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ABSTRACT

The question of how access to services affects health outcomes is critical for policy makers allocating resources across different programs, but it is difficult to answer with cross-sectional data sets. We use data from a panel survey in Indonesia (the Indonesia Family Life Survey) that spans a period of a major expansion in access to midwifery services to investigate whether the expansion resulted in improved health and pregnancy outcomes for women of reproductive age. Between 1990 and 1998 Indonesia trained and posted some 50,000 midwives to communities throughout the country. Results from the IFLS data reveal that between 1993 and 1997 these midwives tended to be placed in communities that were relatively poor and that were relatively distant from public health centers. We show that the addition of a Village Midwife to communities between 1993 and 1997 is associated with a significant increase in BMI in 1997 relative to 1993 for women of reproductive age, but not for men in that age range or for older men and women. We also show that the presence of a Village Midwife during pregnancy is associated with increased birthweight. Both results are robust to inclusion of community-level fixed effects—a strategy that addresses many of the concerns about biases resulting from non-random program placement. The quantitative results are complemented by interviews conducted with Village Midwives themselves. Those interviews provide evidence that the midwives offer a wide array of preventive and curative services, which explains why they are associated not just with positive pregnancy outcomes, but also with improvements in BMI, a more general indicator of health status.

1. INTRODUCTION:

One of the most fundamental demographic changes that developing countries have experienced over the past several decades is mortality decline. On average, individuals are leading longer and in many respects healthier lives than they were a generation ago. In part these changes reflect investment in human resources by both individuals and governments. In most developing countries governments have built, stocked, and staffed schools, health facilities, and family planning clinics, albeit with varying degrees of success. Demonstrating a causal effect on health outcomes of the introduction of public health services in a community, however, is not straightforward.

This paper addresses the question of whether government efforts to provide health care have an impact on the populations the programs target. We draw on a "quasi-experiment" in Indonesia in conjunction with extremely rich longitudinal survey data and complement the quantitative evidence with qualitative interviews. We measure the effect on health status of the introduction of a village healthworker in a community by comparing changes in health status in communities that gained a healthworker with changes in health status in communities that did not.

New healthworkers may not be randomly assigned to communities. Nonrandom assignment poses no conceptual difficulties if the assignment is based on observed characteristics. However, if unobserved factors influence the allocation of healthworkers to communities, estimated "effects" of healthworkers on health outcomes may be biased. We address this concern by exploiting the fact that the healthworkers—in our case midwives—were trained primarily to serve reproductive age women, which allows us to contrast the effect of the healthworkers on these women (the "treated") with other adults in the same community (the "controls").

At a substantive level, the results provide evidence on the effectiveness of a large and important community-based health service intervention that is targeted towards under-served communities. These types of programs have been implemented in a number of low income settings.

In Indonesia, the Village Midwife program, implemented during the 1990s, is estimated to have posted some 50,000 midwives throughout the country (Gani, 1996; Kosen and Gunawan, 1996; Sweet et al., 1995). Our main results focus on the impact of introducing a Village Midwife on a general measure of the health of adults, body mass index. After controlling community-level heterogeneity, we find that among reproductive age women, BMI increases significantly and that the increase is substantively important. In contrast, men and older women (our "control" groups) do not experience an increase in BMI. For women of reproductive age, the benefits of access to midwives extend to pregnancy outcomes: we also find that the introduction of a Midwife is associated with increases in birthweight. We conclude that the expansion of the Village Midwife program has yielded significant improvements in health and we end with a discussion of the likely reasons drawing on qualitative evidence.

BACKGROUND

Indonesia: Health Outcomes and the Health Service Environment

Over the past three decades Indonesia has seen substantial improvements in its level of socioeconomic development. From 1967 to 1997 Indonesia's per capita GDP rose by an annual average of almost 5%. At the same time, Indonesia achieved nearly universal enrollment in primary school and experienced a five-fold increase in enrollment in secondary school (from 10% to 50%). Since the early 1960s, a number of indicators of health status in Indonesia have also shown major improvements. The infant mortality rate has fallen steadily, and by the mid-1990s life expectancy surpassed 60 years.

One dimension of health outcomes that has shown less impressive gains and over which the Indonesian government has evinced considerable concern is maternal mortality, which at 400-600 deaths per 100,000 live births, is the highest in any of the ASEAN nations (Handayani et al., 1996; Mukti, 1996). In fact, Indonesia's statistics for maternal mortality are on a par with those in India and Bangladesh, despite the fact that GDP per capita in Indonesia is about 50% higher than in India and about twice as high as in Bangladesh (Demographic Institute, 1997).

To address poor maternal health, the Ministry of Health embarked on an ambitious program to extend the availability of midwifery services by training and posting midwives in villages throughout Indonesia (MOH, 1994; Kosen and Gunawan, 1996; Handayani et al., 1997). Between 1990 and 1996 the Government of Indonesia planned to provide a midwife in every non-metropolitan community (MOH, 1994). Midwives were typically recruited from three-year nursing academies and given one additional year of midwifery training (Sweet et al., 1995). By 1998 54,000 midwives had been trained, and between 1986 and 1996 the number of midwives per 10,000 population rose more than ten-fold from 0.2 to 2.6 (Hull et al., 1998; Reproductive Health Focus, 2000; MOH, 2000).

Village midwives are charged with a number of duties, including provision of health and family planning services, promoting community participation in health, working with traditional birth attendants, and referring complicated obstetric cases to health clinics and hospitals (GOI, 1989; MOH, 1994). In some settings the midwives are provided with a Delivery Post, which functions as a maternity home within the village. In other settings the midwife has a small office within which she provides services. For three to six years after being placed in a village, the midwives are paid a salary by the Government of Indonesia (Hull et al., 1998). The midwives maintain a public practice during normal working hours and are allowed to practice privately after hours. It is expected that during their years of government service, midwives will build up a client base so that when their contract ends, they can maintain their practice in the village without a government salary (MOH, 1994; Gani, 1996).

The Village Midwife program builds on the public health system of clinics and outreach activities that was put in place in the 1970s and 1980s in Indonesia. The backbone of this system at the community level is the public health center (*puskesmas*). The health center provides a range of services and is a basic source of subsidized outpatient care for both men and women across the age range. Health centers are generally headed by a doctor, who oversees a midwife and various paramedical workers (MOH 1990). Each subdistrict (consisting of 20-40 villages or townships) has one or more health centers.

Staff members of the health center are responsible for implementing outreach programs, including the *Posyandu* (literally the Integrated Service Post but referred to here as a community health post). The community health post is a monthly activity for children under five and their mothers, staffed by community volunteers and if possible by staff from the health centers. When health workers are present the posts generally provide prenatal care, immunization, and contraceptive injections (Kosen and Gunawan, 1996). Otherwise services include the provision of vitamins, oral rehydration solution, nutritional screening and oral contraceptives.

Private practitioners are also an important source of health care in Indonesia. Generally private services are more available in urban than in rural areas, but because employees of the health center can offer private services when the health center is closed, private practitioners are found in rural areas as well (Gani, 1996; Brotowasisto et al. 1988; World Bank 1990).

CONCEPTUAL FRAMEWORK

In Indonesia, as in other countries, improvements in health outcomes and expansion in health services have occurred simultaneously. This fact does not tell us that the investments in services caused the improvements in health. It is plausible that other factors (including economic growth) that have changed over the period, are correlated with both improvements in health and with greater access to services.

In an effort to isolate the role of health services, a number of studies have contrasted spatial variation in program availability or strength with spatial variation in health outcomes. However, a correlation between access and health outcomes at a point in time does not identify the direction of causality. Services may be provided in a particular location in response to demand for those services, or people who want services may move to places where they are provided (Rosenzweig and Wolpin, 1986, 1988). Either scenario yields a spurious correlation between access to services and health outcomes because the relationship is driven by a common (unobserved) factor.

It is also possible that governments target particular types of communities for interventions. Targeting will not bias estimates of the effects of the intervention if it is based on characteristics that are observed and controlled in a regression context. However, if targeting is based on unobserved characteristics (or if the full set of characteristics used for targeting are not controlled in the regression) and those unobserved characteristics are correlated with the outcome of interest, estimated effects of the intervention will be biased. The direction of that bias is ambiguous.

To illustrate, imagine that government services are provided in communities that are under-served by private providers and that health status in those communities is relatively poor, everything else held equal. Unless *all* characteristics that underlie the placement of the program are controlled, the estimated impact of the intervention will be negatively biased—and the magnitude of the bias will be greatest for the interventions targeted to the people who most need them. This issue of selective program placement has been demonstrated to be important in the context of health policies in Indonesia (Frankenberg, 1992; Pitt, Rosenzweig & Gibbons, 1993; Gertler and Molyneaux, 1994).

In theory, social experiments involving random assignment of subjects to treatment and control groups sidestep these complicating issues. While such experiments have produced valuable findings with respect to some policy questions (see, for example, Berggren et al., 1981; Faveau et al., 1991; Newhouse et al., 1993; Dow, Gertler, Strauss & Thomas, 1999), they have their own drawbacks that reduce the circumstances in which they are a realistic option. Social experiments sometimes raise serious ethical issues. Moreover, they are expensive, typically take a long time to complete, and can be difficult to implement. In many instances experiments induce behavioral responses (such as migration to areas that are served in the trial) that substantially complicate evaluation of the intervention. Because experiments are typically small in scale, the results may not readily generalize to the entire population of interest (Ewbank, 1994).

In our view, observational data are an important complement to evaluations of interventions based on randomized trials. Of course, studies based on observational data cannot ignore the complicating issues discussed above.

We adopt a quasi-experimental approach to evaluate the impact of an expansion in access to midwifery services and health outcomes in Indonesia. Using longitudinal household survey data, we compare health prior to the introduction of a midwife in a community with health of the same individual after the intervention. In so doing, all factors that are fixed at the individual and community level are swept out of the model, including any fixed characteristics that are correlated with the placement of midwives. This "fixed effects" model is often used in the program evaluation literature. We are contrasting *changes* in health of the "treated" with *changes* in health of a control group—respondents in communities where midwives were not introduced:

$$\Delta\theta_i = \alpha + \beta\, M_c + \varepsilon_{ic}$$

where $\Delta\theta_i$ is the change in health of individual i and M_c is an indicator variable for whether or not a village midwife was introduced in community c. Time-varying unobserved heterogeneity that affects changes in health is captured in ε_{ic}. The intercept, α, reflects changes in health of the population between the two waves of the survey that are not related to the introduction of a midwife. β measures the difference in changes in health status of those living in communities where a midwife was introduced relative to other communities. It is an "average treatment effect," calculated over all people living in the "treated" communities.

The Village Midwife program was conceived out of concern for maternal mortality rates. Since reproductive age women are likely to be the greatest beneficiaries of the introduction of a midwife, we refine the treatment group to include only those women in the treated communities and compare the effect of introducing a midwife on their health with that of men of the same age living in the same communities

$$\Delta\theta_i = \alpha_1 I_i^{pf} + \alpha_2 I_i^{pm} + \beta_1\, M_c{*}I_i^{pf} + \beta_2\, M_c{*}I_i^{pm} + \varepsilon_{ic}$$

where I_i^{pf} is an indicator variable for prime age females and I_i^{pm} is defined analogously for prime age males. The coefficient on the interaction between the prime age female and Midwife indicator variables, β_1, is an estimate of the difference in the health of a prime age woman in a "treated" community relative to the change in health of a similar woman in a community that did not have a midwife introduced.

If the introduction of a midwife in a village is uncorrelated with time-varying unobserved heterogeneity, ε_{ic}, then this model will provide an unbiased estimate of the effect of the program. However, we will show below that midwives are more likely to be introduced in poorer communities with little infrastructure. If changes in health differ between poorer and better off communities, β_1 will be a biased estimate of the effect of the program. We can get some sense of the extent of that bias by comparing changes in health of men in communities where a midwife was introduced with changes in health of men in other communities. Under the assumption that midwives have no impact of the health of males, this difference, β_2, will be a measure of the "program placement effect". The "difference-in-difference" between the effect on females and the effect on males, β_1-β_2, nets out the "program placement" effect and thus provides an estimate of the "midwife" effect.

It may be that midwives do in fact influence health of males—directly (through providing services to men, for example) or indirectly (through spillovers such as nutrition education to women or through affecting the health behaviors of women which then affects the behaviors of men). In this case, the "difference-in-difference" will be a biased estimate of the impact of the introduction of a midwife. The empirical importance of this concern can be probed by expanding the control groups to include older females, I^{of}, and older men, I^{om}:

[1] $\Delta\theta_i = \alpha_1 I_i^{pf} + \alpha_2 I_i^{pm} + \alpha_3 I_i^{of} + \alpha_4 I_i^{om} + \beta_1 M_c{*}I_i^{pf} + \beta_2 M_c{*}I_i^{pm} + \beta_3 M_c{*}I_i^{of} + \beta_4 M_c{*}I_i^{om} + \varepsilon_{ic}$

Older men are the least likely to directly benefit from the introduction of a midwife; assuming midwives do not have a deleterious impact on the health of older men, the difference-in-difference, β_1-β_4, provides a lower bound estimate of the effect of a midwife.[1] The health of older women, on the other hand, has more in common with prime age women and so they may well benefit from the introduction of a midwife; we expect, therefore, that β_1-β_3, is likely to understate the effect of a

[1] It is possible that midwives will encourage families to reduce their investments in the health of older men in which case the difference-in-difference will be biased upwards. This strikes us as a decidedly implausible and unlikely scenario.

midwife.

If the survey measures all the correlates of changes in health status that affect the allocation of midwives, it is possible to directly estimate the effect of a midwife by controlling those characteristics in the regression. We will experiment with this approach drawing on the rich array of community level information contained in our data source. In addition, the inclusion of individual and community-level observables will increase the efficiency of the regression estimates.

It is possible, however, that even after controlling observed differences across communities, there is a correlation between the introduction of a midwife and unobserved heterogeneity, ε_{ic}, which would bias estimates of the effect of the program. We thus include a community-specific fixed effect, μ_c, which, in a regression of changes in health, $\Delta\theta$, serves as a community-specific time trend and sweeps out all changes that are common across adults in each community that gained a midwife. The conceptual experiment that we have in mind is to contrast changes in health of reproductive age women with changes in health of other adults *living in the same community*. Bias due to program placement will be absorbed in the community effect and we can estimate the effect of the midwife program. Clearly, in this case, we can only estimate the difference-in-differences and we exclude the term for prime age males from the regressions:

[2] $$\Delta\theta_i = \alpha_1 I_i^{pf} + \alpha_3 I_i^{of} + \alpha_4 I_i^{om} + \beta_1 M_c{*}I_i^{pf} + \beta_3 M_c{*}I_i^{of} + \beta_4 M_c{*}I_i^{om} + X_i\gamma + \mu_c + \varepsilon_{ic}$$

but include individual characteristics, X_i, to improve efficiency.

The difference-in-differences will be biased if program placement is based on the health of reproductive age women *relative* to the health of other adults in a particular community. We will explore the evidence for this sort of targeting in the analyses below.

The next section describes the data sources. Regression results follow.

DATA

The data we use for this study are from two rounds of the Indonesia Family Life Survey (IFLS). The IFLS is a panel survey of individuals, households, communities, and facilities. The first round of data (IFLS1, collected in 1993) included interviews with 7,224 households

(Frankenberg, Gertler, and Karoly, 1995). The IFLS conducted interviews in 321 communities in 13 of Indonesia's 26 provinces and is representative of about 83% of the Indonesian population.

In 1997 a resurvey was conducted of the IFLS1 individuals, households, communities, and facilities. This survey (IFLS2) sought to reinterview all IFLS1 households (and all members of these households in 1997), as well as a set of target members of IFLS1 households in 1993 who had migrated out by 1997 (Frankenberg and Thomas, 2000). IFLS2 succeeded at reinterviewing 94.5% of IFLS1 households and 92% of those individuals who are age-eligible for this study.[2]

The IFLS questionnaire covers a broad range of topics. Central for this project, are the fact that height and weight of each household member is recorded by a trained anthropometrist. These measures were taken in both IFLS1 and IFLS2. Our primary indicator of health of adults will be body mass index (BMI) which is weight (in kilograms) divided by height (in meters) squared. BMI is more directly interpretable than weight (which varies systematically with height) and extreme values of BMI have been shown to be associated with elevated risk of morbidity, difficulties with activities of daily living and mortality (Waaler, 1984; Fogel, Costa, and Kim, 1994; Strauss and Thomas, 1998). BMI has also been shown to be associated with physical capacity as indicated by VO_2max (Spurr, 1983) and labor productivity (Thomas and Strauss, 1997).

Table 1 presents summary statistics of levels of BMI for four groups: reproductive age women (age 20 to 45 in 1993), men of the same age, older women and older men. On average, BMI has increased for prime age men and women but remained constant for older respondents. The table also reports the fraction of each group whose BMI is below 18.5, a cut-off below which elevated risks of morbidity and mortality have been well-documented. About 10% of prime age adults are below this cut off and that percentage has declined between 1993 and 1997. Some 30% of older adults are below the cut off and the fraction has increased for older men. The regression models are

[2] Younger, male, and higher-income individuals were less likely to be recontacted in IFLS2. From the point of view of this paper, the key issue is whether attrition is greater in communities that gained a Village Midwife, conditional on observable characteristics. The answer is "no": the difference in completion rates in those communities relative to other communities is 0.7% (t = 1.3).

specified in terms of changes in BMI for each respondent which, since height is fixed, is equivalent to changes in weight. We interpret this change as indicative of a change in general health status.

Part of these changes in BMI reflect changes over the life course and changes in diet or energy expenditure because of changes in household resource availability. The regressions control the age and education of each respondent (which are displayed in Table 1) along with household *per capita* expenditure (PCE) at the time of the survey. PCE is thought to be a good measure of resource availability in the household.

The focus of this paper is on the impact of expanding the Village Midwife program. The program is not the only aspect of the health environment which may have changed during the 1990s. As clarified in the discussion of the conceptual framework above, it is important to control for community-level characteristics that might be correlated with both changes in health and the introduction of a midwife. The IFLS is a particularly rich resource in this regard. Each wave of the survey contains a detailed set of community-specific instruments that are administered in the 321 IFLS enumeration areas. These include extensive interviews with the *kepala desa* (administrative office of the community or village leader), the head of the *PKK* (community women's group) and with knowledgeable informants in a sample of up to 16 health providers and up to 12 schools in the community. Drawing on those data, we have constructed measures of other dimensions of the health service environment and also measures of levels of infrastructure. These measures, which are available for each wave of the survey, include access to public and private health service provides (as indicated by distance to clinics), quality of services (as indicated by strength of outreach of public clinics) and measures of physical and economic infrastructure that are not directly related to the health service environment but may be related to the introduction of a midwife to the community.

Table 2 summarizes aspects of the health service environment and the physical infrastructure environment, as measured by the IFLS1 (1993) and IFLS2 (1997) community-facility surveys. Access to the Village Midwife program is measured with an indicator of whether or not a Village Midwife was present in the community in each of the two survey years. Access to clinics is measured as the distances from the community to the nearest health center and to the nearest private practitioner.[3] With respect to outreach efforts by public clinics, we construct a variable indicating whether or not the community receives monthly visits from health center staff. Physical infrastructure is measured by whether most of the community's roads are paved and whether a public phone is located in the community.[4]

The IFLS data reflect the substantial expansion in the Village Midwife program that is documented in the literature on the Indonesian health system. In 1993 just under 10% of IFLS communities had a Village Midwife; by 1997 45% of IFLS communities did (Table 1). Over the four-year period between survey waves, fully 36% of IFLS communities gained a Village Midwife.

The data also suggest that the strength of health center outreach to communities declined somewhat between 1993 and 1997. The fraction of communities that reported receiving monthly visits from clinic staff fell from 95.6% in 1993 to 88.0% in 1997. Only about 3% of communities gained monthly visits from health center staff, while 10% of communities lost such visits.

The basic measures of access to public and to private services— distances to the closest public and private facilities—changed little between 1993 and 1997. In 1993 the median distances to public and to private facilities were 1.0 and .6 kilometers respectively. In 1997 the median distances were 1.1 and .5 kilometers respectively. Neither change is statistically significant. The lack of change in distance to a public clinic likely reflects the fact that in Indonesia, most of the expansion in fixed-site government health facilities took place prior to the 1990s—a fact that is helpful from the point of view of identifying the effect of an expansion in the midwife program.

With respect to physical infrastructure, about half the communities had a public phone in 1997, up from 44.7% in 1993. Between 1993 and 1997 the fraction of communities in which most roads are paved rose by 14 percentage points, bringing the total fraction to 85.1%

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[3] Data on the availability of services is collected through a Service Availability Roster (SAR). The SAR lists each facility mentioned by the female or male household head of each IFLS household as an option for care. The community leader is then asked to provide information on the distance, travel time, and cost associated with reaching that facility from the center of the community.

[4] Communities with a pay phone are generally quite well-off on other dimensions of development, while communities in which the main road is not paved are generally relatively poor.

The descriptive statistics indicate a substantial increase in access to Village Midwives between 1993 and 1997. We address the question of how these midwives were allocated across communities by using the IFLS data from 1993 to explore how aspects of socioeconomic development and health status, measured at the community level in 1993, are associated with expansion in access to midwives between 1993 and 1997. The dependent variable in the regressions is a dichotomous indicator of whether the community gained a Village Midwife by 1997.[5]

The results are presented in Table 3. In the first model, we include only the variables reflecting per capita expenditure levels in 1993 (included as a spline with a knot at the 25th percentile), to test whether gaining a Village Midwife varies by how poor or wealthy the community is. For communities in the lowest quartile of the expenditure distribution, there is no impact of a rising level of expenditures on the probability that a Village Midwife will be assigned to the community between 1993 and 1997. In contrast, the coefficient on mean expenditure level for communities with expenditures in top three quartiles of the distribution is large, negative, and statistically significant. The results provide strong evidence that among the IFLS communities, it is the poorest as of 1993 that were most likely to gain a Village Midwife by 1997.

In the second specification, we introduce controls for province (coefficients not shown) and for other aspects of community infrastructure. These include whether the community has a public phone and whether the main road in the community is paved. The level of health service infrastructure is measured as the distance from the community center to the nearest public health clinic and to the nearest private practitioner, and by whether the community received monthly visits from health center staff in 1993.

The introduction of these additional controls produces an almost three-fold increase in the R^2 of the model, from .08 to .22. Moreover, the results reveal that the further a community was from a public health clinic in 1993, the more likely it was to gain a Village Midwife by 1997.

[5] We estimate community-level regressions, where each of the 321 IFLS communities serves as an observation.

Distance from a private practitioner also has a positive but only marginally significant effect. Additionally, communities with a public phone in 1993 were significantly less likely to gain a Village Midwife by 1997.

In the third specification we add controls for per capital expenditure levels in 1997 and for whether the community received monthly visits from health center staff in 1997. Because we simultaneously control for these characteristics in 1993, the 1997 characteristics can be thought of as reflecting change since 1993. Based on the coefficients for the 1997 characteristics, it does not appear that the communities that were becoming poorer over time were more likely to gain a midwife, or that health centers reduced their outreach activities in communities that gained a midwife.

In the fourth specification, we introduce a control for the average Body Mass Index of adults in the community in 1993, as a means of assessing whether health status in the community is correlated with placement of midwives. The coefficient on this variable is not statistically significant. Possibly it is not the BMI of all adults, but rather the BMI of certain demographic groups that is correlated with the allocation of Village Midwives. For example, midwives may be targeted towards communities in which women were particularly disadvantaged. In the fifth model we add variables measuring the average BMI of men, of women 50 and above, and of men 50 and above. The coefficient on mean BMI captures the correlation between the BMI of prime age females and the introduction of a midwife. Midwives were more likely to be introduced in communities in which men were heavier than women and less likely to be introduced where older women were lighter than prime age women. On the margin, the presence of men who are heavy is positively associated with gaining a Village Midwife, while the presence of older women who are light is negatively associated with gaining a Village Midwife. However, neither of these correlations is significant, and as a group, the BMI variables are not statistically significant. The fifth specification adds measures of the proportion of adults (by age and sex group) whose BMI is less than 18.5, to ascertain whether the addition of a Village Midwife responds to the prevalence of poor health in 1993 (rather than to an indicator of average health). None of the coefficients on these variables is statistically significant, nor are the health status measures jointly significant.[6]

The community-level measures of health status do not appear to predict gaining a Village Midwife by 1997. Nor does their presence in the models change the relationships of economic status and of access to infrastructure to gaining a Village Midwife.

In sum, it appears that the expansion of Village Midwives between 1993 and 1997 was not a direct response to levels of nutritional status in 1993, but neither was the allocation of midwives to communities random. Instead, the empirical evidence suggests that the communities into which Village Midwives were introduced between 1993 and 1997 were those that in 1993 were relatively poor and distantly located from public health services.

RESULTS

The results presented in Table 3 suggest that a community's levels of poverty and remoteness influence whether it received a Village Midwife. If the characteristics that influence getting a Village Midwife also influence health status, as seems likely, cross-sectional estimates of the relationship between presence of a Village Midwife and health status will be biased unless the specifications include controls for all the factors that affect both health status and allocation of Village Midwives. We address this issues with the strategies described in the conceptual framework, estimating four models that relate change in BMI to exposure to a Village Midwife. An increase in BMI over time is interpreted as health-improving.[7] The independent variable of primary interest is whether the individual lived in a community that gained a Village Midwife between 1993 and 1997.

Midwives and Adult BMI

Table 4 presents the main regression results. Estimates of β are reported in the upper panel (results for all the covariates are available in the Appendix). We begin with the correlation

[6] We also tested for a correlation between mean level of children's nutritional status in 1993 and receipt of a Village Midwife by 1997, and found no significant relationship between the two.
[7] In 1993 only 4.5% of the sample had a BMI of 28 or higher, the level above which morbidity and mortality has been shown to rise.

between the change in BMI of an adult measured in 1993 and in 1997 and whether a midwife was introduced into the village between 1993 and 1997. As shown in the first column, that correlation is essentially zero.

Following the discussion above, in the second specification (Column 2), the treatment and control groups are refined. Women of reproductive age (20-45 years) are considered the "treatment" group, and are contrasted with three "control" groups: males in the same age group, women over 45, and men over 45. This specification allows us to examine the correlations between gaining a village midwife and change in BMI for the four demographic groups and to test whether the correlations differ across the groups (these "difference-in-difference" tests are presented in the lower panel of the table).

The results from this specification indicate that the addition of a Village Midwife to a community is positively associated with change in BMI for women of reproductive age but the correlation is negative for the other demographic groups. The negative correlation is significant for older men. We do not interpret the negative effects as indicating that midwives are hurting everyone except young women, but rather that they are capturing the "program placement" effects and thus reflect the fact that midwives are allocated to those communities where improvements in health status are not likely.

As discussed in the model section above, the difference-in-differences address this concern. Those estimates are reported in the second panel of the table and they indicate that midwives are associated with improved health of young women relative to the other demographic groups.

This result persists when we include observable characteristics of the respondents and their communities (Model 3) although the differential effect on older and younger women is slightly smaller (and significant only at 10%).[8] The fact that residence in a community that gained a Village

[8]At the individual level we include education (included as a spline function with knots at 6 and 9 years of education) and age (included as a spline function with knots at 26, 46, 56, and 66 years). At the household level we include a measure of (log of) per capita expenditure level (included as a spline function with knots at the 25th, 50th, and 75th percentile). We include several other community-

Midwife is associated with improved BMI only among prime age women suggests that the relationship is causal. If placement of Village Midwives occurred in communities where nutritional status improved for other reasons, one would expect the correlation with introduction of a Village Midwife would be positive for all demographic groups.

Our final specification (Model 4) goes one step further. We include a community-specific time trend to ask whether, *within* communities that gained a Village Midwife, the health of reproductive age women improved more than other adults. The difference-in-difference estimates, in the lower panel of the table, indicate that relative to men, the answer is in the affirmative. BMI improved by about 0.20 more for reproductive age women in these communities than older or younger men and this difference is significant. While the difference is slightly bigger for older men, which is consistent with our expectation that spillover benefits of a midwife would be smallest for this group, the difference between the effect on younger and older men is small and not significant. There do, however, appear to be spillover benefits of midwives to older women: while they benefit less than reproductive age women, that difference-in-difference is not significant.

Inferences drawn from the difference-in-difference results are remarkably consistent across the three empirical specifications. There is evidence that unobserved heterogeneity does contaminate the estimates, particularly among older respondents and so we are inclined to place most weight on the estimates in Model 4.

The results indicate that increased access to Village Midwives between 1993 and 1997 has had a positive impact on the health of women, particularly those of reproductive age. Since there is no similar effect on males, we conclude it does not reflect placement of midwives in communities where health would have improved in any case. It is not possible to rule out the possibility that midwives were placed in communities where the health of young women would have improved, relative to that of men. While that strikes us as an unlikely scenario, we can explore its relevance

level measures of change in the health and infrastructure environment between 1993 and 1997: whether the community has gained or lost monthly visits from health clinic staff, changes in distances to public clinics and private practitioners, whether the community gained paved roads, and whether the community gained or lost a public phone. We also include a control for urban/rural status.

by assessing whether the *timing* of the introduction of a midwife to a community affects reproductive health of women. We turn next, therefore, to contrasting the birthweight of babies born before and after a midwife is introduced within a community.

Midwives and Birthweight

We use birthweight as a measure of pregnancy outcome. Birthweight is not only a marker of a successful pregnancy, it also affects the subsequent health of the child. Data from the Philippines have shown that birthweight is correlated both with survival during the neonatal period and with the risk of stunting in the first two years of life (Adair and Guilkey, 1997; Popkin et al., 1993). We exploit the fact that in both rounds of the IFLS women were asked to provide detailed accounts of all pregnancies that occurred in the five years before the survey, including birthweight (if the baby was weighed). We pool the data from IFLS1 and IFLS2 to obtain information on 5,155 pregnancies that occurred between 1988 and 1997 and ended in live births. The pregnancies were reported by 3,445 women, of whom 1,179 were interviewed in both 1993 and 1997.

The mothers reported birthweights for a total of 3,315 births (64% of all births). Mean birthweight was 3,162 grams, and 8.7% of infants were reported as weighing less than 2,500 grams (the standard cutoff for low birthweight).[9] Another 6.3% were reported as weighing exactly 2,500 grams.[10] The distribution of reported birthweights in the IFLS data does not suggest unusually high or low proportions of low birthweight babies relative to other developing countries or relative to other data from Indonesia. There is heaping on weights (in kilograms) that end in .0 or .5, as has been observed in other data sets from developing countries with retrospectively-reported birthweight data (Robles and Goldman, 1999). The heaping indicates measurement error in the reported birthweights, which for our purposes, will inflate standard errors but will not bias the estimated effect of a midwife.

[9] The 1997 Demographic Health Survey reports that 7.7% of live births in the 1992-97 period weighed less than 2500 grams, but does not report average birthweight. Mean birthweight in the 1991 DHS was 3,188 grams (Boerma et al., 1996).

[10] If the birthweights of all of these babies were rounded up, and in fact these babies weigh less than 2,500 grams at birth, the estimate of the percentage babies that are low birthweight would rise to 15%.

We also examined the correlates of reporting a birthweight (results not shown). The probability that a birthweight is reported rises with the mother's age (up to age 35) and, as one might expect, with level of education and with per capita expenditures. Birthweights are also much more likely to be reported for first births and for births delivered either in a medical setting or at home with the attendance of a biomedically trained assistant than for births delivered at home with the assistance of traditional birth attendants. Birthweight is more likely to be reported for later births than for earlier births, but the presence of a Village Midwife in the community during the pregnancy is not associated with whether a birthweight was reported (this finding holds across all communities and in only those communities that had a Village Midwife by 1997).

To analyze the relationship between access to a Village Midwife and birthweight, we used data from the IFLS2 Community-Facility Survey on the number of years a Village Midwife had been present in the community, combined with information on the time of conception, to construct a variable indicating whether a Village Midwife was present in the community during the pregnancy. Within communities that had received a Village Midwife by 1997, 63% of pregnancies occurred before the Village Midwife arrived, 37% occurred after her arrival. This within-community variation in exposure to the program can be used to estimate the effect of the Village Midwife's presence on birthweight, net of aspects of the community that are fixed over time and affect both allocation of Midwives and pregnancy outcomes.

Table 5 presents results from these fixed effects analyses of birthweight. The first column provides the coefficients for the relationship between the presence of a Village Midwife during the pregnancy and birthweight, without any controls. Column 2 adds a variety of pregnancy-specific, mother-specific, and community-specific controls (the full table of results is available in the appendix). For each pregnancy we include markers for whether the pregnancy was the woman's first and the sex of the infant, as well as an indicator of year of birth. We also include measures of the mother's height, her educational level, and the (log of) per capita household expenditure. At the community level, we include the array of measures of physical and health infrastructure described previously.[11]

In both specifications, birthweights are significantly greater within a community after a midwife is introduced relative to before. To attribute this to a program placement effect, one would have to argue that midwives were allocated to areas where birthweight would have improved even in the absence of midwives. That seems very unlikely.

Model 3 also includes a term for the year the baby was born to pick up any time trends in birthweight. Disentangling an effect of time on birthweight from an effect of the presence of Village Midwife on birthweight is potentially difficult since Village Midwives were phased into communities over time. As year of birth increases, so does the probability that a Village Midwife was present in the community. The coefficient on year of birth does not indicate any evidence of a time trend in birthweights.[12]

DISCUSSION

Both the results for change in Body Mass Index and the results for birthweight suggest that gaining access to a Village Midwife is associated with improvements in health outcomes for women of reproductive age, and for their babies. The impact of the Midwife's presence on adult health status is limited to women, primarily those between the ages of 20 and 45. Within communities that gained a Village Midwife, the change in BMI experienced by reproductive-age women is significantly larger than the change in BMI experienced by men.

For reproductive-age women, the coefficient on change in BMI that is associated with gaining a Village Midwife is 0.2. If 0.2 is added to the 1993 BMI of all women of reproductive age,

[11] These include distance to the nearest public clinic, distance to the nearest private clinic, whether most roads in the community are paved, whether the community has a public telephone, and whether the community receives monthly outreach visits from the clinic staff. The community-level variables were measured in both 1993 and 1997. We matched children born prior to October, 1995 to the 1993 data, and those born in October, 1995 or later to the 1997 data. We do not include an indicator of whether the community is urban or rural, since it doesn't change over such a short time period.

[12] We have also estimated the time trend for birthweight separately depending on whether the community ever had a Village Midwife posted to it. In this specification, the time trends are not statistically significant for either type of community, nor do the coefficients on time differ from one another.

the fraction of women whose BMI is less than 18.5 falls from 12.8 to 10.9—a decline of nearly 15%.

The cut-off of 18.5 is used to indicate chronic energy deficiency. Women whose BMI is higher than 18.5 but still low (for example under 20) may not be at increased risk of morbidity or mortality, but if they become pregnant, the amount of weight they will need to gain to achieve a healthy pregnancy will be greater than if their BMI is higher prior to becoming pregnant (Kasovec and Anderson, 1991). In other words, a low starting weight puts women at a disadvantage with respect to the nutritional requirements of pregnancy. Therefore, from the perspective of insuring healthy pregnancies, there may be an advantage to elevating the BMI of reproductive age women to at least 20. If 0.2 is added to the 1993 BMI of women of reproductive age, the fraction of women whose BMI is less than 20 falls from 30.7 to 28.2—a decline of 8%.

To this point we have focused on developing and implementing a statistical strategy for estimating the size, direction, and statistical significance of the association between access to Village Midwives and health outcomes. Our results reveal a moderate impact of gaining a Village Midwife on the Body Mass Index of women of reproductive age and a small impact on birthweight. In both cases the effects are health-improving and statistically significant and likely presage positive effects on a wider array of health behaviors and outcomes.

We turn now to a discussion of why Village Midwives may matter for health outcomes. The IFLS data provide evidence that in terms of service provision, the Village Midwives offer their communities a great deal—not all of it narrowly related to prenatal and delivery care. The IFLS facility survey included interviews with 157 Village Midwives located in 114 of the 147 IFLS communities that had a Village Midwife in 1997.

Table 6 summarizes the services provided by the Village Midwives who were interviewed as part of the IFLS. In addition to prenatal care, delivery assistance, immunizations, and family planning, the vast majority of Village Midwives provide more general curative care and stitch wounds. Additionally, some can incise and drain abcesses, provide TB treatment, and treat dehydration with an IV. Moreover, Village Midwives also prescribe drugs, including antibiotics, and dispense aspirin, cough medication, skin ointment, vitamins, and micronutrient supplements.

That Village Midwives provide general services in addition to those particularly oriented toward maternal and well-baby care is supported by research conducted in Central Java (Mukti et al., 1997). In interviews, record abstraction, and client observations conducted with 19 Village Midwives, researchers found that while reproductive age women are the primary clients of Village Midwives, they also treated a sizable fraction of non-obstetric patients, including men.

The finding that services offered by Village Midwives and used by community residents are more comprehensive than prenatal care and delivery assistance suggests some of the pathways through which availability of a Village Midwife may improve women's health and pregnancy outcomes. If Village Midwives provide a variety of drugs and curative care treatments, their presence may reduce durations of illness from diarrheal and respiratory diseases and thus weight loss associated with such illnesses.

The role of the Village Midwife, as described by the Indonesian Ministry of Health, provides further insights into how the availability of a Midwife affects health status. The MOH views Village Midwife as a health resource in her community. According to the Ministry, she is responsible for providing health services, especially maternal and child health services and family planning, in the area of the village in which she resides. She is to seek out patients rather than waiting passively for them to come to her and she is to visit clients in their homes (MOH, 1994). These activities bring a Village Midwife into contact with a wide range of community residents, in a variety of settings, and provide her with opportunities to advise women on nutrition, food preparation, sanitation, and other health-promoting behaviors.

The ability to offer a range of curative and preventive services, coupled with nutrition education and distribution of vitamins and micronutrients, likely explains the positive associations we observe between the arrival of Village Midwives and improvements in women's nutritional status and improvements in the birthweights of their babies. The associations are robust to several strategies that attempt to correct for unobservable characteristics that might drive both access to midwives and health outcomes, increasing our confidence that a causal mechanism underlies the relationships we observe in the data. We conclude, therefore, that Village Midwives likely offer services of value—particularly to women of reproductive age.

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Table 1
Body Mass Index of Adults: 1993 and 1997

Sex and Age (1993)	N		1993	1997	Change
Women 20-45	3030	BMI	22.1	22.8	0.7*
			(0.06)	(0.07)	(0.03)
		% BMI<18.5	12.7	9.6	-3.1*
		Age	37		
		Education	5.4		
Men 20-45	2232	BMI	21.2	21.6	0.3*
			(0.06)	(0.06)	(0.03)
		% BMI<18.5	12.1	10.7	-1.4
		Age	36		
		Education	6.6		
Women 46 and older	1913	BMI	21.0	21.0	0.0
			(0.09)	(0.09)	(0.04)
		% BMI<18.5	29.1	28.8	-0.3
		Age	61		
		Education	2.4		
Men 46 and older	1649	BMI	20.4	20.4	0.0
			(0.07)	(0.08)	(0.03)
		% BMI<18.5	26.9	30.4	3.5*
		Age	62		
		Education	4.7		

Table includes individuals who were interviewed and measured in both IFLS1 and IFLS2 and were at least 20 years old in IFLS1. Standard errors of mean BMI presented in brackets. * indicates that the 1993 and 1997 levels are significantly different from one another.

Table 2
Access to Health Care and the Health Outreach Programs in 1993 and 1997

	1993	1997
% with a Village Midwife	9.4%	45.8%*
Gained a Village Midwife		36.4
% received monthly visits from health center staff	95.6	87.9*
Gained monthly visits		2.8
Lost monthly visits		10.6
Mean distance to health clinic	1.0	1.1
Mean distance (km) to a private practitioner	.6	.5
% with a public telephone	44.2	52.0*
Gained a public telephone		12.8
Lost a public telephone		5.0
% with a paved (main) road	70.7	84.4*
Gained a paved (main) road		13.7

Based on data from the 321 IFLS communities. * indicates that the 1993 and 1997 statistics are significantly different from one another ($p<.05$).

Table 3: Community-level Correlates of Gaining a Village Midwife by 1997

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
1993 per capita expenditure < 25th %	0.27	1.05	1.53	1.33	1.32	1.07
	(0.78)	(0.92)	1.09	(0.94)	(0.96)	(1.01)
1993 per capita expenditure >= 25^{th} %	-1.90**	-1.28**	-1.00*	-1.12*	-1.08**	-1.00**
	(0.39)	(0.48)	0.50	(0.48)	(0.49)	(0.49)
1997 per capita expenditure < 25th %			-0.78			
			1.09			
1997 per capita expenditure >= 25^{th} %			-0.51			
			0.37			
Mean BMI, 1993				-0.16	-0.24	-0.08
				(0.10)	(0.21)	(0.26)
Mean BMI, males 1993					0.37*	-0.02
					(0.21)	(0.14)
Mean BMI, females > 50					-0.17*	0.27
					(0.09)	(0.24)
Mean BMI, males > 50					-0.09	-0.18
					(0.11)	(0.12)
% with BMI < 18.5						0.62
						(1.10)
% men with BMI < 18.5						3.82
						(2.94)
% females >=50, with BMI<18.5						-0.28
						(1.92)
% males >=50, with BMI<18.5						-0.21
						(1.09)
Urban residence		-0.27	-0.16	-0.21	-0.14	-0.09
		(0.36)	0.37	(0.36)	(0.37)	(0.37)
Distance to nearest public clinic		0.27**	0.32	0.27**	0.25**	0.25**
		(0.12)	0.13	(0.13)	(0.12)	(0.12)
Distance to nearest private practice		0.25*	0.31**	0.24*	0.28**	0.26*
		(0.13)	0.14	(0.13)	(0.14)	(0.14)
Monthly Visit from Health Ctr Staff ('93)		0.15	0.11	0.22	0.08	0.13
		(0.73)	(0.74)	(0.74)	(.74)	(0.76)
Monthly Visit from Health Ctr Staff ('97)			0.79			
			(0.52)			
Public phone in the community		-0.93**	-0.84**	-0.87*	-0.85**	-0.76*
		(0.38)	0.38	(0.38)	(0.39)	(0.39)
Market in the community		-0.03	0.03	0.01	-0.01	0.03
		(0.33)	0.33	(0.33)	(0.34)	(0.35)
Most roads are paved		0.37	0.36	0.33	0.44	0.39
		(0.35)	0.36	(0.35)	(0.36)	(0.37)
Constant	-2.79	-11.00	-8.46	10.03	-11.67	-12.07
F	35.05	93.52	96.33	96.97	103.97	106.56
Prob (F)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
R2	0.08	0.22	0.23	0.23	0.25	0.25
X2 (Health indicators)					9.13	11.81
					.06	0.16

Logistic regressions based on data from 321 communities. Standard errors reported in parentheses. *=p<=.10, **=p<=.05

Table 4: Change in BMI between 1993 and 1997 and Gaining a Village Midwife

		Model 1	Model 2	Model 3	Model 4
		OLS	OLS	OLS	FE
Covariates:					
Individual observables		.	.	Yes	Yes
Community observables		.	.	Yes	.
Community specific time trend		.	.	.	Yes
Gain a Village Midwife by 1997		-0.043			
		(0.035)			
Gain a Village Midwife if:	Female 20-45		0.120*	0.113*	0.174*
			(0.065)	(0.066)	(0.087)
	Male 20-45		-0.075	-0.085	.
			(0.062)	(0.064)	
	Female >45		-0.105	-0.061	0.040
			(0.076)	(0.077)	(0.099)
	Male >45		-0.173**	-0.148**	-0.032
			(0.066)	(0.067)	(0.103)
Difference in Difference					
Treatment	Control				
Female 20-45	Male 20-45		0.195*	0.199**	0.174**
			(0.090)	(0.089)	(0.087)
	Female >45		0.225**	0.171*	0.134
			(0.100)	(0.099)	(0.093)
	Male >45		0.293**	0.261**	0.206**
			(0.092)	(0.091)	(0.097)

The dependent variable is the difference between BMI in 1997 and 1993 (BMI in 1997 – BMI in 1993). Difference-in-difference is differential effect of gaining a midwife on the treatments (females age 20-45) relative to the controls. Individual observables include per capita expenditure in 1993 (splines with knots at the quartiles), education (splines with knots at 6 and 9 years), age (splines with knots at 25, 35, 45, 55, and 65 years) all measured at baseline in 1993. Community-level observables include whether the community gained or lost monthly visits from health center staff, whether the community gained paved roads, whether the community gained or lost a public phone, and change in distance to a public clinic and to a private clinic. N=8824 adults who were measured and interviewed in both 1993 and 1997 and who were at least 20 years old in 1993. Robust standard errors that permit within-community correlations are reported in parentheses. * = $p \leq .10$, ** = $p \leq .05$.

Table 5
Relationship between Birthweight and Presence of Village Midwife During Pregnancy

	Fixed Effects	
	(1)	(2)
Village Midwife present during pregnancy	67.65*	79.50**
	(34.49)	(40.47)

The dependent variable is birthweight measured in grams. Models include a community-level fixed effect. Presence of a Village Midwife during pregnancy is based on information on timing of pregnancy and on arrival date of Village Midwife. Controls in column 2 include first birth, sex, maternal height, maternal age (splines with knots at 25 and 35 years), maternal education (splines with knots at 6 and 9 years), per capita expenditure (splines with knots at the 20^{th}, 50^{th}, and 80^{th} percentile), year of birth, distance to a public clinic, distance to a private practitioner, presence of a phone, whether community receives monthly visits from clinic staff, and whether most roads in the community are paved. Standard errors are included in parentheses. *=p<.10, **=p<=.05.

Table 6
Service Provision by Village Midwives

	Fraction of Village Midwives who provide:
General Care:	
Curative care: exams, injections, and medications	97%
Stitch wounds	76
Hepatitis B immunization	43
Incise and drain abcesses	34
TB treatment	20
IV treatment for dehydration	15
Maternity Care	
Prenatal exam	99
Delivery assistance	91
Tetanus toxoid injection	66
Children's Immunizations (BCG, DPT, polio, measles)	48
Family Planning	
Oral Contraceptives	91
IUD insertions	48
Injectable contraceptives	94
Treatment of side effects	83
Drugs	
Antibiotics	96
Aspirin	97
Antipyretics	98
Cough medicine	94
Skin ointment	89
Oral rehydration solution	93
Iron tablets	95
Vitamin A	84
Malaria medication	27
Tuberculosis medication	25

Based on data from 157 Village Midwives interviewed as part of the IFLS2 Community-Facility Survey.

Appendix Table 1: Gaining a Village Midwife and Change in BMI between 1993 and 1997

	Model 1		Model 2		Model 3		Model 4	
	OLS		OLS		OLS		FE	
	β	(se)	β	(se)	β	(se)	β	(se)
Indicator (1) if								
Gain a Village Midwife (GVM) by 1997	-0.04	(0.03)	.		.		.	
GVM if female < 40			0.12**	(0.06)	0.11**	(0.06)	0.17**	(0.09)
GVM if male < 40			-0.08	(0.06)	-0.09	(0.06)	.	
GVM if female >=40			-0.10	(0.08)	-0.06	(0.08)	0.04	(0.10)
GVM if male >=40			-0.17**	(0.07)	-0.15*	(0.07)	-0.03	(0.10)
Female < 40			0.30**	(0.06)	0.26**	(0.06)	0.29**	(0.06)
Female >= 40			-0.26**	(0.07)	0.07	(0.10)	0.07	(0.10)
Male >= 40			-0.32**	(0.06)	-0.02	(0.10)	-0.03	(0.11)
Per capita expenditure splines: <25 percentile					0.15*	(0.09)	0.11	(0.08)
25-49th percentile					-0.09	(0.14)	0.01	(0.13)
50-74th percentile					0.21	(0.15)	0.14	(0.13)
75th-100th percentile					0.00	(0.07)	-0.01	(0.07)
Education splines: 0-5 years					0.03**	(0.01)	0.03	(0.01)
6-8 years					-0.02	(0.03)	-0.01	(0.03)
9 or more					0.00	(0.01)	0.01	(0.01)
Age splines: 18-25 years					0.03	(0.04)	0.04	(0.03)
26-35 years					-0.03**	(0.01)	-0.03**	(0.01)
36-45 years					-0.03**	(0.01)	-0.03**	(0.01)
46-55 years					-0.01	(0.01)	-0.01	(0.01)
56-65 years					-0.01	(0.01)	0.00	(0.01)
66 years and older					-0.01	(0.01)	-0.01	(0.01)
Comm. gained a monthly visit from clinic staff					-0.01	(0.09)		
Comm. lost a monthly visit from clinic staff					-0.19**	(0.06)		
Change in distance to a public clinic					-0.05**	(0.02)		
Comm. gained paved roads					0.05	(0.05)		
Comm. gained a public phone					0.06	(0.06)		
Comm. lost a public phone					-0.10	(0.09)		
Urban					0.14**	(0.04)		
Constant	0.37	(0.02)	0.38	(0.04)	-1.73	(1.13)	-1.67	(1.13)
F	1.5		47.4		13.23		23.1	
R^2	0.0		0.04		0.06		0.05	

The dependent variable is the difference between BMI in 1997 and in 1993 (BMI in 1997 – BMI in 1993). Models 1-3 are OLS regressions with standard errors adjusted for clustering at the community level. Model 4 is a fixed effects specification, where the fixed effect can be interpreted as a community-level time trend. N=8824 adults who were measured and interviewed in both 1993 and 1997 and who were at least 20 years old in 1993. Standard errors are included in parentheses. *=p<=.10, **=p<=.05.

Appendix Table 2
Relationship between Birthweight and Presence of Village Midwife During Pregnancy

	(1)	(2)
Village Midwife present during pregnancy	67.65*	79.50**
	(34.49)	(40.47)
First Birth		-115.28**
		(25.02)
Male		75.83**
		(20.49)
Maternal height		9.01**
		(1.97)
Age Spline: < 25 years		-4.25
		(9.75)
25-34 years		11.14**
		(3.75)
35-44 years		-5.38
		(5.17)
Maternal Education (spline): 0-5 years		-9.22
		(8.71)
6-9 years		11.57
		(9.32)
10 or more years		-0.38
		(7.83)
pc Expenditure (spline): <20th %		91.23
		(83.82)
20-49th %		-42.87
		(67.98)
50-79th %		46.13
		(53.85)
80-100th %		-2.45
		(33.82)
Year of Birth		1.89
		(4.85)
Comm. distance to nearest public clinic		4.01
		(19.76)
Comm. distance to nearest private provider		26.20
		(23.28)
Most roads in comm. are paved		6.63
		(67.43)
Comm. has a public phone		-90.87
		(56.65)
Comm. received monthly visit from clinic staff		24.95
		(79.63)
Constant	3145.70	1369.27
F	3.9	5.1
R^2	0.1	2.1