IFPRI Discussion Paper 01936

June 2020

Learning Together

Experimental Evidence on the Impact of Group-Based Nutrition Interventions in Rural Bihar

Kalyani Raghunathan

Neha Kumar

Shivani Gupta

Tarana Chauhan

Ashi Kohli Kathuria

Purnima Menon

Poverty, Health, and Nutrition Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), a CGIAR Research Center established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. IFPRI's strategic research aims to foster a climate-resilient and sustainable food supply; promote healthy diets and nutrition for all; build inclusive and efficient markets, trade systems, and food industries; transform agricultural and rural economies; and strengthen institutions and governance. Gender is integrated in all the Institute's work. Partnerships, communications, capacity strengthening, and data and knowledge management are essential components to translate IFPRI's research from action to impact. The Institute's regional and country programs play a critical role in responding to demand for food policy research and in delivering holistic support for country-led development. IFPRI collaborates with partners around the world.

AUTHORS

Kalyani Raghunathan (k.raghunathan@cgiar.org) is a Research Fellow in the Poverty, Health, and Nutrition Division of the International Food Policy Research Institute (IFPRI), New Delhi, India.

Neha Kumar (n.kumar@cgiar.org) is a Senior Research Fellow in IFPRI's Poverty, Health, and Nutrition Division, Washington, DC.

Shivani Gupta (shivani.gupta@cgiar.org) is a Research Analyst in IFPRI's Poverty, Health, and Nutrition Division, New Delhi, India.

Tarana Chauhan (tc678@cornell.edu) is a Ph.D. student in Applied Economics and Management at Cornell University, Ithaca, New York. She was previously a Senior Research Assistant with IFPRI's Poverty, Health, and Nutrition Division, New Delhi, India.

Ashi Kohli Kathuria (akathuria1@worldbank.org) is a Senior Nutrition Specialist with the World Bank's Health, Nutrition and Population Global Practice, New Delhi, India.

Purnima Menon (p.menon@cgiar.org) is a Senior Research Fellow in IFPRI's Poverty, Health, and Nutrition Division, New Delhi, India.

Notices

ABSTRACT

Despite improvements over the last decade or more, India still accounts for a large proportion of the global prevalence of maternal and child undernutrition. We use a cluster-randomized controlled design and two waves of panel data on more than 2000 households from Bihar to analyse the impact on diet quality and anthropometry of a health and nutrition intervention delivered through an at-scale women's self-help group (SHGs) platform. We find that the intervention had small but significant impacts on women and children's dietary diversity, with the main impacts coming from an increase in the consumption of fruits and vegetables and dairy, however, it had no impact on women's body mass index. We identify several potential pathways to impact. To the extent that SHGs can effect broad-based social change, their current reach to millions of women makes them a powerful platform for accelerating improvements in maternal and child health and nutrition outcomes.

Keywords maternal nutrition; India; self-help groups; behavior change communication; randomized controlled trial

ACKNOWLEDGMENTS

This research has received financial support from the World Bank, the Government of Japan through the Japan Trust Fund for Scaling Up Nutrition, the Bill & Melinda Gates Foundation [grant number OPP1132181] and the CGIAR research program on Agriculture for Nutrition and Health. The data for this research was collected by Oxford Policy Management, we thank them and the enumerators that collected the data. We also thank the survey respondents – without whom this research would not be possible – for their time and patience in answering our questions. We thank Vinay Singh for his efforts in collecting and compiling the cost data. This research project has benefitted from many conversations with Harold Alderman and from comments and suggestions from participants at various conferences. All errors and omissions are our own.

ACRONYMS

AB-CC	Activity-Based Costing Center
ABC-I	Activity-Based Costing Ingredients
ANCOVA	Analysis of covariance
BCC	Behavior Change Communication
BMI	Body Mass Index
CC	Convergence and Coordination
CM	Community Mobilizer
FSF	Food Security Fund
GP	Gram Panchayat
HRF	Health Risk Fund
ITT	Intent-to-treat
JEEViKA-MC	JEEViKA Multisectoral Convergence
MDD	Minimum Dietary Diversity
NFHS	National Family Health Survey
NRLM	National Rural Livelihoods Mission
PDS	Public Distribution System
SHG	Self-help group
VO	Village Organization
WHO	World Health Organization

1 INTRODUCTION

Maternal and child health and nutrition outcomes in India have improved slowly over the last decade but the country's large population burden and high rates of child stunting and maternal and child anaemia and underweight mean that it still contributes greatly to the global prevalence of many forms of undernutrition. Improving these outcomes is a complex undertaking, not just because of the scale of the problem, but also because nutritional status 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). Previous efforts to improve the coverage and delivery of focused nutrition programs have had limited impact on outcomes (Jain 2015; Kandpal 2011), mostly because program reach is so variable (Chakrabarti *et al*, 2019) and because additional efforts are needed to address several determinants simultaneously to enable greater change.

There is substantial consensus on the types of interventions that need to be scaled up to address undernutrition in India and globally (Swaminathan, 2009; NITI Aayog, 2017; WHO, 2019). It is also well-accepted that behaviour change interventions must be a central component of programs to improve diets and nutritional outcomes (Menon *et al.*, 2016; Hoddinott *et al.*, 2017; Nair *et al.*, 2017; Kim *et al.*, 2018). However, a key challenge lies in identifying platforms that enable reaching scale and achieving impact (Menon *et al.*, 2020; Quisumbing *et al.*, 2020). Many nutrition behaviour change interventions rely on health workers who deliver counselling to individual households, but household-level counselling cannot create large-scale social change, which requires additional efforts to reach wide audiences through mass media or through community-based efforts. As a function of their broad reach[1], women's groups in India and South Asia, including self-help groups (SHGs), have emerged as a key platform for scaling-up behaviour change interventions, especially in rural areas.

Women's group programs are of much interest in the South Asian context for another reason – women themselves are undernourished and anemic, and this has consequences for their own health and for the health of their children. A dominant thread in the nutrition literature focused on South Asia and India has been on the puzzle of child undernutrition, especially childhood stunting (Ved and Menon, 2012; Jayachandran and Pande, 2017; Spears, 2018). In the last decade, however, empirical analyses have

[1] As of March 2017, the National Rural Livelihoods Mission (NRLM) had already mobilized 38.6 million rural Indian households into SHGs, see https://rural.nic.in/sites/default/files/IRMA-NRLM_Web.pdf.

repeatedly highlighted how poor women's nutrition is and how important women's nutritional outcomes such as underweight and anemia are for the childhood outcomes that have dominated the research and the policy discourse (Coffey, 2015). Despite commentary from almost 30 years ago on the importance and relevance of women's nutrition and women's status to the puzzle of undernutrition in South Asia, few studies have explicitly examined the role of interventions to improve women's nutrition by directly engaging them (Kumar *et al.*, 2018). Certainly, health services targeted to pregnant women have attempted to address some aspects of nutrition, but these are limited to a narrow stage of life and a narrow set of interventions focused on needs during pregnancy (WHO, 2016). More importantly, these services and interventions don't always reach enough women with enough intensity to deliver robust outcomes globally, in India, and in Bihar (Menon, Mani and Nguyen, 2017; Heidkamp *et al.*, 2020). SHGs focused on women and their wellbeing, reaching women across the life course, and with the ability to influence and engage women on nutrition awareness for themselves, their children and their families, offer tremendous opportunities to do what health services simply cannot.

At present, however, little is known about how women's groups can be leveraged to improve women's nutritional wellbeing. We study the impact of a set of nutrition interventions integrated on a pilot basis with a large-scale women's SHG program – JEEViKA - in rural Bihar. The interventions had two components - first, a health and nutrition behaviour change communication (BCC) component that focused on engaging women in discussions on health and nutrition in their group meetings, and second, a convergence and coordination (CC) component that aimed to improve awareness and utilization of existing government services that could be used to facilitate behaviour change – which were clustered at the level of the Gram Panchayat (GP), also the unit for delivery of several other government services. We compare outcomes for women and children in the comparison arm which had functional SHGs that conducted the routine savings and credit and livelihoods-focused activities, to those in the treatment arm where SHGs were also engaged in the health and nutrition interventions. By conducting this research in the context of a community-based women's group platform, we address an explicit *platform-focused* question of whether these existing large-scale platforms reaching millions of women at least once a month can be used to trigger large-scale change. We also assess whether the set of health and nutrition interventions (described in detail below) can be delivered through a women's SHG platform already operating at scale. In addition to our impact estimates, we carefully study pathways to impact using both a mid-term process evaluation as well as empirical analyses of our endline survey data, thereby contributing to an existing gap in the literature (Kumar *et al.*, 2018). Finally, we present per-group and per-beneficiary financial cost estimates, of interest to donors and policymakers.

We find that the intervention had no impact on women's body mass index (BMI) or their likelihood of being underweight but did have positive and statistically significant impacts on the dietary diversity of women and children, notable given economic constraints that might limit ability to respond to behavioural interventions. The lack of impact on anthropometry could be the result of the short implementation period as anthropometric outcomes lie further along the impact pathway than diets, constraints on implementation fidelity, or that the quantity and quality of food being consumed was inadequate to reduce the prevalence of underweight among women. Improvements in diets for women and children come primarily from the fruit, dairy and vegetable food groups, with consumption of animal-source protein remaining low even at endline. Diets remain deficient, with more than 50 percent of women not meeting minimum dietary diversity even in the treatment arm at endline, suggesting that more effort is needed to close barriers to consumption and to improve dietary diversity in this setting. The process evaluation highlights that it is feasible to integrate health and nutrition discussions into the women's group meetings, despite a range of implementation challenges. However, it proved to be more challenging to operationalize the second component of the intervention, which aimed to build linkages with other services, a finding that has been highlighted previously in the same study context (Subramanyam *et al.*, 2017). Analysis of outcomes along the pathways identified in Kumar *et al.* (2018) suggests that impacts were achieved through the agriculture, health and nutrition and the rights and entitlements pathways.

Our paper adds to the literature in several ways. First, it provides evidence on the effectiveness of group-based approaches in delivering BCC interventions in the context of a large state-wide SHG model, the National Rural Livelihood Mission (NRLM), thereby providing suggestive evidence of the potential for impact at scale. Second, it looks at women's outcomes that have not received a great deal of attention previously, specifically women's BMI and dietary diversity. Third, it studies the use of pre-existing general-purpose women's groups rather than groups formed for the purpose of the intervention, (Nair *et al.*, 2017; Saville *et al.*, 2018). Fourth, it investigates potential pathways through which the observed impacts might have occurred. A review of the literature (Kumar *et al.*, 2018) concluded that although women's groups have great potential to improve nutrition in South Asia, the evidence base is thin, and few studies examine pathways to impact. Fifth, and finally, it provides information on the financial costs incurred in conducting the intervention.

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

The intervention - known as the JEEViKA-Multisectoral Convergence (JEEViKA-MC) pilot - was implemented in three blocks of Saharsa district of Bihar, a district in the north-east of the state, close to the border with Nepal. Saharsa is one of the poorest districts in Bihar and performs poorly on health and nutrition indicators. Its rates for wasting and underweight among children under 5 years, anaemia and underweight among women are the same or worse than the state-wide average (NFHS-4 2015-16, 2017). The three intervention blocks within Saharsa were purposively selected for the implementation of the JEEViKA-MC interventions because they had some of the oldest and most mature SHGs. The evaluation was designed as a cluster-randomized controlled trial, with the GP 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 GPs in these three blocks, 24 GPs with mature SHGs 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 standard JEEViKA SHG platform interventions – common to both comparison and treatment arms - includes organizing rural women into SHGs, providing them with training on group functioning, financial literacy, agriculture and livelihoods, federating groups of SHGs into higher-level collectives such as Village Organizations (VOs), and linking SHGs and their federations to banks. SHGs and their federations are provided lines of credit and access to funds with pre-determined rates of interest and terms of repayment. Two specific examples of the funds that JEEViKA provides are the Food Security Fund (FSF), a loan of INR 1,00,000 (approx. USD 1400) provided to 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 (approx. USD 700) 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 intervention we evaluate consists of two additional components over and above the standard set of interventions:

Component 1: Behaviour change communication (BCC)

In addition to their bookkeeping role, CMs in treatment areas were tasked with providing intensive BCC on a range of topics at bi-monthly SHG meetings. The BCC was targeted to households with women of reproductive age, especially those with 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 (CC)

This component was aimed at increasing the interface between service providers and beneficiaries and improving service utilization 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 beginning with coordination activities between government departments and eventually transitioning to home visits by voluntary community members to provide information on child feeding and care.

2.3 Study design

The evaluation of the impact of these additional interventions on the two primary outcomes, women's BMI and child dietary diversity, was designed as a cluster-randomized controlled trial. The 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 GPs in these three blocks, 24 GPs with mature SHGs 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. Based on power calculations, it was estimated that a sample of 2400 households across the available GPs and divided evenly between intervention and comparison areas would give us between 80 and 90% power to detect an effect size of .23 in women's BMI between groups at endline. In order to achieve the desired sample size five villages were selected from each GP and 20 households per village 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 inclusion in our baseline survey, conducted in May 2016. The mother of the child aged 6-24 months was the primary respondent to the household survey. 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, we also collected information on that child, referred to here as the 'youngest child'. This planned study design is summarized in Figure 1.

The intervention began as soon as the baseline survey was over, in June 2016, was implemented across the entire GP (not just for the households in the evaluation survey) and continued until October 2018, giving us a total implementation period of about 28 months. An endline survey of the same set of households was conducted in October 2018, yielding two rounds of panel data. The slight delay in the endline survey resulted in a seasonality shift, which could 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.

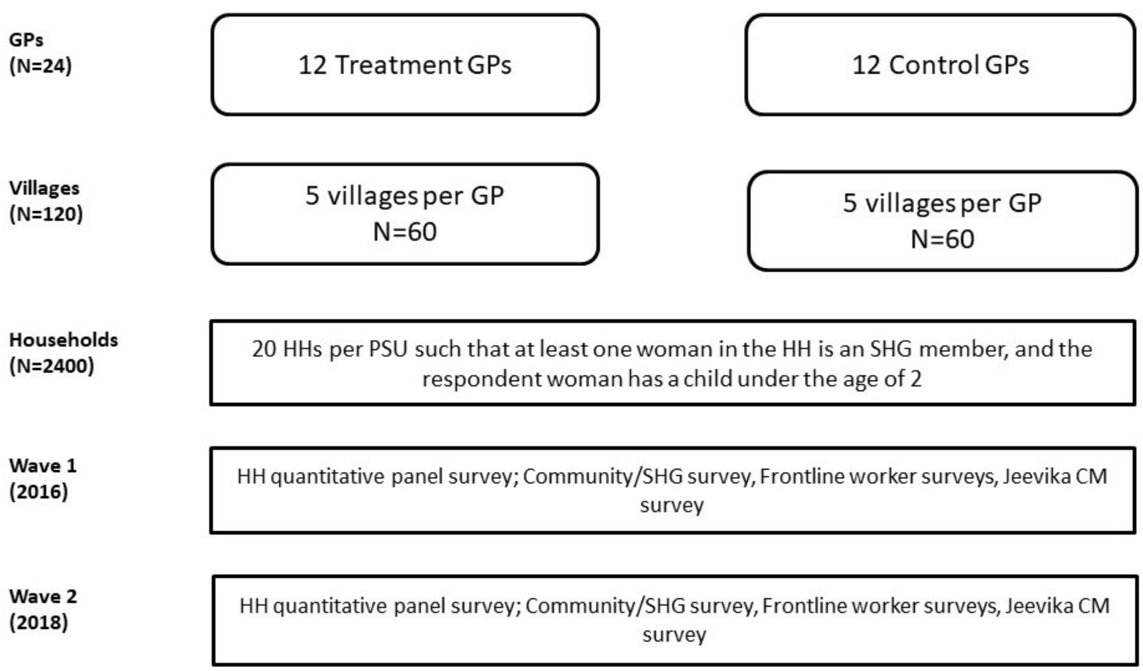

Figure 1*: Planned study design*

3 METHODS

The impact estimates 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:

$$Y_{iG1} = \alpha + \beta Y_{iG0} + \delta T_G + \varepsilon_{iG},$$

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

$$Y_{iG1} = \alpha + \beta Y_{iG0} + \delta T_G + \sum_{j=1}^{J} \gamma_j x_{iGj0} + \varepsilon_{iG}.$$

Here, Y_{iG1} is the outcome indicator measured at endline for individual i in GP G, Y_{iG0} is the outcome indicator measured at baseline for individual i in GP G and T_G is the indicator for being in the treatment GP; x_{iGj0} 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_{Gi} is the idiosyncratic error term.

The two primary outcomes for the evaluation were women's BMI and dietary diversity among children aged 6-24 months (WHO, 2008). Dietary diversity for index children is measured as the number of food groups consumed, while for younger children, aged 6-24 months at endline, we look also at the proportion attaining minimum dietary diversity, defined as consuming 4 out of 7 possible food groups.[2] In addition, 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 (WDDP Study Group, 2017). 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 GP 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).

---

[2] The 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.

3.1 Achieved sample and attrition

We collect information on 1164 treatment and 1082 comparison arm households at baseline (Table 1). Of these, 2,119 households were re-interviewed at endline, for an attrition rate of 5.7 percent overall. From amongst these 2119 households, 805 had 'youngest children' who were 6-24 months at endline and 1881 had 'index children' who were followed up at endline. The 11 percent attrition among index children was a result of several factors, such as the household not being found (N=127, 5.6%) or the child not being alive at endline (N=35, 1.5%). In addition, we performed a back estimation of child age at baseline using the exact date of birth as collected from the child's immunization record at endline; 102 children (4.5%) who were estimated to be outside the 6-24-month range at baseline were also excluded.

Since the household survey was a panel, Table 1 also presents the attrition rate by treatment arm. Households in the comparison arm are slightly less likely to leave (5.4 percent) than households in the treatment group (5.8 percent) but the difference is not statistically significant. Index children are also more likely to be found in the comparison arm as compared to the treatment group, however, again, these differences are not statistically significant. Although low attrition rates rarely affect estimation results in the literature (De Brauw and Harigaya, 2007), we take steps to ensure that this was the case here as well. First, we examine baseline descriptive statistics by attrition status at endline. Next, we estimate a probit model for the probability of re-interviewing households at endline including characteristics that were differential by attrition status and location and treatment dummies. Third, we estimate attrition weights based on the probit models (Wooldridge, 2010), which were distributed tightly, and thus most households would receive similar weights. This ruled out the need to adjust the analysis for attrition.[3]

[3] Further details on these checks can be found in (Gupta *et al.*, 2019), available at http://ebrary.ifpri.org/utils/getfile/collection/p15738coll5/id/6808/filename/6810.pdf.

Table 1: Achieved survey sample sizes at baseline and endline, by group and type of respondent.

	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		

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

4 RESULTS

4.1 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 labourer. 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 labourer or a housewife. We control for both the set of unbalanced covariates and the full set of covariates in our regression specifications.

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$^{\alpha}$	6.14 (2.76)	5.77 (2.54)	5.96 (2.66)	0.2

Source: Author's Calculations.

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

α: These 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.

4.2 Impact estimates

This section presents the estimates of the impact of the JEEViKA-MC intervention on women's diets, BMI and children's diets. All impact tables in this paper will follow the same format: for each outcome, only the coefficient on the treatment indicator is reported. The first model is the unadjusted base specification, i.e., the coefficient on the treatment indicator without controlling for any additional characteristics. The second and third models 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.

4.2.1 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 secular improvement was observed over time in both treatment and comparison arms. 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 2). 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 (Table 3). These findings are robust to the specification employed. The lack of impact of the intervention on women's BMI could, however, be a result of the relatively short intervention period.

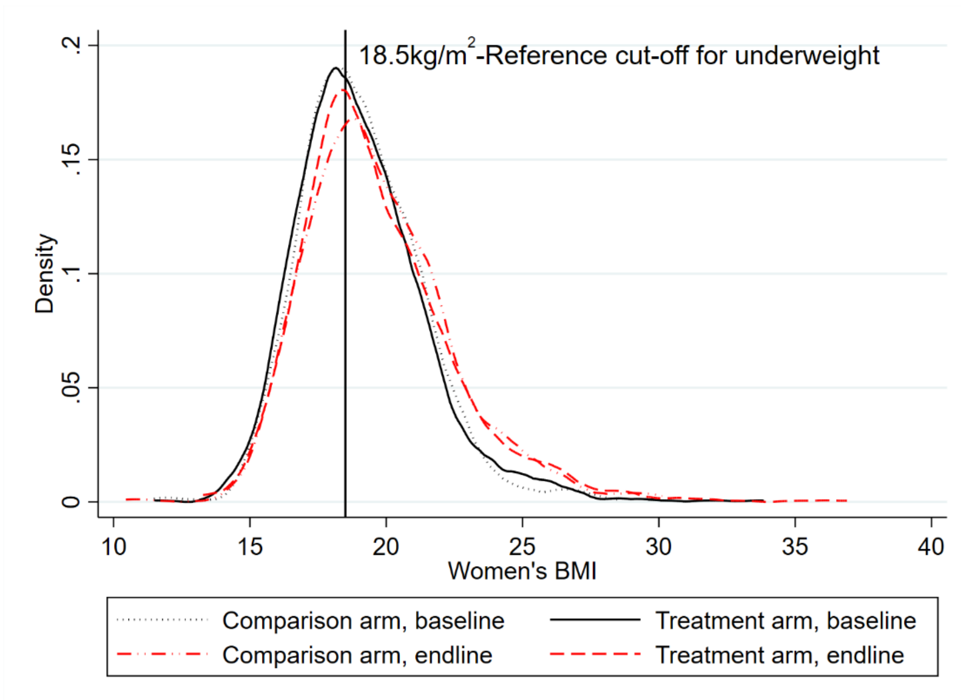

Figure 2: Kernel densities at baseline and endline, by arm

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.

4.2.2 Dietary diversity for women

We also assess changes over time and across arms in the proportion of women attaining MDD, defined as consuming 5 or more food groups out of 10 food groups. MDD is a measure of quality of diets and is useful as an indicator for micronutrient intake but does not necessarily relate to improvements in BMI. Changes in BMI are instead driven by changes in net energy intake, a function of the number of calories consumed and calories expended.

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, going from 27.4 percent at baseline to 47.1 percent at endline. Our endline impact estimates corroborate the descriptive findings, showing a 10.3 percentage point increase in the likelihood of a woman's achieving MDD (Table 4, column 3), which represents a 30 percent increase over the baseline comparison levels. This is a substantial improvement over the course of the intervention period of just around two and a half years.

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*
Partial Specification		x			x	
Full Specification			x			x
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.

Greater dietary diversity, as reflected by the indicator reported on above, has been shown to be associated with intakes of a range of micronutrients that are essential for vital nutrition functions; these include iron, vitamin A, zinc, vitamin C, calcium and more (Arimond *et al.*, 2010). Some food groups are more important than others because they include a range of nutrients in addition to calories. These include flesh foods, eggs, nuts and seeds, and yellow/orange fruits and yellow/orange/green vegetables. To investigate the dietary diversity findings further, therefore, we also 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. At endline, all women reported consuming starchy staples (grains, roots, and tubers), depending on cereal calories as a primary source of energy (Figure 3). The differences in diet composition across arms at endline came mainly from consumption of dairy, fruits and dark green leafy vegetables. The consumption of flesh foods, eggs, and nuts and seeds remained very low in both arms at endline.[4] 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.

Although 77 percent of women self-identify as non-vegetarians, fewer than 15% women in any arm reported eating flesh foods and only 2% reported eating eggs at endline. One possible reason for low consumption of animal-sourced foods could be prevailing social norms and dietary preferences; for example, anecdotal evidence from the field suggests that there is a taboo against eating eggs, and even families that raise poultry do not consume the eggs they produce. Another reason could be resource constraints that prevent non-vegetarian families from consuming animal-sourced foods daily.

[4] We observe large co-movements in the percentage of women consuming different food groups from baseline to endline (in both, the treatment as well as control GPs, figures not reported). Some of this movement can be attributed to seasonality; the baseline survey was conducted in the summer whereas the endline was in the winter months when the availability of fruits and vegetables is greater.

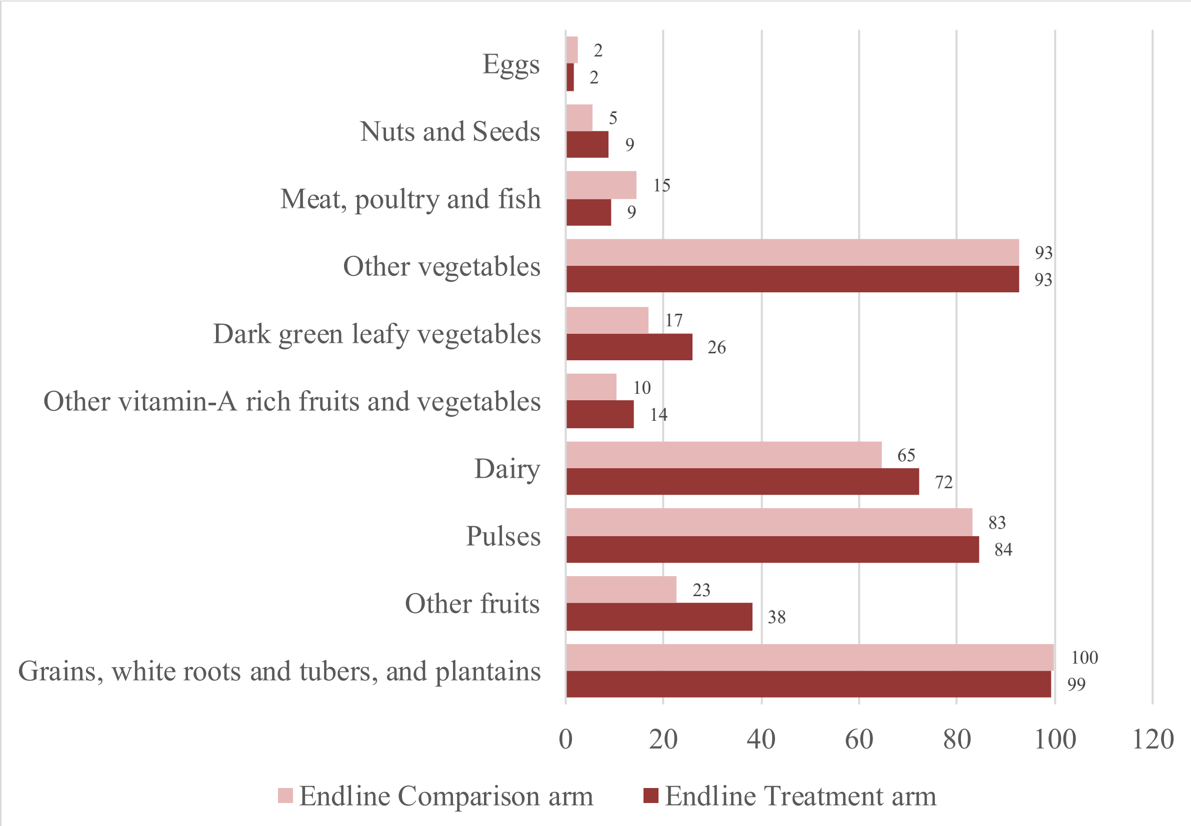

Figure 3: Proportion of respondent women consuming each food group at endline, by treatment arm

4.2.3 Dietary diversity for children

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 at least 4 distinct food groups over a 24-hour period with the maximum of 7 food groups. 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 4). By endline, consumption had improved in every single food group, though in many cases the treatment and comparison arms showed similar improvements.[5]

[5] Similar to the respondent women, we observe large co-movements in the percentage of index children consuming different food groups from baseline to endline (in both, the treatment as well as control GPs). Again, part of this movement is due to the difference in seasons between the baseline and endline surveys.

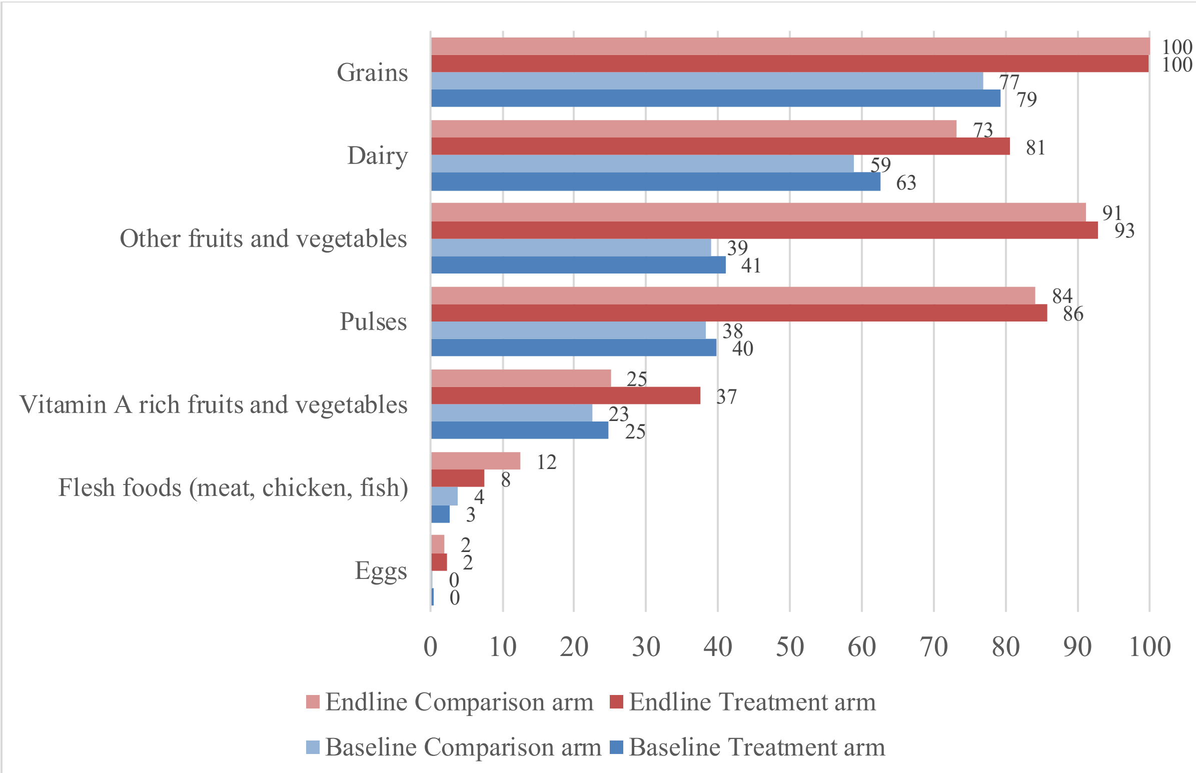

Figure 4: Food groups consumed by index children, by arm at baseline and endline

We find a positive and significant (albeit small) impact of the intervention on index child dietary diversity which is defined as the total number of food groups consumed over a 24-hour period with the maximum of 7 food groups (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 4, we see that overall there is an improvement in consumption of most food groups, the positive impact on the total number of food groups consumed was driven largely by improvements in the consumption of dairy and vitamin A-rich fruits and vegetables among children in the treatment arm as compared to those in the comparison arm. There were significant improvements in the consumption of pulses and other fruits and vegetables by endline, though these changes were observed across 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.

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.

The results on dietary diversity among the youngest children in the household are similar. Reported dietary diversity among youngest children at endline was much better than that of index children of the same age group at baseline, with 58.3 percent of the youngest children in both arms achieving minimum dietary diversity at endline (61.9 in the treatment arm, 54.5 in the comparison arm), compared to only 22.6 percent of index children at baseline. This could be a result either 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 that the pilot resulted in an increase of 0.3 food groups consumed, an 8.4 percent increase over the comparison arm mean (Table A.1, Appendix), but had no impact on the likelihood of achieving minimum dietary diversity. A higher proportion of youngest children in treatment areas consumed all 7 food groups as compared to comparison areas, and the main impact of the intervention seems to be coming from consumption of vitamin A-rich fruits and vegetables, other fruits and vegetables, dairy, and pulses (Figure A.1, Appendix).

4.3 Addressing concerns of reporting bias

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. This 5-question index included 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 the individual score on this scale was then included in the model as an additional covariate. We found no impact of social desirability on the point estimates or their significance (results not reported but available on request).

5 MECHANISMS

The JEEViKA-MC pilot interventions improved dietary diversity for women and children but had no impact on women's BMI or prevalence of underweight. We now investigate which of several possible pathways to impact might have worked to generate our results. Kumar *et al.* (2018) present several hypothesized pathways through which women's groups more broadly could impact health and nutrition outcomes. They are (1) the income pathway, improvements in household income due to savings and credit trainings and bank linkages, (2) the agriculture pathway, improvements in food production and availability due to better agricultural planning, (3) the health and nutrition BCC pathway, improving use of existing resources and adoption of recommended behavior through better information, (4) the rights pathway, involving social accountability training leading to increased demand for service provision, and (5) the cross-cutting pathway of building social capital, acting collectively and empowering women.

Before we delve into examining the different pathways triggered in this intervention, it is important to underscore two points. First, since JEEViKA groups provided the same savings and credit and bank linkages in both treatment and comparison arms, we do not anticipate that the income pathway is driving our results. However, it is possible that the increased focus on the treatment areas came at the neglect of the comparison areas, leading to a dilution of the savings and credit activities in the latter. We provide some evidence to show that this is not the case. Second, though the empowerment effect of group formation and collective action is also common to both arms and hence not expected to change as a result of the intervention, there is some evidence suggesting that adding BCC interventions to existing transfer programs can improve women's empowerment (Roy *et al.*, 2019), making it worthwhile to test this pathway as well.

5.1 Income pathway – standard JEEViKA platform interventions

One concern that could arise in the implementation of a pilot such as this is that the increased attention to the treatment areas could come at the cost of implementation of the standard platform-related activities that are otherwise meant to be constant in both arms, namely the formation of groups and regular savings and credit activities. This could lead to a divergence between the two arms as an unintended consequence of the intervention. To test this, we looked at SHG membership rates, existence of savings and credit activities in SHGs, and individual participation in those activities and loan-taking behavior and found that these were very similar between treatment and comparison arms[6]. When tested in the regression framework we find

[6] Descriptive results on this are not reported but available upon request to authors.

no impact of the JEEViKA-MC interventions on these basic SHG participation- and function-related variables (Table 6). This helps us rule out the income pathway.

Table 6: Impact of JEEViKA-MC pilot on utilization of the JEEViKA platform

	Utilization of JEEViKA platforms					
	Currently SHG member			**SHG has savings and credit activities**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (=1 if treatment GP)	0.009	0.020	0.031	0.016	0.021	0.020
	(0.030)	(0.029)	(0.033)	(0.023)	(0.022)	(0.022)
P-value cluster	0.770	0.499	0.356	0.496	0.346	0.378
P-value bootstrap	0.784	0.536	0.410	0.533	0.383	0.420
Partial Specification		x			x	
Full Specification			x			x
Comparison arm mean	0.733	0.733	0.733	0.896	0.896	0.896
Observations	2,119	2,114	2,114	1,547	1,542	1,542

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.

5.2 Agriculture pathway

The agricultural pathway relates to improvements in household food production and a resulting improvement in food security. The primary channel through which the pilot interventions might have improved food security and relaxed budget constraints was the promotion of year-round kitchen gardens to produce fruits and vegetables. While kitchen gardens were part of the standard set of JEEViKA interventions, the pilot gave additional focus to providing practical advice on how to set these gardens up and ensure that they provided a steady stream of fruits and vegetables throughout the year.

We find some evidence that these interventions were successful. 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 7). 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.

5.3 Health and nutrition behavior change communication pathway

The third pathway 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 assess the impact of the pilot on knowledge, we score the respondent women on a knowledge test based on the BCC material. A correct answer is given a score of 1.[7] Scores on each subsection and on the entire knowledge test are then converted to percentage terms 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.

We then look at exposure to key messages based on the BCC content, and, conditional on the respondent woman having been exposed to the message, at the trial and adoption rates of the specific behavior being recommended.

Table 8 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 in the knowledge domains of child feeding, dietary diversity and kitchen gardens, respectively (in the fully specified model, compared to endline comparison mean scores).

[7] In the case of multiple correct answers, any one correct response was given a score of 1. The overall knowledge score we calculate is lenient and can be considered representative of an upper bound on the respondent's actual knowledge.

Table 7: 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 8: 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.

Figure 5 presents exposure, trial, and adoption of key messages, delivered through the intervention, 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. Given the small sample sizes resulting from low exposure we are unable to rigorously test differences in trial and adoption, so these results are merely descriptive. We also find that 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 that other barriers to adoption exist.

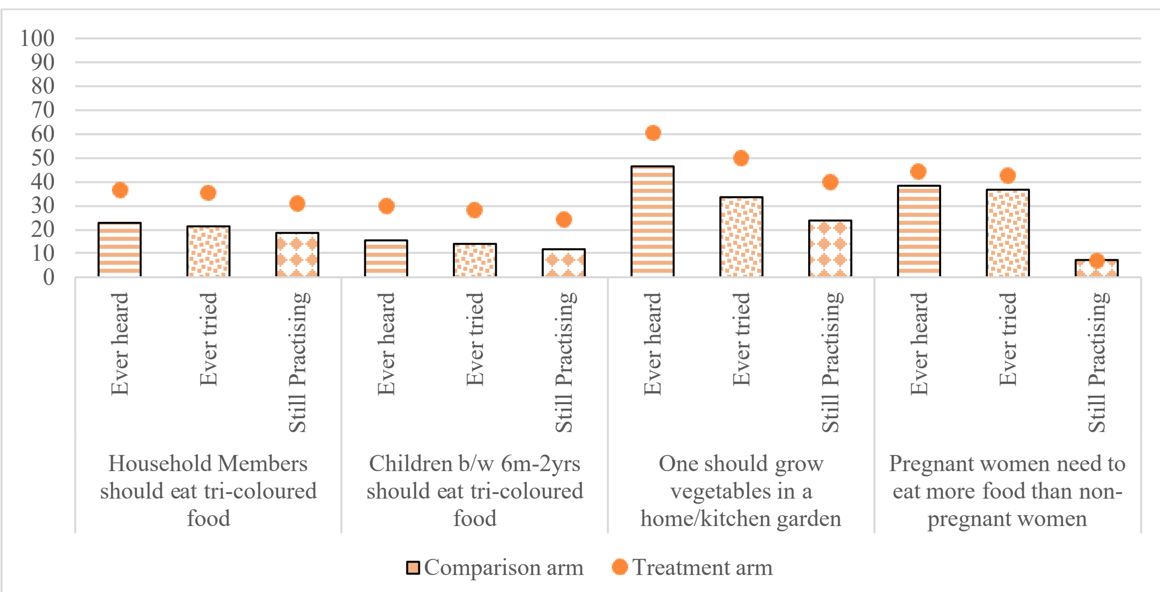

Figure 5: Exposure to messages around dietary diversity/kitchen gardens

5.4 Rights pathway

The fourth pathway is the improved awareness and utilization of government entitlement schemes and existing JEEViKA funds that could affect food consumption.

Of the government schemes promoted under the JEEViKA-MC intervention, the only one that related to food intake was the Public Distribution System (PDS), a large food social safety net that provides subsidized grains and other food items to households on a monthly basis. Over 80 percent of the women in the sample have a ration card and almost all have heard of the ration shop. In the unadjusted model, the only significant difference across treatment and comparison arms is in the possession of a ration card, the card needed to access the system, and here the comparison arm performs better than the treatment arm. This is borne out also in the regression analyses presented in Table 9, where we find no differences across arms as a result of the treatment, except in the possession of a ration card. Overall, therefore, it does not seem to be the case that exposure to the treatment improves awareness of the scheme or the likelihood of ever having purchased something from the PDS ration shop. [8]

The BCC content also promoted the use of the food security fund, or FSF, a JEEViKA-provided fund used to purchase grains and other food items at wholesale prices and at low rates of interest. While available in all areas, the FSF 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. We examine whether households in the treatment arm were more likely to have received food from the FSF. 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 10).

These two sets of results taken together suggest that the improved awareness of government schemes or JEEViKA funds promoting food security did have some impact on utilization.

---

[8] We also investigate household food security directly, using the Household Food Insecurity Access Scale (HFIAS) developed by USAID (Coates *et al*. 2007), and find no impact of the JEEViKA-MC treatment on these outcomes. Results are available on request.

Table 9: Impact of JEEViKA-MC pilot on household PDS indicators

	Household PDS indicators								
	Ever heard of PDS or ration shop			**Household have a ration card**			**Household ever purchased anything from ration shop**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (=1 if treatment GP)	-0.007	-0.007	-0.007	-0.040	-0.042	-0.042	-0.023	-0.025	-0.025
	(0.008)	(0.008)	(0.009)	(0.018)	(0.018)	(0.017)	(0.020)	(0.019)	(0.019)
P-value cluster	0.357	0.385	0.429	0.036**	0.030**	0.023**	0.243	0.203	0.204
P-value bootstrap	0.424	0.457	0.504	0.040**	0.038**	0.028**	0.270	0.221	0.214
Partial specification		x			x			x	
Full specification			x			x			x
Comparison arm mean	0.990	0.990	0.990	0.853	0.853	0.853	0.892	0.892	0.892
Observations	2,115	2,115	2,115	2,115	2,115	2,115	2,115	2,115	2,115

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 10: 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.

5.5 Women's empowerment pathway

Finally, we study whether the pilot intervention had any impact on outcomes related to women's empowerment. To assess this, we scored responses to questions relating to three domains: decision-making, gender norms, and freedom of movement. For decision-making, the respondent woman was asked 9 questions about her involvement in making decisions relating to a range of own and family-related matters and was assigned a score of 1 for each decision she participated in either solely or jointly. For gender norms, she was asked for her agreement or disagreement with statements read aloud to her. If she agreed with a progressive statement (e.g. "Partner should help working woman with the daily housework") or disagreed with a regressive one (e.g. "A woman must accept that her partner beats her to keep the family together") she was given a score of 1. For freedom of movement, she was asked if she was able to visit certain places like the market, friends or relative's homes etc without needing to ask for permission from her husband. For each location she was assigned a score of 0 if she said she always needed to take permission, and 1 otherwise. Total scores on each domain were obtained by simply summing across the questions making up that domain, these totals were then normalised to be out of 100. In all three cases higher scores indicated greater empowerment.

We do not find any additional impact of the interventions on decision-making or on gender norms (Table 11). The only significant impact is on freedom of movement, and here the treatment appears to reduce the respondent woman's ability to move freely without needing to seek permission. Since the intervention did not explicitly target increasing empowerment, which is already addressed by the base JEEViKA platform, these findings are expected, but it is reassuring to note that the intervention did not dilute the empowerment-related impacts of groups in the comparison arm.

Table 11: Impact of JEEViKA-MC pilot on women's empowerment and decision making

	Women's empowerment outcome - normalised Scores								
	Decision-Making			**Gender Norms**			**Freedom of movement**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Treatment dummy (=1 if treatment GP)	-0.747	-0.421	-0.374	-0.980	-1.008	-1.047	-6.436	-5.495	-4.820
	(2.552)	(2.690)	(2.716)	(1.414)	(1.470)	(1.425)	(3.117)	(3.086)	(2.992)
P-value cluster	0.772	0.877	0.892	0.495	0.500	0.470	0.050*	0.088*	0.121
P-value bootstrap	0.803	0.894	0.906	0.524	0.528	0.509	0.051*	0.100	0.152
Partial specification		x			x			x	
Full specification			x			x			x
Comparison arm mean	40.545	40.545	40.545	57.071	57.071	57.071	24.326	24.326	24.326
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.

5.6 Social norms

Finally, the last mechanism through which change might occur is the reshaping of social norms related to nutrition behavior. We do not have explicit data on social norms related to nutrition, so as a proxy we added to our models a village-level average knowledge score for all women except the individual being analysed. Village-level average knowledge scores are positively and significantly associated with better individual outcomes, lending credence to the theory that reshaping social norms could affect behavior change. We do not report these findings.[9]

[9] These findings are available upon request to the authors.

6 FINANCIAL COSTS OF IMPLEMENTING THE JEEVIKA-MC PILOT

For us to comment on the effectiveness of the SHG platform for delivering health and nutrition intervention, we must also consider the costs of such layered interventions. We used a retrospective costing design and calculated costs of the program according to the activity-based costing ingredients method (ABC-I) (Tan-Torres Edejer *et al.*, 2003; Kaplan and Anderson, 2004). This method estimates costs by assigning them to the main activities that form part of the program implementation. We first identified the different activity-based cost centres (AB-CCs) involved with implementation of the pilot, ensuring that the list of AB-CCs was mutually exclusive and exhaustive of all program activities. The AB-CCs we defined were staff time, material development, training costs, travel costs, management costs, and overheads. Once the AB-CCs were defined, the list of inputs or "ingredients" into each activity was developed in consultation with program staff.

We collected financial information on implementation from formal budgets and collected details on staff time and other information from focus group discussions and key informant interviews with program staff, implementers, and managers. In order to assess unit costs, we also collected information on the total number of SHGs, women within these SHGs, and the target beneficiaries reached. We distinguished between the two components—the BCC and the CC.

One advantage of the ABC-I method is the ability to separate costs into those related to start-up activities and those to post-start-up. The JEEViKA-MC intervention had two phases: a feasibility phase of about two years, and the rollout and implementation phase of slightly more than two years (27 months). The feasibility phase was necessary to test the proposed interventions and adapt the model to better fit ground realities. Since many of the costs incurred in the feasibility phase can be classified as up-front fixed or sunk costs, we present cost estimates with and without the costs of the feasibility phase.

The total cumulative cost of implementing the pilot was approximately US$420,354. Of the total costs, about 25 percent was spent on overall project activities, those that cannot be attributed to only the BCC or CC components. Most of the running costs were from component 1; the BCC accounted for 71 percent of the total cost and the CC for only 5 percent.

Figure 6 shows the allocation of the total cumulative cost across the feasibility phase, material development and replication, training, implementation, and monitoring. The feasibility phase accounted for about 44 percent of the total cost of the intervention. This large fraction of total costs is an artefact of the short window of implementation; had implementation continued over a longer horizon, the cost of the feasibility phase would automatically decrease as a proportion of total costs.

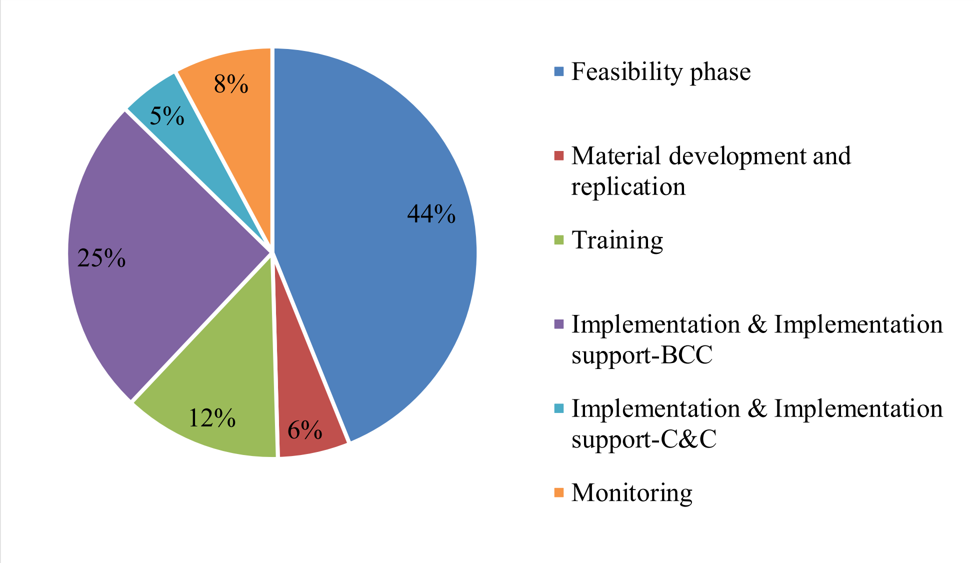

Figure 6: Distribution of total costs across the feasibility phase and post-start-up activities

A total of 1,591 SHGs and a total of 3,823 target beneficiaries (women and children) were reached by the intervention. The total cost per SHG was US$264, per target beneficiary was $110, per SHG member (assuming 12 members per SHG) was $22, per SHG meeting[10] was $4.89, and per SHG member per SHG meeting was $0.49. Table 12 provides estimates of the per-unit costs under different assumptions about the financial cost of the feasibility phase. When we account for 50 percent of the financial cost of the feasibility phase, the per-SHG cost of implementing the pilot drops from US$264 to US$206, and the per-SHG member per-meeting cost for implementing the pilot drops from US$0.49 to US$0.38. However, when we do not include any of the costs incurred in the feasibility phase (treating them as sunk costs), we have a per-SHG implementing cost of US$148, per-beneficiary cost of US$62, and per-SHG member per-meeting cost of US$0.27.

Cost estimates do not mean much in absolute terms and assume significance when compared to the costs of implementing similar interventions. In general, information on the costs of nutrition-sensitive programs is very limited, particularly for the types of interventions studied here (Ruel, Quisumbing and Balagamwala, 2018). One of the few studies that provided cost estimates and had a comparable set of interventions was Nair *et al.* (2017), which calculated an annual per beneficiary cost of $7.[11] Assuming two meetings per month on nutrition and accounting for 0-100% of the feasibility costs, the per SHG-member annual cost of implementing the JEEViKA-MC pilot interventions falls in the range of $6.5-11.8, comparable to Nair *et a*l.'s per-beneficiary estimate. Finally, if one considers that SHG members

[10] Two SHG meetings per month were allocated to discussions on health and nutrition topics, which gives us a total of 54 SHG meetings during the 27-month implementation period.

[11] Other studies that estimate the cost of implementing nutrition education programs do not present estimates that are comparable to ours.

are not the only beneficiaries of the JEEViKA-MC interventions and that other household members could potentially benefit as well, the per-beneficiary costs would fall further.

Table 12: Estimates of per-unit costs under different scenarios (US$)

Scenario	Cost per SHG	Cost per target beneficiary	Cost per SHG meeting
Accounting for full feasibility phase costs	264	110	4.89
Accounting for 1/2 the feasibility phase costs	206	86	3.82
Accounting for 1/4 the feasibility phase costs	177	74	3.28
Not accounting for the feasibility phase costs	148	62	2.75

Source: Authors' calculations.

7 DISCUSSION AND CONCLUSION

Our paper uses 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 promoted health and nutrition behaviour change through improving awareness, and one that served to increase coordination between service providers and beneficiaries. Analysis of two rounds of panel survey data slightly over two years apart suggests that the intervention had no impact on anthropometric outcomes for women, but significantly improved dietary diversity for both women and children.

Since we evaluate the intervention as a whole, we are unable to completely disentangle which of the two components was responsible for the results we observe. However, we enumerate five possible pathways through which the intervention could have worked: (1) the income pathway, (2) the agriculture pathway, (3) the health and nutrition BCC pathway, (4) the rights pathway and (5) the cross-cutting pathway of building social norms and social capital, acting collectively and empowering women. We test each of these to the best of our ability using available data.

We find a significant impact on the agriculture pathway, exhibited by the increased cultivation of kitchen gardens, and on the rights pathway, in the increased use of the FSF and the PDS. This latter result suggests some impact of the convergence component of the intervention, though our expectation would be that both the FSF and the PDS would serve to improve food security rather than diet quality. The main effects of the intervention, however, seem to be operating through the health and nutrition BCC pathway; unsurprising since this was a key intervention component. We find positive impacts on knowledge of health, hygiene and nutrition practices among women in the treatment arm, and show that for certain key health and nutrition messages being promoted through the pilot, women who were exposed to the message were highly likely to try and ultimately adopt the recommended behavior. What is most interesting is that significant changes in knowledge occur in the areas of child feeding, dietary diversity and kitchen gardens, precisely the areas where outcomes also improved. We do not find an impact on the income or women's empowerment pathways. This is unsurprising as these two were common to the treatment and comparison arms by design, however, it reassures us that the implementation of the intervention did not detract implementer attention or resources from the 'business-as-usual' model in the comparison arms.

Despite the improvement in diets and some movement along the agriculture pathway, there is no impact of the intervention on anthropometric outcomes for women. One possible explanation of this 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 and are necessarily further along the impact pathway than diet quality. The second possible explanation is that, despite improvements, the quantity of food being consumed did not add sufficient calories to improve BMI enough to reduce the prevalence of underweight in this population.

A closer look at the diets of mothers and children reveals that the impact on dietary diversity came primarily from higher consumption of vitamin A-rich and other fruits and vegetables, pulses and dairy, and not from animal-source foods. The consumption of eggs and flesh foods was very low even at endline, despite families self-identifying as non-vegetarian, and despite improvements in diets more than 50 percent of treatment arm women did not attain minimum dietary diversity at endline. This suggests that more effort is needed to close barriers to consumption and to improve dietary diversity and consumption of iron-rich foods in this setting. A lack of resources is likely to be a significant factor inhibiting further improvement of diets, as are prevailing social norms or taboos around the consumption of eggs and flesh foods, especially by young children. What is reassuring is that SHGs and the power of the collective could potentially ease both constraints.

Our mid-term process evaluation study pointed to several challenges with the implementation that might have diluted impacts. There were considerable delays to the start of pilot activities, especially the convergence and coordination component. Delays were also observed in the training of JEEViKA staff and cadre, who exhibited role clarity with respect to the BCC component but were unclear on what was required of them for execution of the convergence and coordination component. We also observed a tendency to overload both the platform and the key cadre responsible for delivering the BCC, the CM. The SHG platform was being used simultaneously for several other interventions – sanitation drives, enrolment in life insurance, among others –leaving less time that necessary for deeper discussions around health and nutrition. The CM was often tasked with executing these other interventions along with her regular work of maintaining financial records, resulting in a significant increase in her workload. Finally, the BCC content, while accurate and comprehensive, was often indistinguishable from similar content used to train government frontline workers, making it hard to distinguish this intervention from other existing programs. Because the period of implementation was short and the BCC content long, messages could not be repeated and hence retention of messages delivered earlier in the cycle was low. It would have been more effective to limit the number of messages being delivered, thereby allowing the CM to reinforce the same key messages again and again.

The findings of our evaluation are largely consistent with what other such studies have found. The literature indicates that although several studies find an impact of group-based interventions on dietary diversity either for mothers or for children, very few studies find 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 which reiterates the positive impacts of agricultural interventions on diet diversity, as well as more limited impacts on anthropometric outcomes (Ruel, Quisumbing and Balagamwala, 2018). Finally, our results square also with those from evaluations of other large-scale behavior change interventions implemented by the global initiative, Alive & Thrive (Nguyen *et al.*, 2017). 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 translate into sustained daily consumption of foods to promote linear growth. Trials that included food or cash supplements in Bangladesh with intensive monitored behavior change efforts were more successful in supporting improvements in child growth outcomes (Ahmed et al. 2016). This is not to say that diet quality is not an important goal in and of itself, but merely to point out that over short time periods it may be unreasonable to expect changes in anthropometry as a result of changes in diets.

An important contribution of our paper is the financial costing of this intervention. There remains a serious dearth of evidence on how much nutrition interventions cost, especially more complex integrated interventions such as these. We collect cost information from implementor budgets and interviews and discussions with key program staff. We find that the feasibility phase – used to test the interventions before rollout - was almost half the total costs of implementation; however, this is largely an artefact of the short duration of the platform. When this feasibility phase cost is excluded, the intervention costs $6.5 per SHG member per year, comparable to the cost of implementing similar interventions in Odisha in Nair *et al.* (2017). It is very hard to compare costs across substantially different interventions. However, to provide some numbers to ground the reader, the implementation of a very closely monitored and well-executed weekly BCC strategy in Bangladesh cost about $50 per beneficiary per year (Ahmed *et al.*, 2016). The JEEViKA-MC intervention was relatively low-cost in comparison, but also low-intensity, which could explain the lack of impact relative to the Bangladesh study.

Taken together, our findings indicate that given their scale and their ability to reach women across the life course, women's group platforms have the potential for substantial impact, especially when combined with further strengthening of the platform and careful choice of a focused set of nutrition topics for discussion. This finding of the potential for impact on nutrition is important, because the group-based approach has broad empowerment-related impacts (Brody *et al.*, 2017), and very few other platforms can compete with the ability of SHGs to target multiple pathways to better nutrition simultaneously. Recently, SHG-based 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, skills development programs, or health and nutrition interventions, as in the intervention we test in this paper. The limited available evidence suggests that SHGs could be a particularly useful platform with which to target malnutrition in the context of India, not just because the problem of malnutrition is widespread and pernicious, requiring an approach that can be scaled easily, but also because 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 – could potentially be addressed through the formation and strengthening of these groups.

By providing evidence on the costs and benefits of 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 SHG-platform is here to stay – the reach of the NRLM program is vast and set to increase further over the next decade - so if it can be harnessed effectively to deliver results on nutrition it would greatly accelerate India's progress on this front. Our results suggest that provision of BCC can have an impact even without an accompanying change in resources; that this holds in resource-constrained contexts like Bihar is a particularly important finding. The power of BCC is in improving the efficiency of allocation of existing resources. Interventions that combine this with other financial or livelihoods-related interventions that simultaneously increase the size of the pool of resources could be much more effective. We anticipate that when thus combined, the delivery of BCC through this platform could be transformational.

REFERENCES

Ahmed, A. U., Hoddinott, J. F., Roy, S., Sraboni, E., Quabili, W. R., & Margolies, A., 2016. Which kinds of social safety net transfers work best of the ultra poor in Bangladesh? Operation and impacts of the Transfer Modality Research Initiative.

Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M.C., Deitchler, M., Fanou-Fogny, N., Joseph, M.L., Kennedy, G., Martin-Prevel, Y. and Torheim, L.E., 2010. Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. The Journal of nutrition, 140(11), pp.2059S-2069S.

Brody, C., De Hoop, T., Vojtkova, M., Warnock, R., Dunbar, M., Murthy, P., Dworkin, SL., 2015. Economic self-help group programs for improving women's empowerment: a systematic review. Campbell Systematic Reviews;11(1):1-82.

Chakrabarti, S., K. Raghunathan, H. Alderman, P. Menon, P. Nguyen (2019). India's Integrated Child Development Services programme; equity and extent of coverage in 2006 and 2016. Bulletin of the World Health Organization, Volume 97, Issue 4, pp 270-282.

Coates, Jennifer, Anne Swindale and Paula Bilinsky. 2007. Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3). Washington, D.C.: FHI 360/FANTA.

Coffey, D., 2015. Prepregnancy body mass and weight gain during pregnancy in India and sub-Saharan Africa. Proceedings of the National Academy of Sciences, 112(11), pp.3302-3307.

de Brauw, A., Harigaya, T., 2007. Seasonal Migration and Living Standards in Vietnam. American Journal of Agricultural Economics 89 (2): 430-447.

Gupta, S,, Kumar, N., Menon, P., Pandey, S. and Raghunathan, K., 2019. Engaging women's groups to improve nutrition: Findings from an evaluation of the Jeevika multisectoral convergence pilot in Saharsa, Bihar. Washington, DC: World Bank.

Heidkamp, R.A., Wilson, E., Menon, P., Kuo, H., Walton, S., Gatica-Domínguez, G., da Silva, I.C., Aung, T., Hajeebhoy, N. and Piwoz, E., 2020. How can we realise the full potential of health systems for nutrition? BMJ: British Medical Journal (Online), 368.

Hoddinott, J., Ahmed, I., Ahmed, A., & Roy, S., 2017. Behavior change communication activities improve infant and young child nutrition knowledge and practice of neighboring nonparticipants in a cluster-randomized trial in rural Bangladesh. PLoS ONE, 12(6): 1–13. https://doi.org/10.1371/journal.pone.0179866

International Institute for Population Sciences (IIPS) and ICF. 2017. National Family Health Survey (NFHS-4), India, 2015-16: Bihar. Mumbai: IIPS.

Jain M, 2015. India's struggle against malnutrition-is the ICDS program the answer? World Development, 67, pp 72–89. http://dx.doi.org/10.1016/j.worlddev.2014.10.006.

Jayachandran, S. and Pande, R., 2017. Why are Indian children so short? The role of birth order and son preference. American Economic Review, 107(9), pp.2600-2629.

Kandpal, E., 2011. Beyond Average Treatment Effects: Distribution of Child Nutrition Outcomes and Program Placement in India's ICDS. World Development, 39 (8), pp 1410-1421.

Kaplan, R. S., & Anderson, S. R. (2004). Time-driven activity-based costing. Harvard Business Review, 82(11), 131–140.

Kennedy, E., Kershaw, M., Stickland, J., & Biadgilign, S. (2018). Impact of Social and Behavior Change Communication in Nutrition Sensitive Interventions on Selected Indicators of Nutritional Status. Journal of Human Nutrition, 2(1): 24–33. Retrieved from https://www.researchgate.net/publication/325996318

Kim, S.S., Nguyen, P.H., Tran, L.M., Sanghvi, T., Mahmud, Z., Haque, M.R., Afsana, K., Frongillo, E.A., Ruel, M.T. and Menon, P., 2018. Large-scale social and behavior change communication interventions have sustained impacts on infant and young child feeding knowledge and practices: results of a 2-year follow-up study in Bangladesh. The Journal of nutrition, 148(10), pp.1605-1614.

Kumar, N., Scott, S., Menon, P., Kannan, S., Cunningham, K., Tyagi, P., Wable, G., Raghunathan, K., and Quisumbing, A.R., 2018. Pathways from Women's Groups-based Programs to Nutrition Change in South Asia: A Conceptual Framework and Literature Review. Global Food Security 17: 172-185.

Menon, P., Ruel, M.T., Nguyen, P.H., Kim, S.S., Lapping, K., Frongillo, E.A. and Alayon, S., 2020. Lessons from using cluster-randomized evaluations to build evidence on large-scale nutrition behavior change interventions. World Development, 127 (104816).

Menon, P., Nguyen, P.H., Saha, K.K., Khaled, A., Sanghvi, T., Baker, J., Afsana, K., Haque, R., Frongillo, E.A., Ruel, M.T. and Rawat, R., 2016. Combining intensive counselling by frontline workers with a nationwide mass media campaign has large differential impacts on complementary feeding practices but not on child growth: results of a cluster-randomized program evaluation in Bangladesh. The Journal of nutrition, 146(10), pp.2075-2084.

Menon, P., Mani, S. and Nguyen, P.H., 2017. How are India's districts doing on maternal, infant and young child nutrition?: Insights from the national family health survey-4 (No. 1). International Food Policy Research Institute (IFPRI).

Nair, N., Tripathy, P., Sachdev, H.S., Pradhan, H., Bhattacharyya, S., Gope, R., Gagrai, S., Rath, S., Rath, S., Sinha, R., Roy, S.S., Shewale, S., Singh, V., Srivastava, A., Costello, A., Copas, A., Skordis-Worrall, J., Haghparast-Bidgoli, H., Saville, N., Prost, A., 2017. Effect of participatory women's groups and counselling through home visits on children's linear growth in rural eastern India (CARING trial): a cluster-randomised controlled trial. Lancet Glob. Health 5, e1004–e1016. http://dx.doi.org/10.1016/S2214-109X(17)30339-X.

NITI Aayog, Government of India. 2017. Nourishing India-National Nutrition Strategy. NITI Aayog, Government of India https://niti.gov.in/writereaddata/files/document_publication/Nutrition_Strategy_Booklet.pdf.

Nguyen, P.H., Kim, S.S., Sanghvi, T., Mahmud, Z., Tran, L.M., Shabnam, S., Aktar, B., Haque, R., Afsana, K., Frongillo, E.A. and Ruel, M.T., 2017. Integrating nutrition interventions into an existing maternal, neonatal, and child health program increased maternal dietary diversity, micronutrient intake, and exclusive breastfeeding practices in Bangladesh: results of a cluster-randomized program evaluation. The Journal of nutrition, 147(12), pp.2326-2337.

Quisumbing, Agnes R.; Ahmed, Akhter; Gilligan, Daniel; Hoddinott, John F.; Kumar, Neha; Leroy, Jef L.; Menon, Purnima; Olney, Deanna K.; Roy, Shalini; and Ruel, Marie T. 2020. Randomized controlled trials of multi-sectoral programs: Lessons from development research. World Development 127(March 2020): 104822. https://doi.org/10.1016/j.worlddev.2019.104822

Ruel, M.T., Quisumbing, AR., and Balagamwala, M., 2018. Nutrition-sensitive agriculture: What have we learned so far? Global Food Security 17 (June 2018): 128-153. https://doi.org/10.1016/j.gfs.2018.01.002

Roodman, D., Nielsen, M. Ø., MacKinnon, J. G., & Webb, M. D., 2019. Fast and wild: Bootstrap inference in Stata using boottest. The Stata Journal, 19(1): 4-60.

Roy, S., Hidrobo, M., Hoddinott, J. and Ahmed, A., 2019. Transfers, behavior change communication, and intimate partner violence: Postprogram evidence from rural Bangladesh. Review of Economics and Statistics, 101(5), pp.865-877.

Spears, D., 2018. Exposure to open defecation can account for the Indian enigma of child height. Journal of Development Economics.

Saville, N.M., Shrestha, B.P., Style, S., Harris-Fry, H., Beard, B.J., Sen, A., Jha, S., Rai, A., Paudel, V., Sah, R. and Paudel, P., 2018. Impact on birth weight and child growth of Participatory Learning and Action women's groups with and without transfers of food or cash during pregnancy: Findings of the low birth weight South Asia cluster-randomised controlled trial

Subramanyam, M. *et al*., 2017. Impact of the Gram Varta programme on health, nutrition and women's empowerment in India, 3ie Grantee Final Report, New Delhi: International Initiative for Impact Evaluation (3ie)

Swaminathan, M.S., 2009. Undernutrition in infants and young children in India: a leadership agenda for action. IDS Bulletin, 40(4), pp.103-110.

Tan-Torres Edejer, T., Baltussen, R., Adam, T., Hutubessy, R., Acharya, A., Evans, D. B., & Murray, C. J. L. (2003). Making choices in health: WHO guide to cost-effectiveness analysis. Geneva: World Health Organization.

UNICEF, 2015. UNICEF's approach to scaling up nutrition for mothers and their children. United Nations Children's Fund. Discussion paper. Programme Division, UNICEF, New York, June 2015.

Ved, R. and Menon, P., 2012. Analyzing intersectoral convergence to improve child undernutrition in India: Development and application of a framework to examine policies in agriculture, health, and nutrition (No. id: 5177). *IFPRI-Discussion Papers, (1208)*.

Wooldridge, J.M., 2010. Econometric analysis of cross section and panel data. MIT press.

Women's Dietary Diversity Project (WDDP) Study Group, Development of a Dichotomous Indicator for Population-Level Assessment of Dietary Diversity in Women of Reproductive Age, Current Developments in Nutrition, Volume 1, Issue 12, December 2017, cdn.117.001701, https://doi.org/10.3945/cdn.117.001701

World Health Organization, 2008. Indicators for assessing infant and young child feeding practices: part 1: definitions: conclusions of a consensus meeting held 6-8 November 2007 in Washington DC, USA.

World Health Organization, 2016. WHO recommendations on antenatal care for a positive pregnancy experience. World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/44306/9789241599290_eng.pdf

World Health Organization, 2019. Essential nutrition actions: mainstreaming nutrition through the life-course. https://apps.who.int/iris/bitstream/handle/10665/326261/9789241515856-eng.pdf

APPENDIX

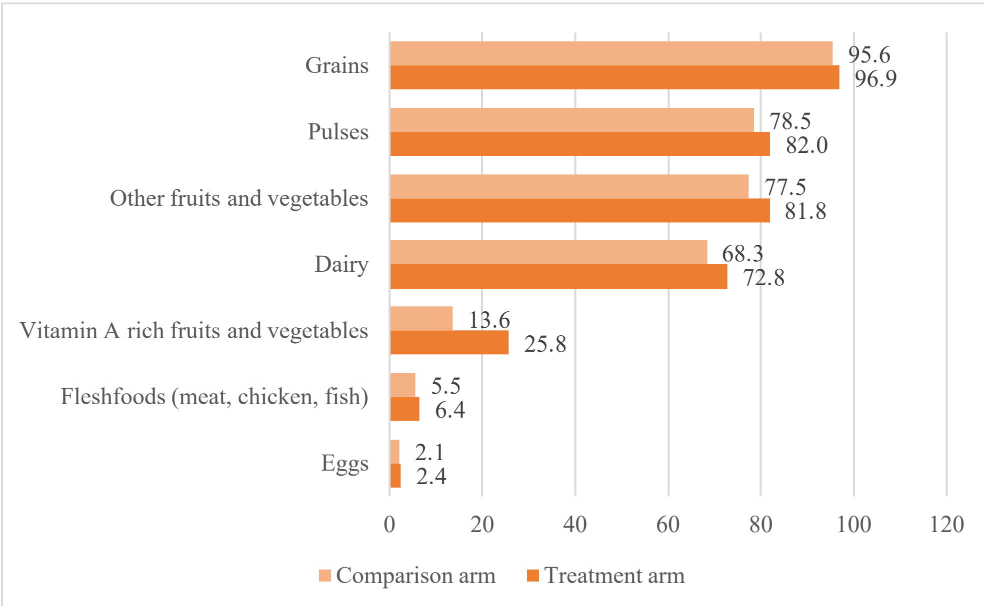

Figure A.1: Food groups consumed by youngest children, by arm at endline

Table A.1: 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.

ALL IFPRI DISCUSSION PAPERS

All discussion papers are available **here**

They can be downloaded free of charge

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
www.ifpri.org

IFPRI HEADQUARTERS
1201 Eye Street, NW
Washington, DC 20005 USA
Tel.: +1-202-862-5600
Fax: +1-202-862-5606
Email: ifpri@cgiar.org