

# An experiment of health services and additional microcredit in 128 villages of Bangladesh

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## Research article

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An experiment of health services and additional microcredit in 128  
villages of Bangladesh

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Abstract

**Background**

Studies in the literature have found mixed results on the effect of microcredit on health outcomes. Of the five previous experimental studies that included microcredit and a health intervention, three reported no significant changes in health status or behaviors.

**Methods**

This study consisted of a 4-celled experimental design in 128 villages in rural Bangladesh to test for marginal and interactive effects of increased microcredit and provision of basic health services. For villages in one cell, an additional microcredit worker was assigned. For those in a second cell, a Health Assistant visited households each month, provided simple medicines and announced a satellite clinic held monthly in each village. For a third cell, both interventions were combined, and villages in a fourth cell served as control.

Baseline questionnaires were completed with a sample of 3933 women (98.7% completed) and, three years later, attempts were made to re-interview the same women (93.7% completed). Outcome measures were food security, contraceptive use, having a trained birth attendant at last birth, and measles immunization.

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**Results**

Comparison of follow-up with baseline levels of the four outcome measures showed significant improvement in food security in all study arms and a significant increase in trained birth attendant at last birth in the health services villages.

Due to confusion within Grameen Bank about which workers would provide the additional microcredit work, that intervention was poorly implemented so in multivariate analyses, the data for that intervention arm were grouped with data from the control arm. Logistic regression with values of the outcomes at follow-up as dependent variable and study arm and women's schooling as covariates (women's schooling was the one covariate that was not balanced across study arms) showed no significant effects of either separate or grouped study arms.

**Conclusion**

Two of the three health behaviors showed no significant changes over time but having a trained birth attendant at last delivery did increase significantly in the health services arm. Therefore community health education can sometimes be effective in promoting healthy behaviors.

Trial registration

1 This was a field trial rather than a clinical trial so trial  
2 registration was unnecessary.

3

4 Keywords: microcredit; experimental study; health services  
5 intervention; Bangladesh; Asia; randomized controlled trial

6

7

## 8 **Background**

9 Microcredit--initially introduced by Professor Mohammed Yunus in a  
10 tiny village of Bangladesh in 1976 (Yunus, 1998)--is now available in  
11 many countries with over 1000 relatively large  
12 microfinance/microcredit institutions (MFIs) and 140 million clients  
13 receiving grants as of 2019 (Convergences, 2020). While the positive  
14 effect of microcredit on women and households seemed to be clear from  
15 the early Bangladesh experience, six recent randomized controlled  
16 trials (RCTs) of microcredit have not found significant effects on  
17 either income, consumption or poverty (Banerjee, Duflo, Glennerster  
18 and Kinnan, 2015; Tarozzi, Desai and Johnson, 2015; Attanasio et al.  
19 2015; Crepon et al. 2015; Angeluicci, Karlan and Zinman 2015; Augsburg  
20 et al. 2015). Earlier cross-sectional studies suffered from selection  
21 biases that could explain why they found significant results while the  
22 RCTs generally have not. Pitt and co-authors (1999) outlined the  
23 three types of biases in the cross-sectional studies: 1) choice-based  
24 sampling; 2) self-selection into microcredit, and 3) non-random  
25 program placement. In some cases econometric methods can be used to  
26 adjust for one or more of these biases. With RCTs, these biases are

1 either eliminated (with intent-to-treat analyses) or minimized.  
2 Earlier studies with econometric methods found that women's  
3 participation in microcredit led to increases in household income,  
4 production and expenditures (Pitt et al., 1998; Khandker and Khan,  
5 1998). However, analytic methods used in the Pitt et al. study have  
6 been debated and a reanalysis with different assumptions did not  
7 replicate the significant results of microcredit on poverty reduction  
8 (Roodman and Morduch, 2014).

9  
10 Regarding the potential effects of microcredit on health, the positive  
11 health impact of microcredit has been postulated as an important  
12 outcome for users and their families (Leatherman and Dunford 2010;  
13 Leatherman et al. 2012). Some programs use microcredit clients'  
14 meetings to teach good health practices, family planning, and other  
15 aspects of reproductive health. Others use microcredit services to  
16 promote health insurance (Churchill, Danso and Appau, 2016). A  
17 theoretical underpinning linking microcredit and health has been given  
18 by Mohindra and Haddad (2005). They posit four pathways linking the  
19 two: economic, social, psychological, and political. The economic  
20 pathway is straightforward because of the "close link between wealth  
21 and health"; the social pathway involves social networks, changing  
22 norms and attitudes and increasing women's social engagement and  
23 participation; and the psychological pathway involves the concept of  
24 self-efficacy. Finally, the political pathway gives women "voice" to  
25 influence public policies and interventions that impact women's  
26 health.

1 With regard to studies of health status and/or behaviors *vis. à vis.*  
2 microcredit, several types of studies in the literature need to be  
3 distinguished. We will restrict consideration to studies with  
4 experimental, quasi-experimental or longitudinal designs. Thus, we do  
5 not consider cross-sectional studies since it is difficult to separate  
6 out the casual role of microcredit in promoting health services  
7 because of various selection and reverse causation biases common to  
8 statistical evaluations of such studies as mentioned above. Even if  
9 microcredit is associated with positive health outcomes, we must ask  
10 whether the impact is greater than what would have been seen without  
11 microcredit.

12

13 The first type of studies includes those which simply measure health  
14 behaviors or status as outcomes after a microcredit intervention.  
15 The second includes those which have a health intervention in addition  
16 to microcredit. The latter has been the policy of the two large MFIs  
17 in Bangladesh--Grameen Bank and the Bangladesh Rural Advancement  
18 Committee. The rationale for this policy by these MFIs is that when  
19 women gather in their borrowing group, it is an ideal occasion for  
20 health education. Another option in microcredit provision that has  
21 been tried is to offer health services or health insurance at reduced  
22 cost for microcredit members.

23

24 The findings from these studies are also mixed. These findings are  
25 reviewed below.

26

1 A quasi-experimental study in Honduras and Ecuador compared behaviors  
2 of women who participated in conventional village banks with those of  
3 women who participated in a health bank. In the latter, women in bi-  
4 weekly meetings heard 15-minute lectures on health topics (e.g.,  
5 maternal health, management of illnesses, nutrition, immunization,  
6 etc.) Women who participated in the health banks had significantly  
7 less switching from breastfeeding to bottle feeding, but other health  
8 indicators were not significantly different between the two groups  
9 (Smith, 2002).

10

11 In the Dominican Republic, a longitudinal study had 3 non-randomized  
12 arms: 1) microcredit only; 2) health promotion only (e.g., management  
13 of acute respiratory infection and diarrhea, immunization, and breast  
14 and cervical cancer screening); 3) microcredit and health promotion  
15 (Dohn et al. 2004). Eleven health indicators were measured at  
16 baseline and a follow-up two years later. The health intervention  
17 included monthly visits to each family by trained health promoters.  
18 Eight of the eleven indicators significantly improved by the follow-up  
19 among those in the microcredit and health area while five of eleven  
20 improved among those in the health area only, and none improved among  
21 those with only microcredit.

22

23 A cluster randomized trial in South Africa included three study arms:  
24 1) four villages with microcredit and an intervention on AIDS and  
25 gender equity; 2) four villages with microcredit only, and 3) four  
26 control villages. Of the three health-related indicators, none was

1 significant in a comparison of microcredit only vs. control but two of  
2 the three HIV-related risk behaviors were significantly lower in the  
3 microcredit and health vs. control comparison (Kim et al. 2009).

4

5 An experimental study in one area of Peru had about half of loan  
6 groups randomized to receive eight 30-minute sessions of health  
7 education. At the follow-up survey one year later, those in the  
8 intervention groups had significantly better health knowledge, but  
9 none of the eight child health indicators (e.g., anthropometry,  
10 reported diarrhea or respiratory infection) was significantly  
11 different between treatment and control groups (Hamad, Fernald and  
12 Karlan, 2011).

13

14 In 138 villages in Benin an RCT with four randomized intervention  
15 groups was undertaken: 1) microcredit and health education of women;  
16 2) microcredit with health education of mixed sex groups; 3)  
17 microcredit only for women; 4) microcredit for both women and men. Of  
18 six calculated health indices that were compared at follow-up three  
19 years later, no significant differences were seen between groups  
20 except on one HIV behavior score. The authors suggest that bundling  
21 health education with microcredit was not sufficient to improve health  
22 behaviors (Karlan, Thuysbaert and Gray, 2017).

23

24 In a recent RCT in India, mandatory health insurance was introduced  
25 for individuals enrolled in an MFI in 101 villages that were randomly  
26 selected with another 100 villages serving as control. The health

1 insurance intervention had no significant impact on health status,  
2 health care usage, or financing of health care expenditures, but this  
3 was largely because many persons in the intervention villages  
4 discovered that the health insurance was “mostly useless” and decided  
5 to drop their microcredit to avoid the health insurance imposition  
6 (Banerjee, Duflo and Hornbeck, 2018).

7

8 Several studies have examined contraceptive use as the outcome. An  
9 RCT in Ethiopia had four cells with villages randomly assigned to each  
10 cell: 1) microcredit only; 2) family planning only; 3) microcredit and  
11 family planning; 4) neither. This study found no effect on  
12 contraceptive uptake (Tarozzi, 2015). Among non-randomized studies,  
13 even when authors used sophisticated techniques, results have been  
14 contradictory. Thus, Pitt et al. (1999) with national data from 87  
15 villages in Bangladesh found no effect of microcredit participation on  
16 contraceptive use. But Steele, Amin and Naved (2001) with a before-  
17 after sample from one area of the country did find a program effect on  
18 contraceptive use. Both studies used econometric methods but the  
19 samples were different, possibly explaining the contradictory results.

20

21 Thus, the effects of microcredit or microcredit and health  
22 interventions combined on the health of individuals and families have  
23 been found to be positive in some studies and settings, but null in  
24 other studies and settings. The objective of the present study was to  
25 determine if the introduction of enhanced microcredit and basic health  
26 services separately and jointly in a randomized design would have any

1 effects on health behaviors of individuals and families in rural  
2 Bangladesh.

3

#### 4 **Methods**

5 Our original study design was to introduce the program interventions  
6 in a random set of villages across Bangladesh that had neither  
7 microcredit nor non-governmental (NGO) health services. However, by  
8 the time of the start of the project in 2005, there were almost no  
9 villages in Bangladesh without microcredit. Indeed, in the 2004  
10 Bangladesh Demographic and Health Survey (BDHS) (Niport & ORC Macro,  
11 2005), only 7 out of the 359 clusters visited, with an average sample  
12 size of 32 women interviewed in each, had no woman reporting  
13 participation in microcredit. Thus we revised the design to have  
14 additional microcredit as an intervention. The logic was that if  
15 microcredit has positive effects then provision of microcredit  
16 services to more households would show increased effects at the  
17 village level. Cluster randomization at the village level was the  
18 only feasible design. Grameen Bank was chosen as the partner to  
19 implement the interventions as it is well known for its microcredit  
20 work and had recently introduced health centers in some parts of the  
21 country to provide basic health services (Amin and Yiping, 1997).

22

23 The 4-celled design of the study is shown in Table 1. To determine  
24 the needed sample size, the criterion variable chosen was  
25 contraceptive use. A baseline level of 50% was assumed (in the 2004  
26 BDHS, the prevalence of contraceptive use among rural women was 56.7%,

1 and modern contraceptive use was 46.0%). We wished to detect a change  
 2 of 15% with Type I and Type II error probabilities of 0.05 and 0.20  
 3 respectively. From the BDHS with rural clusters (villages), we  
 4 estimated the intra-cluster correlation to be 0.052. With these  
 5 estimates and utilization of the software of Hayes and Bennett (1999),  
 6 we calculated that a design with 128 villages and at least 30 women  
 7 interviewed per village would provide an adequate sample size for the  
 8 study--approximately 930 women per study arm (See Table 1).

9

10 Table 1: Study design: Minimum sample size--number of villages (women)  
 11 for before and after surveys for the four intervention arms

		Improved Health	
Additional		Services	
Microcredit			
Worker		Yes	No
Yes		32 (930)	32 (930)
No		32 (930)	32 (930)

19

20 To utilize health facilities and staff available in Grameen health  
 21 centers, we chose villages in the vicinity of such health centers. Of  
 22 the 31 Grameen health centers operating in the country at the time  
 23 (2005), we selected 16 with the lowest reported coverage of  
 24 microcredit in the upazilla (administrative area below the district in  
 25 Bangladesh (like a county or borough in Western countries)) according  
 26 to nationally available data (Palli Karma-Sahayak Foundation, 2004).  
 27 Figure 1 shows the location of the 16 centers. Next, an enumeration

1 of 24 villages in the vicinity outside the catchment areas of these  
2 health centers was done to find villages estimated to have less than  
3 50% of households participating in microcredit and with only  
4 governmental health programs. The catchment area of a Grameen health  
5 center is approximately a circular area around the center with a  
6 radius of about 4 km. In this enumeration, elders in each village  
7 were asked if there was any NGO health program in the village and  
8 approximately what percentage of households participated in  
9 microcredit. These data along with GPS coordinates were utilized to  
10 select eight villages, with two sets of four outside and on opposite  
11 sides of the health center catchment area. This setup is shown  
12 schematically in Figure 2.

13

14

FIGURES 1 AND 2 ABOUT HERE

15

16 After this selection, a census of households in each village was  
17 undertaken. From the census, households with ever married women were  
18 identified. In these households we asked: number of persons in the  
19 household, amount of land owned, and whether any woman of the  
20 household ever belonged to a microcredit group. From these data,  
21 households in the villages were categorized into 3 strata: 1) not  
22 eligible for microcredit; 2) eligible and had accessed microcredit; 3)  
23 eligible but had not accessed microcredit. An eligible household was  
24 one that owned less than 1/2 acre of land.

25

1 Randomization of villages to the four study areas was done by the team  
2 of researchers independently of Grameen Bank and of the baseline  
3 survey; it was done by the researchers at Johns Hopkins University  
4 using a list of random numbers. For each center, we first randomly  
5 selected one of the sets of four villages to receive the health  
6 services intervention. Then among each of the two sets of four  
7 villages on opposite sides of the health center, two were randomly  
8 assigned to have the additional microcredit intervention.

9

10 A baseline survey was conducted among a stratified random sample of  
11 households in each of the 128 villages. In each village, interviews  
12 were attempted in 31 randomly selected households with the following  
13 distribution by strata defined from the census as noted above: 4 in  
14 stratum 1; 12 in stratum 2; and 15 in stratum 3. (In a few villages  
15 one or two more than 31 interviews were completed; interviewers in the  
16 teams were assigned more than 31 interviews on the assumption that  
17 some households would be non-response.)

18

19 The household questionnaire included the following items: a listing of  
20 household members with their relationship to the head, sex, age and  
21 marital status; information on source of drinking water, type of  
22 toilet facility, possession of items (electricity, wardrobe, table,  
23 chair, watch, bed, radio, television, bicycle, motorcycle, sewing  
24 machine and telephone or mobile phone), number of rooms, materials  
25 used in wall and floor construction, type of fuel for cooking, amount  
26 of land owned, any food deficit during the previous year, amount of

1 rice stocked after the last harvest and ownership of domestic animals  
2 (cows, goats, chickens, ducks, fish). One ever married woman in each  
3 household was then selected and consent obtained for interview. The  
4 woman's questionnaire was modeled after the BDHS and included  
5 questions on the following topics: respondent's background (e.g. age,  
6 schooling, religion), a pregnancy history, details about maternal and  
7 child health care, contraceptive use, recent childhood illnesses,  
8 details on participation in microcredit, decision-making in the  
9 household, a 3-year month by month reproductive calendar, fertility  
10 preferences, and domestic violence.

11

12 Fieldwork was carried out between July and September 2006. Both the  
13 census and survey were conducted by a professional survey agency. Since  
14 the baseline was done before the interventions began, the interviewers  
15 were obviously blind to the random assignment of any village. Thirty  
16 interviewers and supervisors (social science graduates who were  
17 experienced in survey methods) were recruited. They received training  
18 on the content of the questionnaires and techniques to establish  
19 rapport with the respondents but still maintaining the neutrality  
20 needed to obtain the most accurate data possible. All questionnaire  
21 data were entered using CSPRO (U.S. Census Bureau, 2012) with range  
22 and consistency checks, as well as double entry for complete checking.

23

24 After the baseline survey, the interventions by Grameen Bank and its  
25 health section, Grameen Kalyan, began. Specifically, for the villages  
26 with the health services intervention, health assistants were hired  
27 and trained by Grameen Kaylan to deliver basic education and health  
28 services. Each female health assistant covered two villages and

1 visited house to house. She provided a) ORS packets, b) vitamins,  
2 iron, paracetamol, deworming tablets, and/or metronidazol tablets, c)  
3 basic health and nutrition education, d) referrals for illnesses to  
4 the Grameen Kalyan Health Center, and e) announcement of a satellite  
5 clinic held each month in the village. The satellite clinic was held  
6 in a location in the village that was provided to Grameen Kalyan at  
7 minimal charge. A doctor or paramedic from the Health Center provided  
8 free services to anyone from the village who presented for care during  
9 the 2-5 hours s/he was there. In cases in which further care was  
10 needed, the patient was referred to the Grameen Kalyan Health Center  
11 or, for advanced care, to the closest government hospital.

12

13 For the additional microcredit intervention, the Grameen Bank area  
14 offices that covered the villages in question were sent a letter from  
15 the Grameen Bank Head office in Dhaka asking them to assign an  
16 additional worker to each of the selected villages. Villages on  
17 opposite sides of the same Grameen Kalyan Health Center were often  
18 covered by different area offices.

19

20 A project office was established in Dhaka with two persons who  
21 monitored the health interventions on a quarterly basis, visiting 4 of  
22 the 16 health centers and surrounding study villages each month. In  
23 addition to meeting with the health assistants and health center  
24 staff, some process data were collected. Specifically, information  
25 was collected on the satellite clinics (e.g. attending health person,  
26 duration of the clinic, number of patients seen, and medicines  
27 dispensed) and work of the health assistants (number of households  
28 visited, number of ORS packets sold, Vitamins, Paracetamol,

1 Metronidazole, iron and deworming tablets given). Monitoring of the  
2 additional microcredit effort was deemed unnecessary since Grameen  
3 staff are well versed in procedures for motivating and giving loans.

4

5 After approximately 3 years of the intervention, a follow-up survey  
6 was done in 2009. We decided to re-interview, to the extent possible,  
7 the women who had been in the baseline survey to provide longitudinal  
8 data at the individual level. For the women who had changed  
9 residence, a tracking system was established to attempt to locate them  
10 in order to complete an interview. Specifically, from other family  
11 members still in the village or from neighbors, we asked for contact  
12 information of the woman--this was typically a cellphone number. In  
13 addition, to account for inevitable loss to follow-up, two  
14 "replacement" interviews were attempted in each village, selecting one  
15 household from each of strata 2 and 3, using the original (2006)  
16 household census data.

17

18 The questionnaire for the follow-up survey was mostly the same as that  
19 of the baseline, but with a few deletions and additions; the main  
20 deletion was the 3-year reproductive calendar while the main addition  
21 involved details of women's microcredit participation. The same  
22 survey organization carried out the follow-up survey and they were  
23 independent of Grameen Bank and interviewers were blind to the  
24 assignment of villages in the intervention. For the work, 36  
25 interviewers were trained and 24 were selected. A "tracking" team was  
26 organized and charged with the task of locating women who had changed  
27 residence since 2006. A staff person from Johns Hopkins University  
28 monitored the quality of data collected during the first 3 weeks of

1 fieldwork. Data were entered in CSPRO and transferred to STATA for  
2 analyses. Baseline and follow-up data were matched for the same  
3 household and woman.

4

5 Census data for each village were used to construct weights for each  
6 household and woman in the baseline survey. For the follow-up survey,  
7 response rates varied by strata, so for the analyses of women in both  
8 surveys, the baseline weight was adjusted by the factor  $1/r_j$ , where  $r_j$   
9 is the follow-up completion rate in strata  $j$ . Weighted analyses and  
10 adjustments for cluster effects were done using SVY commands in Stata  
11 (STATA Corp, 2015).

12

13 To test whether the random allocation of village groups resulted in  
14 balance of characteristics between study arms, we compared village  
15 characteristics (a market in the village; a clinic within 2 miles; a  
16 hospital within 5 miles), household characteristics (wealth, food  
17 deficit during the year; electricity, own land, improved water source  
18 and whether own a cow and/or goat) and woman characteristics (work for  
19 pay, antenatal care for last birth, want no more births, ever attended  
20 school, age, and number of pregnancies). Then to test for selectivity  
21 of women with completed baseline and follow-up interviews, we compared  
22 characteristics of these women with those of women interviewed in the  
23 baseline survey only. The characteristics examined were: age, level of  
24 schooling, parity, household asset score, and marital status.

25

26 To construct the wealth index, the binary asset indicators were  
27 chosen. These were: presence or absence of electricity, a wardrobe,  
28 table, chair, clock, bed, radio, television, bicycle, at least one of

1 a motorcycle, sewing machine or telephone, brick, cement or tin walls,  
2 and modern toilet or pit latrine. In addition, the ratio of the  
3 number of people in the household to the number of rooms in the house  
4 was used. Principal components analysis was employed to combine the  
5 indicators into an asset index (Filmer and Pritchett, 2001). The  
6 first principal component, which accounted for 32% of the variance,  
7 was utilized. The analysis yielded a score for each household. These  
8 scores were ordered and used to divide households into quintiles,  
9 representing their relative wealth with respect to other households in  
10 the study. This asset or wealth index reflects disparities that are  
11 primarily economic (Gwatkin, 2007).

12

13 In the original protocol four individual-level outcomes for the  
14 experiment were specified: contraceptive use, full immunization,  
15 trained birth attendant, and empowerment index. We wanted to stay  
16 close to these in the analyses. For full immunization, we chose  
17 measles vaccination since it often indicates full immunization and  
18 allows a larger age group and thus larger sample size than is the case  
19 with other vaccines. Contraceptive use and trained birth attendant  
20 outcomes were kept as is. Regarding women's empowerment,  
21 unfortunately we were unable to test for changes because there were  
22 unforeseen data collection differences between the baseline and follow-  
23 up surveys. A food security variable was added as an outcome because  
24 we heard anecdotally during the study that conditions had improved in  
25 the country between 2006 and 2009 and we wanted to see to what extent  
26 this was the case, and food (rice) stocks is an excellent indicator of  
27 a household's economic well-being. We also tabulated microcredit

1 participation, i.e. one of the two interventions, to see how it varied  
2 among the study arms.

3

4 Details of the outcome variables are:

5

6 Food security. For all ever married women, this was coded 1 if the  
7 household in which she resided did not experience any food deficit in  
8 the pervious year and 0 otherwise.

9

10 Microcredit participation. For all ever married women, this was coded  
11 1 for those currently a member of a microcredit organization and 0  
12 otherwise.

13

14 Contraceptive use. For all married women ages 15-49 (at both rounds),  
15 this was coded 1 for those using a modern method of contraception and  
16 0 otherwise.

17

18 Skilled birth attendant. For women who had a delivery in the past 3  
19 years, this was coded 1 if there was a trained health worker assisting  
20 (Doctors, nurses, midwives, paramedics, and Health Assistants were  
21 defined as skilled birth attendants) and 0 otherwise.

22

23 Measles immunization. For all women with children between the ages of  
24 12 and 23 months of age, this was coded 1 if the child had received a  
25 measles immunization (with this information either from a vaccination  
26 card or from mother's recall) or 0 otherwise.

27

1 Since only a small proportion of women were lost to follow-up (see  
2 below), we chose to analyze changes with data from women interviewed  
3 in both the baseline and follow-up surveys. When the sample is the  
4 same women at two time points, to test for changes we used McNemar's  
5 test with unweighted data (McNemar, 1947). For the comparisons that  
6 involved different women at baseline and follow-up, we utilized a z-  
7 test of proportions. (The actual variance of the difference of  
8 proportions  $p_1$  and  $p_2$  is  $V(p_1) + V(p_2) - 2 \cdot \text{Cov}(p_1, p_2)$ , but since the  
9 covariance in such situations is almost always positive, we believe  
10 that the decrease of variance here offsets the increase in variance  
11 due to the design effect.)

12

13 The study was approved by the Institutional Review Boards of the Johns  
14 Hopkins School of Public Health and the Bangladesh Medical Research  
15 Council. Informed consent was obtained before conducting an interview.  
16 (Since the questionnaire included a section on domestic violence,  
17 special arrangements were made to have a counselor available at the  
18 closest health center to whom women who reported recent violence could  
19 be referred by the interviewers.)

20

21 Analyses for RCTs is relatively straightforward. With cluster level  
22 randomization we used intent-to-treat analyses. First, we tabulate  
23 the outcome measures at baseline and follow-up surveys by study arm  
24 and test for differences. Since this was an RCT, the intervention  
25 groups were balanced on outcomes at the baseline except for one  
26 variable--women's education (see below). Therefore, difference of  
27 differences analyses was not needed and analyses of outcomes at

1 follow-up was sufficient. Indeed, difference of differences analyses  
2 in this case have been shown to have low power (McKenzie, 2012).

3

4 Since all outcomes were binary, we used logistic regression for each  
5 outcome from the follow-up survey with indicator variables for study  
6 arm. Odds ratio estimates are presented. Since there were  
7 significant differences in the proportion of women who had ever  
8 attended school by study arm, we include this as a covariate in the  
9 regressions. All these analyses used the SVY commands  
10 in Stata, which adjusts for both clustering and sample weights.

11

## 12 **Results**

13

14 A comparison of baseline characteristics of villages, households and  
15 eligible women by intervention arm is given in Table 2. The only  
16 variable with significant differences across the study arms was  
17 whether the woman had ever attended school--the percentages were  
18 significantly higher in the health services and in the combined  
19 intervention village groups than in the other two arms. We therefore  
20 adjusted for this variable in the analyses.

21

1 Table 2: Village, household and eligible women characteristics (percentages in category) at baseline, by  
 2 intervention assignment

3 Level and characteristic	4 Intervention group				
	All groups	Control i.e. None	Micro- credit only	Health services only	Both interven- tions
5 Village level (n=64)					
6 Market in village	50	38	50	53	59
7 Clinic within 2 miles	60	56	63	75	53
8 Hospital within 5 miles	44	34	41	50	53
9 Household level (n=3998)					
10 Poor (bottom three quintiles)	60	64	53	58	64
11 Not food deficit during the year	64	66	60	67	66
12 Electricity in the home	62	66	63	59	60
13 Own land	45	47	38	47	49
14 Improved water source	57	63	54	59	52
15 Own cow and/or goat	47	48	44	46	51
16 Woman level (n=3933)					
17 Currently works for pay	10	10	12	10	10
18 No ANC for last birth	18	15	19	15	21
19 Want no more births	42	44	45	43	39
20 Ever attended school *	54	47	45	60	60
21 Age (mean)	35.5	36.4	35.5	34.6	35.6
22 Number of pregnancies (mean)	4.0	4.2	4.1	3.9	4.1

23 \* p<0.05 for test of equality of proportions between study arms.

24  
 25 Figure 3 is a flow chart of study participants in the baseline and  
 26 follow-up surveys. Of the 4381 households sampled for the baseline  
 27 survey, 3998 were completed (91.3% response rate) and in these  
 28 households, 3933 women were interviewed (response rate of 98.7%). Of

1 these, 3687 (93.7%) also had completed follow-up questionnaires. For  
2 those 246 women lost to follow-up, the reported reasons were:  
3 respondent migrated (54%), respondent incapacitated or died (13%),  
4 respondent not at home (15%), and other (17%). There was no  
5 significant difference in attrition by study arm (not shown). A  
6 comparison of characteristics of those lost to follow-up with those  
7 re-interviewed is given in Table 3. The women lost to follow-up were  
8 in households with significantly lower asset scores and were more  
9 likely to be widowed at baseline. A slightly greater percentage of  
10 those lost to follow-up had above primary schooling, but the  
11 difference was not statistically significant at the  $p=0.05$  level.

12

13 Baseline and follow-up values of the five outcome variables by study  
14 arm are given in Table 4. The results for each outcome are considered  
15 in turn.

16

17

18

1 Table 3: Baseline survey characteristics of women by whether they had  
 2 completed follow-up interviews or not

3	Baseline characteristic	Status of follow-up		p-value
		interview		
		Complete	Incomplete	
4	Number of women	3687	246	
5	MEANS			
6	Age (years)	34.2	35.0	0.49
7	Parity	3.7	3.5	0.37
8	Household asset score	0.01	-0.29	<0.01
9				
10	PERCENT DISTRIBUTIONS			
11	Schooling: None	57.3	58.5	0.10
12	Primary	25.9	20.7	
13	Above primary	16.8	20.7	
14	Marital status:			
15	Married	89.4	82.5	<0.01
16	Widowed	8.9	13.0	
17	Other	1.7	4.5	

18

TABLE 4 ABOUT HERE

1. The percentages of households with food security during the entire year before the survey increased significantly in all four study arms.

2. The level of microcredit participation did not change significantly in any of the study arms. There was actually a decline in microcredit participation in both arms with the additional microcredit intervention.

3. Contraceptive use increased significantly in the control villages but changes in the intervention areas were not significant.

4. The percentage of women having a trained birth attendant at the last delivery increased significantly in the health-services only area and there were no significant changes in the other study arms.

5. For the percentage of children 12-23 months with measles immunization, there was no significant change in any study arm.

The finding that microcredit participation actually declined in the microcredit and microcredit plus health services arms was completely unexpected. As an explanation for this finding, there was a nontrivial problem that occurred in implementing the microcredit intervention. The study design called for selection of eight villages outside the catchment area of each Grameen Health center and, in the randomization, half of these would receive enhanced microcredit,

1 specified as an additional microcredit worker assigned to those  
2 villages. As noted above, at the beginning of the study, the Grameen  
3 Bank headquarters in Dhaka sent a letter to each concerned Grameen  
4 Bank office regarding implementation with an additional worker. While  
5 the design was good, it was problematic from the perspective of  
6 implementation by Grameen Bank. The four villages randomized to  
7 receive additional microcredit around a Health Center were often  
8 covered by two or even three separate Grameen area offices; this led  
9 to confusion and the coordination of where an extension worker was  
10 assigned was haphazard. Unfortunately, this confusion led to  
11 decreased microcredit activity in the microcredit intervention  
12 villages. Since funding for this microcredit extension worker was a  
13 Grameen Bank contribution to the project, there was no control on its  
14 implementation by the project staff. Given these results, for the  
15 multiple logistic regressions, we collapsed the intervention groups to  
16 two--control including the original control and microcredit only arms  
17 and health services including the health services only and health  
18 services plus microcredit arms.

19

20 Table 5 gives the regression results for the four key outcome  
21 indicators at the follow-up survey. The covariate for whether the  
22 woman had ever attended school had significant positive effects for  
23 both food security and measles vaccination. After adjustment for  
24 women's schooling, there were no significant effects of the health  
25 services intervention on any of the outcomes. Results were similar  
26 when the regressions were done without the schooling covariate and  
27 also when the four intervention arms were used instead of two (neither  
28 is shown but both are available upon request).

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Table 5: Estimated odds ratios (and 95% confidence intervals) from logistic regression fit of four outcome variables on experimental and control areas

Covariate	Outcome			
	Food security (n=3687)	Contraceptive use (n=2960)	Measles vaccination (n=268)	Trained birth attendant (n=915)
Control areas <sup>a</sup>	1.00	1.00	1.00	1.00
Health services areas <sup>b</sup>	0.79 (0.51, 1.24)	0.79 (0.48, 1.31)	0.60 (0.14, 2.59)	1.18 (0.58, 2.44)
woman's schooling (ref. = none)	2.51** (1.66, 4.21)	0.48 (0.58, 1.23)	5.14** (1.66, 14.27)	1.38 (0.70, 2.71)
Constant	4.38 (3.24, 5.91)	1.96 (1.34, 2.86)	3.00 (1.09, 8.29)	0.41 (0.20, 0.83)

\*\* p<0.05 for test that odds ratio = 1.0

<sup>a</sup> Including the original control villages and the microcredit-only villages

<sup>b</sup> Including the original health services villages and the health services plus microcredit villages

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**Discussion**

In this study only one of the three health behaviors showed significant improvement over time in the health services intervention villages but not in the control or other arms. The significant result was for presence of a trained birth attendant at last delivery. This result could attest to the effectiveness of the health education imparted by the health assistants about the importance of having trained personnel at birth and/or to the villagers availing themselves of the health facility or health personnel of the Grameen Kalyan Health Centers which they had learned about from the health assistant and/or the medical person during the satellite clinics. However, in the logistic regressions of the follow-up data, the effect of the health services intervention was not significant for any of the three health behaviors. One reason for the finding of significant differences between levels of the outcomes over time but no significant effects in the logistic regressions is that in the former, the design effect did not contribute since it was the same villages at both time points, but in the logistic regression it did and design effects were quite large (the minimum value was 3.8 for measles immunization and maximum was 9.8 for contraceptive use).

For the health interventions generally, the project provided the funds for the extra health worker in the randomly selected villages and this was closely monitored. However, because the project health assistants were based in the Grameen Kalyan health center, which was a considerable distance from the experimental villages, travel to the study villages often took several hours each way. Furthermore,

1 village health workers were at the time paid 3000 taka (46 USD) per  
2 month, which after funds for a pension and travel were subtracted,  
3 became about 2000 taka (31 USD). The salary was in line with pay of  
4 health assistants already attached to the Grameen Health Centers, but  
5 the latter worked in villages within the health center catchment area,  
6 i.e., they had much shorter travel times. The Grameen Kalyan workers  
7 also had some level of job security within the Grameen system which  
8 the temporary health assistant staff of this project did not have.  
9 Thus, there was considerable turnover in Health Assistants of the  
10 project and their morale was low. Almost 3/4 of the way through the  
11 project when this problem became clear, their salaries were raised to  
12 4000 taka which helped with retention.

13

14 The non-significant results of this study are in line with results  
15 from other RCTs of microcredit interventions in diverse settings  
16 reviewed above though only the study in Ethiopia included a health  
17 (family planning) arm and an arm with both interventions. But there  
18 too, of the 40 outcome variables considered, only five showed  
19 significant effects of the interventions (Tarozzi, Desai and Johnson,  
20 2015).

21

22 The RCT is taken as the "gold standard" in medical research and the  
23 same has generally been assumed in social science research. However,  
24 several points in critiques of RCTs involving human behavior change  
25 deserve consideration (Shaffer, 2011; McHugh, Biosca and Donaldson,  
26 2017). Most importantly, results from an RCT typically cannot provide  
27 much insight on the "how and why" of any significant effects that are  
28 found. Human behavior change involves complex pathways between

1 intervention and outcome. Combining qualitative methods with an RCT  
2 is one proposal to try to understand the how and why of the findings.  
3 Of course in the present case the finding of no effects of the  
4 interventions is perhaps simpler to explain due to the problem of  
5 implementation of the microcredit intervention described above.

6

7 Several weakness of the study deserve mention. First, there was  
8 variability or heterogeneity in implementation. In particular, for  
9 the microcredit intervention, though the overall effect on microcredit  
10 participation was negative, villages assigned to additional  
11 microcredit around some Health Centers did show positive effects.  
12 Also, some Health Assistants had greater motivation and enthusiasm for  
13 their work than others and this could have affected what they were  
14 able to convey to women in the study villages [See Appendix]. In  
15 short, the interventions were not uniformly applied; but this is to be  
16 expected with fairly large-scale social science interventions.

17 Second, sample size was reasonable but not large enough to detect  
18 small differences. For example, there were only 268 children between  
19 the ages of 12 and 23 months at follow-up--the denominator for the  
20 outcome of measles immunization. It might also have been useful to  
21 compare treatment of diarrhea across the study arms (since ORS packets  
22 were made available by the Health Assistants in intervention  
23 villages), but only 47 mothers reported diarrhea in a child in the two  
24 weeks before the baseline survey.

25

26 The study had a number of strengths. First, though the sample was not  
27 representative of rural Bangladesh because villages had to be in the  
28 vicinity of a Grameen Health Center where the Health Assistants were

1 available and the medical personnel for the satellite clinics were  
2 based, the 128 villages were from three of the seven divisions of the  
3 country. Second, the project staff were able to monitor the work of  
4 the Health Assistants throughout the project and were able to identify  
5 and address problems when they arose. Third, the same survey  
6 organization carried out both the baseline and follow-up surveys and  
7 response rates were quite high in both surveys. (See Figure 3.)  
8 Fourth, in the follow-up survey we attempted to re-interview all women  
9 interviewed in the baseline and, with tracking efforts, were able to  
10 reach 94% of the original sample.

11

## 12 **Conclusion**

13

14 The results of this study are in line with the results of other RCTs  
15 of microcredit or microcredit combined with health interventions with  
16 largely negative results, (i.e. few null hypotheses could be  
17 rejected). Implementation of the additional microcredit intervention  
18 was poor but the study arm with health workers visiting households  
19 door-to-door did produce positive results on the likelihood of  
20 delivery assisted by a trained birth attendant. Close monitoring of  
21 interventions is essential in such experimental programs so that  
22 researchers can determine if the intervention adheres to what is  
23 outlined for the study and it is possible to properly associate cause  
24 with effect at the time of analyses.

25

26 While RCTs minimize biases of self-selection and non-random program  
27 placement associated with many other study designs, they cannot  
28 provide answers to why a given change occurred, so combining with

1 qualitative research is necessary. Of course, it is impossible to  
2 know beforehand which behavior will change significantly; therefore  
3 probably the most useful qualitative research would be done  
4 afterwards. For example, in the present case, qualitative interviews  
5 could be with a select group of women who had delivered with a trained  
6 attendant as well as with a select group of women who did not, as  
7 documented in the follow-up survey. The RCT can provide an estimate  
8 of the magnitude of the change in behavior and the qualitative  
9 research can give insights on how and why the change occurred.

10

## 11 Abbreviations

12

13 DHS: Demographic and Health Survey; MFI: Microfinance

14 Institution; RCT: Randomized controlled trial

15

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17

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26 Associates for Community and Population Reserach assisted with  
27 questionnaire development, the census of selected villages,

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2 follow-up survey, derivation of weights and data entry for the  
3 project.

4

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15 and women in selected households in the 128 villages who gave of  
16 their time to provide answers to the questionnaires.

17

18

19 Author's contributions

20

21 SB was principal investigator on the National Institute of  
22 Health grant for the study with RA as co-investigator. RA and SB  
23 supervised the two office staff in Dhaka and visited Grameen and  
24 the field sites periodically. NC assisted with monitoring of the  
25 fieldwork for the follow-up survey. NC, LZ and SB worked on the  
26 data analyses. SB wrote the manuscript which was read and  
27 approved by RA, NC and LZ.

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Availability of data

The original data and complete codebook are available from SB. There are plans to have it archived with ISPCR.

Ethics approval and consent to participate

The study was approved by the Institutional Review Boards of the Johns Hopkins School of Public Health and the Bangladesh Medical Research Council. Informed consent was obtained before conducting an interview for both the baseline and follow-up surveys. Since the questionnaire included a section on domestic violence, special arrangements were made to have a counselor available at the closest health center to whom women who reported recent violence could be referred by the interviewers.

Consent for publication

Not applicable

Declaration of competing interests

None



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Appendix

After about twenty months of implementation of the project, it became apparent from the regular monitoring by the JHU project staff, that the work of the health assistants was not meeting the standard set for the design. Since they had to travel long distances to reach the villages, they did not have adequate time to talk with village women individually and some lacked adequate knowledge of treatment for common illnesses. After extensive consultation with local and outside experts, it was decided that a special training of Health Assistants was warranted. In conjunction with the Grameen Bank and the International Centre for Diarrheal Disease Research, Bangladesh, a 3-day training in the Integrated Management of Childhood Illnesses (IMCI) was given. To adequately allow estimation of the effect of this further training, we decided to train health assistants from 8 of the 16 centers, which were randomly selected. We distinguished the two interventions in some analyses. However, there were no significant differences so those results are not presented here. This might have been expected since only ten months remained in the project when the training was done and sample sizes were insufficient to detect anything other than quite large differences.

References

Amin, R, and Yiping, LMA. 1997. NGO-promoted women's credit program, immunization coverage, and child mortality in rural Bangladesh. *Women and Health*, 25(1):71-87.

Angelucci, M, Karlan, D and Zinman, J. 2015. Microcredit impacts: Evidence from a randomized Microcredit program placement experiment in Compartamos Banco. *Am. Econ Journal: Applied Economics*, 7(1):151-182.

1 Attanasio, O, Augsburg, B, DeHaas, R, Fitzsimons, E, and Harmgart, H.  
2 2015. The impacts of microfinance: Evidence from joint-liability  
3 lending in Mongolia. *Am. Econ Journal: Applied Economics*, 7(1):90-  
4 122.

5

6 Augsburg, B, DeHaas, R, Harmgart, H, and Meghir C. 2015. The impacts  
7 of Microcredit: Evidence from Bosnia and Herzegovina, *Am. Econ*  
8 *Journal: Applied Economics*. 7(1): 183-203.

9

10 Banerjee, A, Duflo, E, Glennerster, R, and Kinnan, C. 2015. The  
11 miracle of microfinance? Evidence from a randomized evaluation. *Am.*  
12 *Econ Journal: Applied Economics*, 7(1):22-53.

13

14 Banerjee, A, Duflo, E, and Hornbeck, R. 2018. How much do existing  
15 borrowers value microfinance: Evidence from an experiment on bundling  
16 Microcredit and insurance. *Economica*, 85:671-700.

17

18 Convergences 2020. Microfinance Barometer 2019. Is microfinance  
19 profitable? Available at:  
20 [http://www.convergences.org/wp-content/uploads/2019/09/Microfinance-Barometer-2019\\_web-1.pdf](http://www.convergences.org/wp-content/uploads/2019/09/Microfinance-Barometer-2019_web-1.pdf). Accessed 2020.03.10

21

22

23 Churchill, SA, Danso, JK, and Appau, S. 2016. Microcredit and poverty  
24 reduction in Bangladesh: Average effects beyond publication bias.  
25 *Enterprise Development and Microfinance*, 27(3):204-218.

26

27 Crepon, B, Devoto, F, Duflo, E, and Pariente W. 2015. Estimating the  
28 impact of Microcredit on those who take it up: Evidence from a  
29 randomized experiment in Morocco. *Am. Econ Journal: Applied Economics*,  
30 7(1):123-150.

31

32 Dohn, AL, Chavez, A, Dohn, MN, Saturria, L and Pimentel, C. 2004. *Pan*  
33 *American Journal of Public Health*, 15(3):185-193.

34

1 Filmer D, and Pritchett LH. 2001. Estimating wealth effects without  
2 expenditure data--or tears: an application to educational enrollments  
3 in states of India. *Demography*, 38:115-132.  
4  
5 Gwatkin, DR. 2007. 10 best resources on...health equity. *Health Policy  
6 and Planning*, 22:348-351.  
7  
8 Hamad, R, Fernald, LCH, and Karlan, DS. 2011. Health education for  
9 Microcredit clients in Peru: A randomized controlled trial. *BMC Public  
10 Health*, 11:51-60.  
11  
12 Hayes, RJ, and Bennett, S. 1999. Simple sample size calculation for  
13 cluster-randomized trials. *International Journal of Epidemiology*, 28:  
14 319-326.  
15 Karlan, D, Thukysbaert, B, and Gray, B. 2017. Credit and health  
16 education in Benin: A cluster randomized trial examining impacts on  
17 knowledge and behavior. *Am J. Trop Med Hyg.*, 96(2):501-510.  
18  
19 Kim, J, Ferrari, G, Abransky, T, Watts, C, Hargreaves, J, Morison, L,  
20 Phetla, G, Porter, J, and Pronyk, P. 2009. Assessing the incremental  
21 effects of combining economic and health interventions: The IMAGE  
22 study in South Africa. *Bull World Health Organ*, 87:824-832.  
23  
24 Leatherman, S, and Dunford, C. 2010. Linking health to microfinance to  
25 reduce poverty. *Bull World Health Organ*, 88: 470-471  
26  
27 Leatherman, S, Metcalfe, M, Geissler, K, and Dunford, C. 2012.  
28 Integrating microfinance and health strategies: examining the evidence  
29 to inform policy and practice. *Policy and Planning*, 27(2): 85-101.  
30  
31 Morison, L, Phetla, G, Porter, J, and Pronyk, P. 2009. Assessing the  
32 incremental effects of combining economic and health interventions:  
33 The IMAGE study in South Africa. *Bull World Health Organ*, 87:824-832.  
34

1 McHugh, N, Biosca, O, and Donaldson, C. 2017. From wealth to health:  
2 Evaluating microfinance as a complex intervention. *Evaluation*,  
3 23(2):209-225.  
4

5 McNemar, Q. 1947. "Note on the sampling error of the difference  
6 between correlated proportions or percentages. *Psychometrika*, 12:153-  
7 57.  
8

9 McKenzie, D. 2012. Beyond baseline and follow-up: The case for more T  
10 in experiments. *Journal of Development Economics*, 99:210-221.  
11  
12

13 Mohindra, KA, and Haddad, S. 2005. Women's interlaced freedoms: A  
14 framework linking microcredit participation and health. *Journal of*  
15 *Human Development*, 6(3):353-374.  
16

17 NIPORT & ORC Macro. 2005. *Bangladesh Demographic and Health Survey*  
18 *2004*. Dhaka, Bangladesh.  
19

20 Palli Karma-Sahayak Foundation. 2004. *Maps on Microcredit Coverage in*  
21 *Upazilas of Bangladesh*. Dhaka, Bangladesh.  
22

23 Pitt, MM, Khandker, AR, McKernan, S-M and Latif, MA. 1999. Credit  
24 programs for the poor and reproductive behavior in low-income  
25 countries: Are the reported causal relationships the result of  
26 heterogeneity bias? *Demography*, 36(1):1-21.  
27

28 Roodman, D, and Morduch, J. 2014. The impact of microcredit on the  
29 poor in Bangladesh: Revisiting the evidence. *Journal of Development*  
30 *Studies*, 50(4):583-604.  
31

32 Shaffer, P. 2011. Against excessive rhetoric in impact assessment:  
33 Overstating the case for randomised controlled experiments. *Journal*  
34 *of Development Studies*, 47(11):1619-1635.  
35

1 Smith, SC. 2002. Village banking and maternal and child health:  
2 Evidence from Ecuador and Honduras. *World Development*, 30(4):707-723.  
3  
4 StataCorp. 2015. Stata Statistical Software: Release 14. College  
5 Station, TX: StataCorp LP.  
6  
7 Steele, F, Amin, S, and Naved RT. 2001. Savings/Credit group formation  
8 and change in contraception. *Demography*, 38(2):267-282.  
9  
10 Tarozzi, A, Desai J, and Johnson, K. 2015. The impacts of microcredit:  
11 Evidence from Ethiopia. *Am. Econ Journal: Applied Economics*, 7(1):  
12 54-89.  
13  
14 U.S. Census Bureau, 2012. CSPRO program. Available at:  
15 <https://www.census.gov/data/software/cspro.html> Accessed 2020.03.19  
16  
17 Yunus, M. 1998. *Banker to the Poor: The Autobiography of Muhammad*  
18 *Yunus; Founder of the Grameen Bank*. The University Press Limited,  
19 Dhaka, Bangladesh.  
20  
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1 Table 4: Estimates of five outcome variables at baseline, follow-up  
 2 and the difference and significance tests of change, by study arm

3	Study arm	Sample size	Value of indicator at:		Difference (Fup-Bs)	McNemar's p-value
			Baseline	Follow-up		
4	Percentage of households not food deficit during year (food security)					
5	All areas	3687	67.4	85.6	18.2	0.001
6	Control*	937	67.5	87.1	19.6	0.001
7	MC-only*	921	72.0	85.5	13.5	0.001
8	HS-only*	914	62.8	83.1	20.3	0.001
9	MC and HS*	915	67.1	87.2	20.1	0.001
10	Percentage currently participating in microcredit					
11	All areas	3687	31.6	30.7	-0.9	0.87
12	Control	937	31.3	33.2	1.9	0.90
13	MC-only	921	30.2	26.9	-3.3	0.26
14	HS-only	914	35.1	35.8	0.7	0.74
15	MC and HS	915	29.6	27.8	-1.8	0.19
16	Percentage currently using contraception (currently married women age 15-					
17	49)					
18	All areas	2839	64.6	67.6	3.0	0.17
19	Control*	728	64.8	69.6	4.8	0.02
20	MC-only	721	65.0	66.4	1.4	0.48
21	HS-only	705	65.3	68.1	2.8	0.15
22	MC and HS	685	63.4	66.3	2.9	0.17

23

1	Study area	Sample size (baseline, follow-up)	Value of indicator at:		Difference	p-value
			Baseline	Follow-up		
2	Percent with trained birth attendant at last birth					
3	All areas	1164, 915	31.6	36.4	4.8	0.06
4	Control	302,235	33.2	28.5	-4.7	0.37
5	MC-only	301,243	31.4	33.0	1.6	0.18
6	HS-only*	283,223	29.1	43.9	14.8	<0.01
7	MC & HS	278,214	33.5	39.7	6.2	0.32
8	Percent of children 12-23 months old with measles immunization					
9	All areas	377,268	87.9	86.6	-1.3	0.33
10	Control	95 61	88.5	93.5	5.0	0.14
11	MC-only	90,70	84.6	79.9	-4.7	0.28
12	HS-only	92,69	90.1	83.1	-7.0	0.19
13	MC & HS	100,68	90.0	88.7	-2.3	0.46

14 \* p<0.05 for test of the hypothesis of no change between baseline and  
15 follow-up surveys.

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# Figures

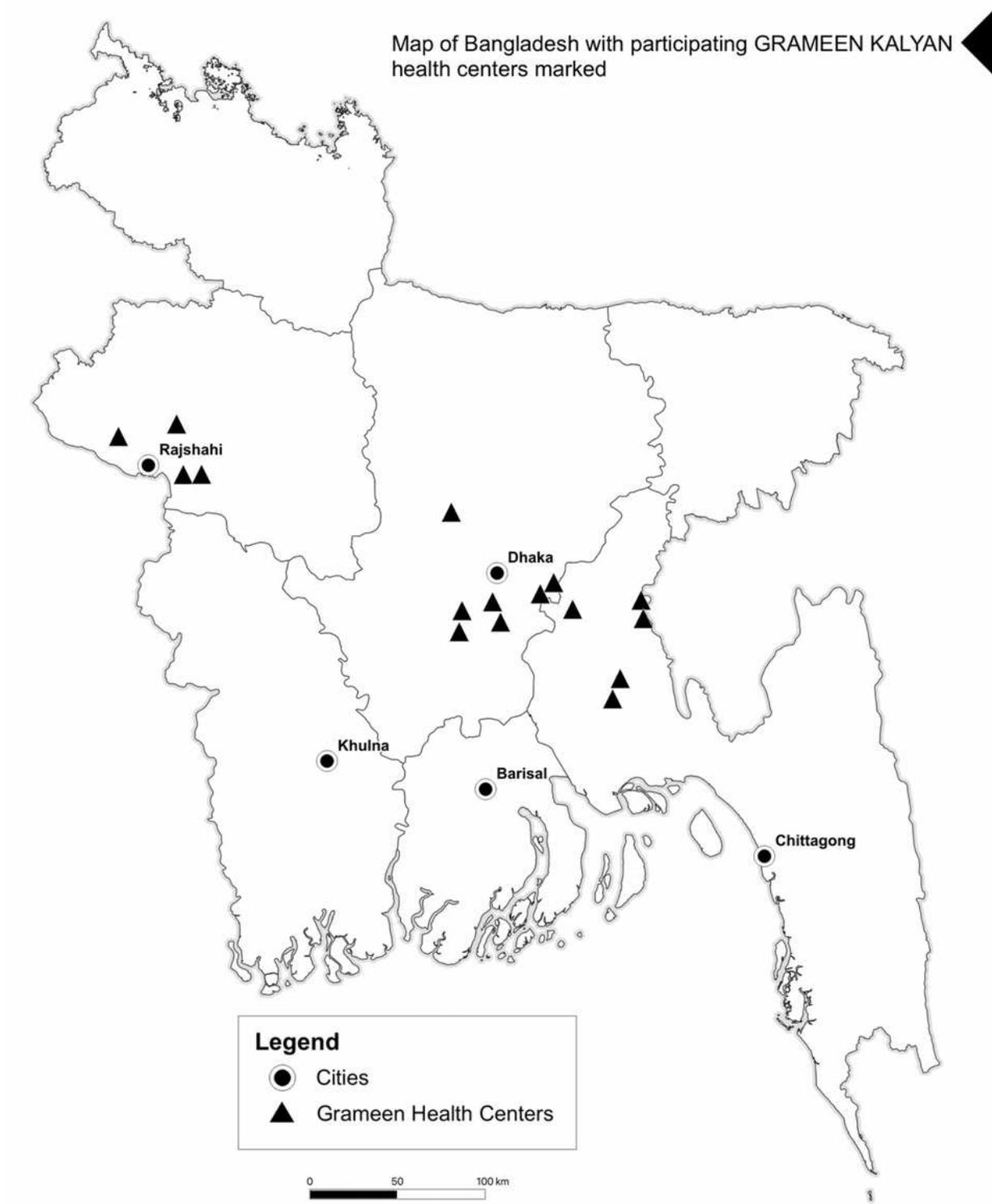
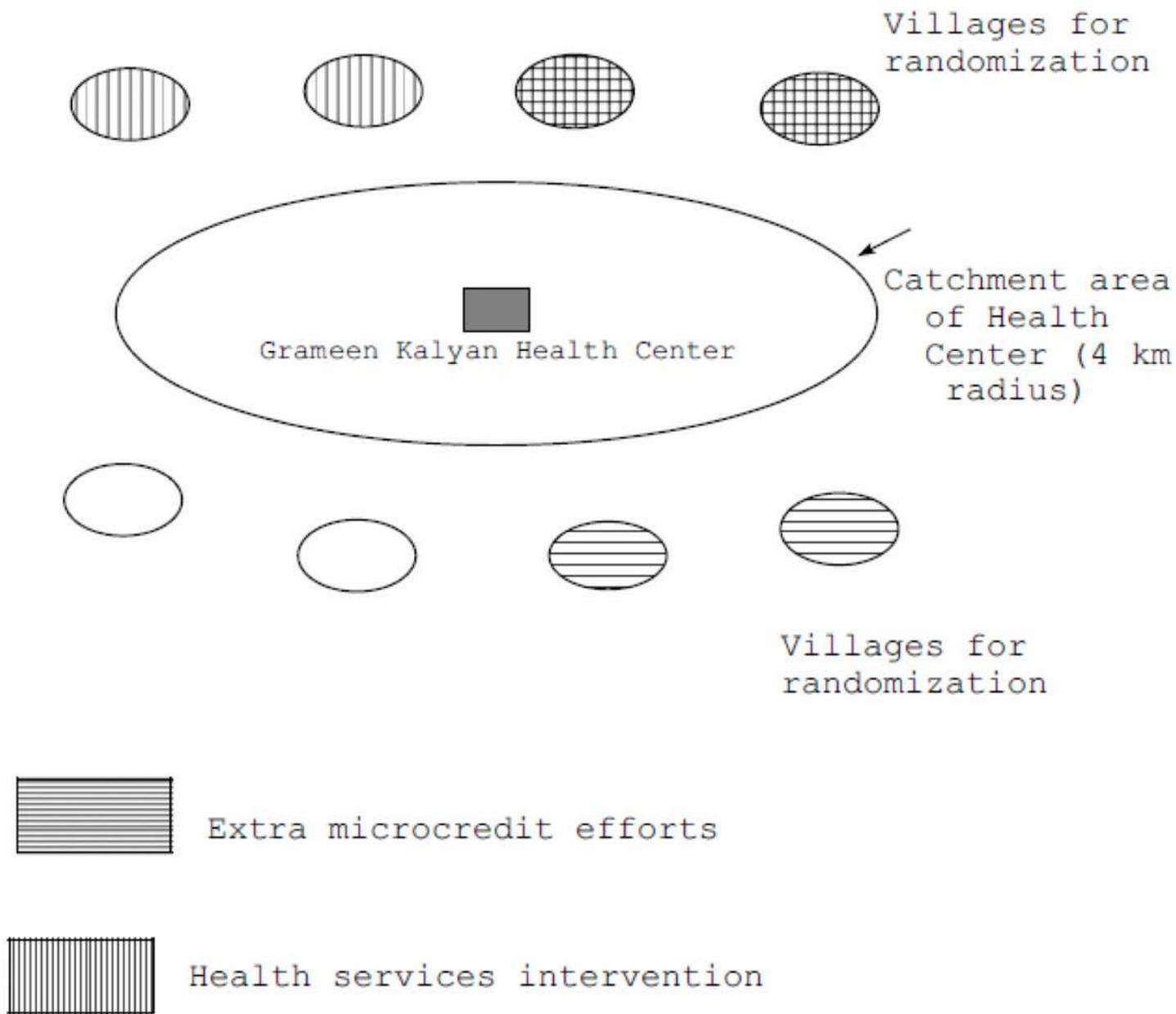


Figure 1

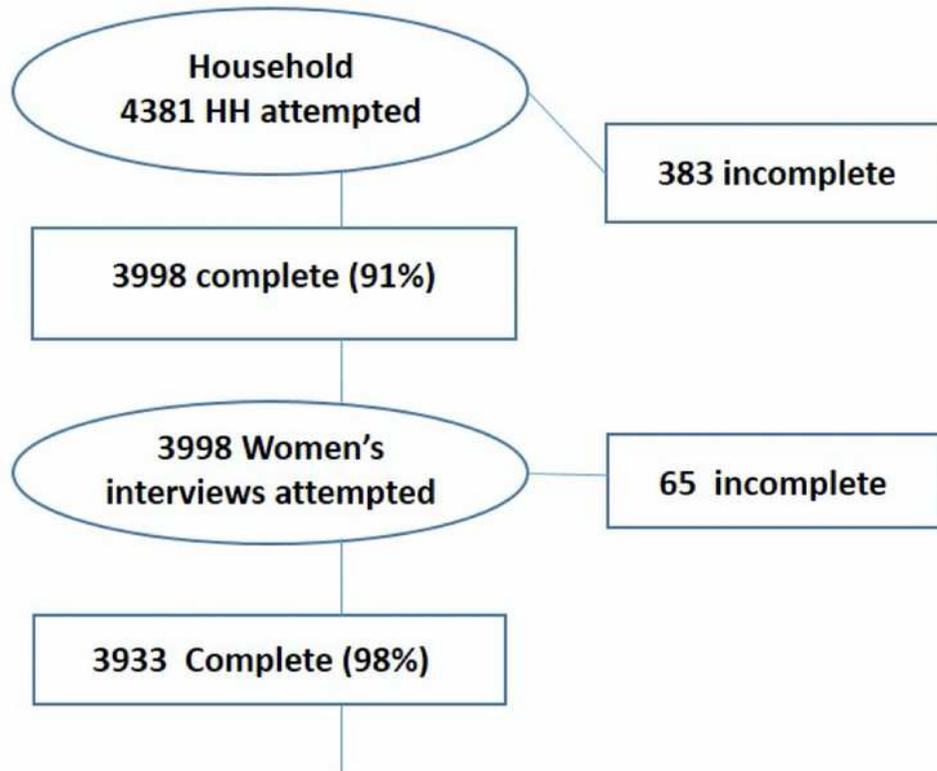
Map of Bangladesh showing location of Grameen Kalyan Health Centers



**Figure 2**

Schematic diagram showing Grameen Kalyan Health Center, its catchment area and four villages outside the catchment area on two opposite sides, which were randomized to receive health services intervention and/or enhanced microcredit services or neither intervention (16 such areas in the design)

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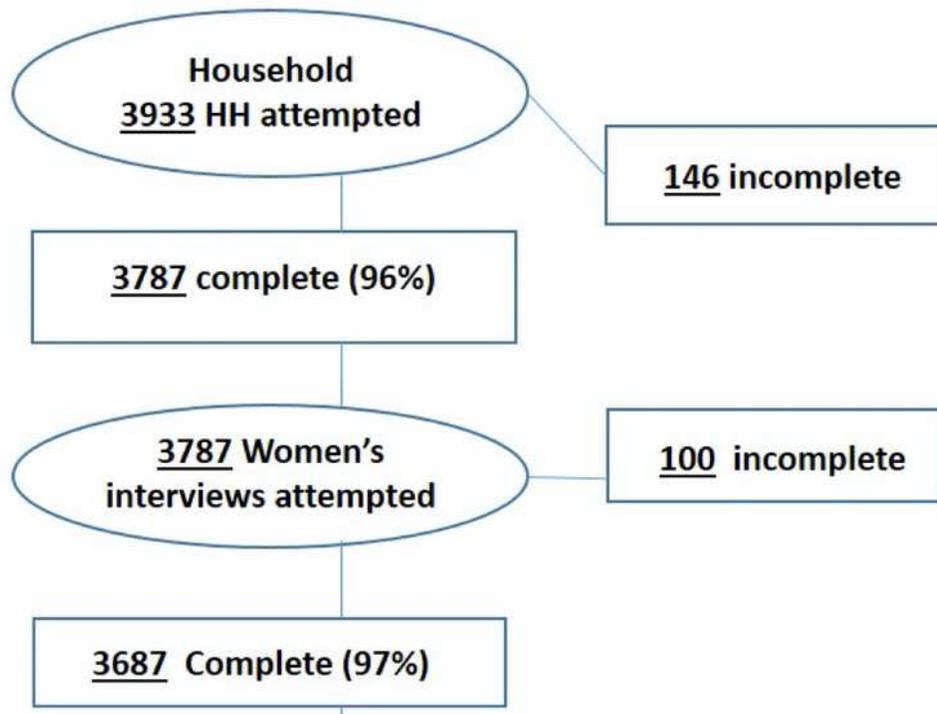


Figure 3

Flow chart showing attempted and completed household and women's questionnaires in the baseline survey of 2006 and follow-up survey of 2009