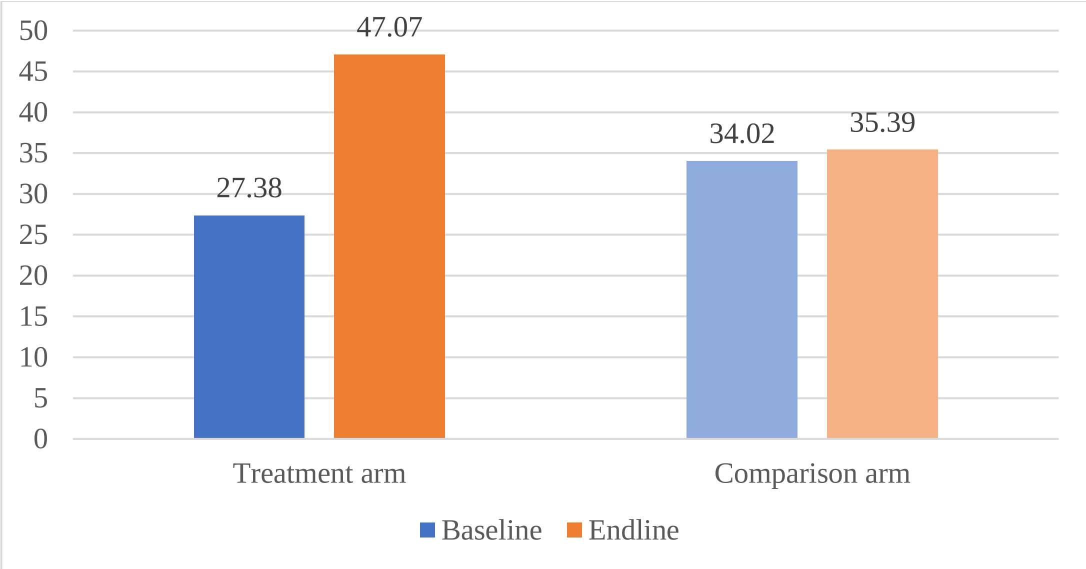

Figure 5: Proportion of women attaining minimum dietary diversity at baseline and endline, by treatment arm

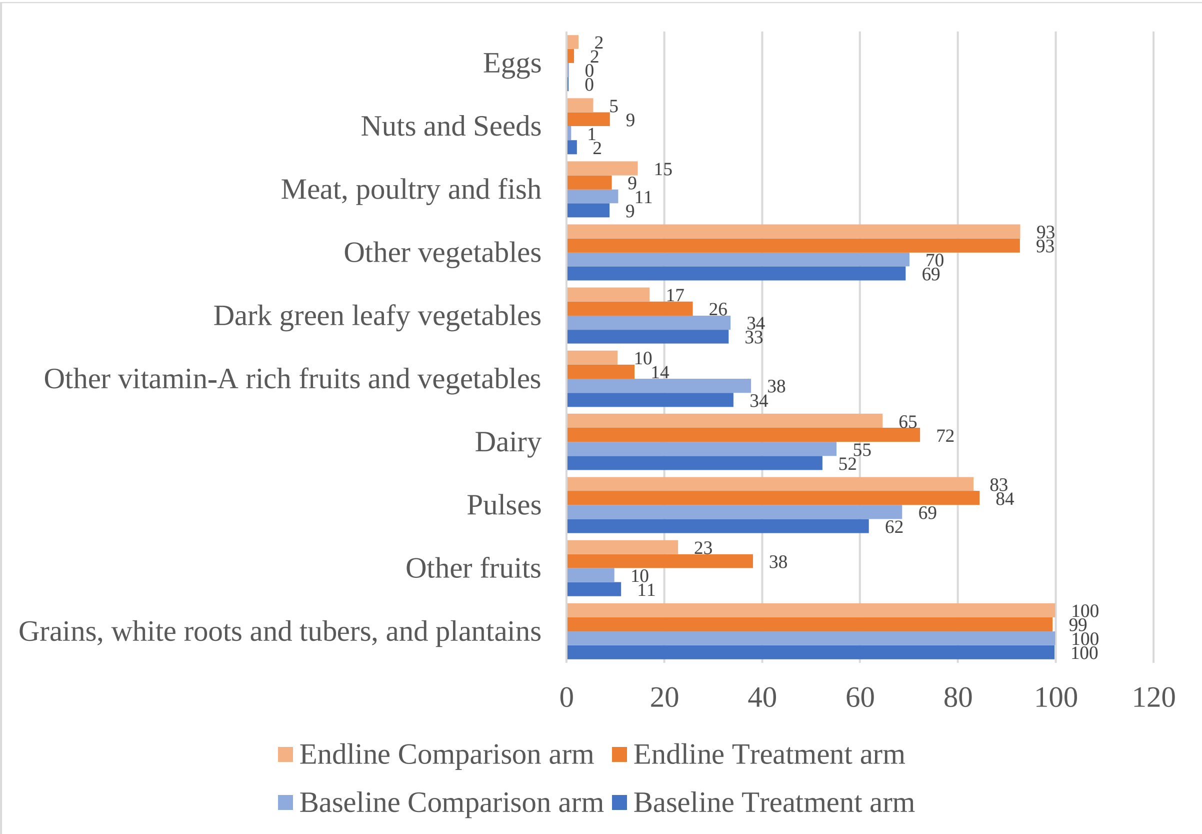

Figure 6: Proportion of respondent women consuming each food group at baseline and endline, by treatment arm

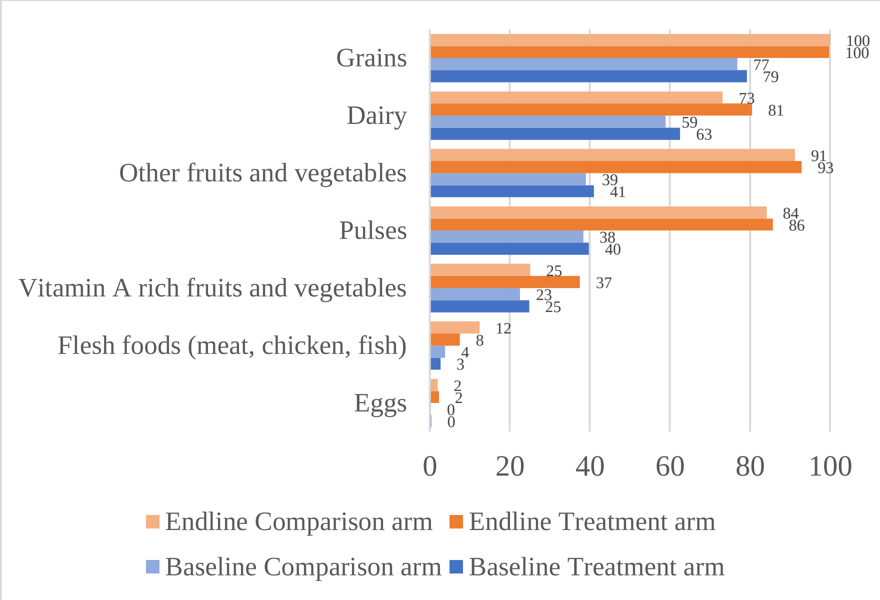

Figure 7: Food groups consumed by index children, by arm at baseline and endline

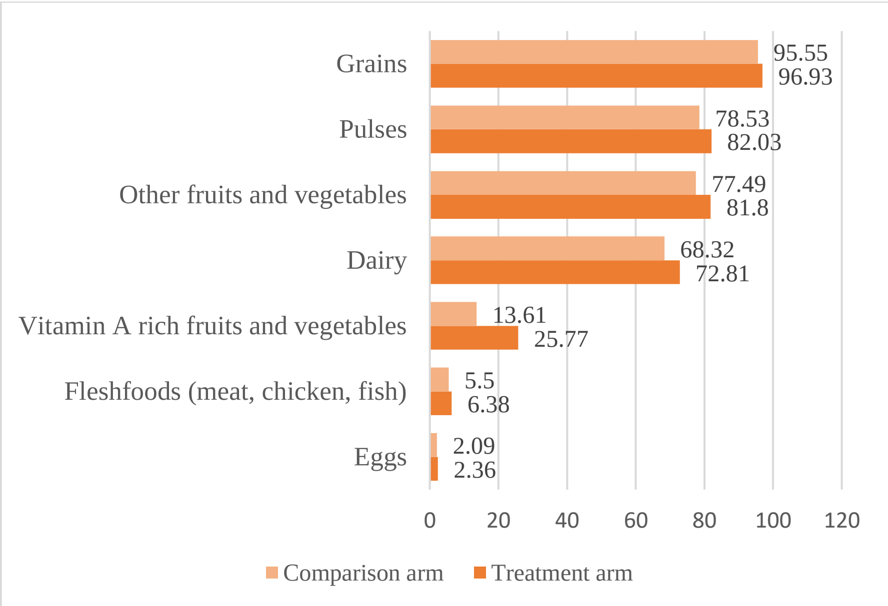

Figure 8: Food groups consumed by youngest children, by arm at endline

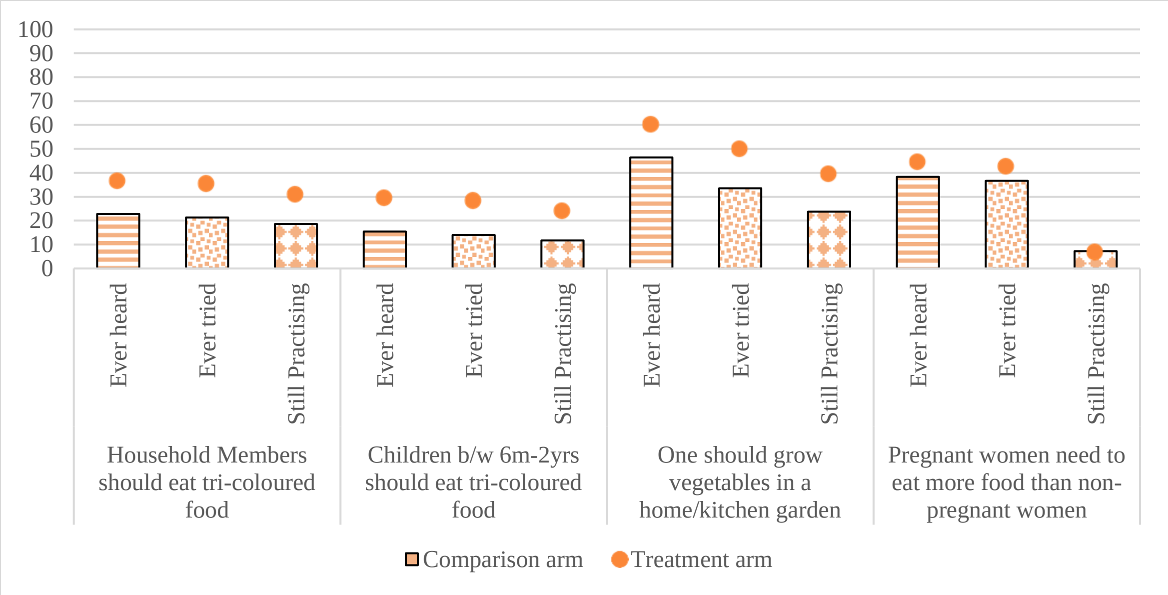

Figure 9: Exposure to messages around dietary diversity/kitchen gardens

Tables

Table 1: Study design

	Baseline		Endline		Attrition rate*	
	Treatment	**Control**	**Treatment**	**Control**	**Treatment**	**Control**
Household						
Respondent women	1,164	1,082	1,096	1,023	5.8	5.4
Index child (youngest child 6–23 months at baseline)	1,164	1,082	971	910	16.5	15.8
Youngest child 6–23 months at endline			423	382		
Community Mobilizer	67	55	65	55		
Community	59	60	68	60		

*The attrition rate is only applicable to households, as they were followed over both rounds of the survey.

Table 2: Baseline household and respondent woman's characteristics at baseline

Baseline characteristics	Treatment arm (N=1096)	Comparison arm (N=1023)	Overall (N=2119)	P-value
	Mean/ Proportion			
Respondent woman characteristics				
Age in years	25.36 (4.18)	25.62 (4.1)	25.49 (4.14)	0.26
Respondent woman's husband is head	44.25	50.83	47.43	0.06*
No. of children	2.67 (1.42)	2.8 (1.49)	2.74 (1.45)	0.17
Years of schooling	2.28 (3.81)	1.91 (3.6)	2.1 (3.71)	0.13
Occupation: non-agriculture day labour	8.42	8.81	8.61	0.86
Occupation: agriculture day labour	14.65	11.94	13.34	0.10*
Occupation: housewife	71.61	74.56	73.04	0.35
Household characteristics				
Household size	6.73 (2.65)	6.54 (2.44)	6.64 (2.56)	0.09*
No. females in age group 0 to 4 years	0.99 (0.81)	0.96 (0.77)	0.97 (0.79)	0.35
No. females in age group 5 to 15 years	0.84 (1.08)	0.83 (1.01)	0.84 (1.04)	0.83
No. females in age group 16 to 30 years	1.17 (0.63)	1.09 (0.57)	1.13 (0.6)	0.02**
No. females in age group 31 to 55 years	0.46 (0.53)	0.39 (0.51)	0.43 (0.52)	0.01**
No. females in age group above 55 years	0.23 (0.44)	0.22 (0.43)	0.23 (0.43)	0.7
No. males in age group 0 to 4 years	0.92 (0.77)	0.89 (0.74)	0.91 (0.76)	0.42
No. males in age group 5 to 15 years	0.52 (0.81)	0.63 (0.88)	0.57 (0.85)	0.03**
No. males in age group 16 to 30 years	0.82 (0.84)	0.79 (0.79)	0.81 (0.81)	0.48
No. males in age group 31 to 55 years	0.49 (0.58)	0.45 (0.56)	0.47 (0.57)	0.18
No. males in age group above 55 years	0.29 (0.46)	0.28 (0.46)	0.29 (0.46)	0.63
Caste of household head: other backward castes	54.11	60.41	57.15	0.13

Caste of household head: scheduled caste	37.04	35.19	36.15	0.64
Caste of household head: scheduled tribe	2.65	1.86	2.27	0.39
Religion of household head: muslim	9.12	9.87	9.49	0.83
Highest number of years of schooling in household, female	3.58 (4.02)	3.1 (3.86)	3.35 (3.95)	0.09*
Any female household member has a bank account	84.49	83.38	83.95	0.75
Household has electricity	79.38	68.23	74	0.04**
Household has improved: floor materials	15.05	11.14	13.17	0.09*
Assets out of a sum of 25[i]	6.14 (2.76)	5.77 (2.54)	5.96 (2.66)	0.2

Source: Author's Calculation

Legend: * p<0.10; ** p<0.05; *** p<0.01

Table 3: Impact of the JEEViKA-MC pilot on respondent woman's BMI and likelihood of being underweight

	Respondent woman					
	Body mass index			**Likelihood of being underweight**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (= 1 if treatment GP)	−0.008	−0.025	−0.025	0.000	0.003	0.002
	(0.088)	(0.084)	(0.082)	(0.017)	(0.017)	(0.017)
P-value cluster	0.928	0.771	0.762	0.988	0.840	0.911
P-value bootstrap	0.943	0.781	0.775	0.993	0.850	0.923
Partial specification		x			x	
Full specification			x			x
Comparison arm mean	19.085	19.085	19.085	0.431	0.431	0.431
Observations	2,108	2,103	2,103	2,108	2,103	2,103

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 ('partial specification') adds baseline covariates that were unbalanced at the 10 percent level, and column 3 ('full specification') controls for all relevant baseline characteristics. For list of characteristics refer to Table 2 All specifications include block-level fixed effects.
4. All columns control for baseline values of the outcome variable; baseline comparison arm mean values are provided for comparison.

Table 4: Impact of the JEEViKA-MC pilot on women's dietary diversity

	Respondent women					
	Women who met minimum dietary diversity (five or more food groups)			**Total number of food groups consumed in last 24 hours**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (= 1 if treatment Gram Panchayat)	0.114	0.102	0.103	0.338	0.307	0.309

	(0.035)	(0.035)	(0.037)	(0.120)	(0.120)	(0.126)
P-value cluster	0.004***	0.008***	0.010**	0.010**	0.017**	0.022**
P-value bootstrap	0.012**	0.020**	0.026**	0.031**	0.042**	0.051*
Comparison arm mean	0.340	0.340	0.340	3.869	3.869	3.869
Observations	2,115	2,110	2,110	2,115	2,110	2,110

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 ('partial specification') adds baseline covariates that were unbalanced at the 10 percent level, and column 3 ('full specification') controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.
4. All columns control for baseline values of the outcome variable; baseline comparison arm mean values are provided for comparison.

Table 5: Impact of the JEEViKA-MC pilot on dietary diversity among index children

	Index child		
	Total number of food groups consumed in last 24 hours		
	(1)	**(2)**	**(3)**
Treatment dummy (= 1 if treatment GP)	0.194	0.166	0.169
	(0.077)	(0.078)	(0.080)
P-value cluster	0.018**	0.043**	0.046**
P-value bootstrap	0.046**	0.081*	0.089*
Partial specification		x	
Full specification			x
Comparison arm mean	2.398	2.398	2.398
Observations	1,881	1,878	1,878

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 adds baseline covariates that were unbalanced at the 10 percent level, and column 3 controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.

4. All columns control for baseline values of the outcome variable; baseline comparison arm mean values are provided for comparison.

5. All columns additionally control for endline values of child's age and gender dummy.

Table 6: Impact of JEEViKA-MC pilot on the dietary diversity of the youngest child

	Youngest child					
	Total number of food groups consumed in last 24 hours			**Child achieved minimum dietary diversity**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (= 1 if treatment GP)	0.292	0.261	0.286	0.077	0.063	0.076
	(0.116)	(0.120)	(0.118)	(0.048)	(0.048)	(0.048)
P-value cluster	0.020**	0.041**	0.024**	0.123	0.200	0.125
P-value bootstrap	0.051*	0.077*	0.054*	0.168	0.242	0.177
Partial specification		x			x	
Full specification			x			x
Comparison arm mean	3.411	3.411	3.411	0.545	0.545	0.545
Observations	805	804	804	805	804	804

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.

2. Standard errors in parentheses.

3. The first column within each outcome reports the unadjusted base specification, column 2 adds baseline covariates that were unbalanced at the 10 percent level, and column 3 controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.

4. Endline comparison arm mean values are provided for comparison.

5. All columns additionally control for endline values of child's age and gender dummy.

Table 7: Impact of JEEViKA-MC pilot on utilization of FSF fund provided through the JEEViKA platforms

	Any family member received food from the FSF		
	(1)	**(2)**	**(3)**
Treatment dummy (= 1 if treatment GP)	0.109	0.108	0.112
	(0.023)	(0.025)	(0.026)
P-value cluster	0.000***	0.000***	0.000***
P-value bootstrap	0.002***	0.001***	0.002***
Partial specification		x	

Full specification			x
Comparison arm mean	0.637	0.637	0.637
Observations	1,387	1,383	1,383

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.

2. Standard errors in parentheses.

3. The first column within each outcome reports the unadjusted base specification, column 2 adds baseline covariates that were unbalanced at the 10 percent level, and column 3 controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.

4. Endline comparison arm mean values are provided for comparison

Table 8: Impact of JEEViKA-MC pilot on kitchen gardens utilization

	Use of kitchen gardens								
	Anyone in family ever had a kitchen garden			**Family currently has a kitchen garden**			**Cultivate the kitchen garden year-round**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (= 1 if treatment GP)	0.129	0.121	0.127	0.073	0.071	0.082	0.074	0.069	0.078
	(0.039)	(0.040)	(0.041)	(0.038)	(0.039)	(0.036)	(0.036)	(0.036)	(0.036)
P-value cluster	0.003***	0.006***	0.005***	0.070*	0.079*	0.030**	0.054*	0.072*	0.041**
P-value bootstrap	0.007***	0.011**	0.009***	0.090*	0.101	0.054*	0.071*	0.100	0.052*
Partial specification		x			x			x	
Full specification			x			x			x
Comparison arm mean	0.485	0.485	0.485	0.667	0.667	0.667	0.401	0.401	0.401
Observations	2,119	2,114	2,114	1,279	1,274	1,274	1,279	1,274	1,274

Source: Authors’ calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 adds baseline covariates that were unbalanced at the 10 percent level, and column 3 controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.
4. Endline comparison arm mean values are provided for comparison

Table 9: Impact of JEEViKA-MC pilot on household food insecurity indicators and overall score

	Household food insecurity outcome											
	HH food insecurity: anxiety and uncertainty			**HH food insecurity: insufficient food quality**			**HH food insecurity: insufficient food intake**			**Food security access scale score**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (= 1 if treatment GP)	0.006	0.013	0.007	−0.022	−0.015	−0.018	−0.025	−0.015	−0.016	−0.243	−0.198	−0.217
	(0.027)	(0.025)	(0.022)	(0.028)	(0.026)	(0.023)	(0.027)	(0.026)	(0.026)	(0.202)	(0.184)	(0.186)
P-value cluster	0.836	0.606	0.766	0.450	0.568	0.436	0.365	0.557	0.542	0.241	0.294	0.256
P-value bootstrap	0.864	0.607	0.761	0.491	0.595	0.464	0.391	0.574	0.551	0.274	0.327	0.266
Partial specification		x			x			x			x	
Full specification			x			x			x			x
Comparison arm mean	0.484	0.484	0.484	0.642	0.642	0.642	0.412	0.412	0.412	4.164	4.164	4.164
Observations	2,119	2,114	2,114	2,119	2,114	2,114	2,119	2,114	2,114	2,119	2,114	2,114

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.

2. Standard errors in parentheses.

3. The first column within each outcome reports the unadjusted base specification, column 2 adds baseline covariates that were unbalanced at the 10 percent level, and column 3 controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.

4. All columns control for baseline values of the outcome variable; baseline comparison arm mean values are provided for comparison

Table 10: Impact of the JEEViKA-MC pilot on CM's diet and kitchen garden-related knowledge scores

	Normalized Knowledge score								
	Child feeding			**Dietary diversity**			**Kitchen gardens**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (=1 if treatment GP)	26.302	25.176	26.768	10.493	9.927	9.516	0.620	0.381	0.651
	(2.746)	(2.776)	(2.894)	(2.433)	(2.497)	(2.356)	(0.758)	(0.699)	(0.924)
P-value cluster	0.000***	0.000***	0.000***	0.000***	0.001***	0.001***	0.422	0.591	0.488
P-value bootstrap	0.000***	0.000***	0.000***	0.004***	0.002***	0.004***	0.437	0.587	0.511
Partial specification		x			x			x	
Full specification			x			x			x
Comparison arm mean	61.818	61.818	61.818	88.182	88.182	88.182	98.636	98.636	98.636
Observations	120	120	120	120	120	120	120	120	120

Source: Authors' Calculation

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 adds endline covariates that were unbalanced at the 10 percent level, and column 3 controls for all relevant endline characteristics. All specifications include block-level fixed effects.
4. Endline comparison arm mean values are provided for comparison.

Table 11: Impact of the JEEViKA-MC pilot on diet-related knowledge scores for women

	Normalized Knowledge score								
	Child feeding			**Dietary diversity**			**Kitchen gardens**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (=1 if treatment GP)	4.137	4.010	3.841	4.394	4.087	4.150	2.031	2.046	2.179
	(1.143)	(1.162)	(1.151)	(1.360)	(1.271)	(1.247)	(1.185)	(1.113)	(1.119)
P-value cluster	0.001***	0.002***	0.003***	0.004***	0.004***	0.003***	0.100	0.079*	0.064*
P-value bootstrap	0.011**	0.017**	0.020**	0.009***	0.007***	0.005***	0.125	0.097*	0.076*
Partial specification		x			x			x	
Full specification			x			x			x
Comparison arm mean	59.129	59.129	59.129	84.861	84.861	84.861	93.622	93.622	93.622
Observations	2,119	2,114	2,114	2,119	2,114	2,114	2,119	2,114	2,114

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.

2. Standard errors in parentheses.

3. The first column within each outcome reports the unadjusted base specification, column 2 adds baseline covariates that were unbalanced at the 10 percent level, and column 3 controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.

4. Endline comparison arm mean values are provided for comparison

Appendix

A. Attrition

Enumerators were generally successful in resurveying respondent women from the baseline households. In total, 2,119 of the 2,246 respondent women that were included in the baseline survey were resurveyed at endline, representing an attrition rate of 5.65 percent over the 30-month period (Table 4.1). Although the overall attrition rate is reasonably low, one might be concerned that the respondent women that could not be found were different in specific ways from the households that were found, and if so, that the impact results may be biased. To allay these fears, we conduct attrition analysis for the respondent woman sample. Since some of the primary outcomes are defined at the index child level, we also present attrition analysis for the index child sample. The attrition among index children is 16.25 percent over the 30-month period. In the text that follows we analyze the characteristics of the dropout respondent women and index children relative to those who were located for the endline survey.

A.1 Endline sample and attrition

We find slight differences in the attrition rates across the two intervention groups (Table A.1).[2] Respondent women in the control group were slightly less likely to attrit (5.5 percent) than respondent women in the treatment group (5.8 percent), but these differences were not statistically significant. A similar pattern of attrition among the index children was observed, with the index children more likely to be found in the control group as compared to the treatment group.

Table A.1 Attrition by treatment status

Panel A: Respondent women	**Treatment**	**Control**
Baseline	1,164	1,082
Endline	1,096	1,023
Percent Found, Endline	94.2	94.5
Panel B: Index children	**Treatment**	**Control**
Baseline	1,164	1,082
Endline	971	910
Percent Found, Endline	83.4	84.1

Source: Authors' calculations.

We also observed some differences in attrition rates by block (Table A.2). In Saur Bazaar and Sonbarsa Raj the attrition rate at the respondent woman level was 5.7 and 7.9 percent, respectively, whereas it

[2] These attrition rates are based on attrition rates as measured by whether the index child was found at the time of endline. This also takes into account missing data on anthropometric measures or date of birth at endline.

was only 2.4 percent in Pattarghat. The difference in attrition among index children follows the same pattern as for respondent women, with attrition rates highest in Sonbarsa Raj and lowest in Pattarghat.

Table A.2 Attrition by block

Panel A: Respondent women	**Overall**	**Pattarghat**	**Saur Bazaar**	**Sonbarsa Raj**
Baseline	2,246	411	1,240	595
Endline	2,119	401	1,170	548
Percent Found, Endline	94.3	97.6	94.3	92.1
Panel B: Index children	**Overall**	**Pattarghat**	**Saur Bazaar**	**Sonbarsa Raj**
Baseline	2,246	411	1,240	595
Endline	1881	352	1,039	549
Percent Found, Endline	83.7	85.6	83.8	82.3

Although low attrition rates rarely affect estimation results in the literature (e.g., de Brauw and Harigaya 2007), it is still worth ensuring that impact estimates are not going to be biased by nonrandom attrition. We approach this from two perspectives. First, we examine baseline descriptive statistics on respondent women by endline attrition status. Next, we estimate a probit model for whether respondent women were found, based on characteristics that looked like they might be important from the descriptive statistics.

We first examine several measures of demographics, wealth and dwelling characteristics, and household activities in the baseline survey, by whether respondent women were found in the final survey (Table A.3). We do this for the sample as a whole as differences in attrition by treatment and comparison arms were small and insignificant. We perform a test of equality of means for each of these variables across the panel and lost respondent women. We find that the primary differences exist in demographic characteristics. For example, households with greater number of females in the age ranges of 16–30 and 31–54 years old are more likely to leave the sample whereas those with fewer females in the age range of 5–15 years were more likely to stay. A few additional variables are of significance; for example, whether the flooring of the dwelling was made of improved materials, whether the household used dung as the primary source of cooking fuel, the level of schooling within the household and whether the household belonged to the general caste category. The respondent woman’s characteristics were significantly different between those that were re-interviewed as compared to those that were not. However, many of the other variables are not significant, which suggests that at least the amount of selection occurring on observable variables is quite small.

Table A.3 Descriptive statistics, select baseline characteristics, by whether household was resurveyed at endline

Variables	Baseline Average	Panel Households	Non-Panel Households	p-value, test of equality of means
Religion of household head				
Hindu	0.90	0.90	0.87	0.32
Muslim	0.10	0.09	0.13	0.30
Caste of household head				
Scheduled caste	0.36	0.36	0.36	0.99
Scheduled tribe	0.02	0.02	0.02	0.55
Other backward castes	0.57	0.57	0.51	0.19
General	0.04	0.04	0.09	0.08
Demographic characteristics				
Household size	6.64	6.64	6.65	0.95
No. of male members 0–4 years old	0.91	0.91	0.91	0.99
No. of male members 5–15 years old	0.57	0.57	0.51	0.42
No. of male members 16–30 years old	0.81	0.81	0.88	0.36
No. of male members 31–54 years old	0.47	0.47	0.41	0.20
No. of male members <= 55 years old	0.28	0.29	0.23	0.14
No. of female members 0–4 years old	0.97	0.97	0.99	0.80
No. of female members 5–15 years old	0.83	0.84	0.66	0.04
No. of female members 16–30 years old	1.14	1.13	1.28	0.00
No. of female members 31–54 years old	0.43	0.43	0.53	0.04
No. of female members <= 55 years old	0.23	0.23	0.25	0.50
Education				
Highest number of years of schooling in HH	5.82	5.77	6.71	0.02
Highest number of years of schooling in HH, female	3.39	3.35	4.17	0.04
Highest number of years of schooling in HH, male	5.09	5.05	5.83	0.07
Socioeconomic characteristics				
Flooring of improved materials	0.14	0.13	0.20	0.07
Walls of improved materials	0.49	0.49	0.46	0.41
Roof of improved materials	0.38	0.38	0.40	0.56
Access to electricity	0.74	0.74	0.76	0.54
Main cooking fuel: Liquefied Petroleum Gas	0.05	0.05	0.09	0.11
Main cooking fuel: wood	0.82	0.82	0.83	0.74
Main cooking fuel: dung	0.12	0.12	0.06	0.01
Total number of assets owned (0, 25)	5.98	5.96	6.30	0.22
Any HH member has a bank account	0.89	0.89	0.89	0.97

Variables	Baseline Average	Panel Households	Non-Panel Households	p-value, test of equality of means
Any HH female member has a bank account	0.84	0.84	0.86	0.56
Any HH male member has a bank account	0.58	0.58	0.55	0.47
Respondent woman's characteristics				
Age	25.39	25.49	23.88	0.00
Years of schooling	2.15	2.10	3.03	0.02
No. of children	2.71	2.74	2.26	0.00
% occupied in non-agricultural day labor	0.08	0.09	0.06	0.30
% occupied as housewives	0.73	0.73	0.80	0.05
% occupied in agricultural day labor	0.13	0.13	0.09	0.07
Index child's characteristics				
Age	14.36	14.36	14.38	0.99
Sex: male	0.51	0.51	0.50	0.83

Source: Authors' calculations.

To follow the methodology described by Wooldridge (2002), we estimate a probit model in which the dependent variable takes a value of 1 if the household was found at the endline survey and 0 if it was not. We use baseline demographic and socioeconomic variables from Table A.3 for which the difference in means was significantly different and add treatment and block dummies as additional controls. In addition, we estimate probit models for attrition among the respondent women as well as the index children. We also present a fully interacted model which includes all covariates interacted with the treatment dummy, to confirm that the predictors of attrition are the same across the treatment and comparison groups. The results from these models are presented in Table A.4.

Table A.4 Probit model predicting households staying in the sample between baseline and endline surveys

	Base model		Fully interacted model	
	(1)	(2)	(3)	(4)
Variables	Respondent Woman	Index Child	Respondent Woman	Index Child
Treatment area	0.009	-0.004	0.002	0.028
	(0.006)	(0.010)	(0.031)	(0.088)
Household caste is General	-0.034		-0.018	
	(0.033)		(0.033)	
No. of male members 5-15 years old		-0.001		0.003

		(0.005)		(0.006)
No. of female members 0-4 years old		-0.024***		-0.010
		(0.008)		(0.013)
No. of female members 5-15 years old	0.001	-0.004	0.004	-0.005
	(0.005)	(0.004)	(0.005)	(0.006)
No. of female members 16-30 years old	-0.010	0.018**	-0.017*	0.014
	(0.007)	(0.009)	(0.009)	(0.013)
No. of female members 31-54 years old	-0.012*	-0.003	-0.008	-0.003
	(0.007)	(0.006)	(0.011)	(0.006)
Highest number of years of schooling in HH	-0.003		0.000	
	(0.003)		(0.007)	
Highest number of years of schooling in HH, female	0.004		-0.000	
	(0.003)		(0.003)	
Highest number of years of schooling in HH, male	0.002		-0.001	
	(0.002)		(0.006)	
Index child's age		-0.005***		-0.005***
		(0.001)		(0.002)
Index child is male		-0.021		-0.019
		(0.013)		(0.021)
Respondent woman's age	0.004	0.002	0.004	0.002
	(0.002)	(0.002)	(0.002)	(0.003)
Respondent woman's years of schooling	-0.003		0.001	
	(0.003)		(0.003)	
Respondent woman's no. of children	0.000	0.004	0.000	0.002
	(0.006)	(0.008)	(0.007)	(0.010)
Respondent woman's occupation is housewife	0.001	-0.014	-0.009	0.000
	(0.011)	(0.014)	(0.013)	(0.013)
Respondent woman's occupation is agriculture day laborer	0.017	0.007	0.016	0.006
	(0.017)	(0.019)	(0.017)	(0.020)
Flooring of improved materials	-0.017		-0.017	
	(0.015)		(0.015)	
Main cooking fuel is liquified petroleum gas		-0.025		-0.044
		(0.028)		(0.048)
Main cooking fuel is dung	0.026***	0.011	0.017	0.017

	(0.010)	(0.015)	(0.016)	(0.018)
Saur Bazaar	-0.038***	0.006	-0.032**	0.016
	(0.010)	(0.010)	(0.013)	(0.014)
Sonbarsa Raj	-0.076***	0.007	-0.080***	-0.006
	(0.018)	(0.010)	(0.019)	(0.010)
Treated*Household caste is General			-0.019	
			(0.047)	
Treated*No. of male members 5-15 years old				-0.009
				(0.009)
Treated*No. of female members 0-4 years old				-0.022
				(0.016)
Treated*No. of female members 5-15 years old			-0.005	0.002
			(0.009)	(0.007)
Treated*No. of female members 16-30 years old			0.012	0.005
			(0.015)	(0.017)
Treated*No. of female members 31-54 years old			-0.010	
			(0.014)	
Treated*Highest number of years of schooling in HH			-0.007	
			(0.007)	
Treated*Highest number of years of schooling in HH, female			0.009*	
			(0.005)	
Treated*Highest number of years of schooling in HH, male			0.005	
			(0.006)	
Treated*Index child's age				-0.000
				(0.002)
Treated*Index child is male				0.002
				(0.025)
Treated*Respondent woman's age				0.000
				(0.004)
Treated*Respondent woman's years of schooling			-0.009	
			(0.006)	

Treated*Respondent woman's no. of children			0.001	0.003
			(0.007)	(0.014)
Treated*Respondent woman occupation's housewife			0.017	-0.032
			(0.016)	(0.026)
Treated*Main cooking fuel is Liquified Petroleum Gas				0.021
				(0.025)
Treated*Main cooking fuel is dung			0.023	-0.018
			(0.020)	(0.040)
Treated*Saur Bazaar			-0.017	-0.020
			(0.017)	(0.020)
Treated*Sonbarsa			0.000	0.020
			(0.015)	(0.015)
Observations	2,198	1,995	2,198	1,995

Source: Authors' calculations.

Legend: *p<0.10; **p<0.05; ***p<0.01; Standard errors in parentheses

For the respondent woman-level analysis, only four variables appear to have a significant relationship with the dependent variable, these are: number of female members in the age range 31–54 years, main cooking fuel is dung and the block dummies for Saur Bazar and Sonbarsa Raj. For the attrition at the index child level, there are three covariates that have a statistically significant coefficient: age of the index child, number of female members 0–4 years old and number of female members 16–30 years old. We do not expect this to bias our impact estimates.

Figure A.1 Distribution of attrition weights at the household level

Although few variables were significantly related to the dummy variable for remaining households, the model does have some predictive power. Respondent women who remain in the sample have an average predicted probability of staying at 94.7 percent, while for the missing respondent women it is 92.1 percent. The median predicted probability of staying in the sample is slightly higher, at 95.3 percent. When we plot a kernel density of the attrition weights (Figure A.1), it is clear that most households will receive similar weights and only a few have probabilities of less than 85 percent, which corresponds to a weight of 1.17. In fact, the lowest predicted probability of staying in the sample is 0.725, so no respondent woman would receive a weight of larger than 1.38. As more than 94 percent of respondent women were found in the final survey, all of these findings about the attrition weights are reasonable. In addition, because the distribution of weights is tight, it is unlikely that results will change when we control for attrition.

B. Impact of the pilot correcting for social desirability

Table B1: Impact of the JEEViKA-MC pilot on maternal BMI, correcting for social desirability

	Respondent woman					
	Body mass index			**Likelihood of being underweight**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (= 1 if treatment	0.002	-0.014	-0.016	-0.001	0.002	0.001

GP)						
	(0.088)	(0.084)	(0.082)	(0.017)	(0.017)	(0.017)
P-value cluster	0.986	0.866	0.850	0.948	0.907	0.957
P-value bootstrap	0.985	0.873	0.864	0.951	0.919	0.970
Partial specification		x			x	
Full specification			x			x
Comparison arm mean	19.085	19.085	19.085	0.431	0.431	0.431
Observations	2,108	2,103	2,103	2,108	2,103	2,103

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 ('partial specification') adds baseline covariates that were unbalanced at the 10 percent level, and column 3 ('full specification') controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.
4. All columns control for baseline values of the outcome variable; baseline comparison arm mean values are provided for comparison.

Table B2: Impact of the pilot on index child food group consumption, correcting for social desirability

	Index Child		
	Total number of food groups consumed in last 24 hours		
	(1)	**(2)**	**(3)**
Treatment dummy (=1 if treatment GP)	0.201	0.172	0.177
	(0.078)	(0.079)	(0.082)
P-value cluster	0.017**	0.040**	0.042**
P-value bootstrap	0.044**	0.075*	0.082*
Comparison arm mean	2.398	2.398	2.398
Observations	1,881	1,878	1,878

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 ('partial specification') adds baseline covariates that were unbalanced at the 10 percent level, and column 3 ('full specification') controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.

4. All columns control for baseline values of the outcome variable; baseline comparison arm mean values are provided for comparison.

Table B3: Impact of the pilot on the dietary diversity of the youngest child, correcting for social desirability

	Youngest child					
	Total number of food groups consumed in last 24 hours			**Child achieved minimum dietary diversity**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (= 1 if treatment GP)	0.293	0.261	0.285	0.075	0.061	0.074
	(0.117)	(0.121)	(0.119)	(0.048)	(0.048)	(0.048)
P-value cluster	0.020**	0.042**	0.025**	0.131	0.220	0.142
P-value bootstrap	0.050*	0.079*	0.057*	0.175	0.255	0.190
Partial specification		x			x	
Full specification			x			x
Comparison arm mean	3.411	3.411	3.411	0.545	0.545	0.545
Observations	805	804	804	805	804	804

Source: Authors' calculations.

Notes:

1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. Standard errors in parentheses.
3. The first column within each outcome reports the unadjusted base specification, column 2 ('partial specification') adds baseline covariates that were unbalanced at the 10 percent level, and column 3 ('full specification') controls for all relevant baseline characteristics. For list of characteristics refer to Table 2. All specifications include block-level fixed effects.
4. All columns control for baseline values of the outcome variable; baseline comparison arm mean values are provided for comparison.

[i] The 25 assets on which information was collected include: Pressure cooker, Chair, Cot/ Bed, Bed net (for flies/mosquitos), Table, Electric fan, Radio/Transistor, B & W television, Colour television, Sewing machine, Mobile Phone, Landline Phone, Computer, Refrigerator, Air conditioner / Cooler, Washing Machine, Clock or watch, Car/Jeep, Motorcycle/scooter, Bicycle, Tractor, Water pump, Thresher and Animal-drawn cart