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ABSTRACT

Family Planning and Women's and Children's Health: Long Term Consequences of an Outreach Program in Matlab, Bangladesh*

The paper analyzes the impact of an experimental maternal and child health and family-planning program that was implemented in Matlab, Bangladesh in 1977. Village data from 1974, 1982 and 1996 suggest that program villages experienced extra declines in fertility of about 17%. Household data from 1996 confirm that this decline in "surviving fertility" persisted for nearly two decades. Women in program villages also experienced other benefits: lower child mortality, improved health status, and greater use of preventive health inputs. Some benefits also diffused beyond the boundaries of the program villages into neighboring comparison villages. These program effects are robust to the inclusion of individual, household, and community characteristics. This paper concludes that the benefits of this reproductive and child health program in rural Bangladesh have many dimensions extending well beyond fertility reduction, which do not appear to dissipate after two decades.

JEL Classification: O12, J13, I12, J16

Keywords: fertility, family planning, health and development, program evaluation, Bangladesh

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1. Introduction

This paper estimates the impact of a reproductive health intervention in Matlab, Bangladesh on broad measures of well-being of women and their families. The Maternal and Child Health and Family Planning (MCH-FP) program, launched in 1977, provided married women in designated "treatment" villages with home delivery of contraceptive supplies, follow-up services, and general advice (Phillips et al. 1982). Additional maternal and child health services were added over time (Phillips et al. 1988, Fauveau 1994; Muhuri, 1995). Women in neighboring "comparison" villages were served mainly by clinics run by the Bangladesh government. Women in both areas were tracked carefully and continuously. The Matlab experiment has been shown to have significantly reduced fertility as well as maternal, infant and child mortality (Phillips et al. 1982, 1988; Koenig et al. 1990, 1991; Fauveau, 1994; Rahman et al. 2009).

This paper uses Census data from 1974 and 1982 together with the Matlab Health and Socioeconomic Survey (MHSS) of 1996 to make three contributions. First, new methods confirm that treatment and comparison areas in Matlab had similar pre-program characteristics, a fact that has been implicitly assumed in much of the Matlab literature but rarely demonstrated. This increases confidence in the quasi-random design of this intervention (e.g. Bertrand, Duflo, and Mullinathan 2004; Duflo, Glennerster and Kremer 2008). Second, unlike most existing studies which have focused on the initial demographic impacts of the program, particularly between 1976 and 1985, this paper illustrates that the program had long-term impacts on not only fertility but also child mortality and maternal and child health more broadly. Third, this paper illustrates that the program may have had informational "spillovers" that lowered fertility in comparison area villages that lie adjacent to the treatment villages. This has implications for estimating impact and cost-effectiveness of the program. Overall, the results suggest that policies along the lines of the Matlab experiment may be effective not only in lowering fertility, but also in improving the long-term health of mothers and their children. Traditional cost-benefit calculations of such policies tend to neglect such multifaceted effects.

This paper also contributes to the broader literature on the effectiveness of family planning and reproductive health programs (Schultz, 2008). Some research now corroborates the assertion that such programs reduce fertility and have cross effects on variables such as infant mortality or female employment. Most studies however, are based on cross-sectional or panel data, and face the challenge of omitted variables and/or non-random program placement: if programs are placed in areas with different demands for children and health, estimates of impact may be biased and lead to spurious estimates (Rosenzweig and Wolpin, 1982; Schultz, 1994). The Matlab experiment's quasi-random design permits researchers to compare individuals who did and did not have the opportunity to benefit from the program and to make stronger causal inferences. The finding that its effects persisted over nearly two decades, and had numerous "spillovers" is thus noteworthy.

The remainder of this paper is structured as follows: Section 2 briefly reviews the literature on Matlab; section 3 contrasts village outcomes from 1974 to 1996; section 4 presents regression analysis at the individual level; section 5 summarizes relevant studies of program costs and benefits; and section 6 concludes.

2. Background

Matlab thana (sub-district) lies about 55 kilometers south of Dhaka, Bangladesh's capital. It is a flat and low-lying deltaic plain. The region is entirely rural and has limited inter-village trade and commerce. The dominant occupations are subsistence farming and fishing. The society is quite traditional and religiously conservative, particularly with regards to the status of women (Abdullah and Zeidenstein, 1979; Chen et al. 1983; Menken and Phillips 1990; Fauveau 1994). The total fertility rate has declined from more than 6 to 3.2 between 1976 and 1995 (Fauveau 1994; ICDDR,B 2004). Infant mortality has fallen from 110 per thousand live births in 1983, to 75 in 1989 and 65 in 1995.

In 1966, the International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) established a Demographic Surveillance System (DSS) to record monthly births, deaths, marriages, migration within 149 villages. In October 1977 it launched a maternal and child health and family planning program. Villages in contiguous areas (blocks A, B, C, and D) including about half of the 180,000 population of Matlab received the services of a family planning outreach program (hereafter referred to as "program"), while the remainder (blocks E and F) continued to receive only usual health and family planning services delivered through local government clinics or private providers (hereafter "comparison").

The program recruited relatively educated and married women from the surrounding area who practiced contraception themselves to provide home delivery of health services to married women of childbearing age every two weeks. These Community Health Workers (CHWs) advise women on the use of birth control, provide supplies (including the pill and injectable) as well as follow-up services, and refer women to local clinics or hospital when necessary (Phillips et al. 1982, 1988). After 1981 additional maternal and child health services were added to the program, such as tetanus toxoid immunization for women, measles immunization for children 9 months to 5 years, and then other EPI childhood vaccinations, oral rehydration therapy (ORT) for diarrhea, vitamin A supplements, and antenatal care, etc. (Phillips et al. 1988; Fauveau 1994). By the 1990s, the Government of Bangladesh provided some of these vaccinations but their adoption is not recorded (LeGrand and Phillip 1996, p.58.[1]

An influential literature in public health and demography has examined these reliable and detailed registration data interpreting observational regularities and experimental programs in Matlab. While the literature is too large to review comprehensively, a few important studies are noted which are related to our results. An early study showed that the prevalence of modern methods of contraception among married women of reproductive ages increased sharply from 7% to 33% after 18 months of program operation, which was sustained for two years and then continued to increase after 1982 (Phillips, 1988; Koenig et al. 1992). DSS quarterly general fertility rates from 1976 to 1981 showed that the program areas experienced 22 to 25% lower fertility than did the comparison areas (Phillips, et al. 1982). From 1978 onwards neonatal mortality rates were slightly lower in treatment than comparison areas, but the subsequent declines in these rates do not appear to differ (Fauveau, 1994: p.144). The impact of measles vaccination in the treatment areas on child mortality is documented, and contributed to the adoption of this preventive health intervention by the Bangladesh Government Health program and elsewhere (Koenig et al. 1990, 1991; Menken and Phillips, 1990; LeGrand and Phillips, 1996). But the persistence of these early CMH-FP intervention effects on long term family outcomes of fertility and maternal and child health are rarely assessed. Several other studies are discussed in subsequent sections of this paper.

This paper extends this literature by analyzing the impact of the program using the 1996 MHSS.

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[1] Measles declined more rapidly in the entire MCH-FP program areas than in the comparison areas, although perinatal mortality did not decline in the early period of 1979-82 (Koenig et al. 1990; Fauveau et al. 1990; LeGrand and Phillips 1996). Maternal mortality in treatment villages may have declined more rapidly though it is difficult to estimate precisely (Koenig et al. 1988; Fauveau 1994; Rahman et al. 2009).

This is a multistage cluster random sample of approximately one-third (2687) of the *baris* (residential compounds typically of linked kin) in the Matlab DSS, covering 4364 households (Rahman et al, 1999).[2] One household in each *bari* is randomly selected, and one additional household is purposely selected to favor close kin. Married women are selected if they are the head, the spouse of the head, or if they or their spouses are older than 50. A second person is selectively chosen. The survey is designed to be representative when these two strata of women are suitably weighted to account for the lesser representation in the sample of people living in *baris* with many households, or households with many women age 15 to 49.[3] Our sample includes married women because they were eligible for the CMH-FP treatment. In the group of women aged 15--24, 25—29 and 30—54, the proportion of women who are ever-married is, 41% , 89%, and 99% respectively.

3. Unconditional Estimates of Program Impact

The first step of our analysis is to compare fertility of married women between the program and comparison areas using the 1996 MHSS.[4] We regress total fertility (children ever born) on age dummies as well as their interaction with residence in a program village. Figure 1 plots the resulting expected values of fertility for women by age groups in the treatment and comparison areas. The lower panel shows the difference between the treatment and comparison fertility coefficients and their 95%

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[2] The MHSS is a collaborative effort distributed by the Inter-University Consortium for Political and Social Research (ICPSR) at the University of Michigan and Rand (rand.org/labor/FLS/MHSS/html).

[3] We use sample weights that correspond to an individual's probability of selection from Matlab into the MHSS. They are from the Rand public use data file called MHDWGTS (variable name is pr_ind12) and are intended to adjust observations for within-household selection as well as the selection of the household. We cap very low probabilities of selection at 0.1. All values below this are recoded as 0.1, as suggested by the MHSS codebook (page 34). Our sample of 5307 omits 34 women for whom sample weights could not be found in the public release data file, and community infrastructure data could not be matched to one village. Differences between program and comparison individuals and estimates of reduced form relationships with predetermined control variables discussed in the paper are weighted to be representative. Un-weighted regressions were also estimated, and are available from the authors. See further discussion of weights in footnote 5.

[4] An important caveat here is that the original resident population in 1977 may not be represented in the 1996 MHSS. Female migration and mortality could change the composition of the population observed in 1996 in treatment and control villages. When dummy variables are added to the fertility or other outcome regressions that are equal to one only if the woman moved after marriage into the DSS area, or moved from program to comparison areas, or vice versa, these dummies are never statistically significant as explanatory variables in the fertility or family outcomes studied here.

confidence interval (i.e. 1.96*standard errors). Fertility among married women over the age of 55 in 1996 is indistinguishable between the program and comparison villages, consistent with the hypothesis that these older women had virtually completed their childbearing when the program began and these "pre-program" fertility levels did not differ in the treatment and comparison areas. Conversely, the unconditional fertility of younger women in the program villages is lower than in comparison areas. This corroborates the persistence of early evidence by Phillips et al. (1982, 1988) and others who find by 1979 that post-program general fertility rates were 25% lower in the program than comparison villages.

A second way to assess the program effect on fertility between the program and comparison villages is to analyze changes over time in aggregate measures of fertility at the village level. We perform this comparison using census data from 1974 and 1982. Because the number of children ever born to a woman is not reported, we use age and sex of residents to construct the ratio of the number of children aged 0 to 4 to the number of women of childbearing age 15 to 49 (C/W) as an aggregate measure of "surviving fertility" in the last five years. Aggregate "difference in difference" estimates of the program's effect can be derived from a regression across the 141 villages constructed from the Census of 1974 before the program, and either the 1982 Census or the weighted 1996 MHSS:

$$C/W_{jt} = \beta_0 + \beta_1 P_j + \beta_2 T_t + \beta_3 P_j{*}T_t + e_{jt}$$

$$j = 1, 2, ..., 141, \text{ for villages ; and } t = 1974 \text{ and } 1982 \text{ or } 1996 \quad ,$$

where C/W_{jt} is the child-woman ratio in village j in time period t, P_j takes value 1 if village j is in the program program area and zero otherwise, T_t takes value 1 if the observation is for a year after the program has started (i.e. 1982, 1996) and zero for the pre-program year 1974, $P_j{*}T_t$ is the interaction of the two variables, and e_{jt} is the error. The pre-program fertility differences between program and comparison villages is estimated by β_1, change over time in all areas is estimated by β_2, and the post-program treatment effect on those residing in a program village in a subsequent census or survey is estimated by β_3. Because the impact of the program is assumed homogeneous in all villages, including village-level fixed effects would yield the same estimates of the program effect.

OLS estimates of the above equation generate the local average program's treatment effect

(LATE) after the program started in 1977 or β_3, holding constant for any pre-existing persistent differences in fertility between the treatment and comparison villages as measured in 1974 that are represented by β_1. Because the variance in the observations on village surviving fertility, e_{jt}, are expected to be heteroskedastic and greater for smaller villages, the regressions are therefore estimated using generalized least squares (GLS) where the weights (i.e. STATA aweights) are the inverse of the square root of the number of women age 15-49 observed in each village observation. The sample size is 282 from combining two cross sections of villages, and the GLS estimates are reported in the two columns of Table 1 for the two different post-program census or survey years, 1982 and 1996.

The values of the child-woman ratio for the treatment villages are on average slightly larger than in the comparison villages , β_1 =.022 (Table 1, col. 1). Five years after the launch of the program in 1982, the C/W is, holding constant the initial village levels in 1974, 17% lower in the program than comparison villages, β_3 = -.143, namely -.14/.81 = -.17 . In 1996 this difference in difference estimator of the program effect (Table 1 column 2) is -.127 or 16% lower than in 1974, despite the fact that this child-woman ratio declined in the comparison villages by 39% by 1996 (β_2/β_0 or -.31/.81 = -.39). This difference in child-woman ratios is one approximation for the program's impact on individual "surviving family size", or community natural rates of population growth.

The 1974 Census also provided indicators of education, housing, and religion. Population-weighted differences between the averages for program and comparison villages are summarized in the last two columns of Table 2.[5] Note that there was no statistically significant difference in levels of formal schooling in the two areas for adults over the age of 14 and children aged 6-14 in 1974. However, Muslims are more dominant in 1974 in the comparison than in the program areas, 88 vs. 79%, which is statistically significant between the groups of village means, i.e. t = 2.01. This religious difference also increases over time, and by 1996 (Table 2, panel (B)) it is 93 and 80% in the two areas, respectively. Because Muslims engage in different occupations than the minority Hindus, and their livelihoods might affect their desired family size and economic behavior, a control for Muslim religion

[5] Many individuals in the 1996 MHSS in the two representative strata 1 and 2 cannot be matched to a weight in the Rand data file: roughly one fourth of the adults 15+, and somewhat larger share of the children aged 6-14. To see if the characteristics of those matched to a weight differed, the un-weighted individuals were assigned the average weight in the matched sample, which was .53. The population means for the villages in the program and comparison areas did not change appreciably, and the differences were very similar to those reported in Table 2 Panel B.

of the household head is included in the subsequent multivariate analysis of the 1996 MHSS. Moreover, the program average treatment effects are allowed to differ for Muslim and Hindu households, to assess possible heterogeneity in their response to the program (Fauveau 1994; Munshi and Myaux 2006).

Between 1974 and 1996, years of schooling of adults roughly doubled in Matlab (Table 2). In 1996 they are greater in program than comparison areas (3.73 versus 3.60 years, but the difference is not significant. The village average years of schooling of children age 6 to 14 are also significantly higher in the program villages by 1996, 2.26 vs. 1.84 years, consistent with the hypothesis that parents with program assistance in controlling their fertility traded off child quantity for child quality (e.g. Becker and Lewis 1974).

4. Conditional Estimates of Program Impact

Assuming that the program and comparison areas had similar characteristics in 1977, the partial associations of the program in 1996 with long-term outcomes are estimated at the individual level, first as the treatment-comparison differences unconditional on any control variables (Table 3), and then conditional on a common set of arguably predetermined control variables. The dependent variables are as follows:

1) Fertility/child mortality (Tables 4 and 5): (i) The number of children ever born; (ii) Number of children alive; (iii) Age (in years) at which a woman had her first birth; (iv) Years between the birth of the first and second child ; (v) Years between the birth of the second and the third child *;* (vi) A binary variable that takes value 1 if the child died before the age of five*,* and 0 otherwise.

2) Women's health (Table 6): (i) A subjective measure of current health (*CurrHealthy*) that takes the value of 1 if a woman's self-assessment of her health status is "Healthy" and 0 otherwise; (ii) The self-reported capacity to perform five activities of daily living (ADLs) that is normalized to 1 (no functional limitations) or 0 (maximum limitations) *(ADLEq0);*.[6] (iii) the woman's weight in

[6] ADLEq0=(1.0-ADLscore). A woman's self-reported capability to perform five activities of daily living, drawn from section GH2 of the MHSS, are aggregated into a score: (a) walk for one mile; (b) carry a heavy load for 20 meters; (c) draw a pail of water from a tube-well; (d) stand up from a sitting position without help; (e) use a ladder to climb to a

kilograms *; (iv)* A woman's body-mass-index in kg/m^2 (*BMI*) ; (v) A binary variable that takes value 1 if a woman's BMI is greater than 18, and 0 otherwise.

3) Use of preventive health inputs (Table 7): (i) The average number of antenatal visits per pregnancy for all of a woman's pregnancies; (ii-iv) A binary variable that takes value 1 if the most recent child born in the past 5 years received a vaccination against polio, measles and DPT .

We examine woman resides in a program area. The program's impacts are however expected to vary by the woman's birth cohort or age in 1996. As already noted, the program effect should be negligible among women over the age of 60 in 1996, unless there are intergenerational spillovers within the household or bari. But the program effect may not increase monotonically among younger women who had more years at risk of childbearing after the program started but fewer years to bear children and is allowed to vary by women's five-year age groups.

A second independent variable is whether a woman resides in a comparison-area village that shares a common boundary with a program village. The program's impact in these communities can provide insights into the mechanisms of behavioral change. For example, if the program's main contribution was to reduce the costs of using contraceptives and health-care services, we can expect women in boundary areas to remain largely unaffected by the program's presence and show outcomes similar to other comparison area villages. If however, the program's main contribution was to change social norms and provide new information about improved health technologies, we should see these women in boundary villages resemble their counterparts in program villages. In this case, we could infer that knowledge may have diffused geographically through social networks and influenced behavior in neighborhoods where women shared their knowledge and experiences (Munshi and Myaux 2006). Understanding such spillover effects is important for two additional reasons: First, positive (negative) spillovers can lead to an understatement (overstatement) of the program's effects estimated only by local average treatment effects (LATE). Second, if spillovers are small relative to program direct effects, such evidence of weak diffusion could help to justify the continuing costly program component of the fortnightly visits to each woman's home. The strength of social networks may also differ by the age of the women, suggesting an additional reason to allow the spillover effect

storage place that is at least 5 feet in height. Responses were coded either as "can perform the task easily" (a value of 1), "can do it with difficulty" (2) and "unable to perform" (3). This ADL index is normalized following Stewart et al. (1990).

to differ by three age groups for women. We assume the effect of the Matlab MCH-FP program in "boundary" comparison villages is a constant share of the direct program effect, if it shares at least one boundary with a treatment village, and is otherwise negligible.[7]

Because the behavior of women living in a village on the boundary of the program may differ from women in other comparison villages and differ by the woman's age, auxiliary regressions were estimated only for women in comparison areas. To conserve space, we only summarize the results here. These unconditional differences between boundary and non-boundary villages measure program local spillovers. We find that the 12 percent of the comparison women in boundary villages had 0.35 (t = 2.55) fewer births in 1996, whereas the proportion of their children born before 1991 who had died by age 5 is surprisingly larger, namely .022 (1.86)). Women's health indicators are mixed: better for weight, BMI, BMI greater than 18, and ADLs, whereas fewer women report themselves as currently healthy in the boundary villages. The receipt of childhood vaccinations for polio and DPT are significantly less common in the boundary than in the other comparison villages, whereas the frequency of measles shots and antenatal care of the women does not differ. These simple geographic differences with no controls suggest that fertility changes may have partially diffused from the program villages without the benefit of supplies and services delivered in the home, but this beneficial spillover was not evident for indicators of child or maternal health, or the use of preventive health inputs.

Since women's reproductive behaviors may be influenced by additional variables that are not themselves attributable to family choices, and could differ across treatment and comparison areas, we also include a variety of control variables. Female years of schooling is included to control for the higher opportunity costs of the time of more educated women to have an additional child that may be partially offset by their higher income opportunities (Mincer 1963; Schultz 1981, 2002) and schooling may improve their skills to evaluate health inputs or contraceptives. Female schooling is also

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[7] The functional form that the diffusion of health knowledge follows is not established in the empirical literature. Alternative specifications of this spillover effect were explored, but none we tried provided a better fit to the data on children ever born, child mortality to age five, etc. Miguel and Kremer (2004) model the health externalities of intestinal worms in a school age cohort in terms of the logarithm of the number of treated persons in the geographic area. Why this specification is adopted is not discussed, though it does provides a basis to decompose the effects of the intervention operating through population density, and the density of treatment in the program area.

interacted with the program (*Treatment X YrsSch*) to assess the possibility that a woman's schooling and access to the treatment are substitutes in the use of effective new forms of birth control. Some previous studies of family planning in Colombia in 1964, Taiwan in the late 1960s, and Thailand in the late 1970s (Schultz 1980, 1992) found that both schooling and local family-planning programs are associated with lower levels of fertility, but their interaction is partially associated with higher fertility. Muhuri (1995) also reports that the MCH-FP program is associated with a larger decline in child mortality among the less-schooled women.

As explained previously, we include a dummy if the household head is Muslim, and interact this with the treatment area dummy (*Treatment X Muslim).* If family planning knowledge is less likely to be shared informally between Muslims and Hindus than within these groups, the minority Hindus might be at a disadvantage in social learning processes, and thus have more to gain from the program's outreach informational efforts (Munshi and Myaux 2006).

We also include a variety of controls for husband characteristics, household composition and village infrastructure. A control is included for the husband's schooling as a measure of household income/wealth that is fixed at the start of the adult life cycle, and is not expected to reduce fertility as much as the wife's education (Schultz 1981). Husband's age is also included in quadratic form as an indicator of household life cycle income and wealth, and a dummy is set to one if the husband's education or age is missing, to retain these women in the sample.

Finally, four infrastructure features of the 141 villages in the 1996 MHSS are included as controls for economic, health, and environmental conditions of families. In particular, controls are included for (i) the presence of a paved/pucca road in the village, (ii) our map-estimated distance between the village and a sub-center hospital where contraceptives are believed to be provided by regular government programs, (iii) the presence of a secondary school in either the same village or a neighboring village, and finally (iv) a village's access to a motor boat and presumably located along one of the canals or tributaries of the rivers in Matlab.

4.1 Impacts on Fertility and Mortality

The weighted fertility regression estimates in Table 4, col. 1 indicate that the program reduces fertility by 1.54 births for women aged 45 to 49. The estimate is at least 1.0 less birth for women aged 30 to 54. As expected, there is no significant partial impact on the fertility of women older than 54. These individual weighted regressions in Table 4, or Tables 5, 6, or 7, include all discussed control variables and standard errors are adjusted for clustering at the bari level.

An additional year of schooling on average reduces fertility by .064 children, but the interaction of schooling and treatment is not statistically significant, suggesting that female education and program treatment are neither substitutes nor complements. Muslims have 0.10 more children than do Hindus in the comparison areas, and in the treatment area Muslims have 0.48 more children (i.e. .10 + .38). The program appears to be associated with a reduction in the relative fertility of the minority group, the Hindus, compared to the Muslims.

Women in boundary villages report lower fertility. This reduction of -0.34 births is statistically significant for women aged 15-34, and is 43 percent of the impact seen for women this age in program villages. This confirms a diffusion of family planning knowledge and application beyond the treatment area among younger women, although this spillover effect does not statistically extend further to affect fertility in next neighboring villages, or to diminish systematically as a linear or a polynomial function of distance to the nearest program village (not shown), perhaps because women's social networks are quite circumscribed under purdah (Abdullah and Zeidenstein 1979).

Joint F-tests for the 12 treatment variables, the two Muslim variables, the three boundary-area variables and the five infrastructure variables are provided at the bottom of Table 4. All of the F tests are significant at least at the 5% level, except for the four village infrastructure variables. The sample size is 5273 married women, and the R squared is .59. Although the heterogeneity in fertility response to the program is not confirmed individually with respect to the mother's schooling or Muslim on fertility, these interaction variables are occasionally significant and informative in the subsequent regressions.

Because the MCH-FP Program was designed to reduce both fertility and mortality, the woman's number of surviving children is also a dependent variable (Table 4, col. 2). This approximates the net program effect on final family size for older women, or the effect on population growth. The estimated coefficient on the program treatment is a smaller absolute value than the coefficient with children ever born, signaling that the program is associated with a larger fraction of children surviving. But the program induced reduction in fertility exceeds the magnitude of the increased child survival, confirming that the program has reduced the surviving size of families, and at least in this first two decades slowed population growth among the remaining residents. For example, among women 45 to 49 the program impact on child survival "offsets" almost half of the decrease in fertility, and the increase in child survival offsets almost 30% of the fertility decline among younger women age 25 to 29.

Columns 3 in Table 4 shows that the program is not associated consistently with the age at first birth, but the program increases significantly the spacing between the second and third birth at ages 25-34 (column 5). This is consistent with previous studies that have found that the MCH-FP program contributed to women adopting contraception not only to avoid unwanted births at the end of their reproductive period, but also to space their later births further apart (Phillips et al. 1988; Koenig et al. 1992; DeGraaf 1991).

The effect of the woman's schooling on her number of surviving children is a third smaller than the effect on fertility, because her schooling is also associated with lower child mortality. Her husband's schooling is associated with having a *larger* number of surviving children, shown in column 2 of Table 4, though this effect is not significant. During the last 22 years the educational attainment of adults has increased in Matlab (Table 2), but our regression estimates of fertility in 1996 in Table 4 suggest that the increasing schooling of women by about 2.1 years between the cohorts aged 50-54 and 25-29 (not reported) could account for only a small reduction in fertility of -.13 , or in surviving fertility of -.09 . Conversely, the partial local average effects of the MCH-FP program intervention on fertility and surviving fertility for women age 30 to 54 are roughly seven times larger than those associated with the advance in women's schooling.

The MHSS survey sample weighted mean of child mortality for births before 1991 is 0.160 in Table 3, and is higher for males than females. The unconditional difference between the program and comparison areas (i.e. local area treatment effect) in the last column of Table 3 is negative and significant for both sexes, and the program effect is larger for males than females, though the gender difference is insignificant (not reported). Previous studies based on the larger Matlab DSS noted the sensitivity of child mortality rates by gender to the number and gender of the child's siblings. However, these family composition and birth timing variables are excluded here as controls, because they may be affected by family choices, and hence are potentially correlated with mortality and fertility for other reasons or endogenous to these family outcomes (Koenig et al. 1990, 1991;Faveau et al. 191; Muhuri and Preston 1991; Muhuri 1995; Muhuri and Menken 1997; Foster and Roy 2000; Sinha, 2005).

The MCH-FP program expanded its objectives in about 1982 to include reduction of child mortality and improvement in maternal health (Fauveau, 1994: p. 91). The full DSS vital event registry suggests that year to year variation in infant and child death rates in all of Matlab was substantial, but child mortality in program areas may have trended lower than in the comparison areas by the late 1980s and the two areas may have begun to re-converge by 2000, though the significance of these local area differences is not reported (ICDDR,B, 2004). Table 5 reports weighted logistic maximum likelihood estimates of the probability that a child died before age 5, represented first in column 1 by odds-ratios and associated z statistics, and in column 3 and 5 for boys and girls estimated separately. With a nonlinear model such as the logistic, especially when interactions are estimated between explanatory variables such as the mother's age and program treatment, it is preferable to evaluate the derivative of the probability of child mortality with respect to program treatment, where the conditional marginal effect is evaluated at the sample means (STATA 11, User Guide p. 20.25.1; Ai and Norton, 2004).These are reported for comparison in columns 2, 4 and 6. Our observations on births extend from about 1960 to 1991, and it is not surprising that treatment-comparison differences are not significant for women older than 54 in 1996, whose children would have largely been born before 1982 when the program expanded to focus on child health. For younger women, the conditional marginal effect of the program are of similar magnitude across four age groups (i.e. 0.9) indicating a program reduction in child mortality, though they are not significantly different from 1.0 for women between age 25 and 34, but are statistically significant for women age 35-44 and 45-54. When the boys and girls are estimated separately, the odds ratios and the conditional marginal effects at sample means are not significant for boys, but for girls the odds ratio for women age 35-44 are significant and the conditional marginal effects are significant among women less than 25, 35-44, and 45-54.[8]

[8] When the samples of boys and girls are stacked allowing all estimated coefficients to be sex specific, the estimated program effects are not statistically significantly different for boys and girls using either the odds ratio or conditional marginal effects (not reported), because the estimated effects for boys are often of a similar magnitude to those of girls and they are estimated less precisely than for girls.

The effect of one more year of schooling of women is a 0.04 lower odds-ratio of child mortality, whereas the schooling of husbands is not significantly related to the overall child mortality. Mother's schooling is more closely related to boy's mortality and father's schooling to girl's mortality. Inclusion of time trends for the child's date of birth are significantly different from zero only after 1970, and inclusion of these time trends did not change the sign or significance of the program treatment variables as reported in Table 5.

There is no discernible program spillover effect on child mortality in "boundary" comparison villages adjacent to program villages. We interpret this lack of relationship as suggesting the provision of child health services to women directly in their homes by the MCH-FP may have been critical in enhancing the program impact reducing child mortality.

4.2 Impact on Women's Health

The provision of family-planning as well as health services may impact long-term female health through improved reproductive health, reduced morbidity and/or improved nutrition, and longer intervals between later births. Such impacts of policy interventions are, however, rarely confirmed because of the lack of social experiments and long term follow-up evaluation studies of reproductive health programs (an exception is Frankenberg and Thomas 2001). Moreover, there is no agreement on how to measure adult health status at reasonable cost in a household survey (Rahman et al. 2004; Kuhn et al. 2004; Thomas and Strauss 2008). The 1996 MHSS asked women whether they were "healthy" (GH01), and three fourths responded positively (Table 3), but the proportion did not differ significantly between the program and comparison areas (Table 3, last column), nor when controls are added in Table 6, col. 1.

An index of activities of daily living (ADL) is a second survey indicator of adult health status, used primarily among the elderly to assess the onset of chronic illness and disabilities which limit physical functioning. However, ADLs have not been extensively validated at younger ages or in low income countries as a reliable measure of health status (Steward et al. 1990; Strauss, et al. 1995), though they have been related to mortality among persons over age 50 in Matlab (Kuhn, et al. 2004). The unconditional difference in our ADL index between the program and comparison areas is not significant, and it is not substantial (+.003) in relation to the weighted mean of 0.88. The weighted regression estimates of the program's impact on a woman's ADL index by her age are all insignificant (Table 6 col. 2).

A third class of survey indicators of health and nutritional status relies on weight and height. Women in the treatment area weigh 0.79 kg more than in the comparison area (Table 3) when the mean is 41.6 kg. In the weighted regression with controls, differences are shown for women aged 30-54 to again be significant (Table 6, col. 3). We also consider women's Body Mass Index (BMI= kg/m^2) as an indicator of health since this is often consulted as a risk factor for various causes of death (Waaler 1984; Fogel 2004). We find that women's BMI is unconditionally .47 units significantly larger in the program than in comparison areas. When the controls are added and the program effects are disaggregated by age, however, the point estimates are larger for women age 30 to 54, but no longer significant.

We also explore whether a woman's BMI exceeds a critical healthy threshold. Values below 18.5 are driven by deficits in calorie consumption, combined with physically demanding work, and poor health, diarrhea and inflammatory disease, and are also known to increase mortality risks (WHO 1995, 2006). Average BMI in Matlab is close to this threshold, at about 18.4 kg/m^2 in the comparison areas in 1996. Menken et al. (2003) estimate the hazard of dying for women in the Matlab comparison areas between 1975--1986 and find that for women aged 16 to 65, a one point increase in BMI lowers the prospective hazard of death by 17%. To overcome the non-monotonic nature of the relationship between BMI and health, we focus on the upward shift in the distribution of women's BMI to values greater than 18.The unconditional difference between program and comparison areas is .060 with the mean of .590, which is significant (Table 3). The effect is statistically significant in the regression with controls in Table 6 col. 5 for women age 35– 40 and 50- 59. We regard BMI in excess of 18 as the most reliable and objective health indicator of those available for adult women in the MHSS (Cf. Schultz, 2010).

4.3 Impact on Use of Preventive Health Inputs

Many specific interventions promoted by the MCH-FP program might be responsible for the program associated improvements in maternal and child health. One way to investigate these mechanisms is to estimate the unconditional impact of the program on use of preventive health inputs (Table 3) as well as the conditional impact with controls (Table 7). The program effects on the use of curative health inputs, such as ORT, are difficult to interpret, because the program may reduce the incidence of diarrhea, while increasing the use of ORT among those who are ill. The unconditional weighted differences in preventive health input usage for all women in the program and comparison areas are significant (Table 3). The average number of antenatal medical visits a woman reports for all of her pregnancies (Table 7, col. 1) is significantly larger in program than in the comparison areas, including controls for women under age 25, 25-29, 30-34, 35-39, and 40-44.[9]

Because the MHSS reports childhood vaccinations only for the last child born after 1991, the number of mothers reporting whether their children received these health inputs is relatively small, as shown in the regressions in Table 7 col. 2-4, and describe input use at a later stage in the program when government clinics may have also made them available. Nonetheless, all age groups of recent mothers report obtaining these childhood vaccinations more frequently and more prenatal care in the program villages than in the comparison villages. The distance from the village to the nearest sub-hospital (clinic) is significantly associated with a reduction in prenatal care, as might be anticipated, but this distance to clinic is positively related to childhood vaccinations for polio and DPT. Women residing in boundary villages next to the program report no difference in their childhood vaccinations.[10]

5. How Cost-Effective is the Program?

This study affirms that the MCH-FP program contributed to longer term declines in cohort fertility, surviving fertility, as well as improvements in women's BMI and child health. While aggregation of these benefits into a single program outcome is beyond the scope of this study, our results nevertheless contribute to the discussion of the program's cost-effectiveness. An often cited estimate of program costs per-prevented birth in Matlab is about \$180, with a range of \$150--\$220 (Simmons et al. 1991). Sixty percent of costs were attributable to personnel and transportation, 8% for contraceptives, and 12% for other service related supplies. While this exceeds the cost of most family planning programs implemented at this time, it has been argued that the program was actually more cost-effective than the

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[9] In previous work, we have examined the difference in inoculations for neonatal tetanus, which was a serious health risk in Matlab at this time (Schultz and Joshi, 2007). We omit this indicator here, however, because programs other than the MCH-FP prescribed tetanus toxoid inoculations, particularly as a placebo in cholera vaccine trials in the 1970's (Fauveau 1994; LeGrand and Phillips 1997).

[10] Barham (2008) explores the consequences of the program's promotion of maternal and child health inputs in various blocks of villages from 1982 to 1986 for cognitive functioning of adolescents in the 1996 MHSS. We did not find significant differences in fertility or child mortality from 1981 to 1985 between these blocks (A&C and B&D) when there there were regional differences in program priorities in child and maternal health.

Bangladesh Government program operating at this time in the comparison areas (Simmons et al. 1991).[11]

Our study suggests that these estimates may have understated program benefits for three reasons. First, the benefits persist for longer than is typically considered, as families adjust their allocation of resources over a lifetime. Weighting the program effects by population shares in the respective age groups suggests the local program effects on average number of children born in program areas is a 0.78 child reduction by 1996, which is 16% of the average in comparison areas (Tables 3 and 4). Second, the program's information benefits may diffuse into comparison villages that border the program villages. The population weighted spillover effects of the program is estimated to represent a further decline in overall fertility by 0.9% for women under 35, and 0.6% for women age 35-54. Third, the program's benefits exceed its original objectives of reducing fertility and mortality. It also seems likely the program had persisting effects on the physical and mental development of children through improvements in their health (Table 5), schooling (e. g. Table 2), and potentially their cognitive functioning (e.g. Barham, 2008; Schultz, 2008). The Matlab quasi experiment has created an environment in which families substitute their life cycle resources toward greater human capital investments in women and in their children (Foster and Roy 2000; Joshi and Schultz 2007; Schultz 2010).

6. Conclusions

This paper illustrates that the well-known MCH-FP program launched in Matlab, Bangladesh in 1977 had long-term impacts on family well-being. By 1982 surviving fertility (child-woman ratio) was significantly 17% lower in the treatment than in the comparison villages. In 1996 surviving fertility remained 16% lower despite the fact that this measure of fertility has fallen rapidly in the comparison areas by 39%. Regression analysis of individual fertility with individual, household, and community

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[11] The cost per averted birth of the government program in the comparison areas was estimated to be $298 (Simmons et al. 1991). Obtaining this estimate is complicated by the lack of an obvious control population. Moreover, many features of the MCH-FP and the Bangladesh Government program differed, including not only the outreach design, but also the systems of oversight, personnel tenure, and compensation. It is likely that the government program was withdrawn from Matlab program blocks (LeGrand and Phillips 1996). Fauveau (1994) revised the cost accounting of the program for the period 1986-1989 and concluded that the program expenditure per prevented birth was $60, or substantially lower than previously estimated.

controls suggest the fertility of women under age 55 in 1996 was reduced by .78 children, or 16% of that in comparison areas. The program also decreased child mortality and improved women's health as measured by their weights and BMI greater than 18. The program also led women in the program area to use more frequently preventive health inputs for themselves and their children.

Since the program offered a combination of family planning, reproductive health, and child health interventions, it is not possible to attribute any particular share of the estimated consequences of the program to one or another of the program's components (Joshi and Schultz 2007). The contrast between women in the program villages and those in the boundary villages, however, underscores the value of health workers visiting women directly in their homes. Women in boundary villages are affected by informational spillovers of the program and report lower fertility than other women in comparison areas, but they are only two-fifths of the direct program effect. Women in the boundary villages do not, however, experience reductions in child mortality, or more frequent use of preventive health inputs. These side effects of the program suggest that investments in family planning, reproductive and child health may generate broad improvements in well-being of women and their children in some poor remote agrarian environments. Such benefits may accrue slowly, but conventional cost-benefit estimates per averted births may overlook the poverty-alleviating effects of such programs that enable families to reallocate resources within a smaller family over its life cycle.

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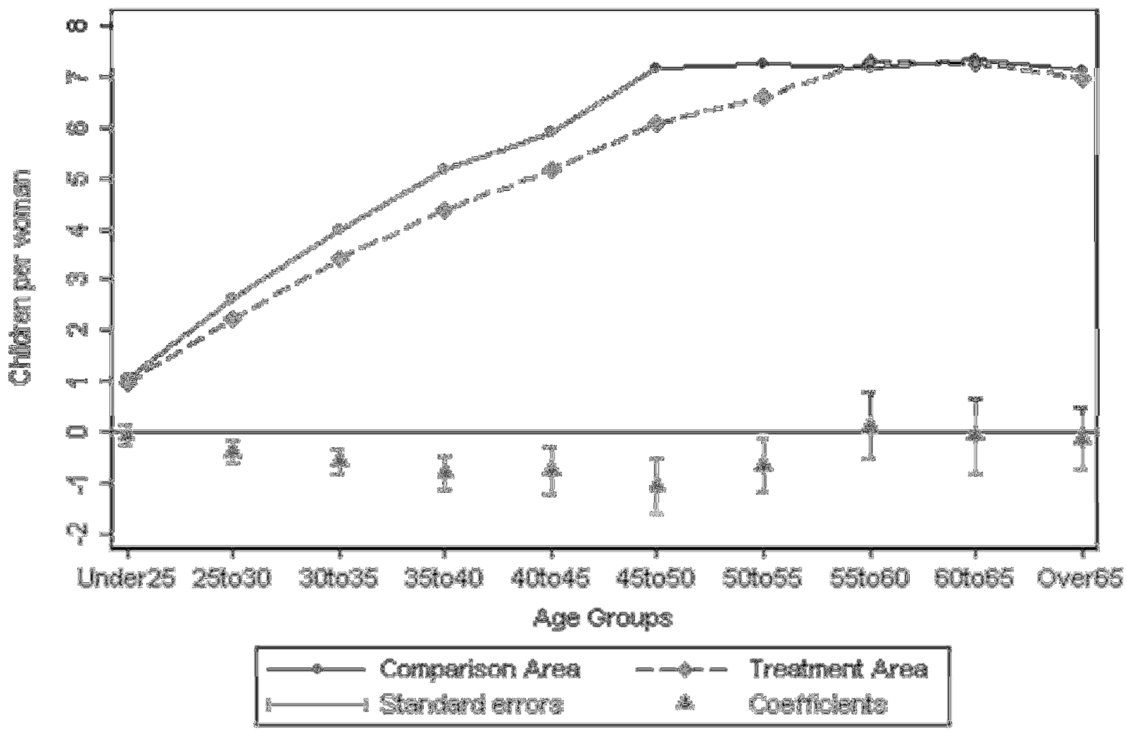

Figure 1: Number of children ever born to married women residing in treatment and comparison villages, by age-groups in Matlab Health and Socioeconomic Survey, 1996. The coefficients refer to ordinary least squares estimates of the differences in fertility between the treatment and comparison areas fertility of women within various age groups, and the 95 percent confidence intervals are around this estimated local area treatment effects, adjusting for the sample weights implied by the survey design

Table 1: Difference in Difference in Surviving Fertility or Children 0-4/Women 15-49 Ratios in Treatment and Comparison Villages Before and After Program

Dependent and Independent Variables	1982 and 1974	1996 and 1974
Preprogram level or constant (β_0)	0.810	0.810
	(82.2)**	(112.0)**
Difference between treatment and comparison areas pre-program	0.022	0.022
, i.e. in 1974 Census (β_1)	(1.58)	(2.14)*
Difference between post-program and pre-program in	-0.064	-0.314
a comparison areas (β_2)	(4.80)**	(16.90)**
Difference between post-program and pre-program in	-0.143	-0.127
treatment areas (β_3)	(7.78)**	(4.92)**
R-squared	0.541	0.760

Notes: (i) Regressions are generalized least squares weighted by the no. of women aged 15-49 in each village census or 1996 MHSS (STATA aweight); (ii) Sample size is 282 (i.e. before and after cross sections of village means); (iii) Absolute values of t statistics in parentheses.
Source: From authors' calculations
† $p < 0.10$; * $p<0.05$; ** $p<0.01$

Table 2: 1974 Census and 1996 Survey Differences Between Treatment and Comparison Villages

	Comparison Area			Treatment Area			Village Difference (Treatment - Comparison) (N=141)	
Variable	Obs	Mean	Std Error	Obs	Mean	Std Error	Mean	t-statistic
Panel (A): 1974 DATA								
Average years of schooling for people aged 15 or more	31560	1.77	0.533	38780	1.80	0.463	0.0602	(0.67)
Average years of schooling for people aged 6–14	15898	1.41	0.425	19691	1.42	0.330	0.016	(0.26)
Persons aged 15 or more with no reported schooling	31560	0.700	0.097	38780	0.699	0.067	-0.0011	(0.08)
Persons aged 6–14 or more with no reported schooling	15898	0.407	0.139	19691	0.411	0.167	-0.0090	(0.38)
Household had a tin roof and wall	76268	0.820	0.094	83757	0.811	0.077	-0.0088	(0.61)
Individual reported religion as Muslim	77047	0.881	0.214	84472	0.794	0.289	-0.087**	(2.01)
Panel (B): 1996 DATA								
Average years of schooling for people aged 15 or more	5535	3.38	1.23	5560	3.52	1.38	0.142	(0.65)
Average years of schooling for people aged 6–14	1931	1.88	0.650	1870	2.27	0.887	0.392***	(3.00)
Persons aged 15 or more with no reported schooling	5536	0.413	0.124	5563	0.411	0.163	-0.0012	(0.05)
Persons aged 6–14 or more with no reported schooling	1989	0.146	0.140	1942	0.127	0.153	-0.019	(0.80)
Household had a tin roof and wall	8663	0.959	0.070	8551	0.974	0.039	0.0145	(1.51)
Individual reported religion as Muslim	8663	0.924	0.188	8551	0.797	0.321	-.127***	(2.87)

Source: From authors' calculations.
Village differences are calculated based on village-levels averages.
† $p < 0.10$; * $p<0.05$; ** $p<0.01$.

Table 3: Definitions and Weighted Sample Statistics from the 1996 Matlab Health and Socioeconomic Survey

Variable Name	Description	Mean	Std. Dev	Unconditional Program Impact
	Summary of Dependent Variables			
TotalChildren	Total no. of children ever born	4.744	2.876	-0.467** (0.089)
TotalAlive	Total no. of children alive	3.764	2.193	-0.215** (.070)
AgeAtFirstBirth	Age at which a woman had first child	23.209	4.795	-0.0536 (0.169)
SecondInterval	Years between first and second child	3.290	2.121	0.188** (0.080)
ThirdInterval	Years between second and third child	3.228	1.935	0.306** (0.077)
Died5	Child born alive to a married woman in the sample died before the age of 5	0.160	0.366	-0.0212*** (0.008)
Died5 (males)	Child born alive to a married woman in the sample died before the age of 5	0.161	0.367	-.0257** (0.011)
Died5 (females)	Child born alive to a married woman in the sample died before the age of 5	0.158	0.365	-0.0184* (0.099)
Currently Healthy	Self-reported health status is "Healthy"	0.752	0.431	.0005 (.015)
ActivityIndex	Womans ADL Index (0 to 1)	0.882	0.205	0.003 (0.007)
Weight	Woman's weight (in kg)	41.620	6.674	0.792** (0.253)
BMI	Womans body-mass-index (kg/m^2)	18.787	2.701	0.473** (0.103)
BMIGr18	Woman's BMI exceeds 18 (kg/m^2)	0.590	0.492	.0603** (0.0187)
NumAnteNatalChecks	Average no. prenatal checks in past pregnancies	0.953	1.385	0.575** (0.045)
Vaccinations:				
Polio	Polio vaccination for last child born in past 5 yrs	0.786	0.410	0.336** (0.024)
Measles	Measles vaccination for last child born in past 5 yrs	0.646	0.478	0.369** (0.027)
Diphtheria-Pertussis-Tetanus	DPT vaccine for last child born in past 5 yrs	0.742	0.437	.354** (0.025)

Continued on next page

Table 3: Definitions and Weighted Sample Statistics from the 1996 Matlab Health and Socioeconomic Survey

Variable Name	Description	Mean	Std. Dev	Unconditional Program Impact
	Summary of Independent Variables			
Treatment	Woman resides in the treatment area	0.565	0.496	
Muslim	Household head is Muslim	0.876	0.329	
Age	Woman's Age	40.459	14.436	
Years of schooling	Years of Schooling completed of woman	2.196	2.890	
Husband age	Age of husband (in years)	37.466	22.239	
Husband years schooling	Husband's years of schooling completed	2.279	3.408	
Unmarried female head	Woman is unmarried and heads her own household	.0659	0.248	
Married female head	Woman is married and heads her own household	.0555	0.229	
Husband absent	Husband absent and woman not household head	0.114	0.317	
Husband age missing	Husband's age is missing	0.193	0.394	
Husband schooling missing	Husband's years of schooling missing	0.179	0.383	
Boundary Village × Age Under 35	Boundary village × (Age $<$ 35)	.0603	0.238	
Boundary Village × Age35to55	Boundary village × (Age$\geq$35 & Age$<$55)	.056	0.229	
Boundary Village × AgeOver55	Boundary village × (Age $\geq$ 55)	.036	0.185	
Village has pucca Road	Village has a pucca road	0.173	0.378	
Distance to hospital	Distance from the hospital sub-center (in km)	3.313	2.207	
Secondary school nearby	Secondary school in village/neighbouring village	0.750	0.433	
Village has motor boat	Village accessible by motor boat	0.312	0.463	

Notes: (i) Sample statistics and unconditional program-comparison difference estimates weighted by MHSS individual weights (STATA pweight); (ii) Absolute robust standard errors of program -comparison differences in parentheses; (iii) The variable *Died5* is constructed based on the sample of 24865 children whose mothers constitute the sample of married women. All other variables in the table are constructed for the sample of married women.

Source: From authors' calculations

† $p < 0.10$; * $p<0.05$; ** $p<0.01$

Table 4: Regressions on Children Ever Born, Surviving Number, and Timing of Births

Explanatory Variables	TotalChildren	TotalAlive	AgeFirstBirth	SecondInterval	ThirdInterval
	(1)	(2)	(3)	(4)	(5)
Treatment X Age<25	-0.491*	-0.196	-0.304	0.745	0.275
	(1.74)	(0.80)	(0.38)	(1.33)	(0.42)
Treatment X ($25 \leq$ Age < 30)	-0.836***	-0.590**	0.431	0.143	0.680*
	(3.05)	(2.43)	(0.58)	(0.37)	(1.90)
Treatment X ($30 \leq$ Age < 35)	-1.068***	-0.710***	0.068	0.359	0.684**
	(3.72)	(2.89)	(0.09)	(0.95)	(2.11)
Treatment X ($35 \leq$ Age < 40)	-1.150***	-0.652**	0.322	0.081	0.425
	(3.82)	(2.45)	(0.42)	(0.20)	(1.34)
Treatment X ($40 \leq$ Age < 45)	-1.057***	-0.843***	-1.504*	0.382	-0.353
	(3.06)	(2.83)	(1.91)	(0.96)	(1.02)
Treatment X ($45 \leq$ Age < 50)	-1.547***	-0.805**	-0.440	0.323	0.112
	(4.36)	(2.56)	(0.57)	(0.80)	(0.29)
Treatment X ($50 \leq$ Age < 55)	-1.034***	-0.414	0.268	-0.158	0.381
	(2.96)	(1.39)	(0.32)	(0.39)	(1.07)
Treatment X ($55 \leq$ Age < 60)	0.077	0.255	0.292	-0.338	0.078
	(0.17)	(0.69)	(0.36)	(0.73)	(0.21)
Treatment X ($60 \leq$ Age < 65)	-0.267	-0.337	-0.467	-0.447	-0.331
	(0.57)	(0.83)	(0.55)	(0.98)	(1.00)
Treatment X Age ≥ 65	-0.322	0.171	-1.429	0.112	0.190
	(0.78)	(0.48)	(1.60)	(0.25)	(0.56)
Treatment X Years of schooling	0.004	-0.005	-0.030	0.019	0.037
	(0.19)	(0.26)	(0.56)	(0.60)	(1.08)
Treatment X Muslim	0.390	0.293	0.007	0.068	-0.260
	(1.58)	(1.34)	(0.01)	(0.22)	(1.08)
Muslim	0.100	0.175	0.022	0.054	0.058
	(0.45)	(0.87)	(0.04)	(0.20)	(0.31)
$25 \leq$ Age < 30	1.307***	1.266***	0.605	0.647*	0.571*
	(10.65)	(11.54)	(1.59)	(1.89)	(1.81)
$30 \leq$ Age < 35	2.485***	2.187***	0.624	0.092	0.686**
	(18.41)	(19.43)	(1.59)	(0.28)	(2.06)
$35 \leq$ Age < 40	3.460***	2.961***	0.000	0.065	0.703*
	(18.34)	(18.65)	(0.00)	(0.17)	(1.96)
$40 \leq$ Age < 45	4.119***	3.633***	0.278	-0.129	1.204***
	(17.59)	(18.45)	(0.49)	(0.30)	(3.15)
$45 \leq$ Age < 50	5.569***	4.321***	-1.291**	-0.423	0.996**
	(22.66)	(20.36)	(2.14)	(0.93)	(2.40)
$50 \leq$ Age < 55	5.711***	4.339***	-2.123***	-0.143	0.770*
	(21.52)	(19.49)	(3.16)	(0.31)	(1.93)
$55 \leq$ Age < 60	5.639***	4.137***	-3.255***	0.163	0.805*
	(16.79)	(15.24)	(5.04)	(0.33)	(1.87)
$60 \leq$ Age < 65	6.190***	4.747***	-2.963***	0.000	0.757*
	(17.49)	(16.43)	(4.04)	(0.00)	(1.94)
Age ≥ 65	6.386***	4.348***	-2.605***	-0.237	0.825**
	(21.82)	(17.17)	(3.31)	(0.48)	(2.05)
Years of schooling	-0.064***	-0.043***	0.158***	-0.024	0.013
	(3.49)	(2.64)	(3.47)	(0.81)	(0.47)
Husband age	0.125***	0.106***	-0.303***	0.071**	-0.012

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Explanatory Variables	TotalChildren	TotalAlive	AgeFirstBirth	SecondInterval	ThirdInterval
	(1)	(2)	(3)	(4)	(5)
	(5.87)	(5.85)	(5.77)	(2.13)	(0.43)
Husband age squared	-0.120***	-0.106***	0.225***	-0.058*	0.002
	(5.38)	(5.61)	(4.60)	(1.94)	(0.10)
Husband years schooling	-0.013	0.010	-0.014	0.004	-0.012
	(0.96)	(0.83)	(0.46)	(0.16)	(0.72)
Unmarried female head	-0.712**	-0.695***	-1.658	0.966***	-0.348
	(2.55)	(3.13)	(1.61)	(3.24)	(1.11)
Married female head	-0.295**	-0.161	0.317	0.158	0.278
	(2.50)	(1.58)	(1.01)	(1.02)	(1.54)
Husband absent	-1.443***	-1.169***	-1.932*	1.066***	-0.357
	(5.84)	(5.75)	(1.78)	(2.97)	(1.15)
Husband age missing	2.786***	2.255***	-7.737***	1.236	-0.391
	(5.57)	(5.33)	(5.30)	(1.37)	(0.48)
Husband schooling missing	-0.085	0.063	-0.261	0.092	0.140
	(0.72)	(0.62)	(1.05)	(0.58)	(0.83)
Boundary village X Age $<$ 35	-0.357***	-0.241**	0.185	0.011	-0.097
	(2.81)	(2.24)	(0.47)	(0.05)	(0.47)
Boundary village X 35 $\geq$ Age $<$ 55	-0.283	-0.270*	-0.442	0.588**	-0.104
	(1.51)	(1.77)	(0.98)	(2.36)	(0.54)
Boundary village X Age $\geq$ 55	0.409	-0.027	0.174	0.015	0.017
	(1.43)	(0.11)	(0.34)	(0.06)	(0.08)
Village has Pucca Road	0.129	0.099	-0.100	-0.043	0.048
	(1.45)	(1.36)	(0.47)	(0.37)	(0.43)
Distance to hospital	0.007	0.018	-0.087	-0.019	-0.047
	(0.26)	(0.76)	(1.32)	(0.61)	(1.55)
Secondary school nearby	-0.050	0.015	0.165	0.007	-0.051
	(0.62)	(0.24)	(0.87)	(0.07)	(0.51)
Village has motor boat	0.032	0.051	0.225	0.045	-0.023
	(0.41)	(0.77)	(1.22)	(0.50)	(0.25)
Constant	-1.181**	-1.347***	32.893***	1.091	3.087***
	(2.23)	(2.97)	(24.31)	(1.24)	(4.07)
R-squared	.589	.506	.273	.021	.036
N	5273	5273	4972	4507	3996
Joint test: Treatment (12, N)	4.60	3.59	1.63	1.20	2.26
p-value	0.00	0.00	0.08	0.27	0.01
Joint test: Schooling (2, N)	9.03	6.21	8.06	0.35	1.31
p-value	0.00	0.00	0.00	0.71	0.27
Joint test: Muslim (2, N)	9.42	12.99	0.01	0.50	0.85
p-value	0.00	0.00	0.99	0.61	0.43
Joint test: Boundary (3, N)	3.84	2.27	0.46	1.87	0.17
p-value	0.01	0.08	0.71	0.13	0.92
Joint test: Infrastructure (4, N)	0.55	0.75	1.08	0.24	0.74
p-value	0.70	0.56	0.36	0.92	0.56

Notes: (i) Robust absolute value t-statistic in parentheses; (ii) See text for detailed definition of dependent and explanatory variables.
Source: From authors' calculations.
† p< 0.10; * p<0.05; $**$ p<0.01.

Table 5: Logit Regression for Child Mortality Below the Age of 5, Child Samples

Explanatory Variables	Total		Boys		Girls	
	Odds Ratio	Marginal	Odds Ratio	Marginal	Odds Ratio	Marginal
	(1)	(2)	(3)	(4)	(5)	(6)
ChildMale	1.003	1.001				
	(0.06)	(0.06)				
Treatment X Age<25	0.388	0.878**	0.495	0.901	0.312	0.857**
	(1.42)	(2.01)	(0.67)	(0.86)	(1.39)	(2.16)
Treatment X (25 ≤ Age < 35)	0.746	0.952	0.783	0.959	0.699	0.941
	(1.10)	(1.18)	(0.66)	(0.70)	(1.00)	(1.09)
Treatment X (35 ≤ Age < 45)	0.568**	0.917**	0.671	0.937	0.479**	0.894**
	(2.21)	(2.51)	(1.12)	(1.22)	(2.17)	(2.57)
Treatment X (45 ≤ Age < 55)	0.628**	0.929**	0.636	0.930	0.611	0.923*
	(2.01)	(2.22)	(1.39)	(1.53)	(1.56)	(1.73)
Treatment X (Age ≥ 55)	0.727	0.949	0.685	0.940	0.749	0.951
	(1.35)	(1.44)	(1.14)	(1.23)	(0.90)	(0.95)
Treatment X Years of schooling	1.020	1.003	1.013	1.002	1.026	1.003
	(0.71)	(0.71)	(0.38)	(0.38)	(0.63)	(0.63)
Treatment X Muslim	1.248	1.043	1.242	1.042	1.284	1.051
	(1.08)	(1.08)	(0.77)	(0.77)	(0.89)	(0.89)
Muslim	0.800	0.963	0.744	0.952	0.832	0.968
	(1.28)	(1.22)	(1.24)	(1.16)	(0.76)	(0.73)
25 ≤ Age < 35	0.664	0.936	0.620	0.927	0.677	0.937
	(0.82)	(0.89)	(0.55)	(0.61)	(0.70)	(0.75)
35 ≤ Age < 45	0.577	0.918	0.455	0.892	0.698	0.941
	(1.03)	(1.12)	(0.85)	(0.96)	(0.61)	(0.64)
45 ≤ Age < 55	0.638	0.931	0.580	0.919	0.680	0.937
	(0.79)	(0.84)	(0.57)	(0.61)	(0.60)	(0.63)
Age ≥ 55	0.684	0.940	0.682	0.939	0.668	0.935
	(0.65)	(0.68)	(0.39)	(0.41)	(0.61)	(0.64)
Years of schooling	0.959**	0.995**	0.943**	0.992**	0.974	0.997
	(2.06)	(2.06)	(2.06)	(2.07)	(0.99)	(0.99)
Husband age	1.030	1.004	1.034	1.004	1.023	1.003
	(1.05)	(1.04)	(1.04)	(1.04)	(0.56)	(0.56)
Husband age squared	0.985	0.998	0.983	0.998	0.988	0.998
	(0.70)	(0.70)	(0.63)	(0.63)	(0.40)	(0.40)
Husband years schooling	0.985	0.998	1.005	1.001	0.965**	0.995**
	(1.20)	(1.19)	(0.28)	(0.28)	(2.07)	(2.06)
Unmarried female head	2.147**	1.177**	3.181***	1.298***	1.559	1.096
	(2.44)	(2.23)	(3.44)	(3.19)	(0.93)	(0.87)
Married female head	0.966	0.994	1.413	1.071	0.619**	0.925***
	(0.21)	(0.22)	(1.49)	(1.39)	(2.37)	(2.69)
Husband absent	2.200**	1.184**	2.875***	1.265***	1.789	1.131
	(2.40)	(2.20)	(3.15)	(2.92)	(1.16)	(1.08)
Husband age missing	1.768	1.125	1.527	1.089	1.817	1.135
	(0.62)	(0.59)	(0.40)	(0.38)	(0.45)	(0.43)
Husband schooling missing	0.829*	0.968*	0.868	0.976	0.790	0.960*
	(1.65)	(1.72)	(0.89)	(0.92)	(1.62)	(1.71)
Boundary village X Age < 35	0.936	0.988	1.199	1.035	0.756	0.953
	(0.32)	(0.33)	(0.58)	(0.56)	(0.94)	(1.02)

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Explanatory Variables	Total		Boys		Girls	
	Odds Ratio	Marginal	Odds Ratio	Marginal	Odds Ratio	Marginal
	(1)	(2)	(3)	(4)	(5)	(6)
Boundary village X 35 $\geq$ Age $<$ 55	1.058	1.010	1.224	1.039	0.934	0.988
	(0.45)	(0.44)	(1.14)	(1.10)	(0.42)	(0.42)
Boundary village X Age $\geq$ 55	1.271	1.047	1.336	1.058	1.187	1.034
	(1.47)	(1.40)	(1.59)	(1.51)	(0.75)	(0.72)
Village has Pucca Road	0.945	0.990	0.985	0.997	0.908	0.983
	(0.67)	(0.68)	(0.13)	(0.13)	(0.82)	(0.84)
Distance to hospital	0.982	0.998	0.975	0.997	0.988	0.998
	(0.84)	(0.84)	(0.83)	(0.83)	(0.40)	(0.40)
Secondary school nearby	0.965	0.994	1.021	1.004	0.918	0.985
	(0.55)	(0.55)	(0.23)	(0.23)	(1.06)	(1.05)
Village has motor boat	0.927	0.987	0.944	0.990	0.912	0.983
	(1.18)	(1.18)	(0.66)	(0.66)	(1.12)	(1.13)
R-squared						
N	24865	24865	12409	12409	12456	12456
Joint test: Treatment (7, N)	1.41	2.10	0.50	0.65	1.56	2.64
p-value	0.22	0.06	0.77	0.66	0.17	0.02
Joint test: Schooling (2, N)	2.13	2.13	2.42	2.42	0.54	0.54
p-value	0.12	0.12	0.09	0.09	0.58	0.58
Joint test: Muslim (2, N)	0.82	0.75	0.92	0.77	0.40	0.40
p-value	0.44	0.47	0.40	0.46	0.67	0.67
Joint test: Boundary (3, N)	0.83	0.76	1.10	0.99	0.62	0.66
p-value	0.48	0.52	0.35	0.40	0.60	0.58
Joint test: Infrastructure (4, N)	0.75	0.75	0.27	0.27	0.98	0.98
p-value	0.56	0.56	0.90	0.90	0.42	0.42

Notes: (i) Results are of logit model; (ii) Robust absolute value t-statistics for the logit model (obtained using a linearized Taylor approximation for variances) and z-statistics for the marginal effects are in parentheses; (iii) Marginal effects are computed with STATA's "margeff" command; (iv) See text for detailed definition of dependent and explanatory variables.
Source: From authors' calculations.
† $p < 0.10$; * $p<0.05$; ** $p<0.01$.

Table 6: Regression for Alternative Indicators of Women's Health

Explanatory Variables	CurrHealthy	ADLEq0	Weight	BMI	BMIGr18
	(1)	(2)	(3)	(4)	(5)
Treatment X Age<25	-0.034	-0.026	0.024	-0.128	-0.053
	(0.50)	(0.45)	(0.02)	(0.20)	(0.56)
Treatment X (25 ≤ Age < 30)	-0.012	0.081	1.174	0.336	0.027
	(0.17)	(1.39)	(1.23)	(0.53)	(0.32)
Treatment X (30 ≤ Age < 35)	-0.053	0.005	2.086**	0.716	0.131
	(0.77)	(0.08)	(2.25)	(1.15)	(1.58)
Treatment X (35 ≤ Age < 40)	0.018	0.036	1.954**	0.726	0.168*
	(0.25)	(0.56)	(1.98)	(1.16)	(1.93)
Treatment X (40 ≤ Age < 45)	-0.071	0.071	1.957*	0.802	0.150
	(0.86)	(0.92)	(1.83)	(1.19)	(1.62)
Treatment X (45 ≤ Age < 50)	-0.073	-0.023	2.306**	0.786	0.082
	(0.92)	(0.30)	(2.00)	(1.13)	(0.85)
Treatment X (50 ≤ Age < 55)	-0.065	0.092	2.154**	0.479	0.228***
	(0.78)	(1.21)	(2.18)	(0.73)	(2.60)
Treatment X (55 ≤ Age < 60)	-0.118	0.110	1.125	0.201	0.223**
	(1.32)	(1.39)	(0.94)	(0.23)	(2.27)
Treatment X (60 ≤ Age < 65)	-0.014	0.015	1.973	0.469	0.099
	(0.15)	(0.22)	(1.55)	(0.68)	(0.99)
Treatment X Age ≥ 65	-0.141	0.021	2.110*	0.959*	0.162
	(1.60)	(0.38)	(1.93)	(1.69)	(1.63)
Treatment X Years of schooling	-0.011**	-0.005	0.203**	0.053	0.005
	(2.31)	(0.92)	(2.22)	(1.39)	(0.83)
Treatment X Muslim	0.022	-0.011	-0.555	-0.050	-0.009
	(0.40)	(0.25)	(0.77)	(0.09)	(0.14)
Muslim	-0.042	-0.062*	0.442	-0.571	-0.045
	(0.91)	(1.66)	(0.83)	(1.10)	(0.79)
25 ≤ Age < 30	-0.078**	-0.087***	-0.051	-0.114	-0.023
	(2.28)	(3.00)	(0.09)	(0.48)	(0.48)
30 ≤ Age < 35	-0.084**	-0.081***	-1.001	-0.386	-0.145***
	(2.35)	(2.81)	(1.58)	(1.55)	(2.76)
35 ≤ Age < 40	-0.122***	-0.183***	-0.166	-0.267	-0.152**
	(2.63)	(4.48)	(0.23)	(0.91)	(2.46)
40 ≤ Age < 45	-0.143***	-0.318***	-1.117	-0.381	-0.213***
	(2.67)	(6.02)	(1.30)	(1.04)	(3.08)
45 ≤ Age < 50	-0.156***	-0.405***	-2.287***	-0.541	-0.224***
	(2.73)	(6.79)	(2.60)	(1.48)	(3.14)
50 ≤ Age < 55	-0.261***	-0.616***	-4.498***	-1.242***	-0.445***
	(4.75)	(11.11)	(5.60)	(3.24)	(6.61)
55 ≤ Age < 60	-0.253***	-0.687***	-3.411***	-0.746	-0.421***
	(3.97)	(11.47)	(3.67)	(1.42)	(5.46)
60 ≤ Age < 65	-0.409***	-0.820***	-4.633***	-1.141***	-0.401***
	(5.83)	(16.25)	(4.87)	(2.84)	(5.32)
Age ≥ 65	-0.400***	-0.898***	-5.314***	-1.786***	-0.444***
	(6.27)	(19.66)	(5.61)	(4.91)	(5.45)
Years of schooling	0.008*	0.004	0.268***	0.081***	0.007
	(1.89)	(0.97)	(3.70)	(2.61)	(1.28)
Husband age	-0.002	0.002	0.188***	0.055*	0.006

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Explanatory Variables	CurrHealthy	ADLEq0	Weight	BMI	BMIGr18
	(1)	(2)	(3)	(4)	(5)
	(0.46)	(0.53)	(2.89)	(1.91)	(1.10)
Husband age squared	0.003	-0.002	-0.176***	-0.052*	-0.004
	(0.63)	(0.72)	(2.84)	(1.93)	(0.83)
Husband years schooling	0.005	0.003	0.181***	0.071***	0.009**
	(1.62)	(1.06)	(3.83)	(3.59)	(2.57)
Unmarried female head	0.040	0.024	0.915	-0.382	0.001
	(0.69)	(0.45)	(1.20)	(0.60)	(0.01)
Married female head	-0.000	0.017	-0.001	0.179	0.005
	(0.01)	(0.53)	(0.00)	(0.76)	(0.11)
Husband absent	-0.041	-0.024	-0.200	-0.759	-0.095
	(0.73)	(0.49)	(0.27)	(1.19)	(1.40)
Husband age missing	-0.063	0.060	4.112**	1.834**	0.247
	(0.54)	(0.62)	(2.39)	(2.41)	(1.58)
Husband schooling missing	0.034	0.006	0.746*	0.278*	0.041
	(1.36)	(0.24)	(1.92)	(1.65)	(1.32)
Boundary village X Age $<$ 35	-0.061*	0.005	0.992*	0.366	0.077*
	(1.74)	(0.16)	(1.72)	(1.55)	(1.72)
Boundary village X 35 $\geq$ Age $<$ 55	-0.144***	0.011	1.071*	0.377	0.075
	(2.98)	(0.25)	(1.93)	(1.58)	(1.57)
Boundary village X Age $\geq$ 55	-0.021	0.057	1.008	0.888*	0.221***
	(0.36)	(1.42)	(1.19)	(1.83)	(3.32)
Village has Pucca Road	-0.007	-0.008	0.342	0.111	-0.034
	(0.36)	(0.40)	(0.97)	(0.70)	(1.26)
Distance to hospital	-0.007	0.001	0.174*	0.024	0.009
	(1.04)	(0.08)	(1.81)	(0.61)	(1.23)
Secondary school nearby	0.022	0.006	0.086	0.007	-0.008
	(1.13)	(0.37)	(0.30)	(0.06)	(0.38)
Village has motor boat	-0.008	-0.051***	0.155	0.065	-0.010
	(0.43)	(3.17)	(0.59)	(0.55)	(0.46)
Constant	1.007***	0.963***	35.463***	17.583***	0.503***
	(8.57)	(9.96)	(21.36)	(18.74)	(3.36)
R-squared	.121	.374	.173	.107	.091
N	5269	5271	4672	4653	4653
Joint test: Treatment (12, N)	1.20	1.37	1.96	1.83	2.61
p-value	0.28	0.17	0.02	0.04	0.00
Joint test: Schooling (2, N)	2.97	0.55	20.80	9.72	3.00
p-value	0.05	0.58	0.00	0.00	0.05
Joint test: Muslim (2, N)	0.65	5.32	0.38	4.88	1.60
p-value	0.52	0.00	0.68	0.01	0.20
Joint test: Boundary (3, N)	3.46	0.67	1.96	2.19	4.21
p-value	0.02	0.57	0.12	0.09	0.01
Joint test: Infrastructure (4, N)	0.56	2.59	1.24	0.29	0.99
p-value	0.69	0.03	0.29	0.89	0.41

Notes: (i) Robust absolute value t-statistic in parentheses; (ii) See text for detailed definition of dependent and explanatory variables.
Source: From authors' calculations.
† p< 0.10; * p<0.05; $**$ p<0.01.

Table 7: Regression for Preventive Health Inputs

Explanatory Variables	No. of antenatal visits per pregnancy	Child Vaccinations Polio	Measles	DPT
	(1)	(2)	(3)	(4)
Treatment X Age<25	0.743***	0.387***	0.355***	0.460***
	(3.12)	(3.12)	(2.68)	(3.59)
Treatment X (25 ≤ Age < 30)	0.849***	0.439***	0.391***	0.494***
	(4.09)	(3.69)	(3.17)	(4.14)
Treatment X (30 ≤ Age < 35)	0.730***	0.388***	0.296**	0.439***
	(3.78)	(3.31)	(2.31)	(3.56)
Treatment X (35 ≤ Age < 40)	0.650***	0.427***	0.283**	0.513***
	(3.52)	(3.37)	(2.03)	(3.85)
Treatment X (40 ≤ Age < 45)	0.330*	0.344**	0.387**	0.398**
	(1.67)	(2.18)	(2.38)	(2.44)
Treatment X (45 ≤ Age < 50)	0.052	0.371**	0.318*	0.412*
	(0.29)	(2.12)	(1.69)	(1.86)
Treatment X (50 ≤ Age < 55)	0.081	-0.521***	0.565***	0.500***
	(0.45)	(3.50)	(3.61)	(3.29)
Treatment X (55 ≤ Age < 60)	-0.108	.	.	.
	(0.71)	.	.	.
Treatment X (60 ≤ Age < 65)	-0.292	.	.	.
	(1.51)	.	.	.
Treatment X Age ≥ 65	-0.188	.	.	.
	(1.29)	.	.	.
Treatment X Years of schooling	0.006	-0.020**	-0.013	-0.023***
	(0.35)	(2.54)	(1.47)	(2.75)
Treatment X Muslim	-0.025	0.103	0.120	0.016
	(0.18)	(0.99)	(1.09)	(0.15)
Muslim	0.013	-0.055	-0.056	0.034
	(0.12)	(0.55)	(0.56)	(0.34)
25 ≤ Age < 30	-0.050	-0.043	0.006	-0.042
	(0.34)	(0.72)	(0.10)	(0.70)
30 ≤ Age < 35	-0.170	-0.011	0.027	-0.020
	(1.15)	(0.17)	(0.38)	(0.30)
35 ≤ Age < 40	-0.396**	-0.048	0.047	-0.094
	(2.40)	(0.57)	(0.52)	(1.09)
40 ≤ Age < 45	-0.524***	-0.044	-0.075	-0.086
	(2.95)	(0.45)	(0.75)	(0.88)
45 ≤ Age < 50	-0.599***	0.001	0.104	-0.120
	(3.31)	(0.01)	(0.63)	(0.72)
50 ≤ Age < 55	-0.674***	.	.	.
	(3.65)	.	.	.
55 ≤ Age < 60	-0.678***	.	.	.
	(3.92)	.	.	.
60 ≤ Age < 65	-0.533**	.	.	.
	(2.57)	.	.	.
Age ≥ 65	-0.534***	.	.	.
	(3.07)	.	.	.
Years of schooling	0.052***	0.011	0.014*	0.014*
	(3.81)	(1.40)	(1.77)	(1.80)

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Explanatory Variables	No. of antenatal visits per pregnancy	Polio	Measles	DPT
Husband age	-0.013	0.015	0.031**	0.017
	(0.76)	(1.45)	(2.44)	(1.52)
Husband age squared	-0.001	-0.014	-0.029*	-0.013
	(0.08)	(1.13)	(1.91)	(1.03)
Husband years schooling	0.010	0.006	0.002	0.004
	(1.09)	(1.30)	(0.49)	(0.92)
Unmarried female head	-0.305*	0.017	-0.088	0.069
	(1.75)	(0.14)	(0.54)	(0.56)
Married female head	0.232**	0.039	0.042	0.064
	(2.09)	(1.05)	(0.80)	(1.62)
Husband absent	-0.404**	0.050	0.000	0.068
	(2.35)	(0.43)	(0.00)	(0.53)
Husband age missing	-0.632	0.341	0.714**	0.422*
	(1.36)	(1.51)	(2.53)	(1.73)
Husband schooling missing	0.024	0.053	0.039	0.026
	(0.31)	(1.45)	(0.91)	(0.67)
Boundary village X Age < 35	-0.173	-0.030	-0.002	-0.098
	(1.42)	(0.51)	(0.04)	(1.64)
Boundary village X $35 \geq$ Age < 55	-0.119	0.021	-0.063	0.031
	(1.33)	(0.20)	(0.59)	(0.28)
Boundary village X Age ≥ 55	-0.179**	.	.	.
	(2.22)	.	.	.
Village has Pucca Road	0.010	0.020	0.046	0.033
	(0.16)	(0.67)	(1.34)	(1.06)
Distance to hospital	-0.046***	0.029***	0.009	0.023**
	(2.97)	(2.86)	(0.78)	(2.14)
Secondary school nearby	-0.041	-0.037	-0.003	-0.059**
	(0.82)	(1.46)	(0.10)	(2.18)
Village has motor boat	0.128***	0.050*	0.055*	0.025
	(2.67)	(1.76)	(1.71)	(0.87)
Constant	1.818***	0.119	-0.389	-0.011
	(4.26)	(0.48)	(1.41)	(0.04)
R-squared	.339	.209	.188	.21
N	5049	1736	1736	1737
Joint test: Treatment (12, N)	11.93	23.76	6.45	7.43
p-value	0.00	0.00	0.00	0.00
Joint test: Schooling (2, N)	11.14	3.56	1.60	3.82
p-value	0.00	0.03	0.20	0.02
Joint test: Muslim (2, N)	0.02	1.14	0.96	0.79
p-value	0.98	0.32	0.38	0.45
Joint test: Boundary (3, N)	2.14	0.17	0.18	1.54
p-value	0.09	0.84	0.84	0.21
Joint test: Infrastructure (4, N)	4.70	3.60	1.15	2.70
p-value	0.00	0.01	0.33	0.03

Notes: (i) Robust absolute value t-statistic in parentheses; (ii) See text for detailed definition of dependent and explanatory variables.
Source: From authors' calculations.
† $p < 0.10$; * $p<0.05$; $**$ $p<0.01$.