California Center for Population Research
University of California - Los Angeles

Can Expanding Access to Basic Health Care Improve Children's Health Status? Lessons from Indonesia's "Midwife in the Village" Program

Elizabeth Frankenberg
Wayan Suriastini
Duncan Thomas

CCPR-018-04

August 2004

California Center for Population Research
On-Line Working Paper Series

Can Expanding Access to Basic Health Care Improve Children's Health Status? Lessons from Indonesia's "Midwife in the Village" Program

(Basic Health Care and Children's Health Status)

Elizabeth Frankenberg[1] Wayan Suriastini[2] and Duncan Thomas[1]
[1]UCLA, [2]SurveyMETER and University of Gadjah Mada

Abstract

In the 1990s, the Indonesian government placed over 50,000 midwives in communities throughout the country. We examine how this expansion in health services affected children's height-for-age. To address the problem that midwives were not randomly allocated to communities, the estimation exploits the biology of childhood growth, the timing of the introduction of midwives to communities, and rich longitudinal data. The evidence indicates that the nutritional status of children fully exposed to a midwife during early childhood is significantly better than that of their peers of the same age and cohort in communities without a midwife. These children are also better off than children measured at the same age from the same communities, but who were born before the midwife arrived. Within communities, the improvement in nutritional status across cohorts is greater where midwives were introduced than where they were not. This result is robust to the inclusion of community fixed-effects.

Keywords: child health, health programs, community, less developed countries, Indonesia,

Submitted: December, 2003. This version: August, 2004. Word count: 7,458

INTRODUCTION

Poor nutrition in early childhood is associated with elevated mortality risk, poorer cognitive development, greater functional impairments in adulthood as well as lower earnings (Martorell and Arroyave 1988; Strauss and Thomas 1995). Relative to developed countries, children in less developed countries typically exhibit considerable cumulative deficits in linear growth early in life. The most immediate cause of growth faltering may be delayed onset of the childhood phase of growth which begins around weaning and is likely related to the nutritional content of complementary feeding as well as exposure to infectious diseases (Martorell and Habicht 1986; Karlberg at el. 1994; Liu et al. 1998).

One way to improve nutritional status is through public health interventions that increase children's access to curative and preventive health care and mothers' access to information about nutrition and feeding practices. The biology of child growth suggests interventions that affect child nutrition will be of greatest benefit to children between the ages of one and four. This paper exploits that insight to examine the effect of a public health intervention on child height for age, an indicator of longer-run nutritional status.

The context for this research is Indonesia, where a program to expand access to midwives was introduced in the 1990s (Ministry of Health 1994, 2000; Handayani et al. 1997). Between 1990 and 1998, 54,000 graduates of nursing academies were given one year of midwifery training and placed in under-served communities (Sweet et al. 1995). These village midwives establish health care practices within the community and serve as a health resource to residents (Hull et al. 1998). The government pays the midwive's salaries for three years in expectation that this will lead to a permanent and sustainable private practice in the community (Gani 1996).

Previous research documents a positive impact of the village midwife program on the health and pregnancy outcomes of women of reproductive age, as well as on the birthweights of their infants (Frankenberg and Thomas 2001). The midwives are also likely to affect the health of young children directly, because they provide services such as preventive care and nutrition counseling, immunizations, and basic curative care services.

Indonesia is not alone in investing in health programs that emphasize direct outreach to families and communities. Many countries and international organizations have supported village-level health workers and outreach activities of paramedical and medical personnel (Berman 2000). These efforts originated in part in the "Health for All by the Year 2000" movement that emphasized community involvement in preventing poor health rather than clinic-based curative interventions (Claeson and Waldman 2000). Examples of such outreach-based programs include tetanus toxoid immunization programs and teaching mothers to prepare rehydration solutions in Bangladesh, training community health workers to diagnose and treat childhood pneumonia in India, community centers for rehabilitating malnourished children in Guinea Bissau, and provision of immunizations through visits to community groups in Mozambique (Cutts et al. 1990; Bang, Bang, and Sontakke 1994; Perra and Costello 1995; Chowdhury et al. 1997; Jamil et al. 1999). It is common for outreach workers to be assigned to areas in which health services are either non-existent or very limited and where health status is poor. Thus, a careful evaluation of the impact of Indonesia's village midwife program on child health provides results of general relevance for less developed countries.

The purposeful targeting of these programs to areas where health is likely to be poor raises methodological issues that complicate efforts to link access to care to health outcomes. If targeting is based on characteristics that are controlled when evaluating the program, purposive program placement poses no conceptual difficulty. However, if program placement is associated with characteristics that are not measured or if it induces migration to those areas because of the program, then estimates of the impact of the program will be biased if these effects are ignored (Rosenzweig and Wolpin 1986; Angeles, Guilkey, and Mroz 1998). Selective program placement is shown to be important for the village midwife program. It is addressed directly by our estimation method, which exploits the biology of childhood growth, the timing of the expansion of the midwife program, and very rich longitudinal data. These are described in the next section, which is followed by our results. We find that the introduction of a midwife had a large positive effect on the height-for-age of young children.

DATA AND METHODS

Data are drawn from the Indonesia Family Life Survey (IFLS), a panel survey of individuals, households, communities, and facilities. The first wave (IFLS1), collected in 1993, interviewed 7,224 households in 13 provinces and represents nearly 85 per cent of the Indonesian population (Frankenberg and Karoly 1995). The survey covers 321 enumeration areas, small survey-defined household clusters, in 312 administrative areas known as *desa* (village) or *keluruhan* (township). For the remainder of this paper we use the term *community* to designate both an IFLS enumeration area and the administrative area in which it is located. In rural areas the median community has slightly over 3,300 inhabitants and covers an area of 4.8 square kilometers. The median community in urban areas is about one-third the physical size of a rural community and has three times as many people.

In the 1997 resurvey (IFLS2 we sought to re-interview all IFLS1 households including all members of those households in 1997, as well as a set of target members of IFLS1 households in 1993 who had migrated away by 1997 (Frankenberg and Thomas 2000). IFLS2 succeeded in reinterviewing 94.5 per cent of IFLS1 households, As in 1993, community and facility surveys collected detailed information on community infrastructure, health services, and various programs, including the village midwife program.

In the household survey, a trained health worker measured the height and weight of each household member. The height of each child in the IFLS sample is compared with the National Center for Health Statistics (NCHS) anthropometric reference for a well-nourished child of the same age and sex and expressed as a z-score (which is given by the deviation from the reference median divided by the reference standard deviation). On average, the height-for-age of children in Indonesia between the ages of one and eight is about 1.8 standard deviations below the median for the reference population, regardless of survey year. (The average is 0.03 standard deviations greater in 1997, relative to 1993. This difference is not significant and we find no differences in the distributions in the two years.) Over one-third of the children are "stunted," as measured by height-for-age being more than two standard deviations below the reference median.

The Village Midwife Program

Our principle goal is to assess whether the introduction of village midwives in the 1990s resulted in improvements in child height for age. We first consider whether midwives offer services that might improve children's health and the extent to which children have access to these midwives.

To determine whether village midwives provide services of potential importance for children's health, we analyze data collected from the midwives and from other non-program private-sector midwives and private doctors and clinics as part of the IFLS facility survey. Practitioners were selected for interview from a list of providers compiled for each community from a combination of IFLS household respondents' and key community informants' answers to questions about the health facilities available to community residents. In 1997, interviews were conducted with 148 village midwives.

In addition to incorporating outreach and prevention into their services, village midwives provide a number of services that likely affect children's health (Table 1). Almost all village midwives offer curative care and medicines such as antibiotics and cough syrup, and nearly half provide children's immunizations. Village midwives also provide important micronutrient supplements: vitamin A and iron. Comparing village midwives to private midwives (column 2) and to doctors and clinics (column 3), demonstrates that most services are more likely to be available, and at cheaper prices, from village midwives than from other private practitioners. Moreover, the latter are not typically located within the communities that have village midwives. For example, only 15 per cent of the communities in which a village midwife resides also have a doctor practicing there, whereas a doctor practices in 62 per cent of the communities in which there is no village midwife. For private midwives the figures are 9 percent and 48 per cent for communities with and without a village midwife, respectively.

The range of services offered by village midwives suggests pathways through which their presence likely improves child health. If a village midwife provides oral rehydration solution and antibiotics, for example, she may reduce durations of illness from diarrheal diseases and prevent the dehydration that often accompanies severe diarrhea. Because of the midwives' health training and ability to offer an array of curative and preventive services, coupled with education about nutrition and feeding practices, their presence may well result in improvements in children's nutritional status.

According to IFLS community informants, just under 10 per cent of IFLS communities had a village midwife in 1993. By 1997, that fraction had risen to almost 46 per cent, indicating rapid expansion of the program during the 1990s. If this expansion favored communities in which health status (or its proximate determinants) was poor, the correlation between the presence of a midwife and health status will provide a downward biased estimate of the impact of the program. To provide some insights into whether this is a serious concern for evaluating the village midwife program, we have estimated community level regressions relating the presence of a midwife to the characteristics of the community. Specifically, Table 2 reports multinomial logit estimates of how the probability that a community

had a village midwife in 1993

gained a village midwife between 1993 and 1997

did not have a village midwife by 1997

varies with indicators of community infrastructure and socio-economic development, as measured in 1993. If village midwives were purposively placed in poorer communities, these characteristics should be negatively associated with the first two outcomes. Communities without a midwife by 1997 are the reference group. All models include province fixed effects.

Communities in which the primary road is not paved and there is no public telephone are significantly more likely to have a midwife by 1993. Not having a sewerage system and being far away from the nearest government health clinic are also associated with having a midwife by 1993 (although these effects are not individually significant). The same patterns emerge for the probability a community gained a midwife between 1993 and 1997. Since there is substantial collinearity in the indicators of community infrastructure, a Wald test for joint significance of community infrastructure is reported in the lower part of the table. It is large and indicates these characteristics are significantly related to the placement of midwives. Measures of the economic status of the community are not individually significant and, taken jointly, only significant at 5 per cent. This may be because village midwives have not been targeted to the economically poorer communities, or because our indicators of economic status are measured with error, at least relative to those used to target communities. Because some evidence suggests that public health interventions in Indonesia have first been allocated to provinces and then allocated to communities within provinces, the regressions include province fixed effects. None of the estimates in Table 2 is substantively affected by the exclusion of province controls.

Estimates of the effects of the village midwife program on child health will not be contaminated by selective program placement if placement is orthogonal to health. The second model examines this issue. It relates the presence of midwives to the health of children (measured by average height-for-age z-score of children age 6 through 9 in the community) and to the health of adults (measured by the percentage with body mass index, BMI, greater than 18.5), which is a standard cut-off below which both morbidity and mortality risks are elevated. Both child and adult health are negatively associated with the presence of a midwife, they are individually significant in 3 out of 4 cases and they are jointly significant demonstrating that program placement is related to prior health. This effect may be stronger in later years since the correlation between health and gaining a midwife by 1997 is stronger than the correlation with having a midwife in 1993. However, the evidence is only suggestive since the difference in the correlations is not significant for child health and the interpretation of the estimate for BMI and having a midwife by 1993 will be contaminated if the midwife had provided services which resulted in greater adult weight.

The correlation between presence of a midwife and health status does not pose a problem for measuring the effect of the midwife program if it can be fully explained by observed characteristics. This is investigated in the final column in Table 2 which reports results from a multinomial logit model of midwife placement that includes infrastructure, economic and health status characteristics. Slightly over one-quarter of the variation in the allocation of midwives is explained by these covariates. Community infrastructure continues to explain a significant fraction of that variation, whereas economic characteristics are no longer significant. However, key for this study, is the fact that the correlation with health status persists (p-value=0.04) suggesting there are unobserved factors that affect both health status and the allocation of midwives to communities.

This result has important methodological implications for evaluating the midwife program. Specifically, a comparison of children's health status in communities that have a midwife with health status in communities that do not is likely to understate the midwife's impact, because children in the former communities are already disadvantaged relative to children in the latter communities and that disadvantage cannot be fully controlled by observed differences between the communities.

The Relationship Between Program Exposure and Child Health

To evaluate the effectiveness of the village midwife program, a natural starting place is comparison of the health of children who have been treated by a midwife with the health of children who have not. This estimate is likely to be biased, because treatment by a midwife typically involves a child's caretaker deciding to take the child for treatment. It is not possible to separate the effect of that choice (and other choices of the caretaker) from the effect of the treatment itself. Moreover, given the design of the program and the training midwives receive, the benefits of a midwife may also accrue to children that she does not treat, because of spillovers from, for example, health and nutrition education and counseling. To evaluate the program, we will assess whether the presence of a midwife in a community is associated with improved child health. This is complicated by the fact that midwives do not appear to have been randomly assigned to communities. However, the combination of the physiology of child growth, the longitudinal dimension of IFLS, and the timing of the expansion of the village midwife program provides unique opportunities to measure the causal effect of the program on child height-for-age, an indicator of longer-run nutritional status. Adult stature reflects both genotype and phenotype influences with the latter being critically important during the fetal period and the first few years of life (Martorell and Habicht 1986). These influences are substantially more muted after the child has reached four years of age. We thus examine the relationship between child height and the presence of a village midwife in the community during the early years of the child's life. Comparisons with children in communities that did not have a village midwife are difficult to interpret because of the confounding impact of selective placement of midwives. However, exploiting the timing of the introduction of the midwife to a community, we can measure the effect of the midwife by comparing the height-for-age of young children, who were exposed to a midwife during the vulnerable early years of life, with the height-for-age of older children who live in the same community but who were not exposed to the midwife while they were young. Because these children live in the same community, this approach sweeps out the influence of time-invariant aspects of the community that affect child height and those that affect the assignment of midwives to particular communities.

The intuition is illustrated in panel A of Figure 1 which is a Lexis diagram of child age (vertical axis) and calendar time (in years on the horizontal axis). The thick diagonal lines demarcate three cohorts of children, *c*. The parallelogram labeled “Older Cohort” identifies children born between the beginning of 1984 and the end of 1987. Children belonging to the “Middle Cohort” were born between 1988 and the end of 1991. Children in the “Younger Cohort” were born between 1992 and the end of 1995.

The broken vertical lines indicate the two points in time, t, in 1993 and again in 1997 when height was measured in IFLS. At the first height measurement, children from the older cohort were between the ages of five and eight, while children from the middle cohort were between the ages of one and four. At the second height measurement, children from the middle cohort were between the ages of five and eight, while children from the younger cohort were between the ages of one and four. (Children in the older cohort would be age 9 through 12 in 1997 and since many will have begun the puberty growth spurt by that time, they are not included in the analysis. The majority of children in the younger cohort were not born in 1993.)

There are, therefore, four groups of age-eligible children for this analysis. Within each group, the extent of exposure to a village midwife during the vulnerable period of early childhood varies as a function of whether the village had a midwife and, if so, when she arrived. For each group of children, multivariate least squares regressions provide estimates of the relationship between height-for-age, ?, and community-level indicators of whether a midwife was present in 1993 (M_v^{93}) or was added between 1993 and 1997 (M_v^{97}). Children in communities in which a midwife was not present in either year serve as the reference category. The regressions also control a vector of individual, *i*, village, *v*, and time-specific, *t*, covariates, X_{ivt}. These covariates encompass demographic, biological, and socioeconomic attributes that are likely to be correlated with nutritional status and include the child's sex and age in months, the mother's and father's heights and presence in the household, the mother's education, urban residence, province of residence, and health infrastructure in the community. Unobserved heterogeneity is captured by e which is assumed to have a linear and additive effect on height but may vary by child, time and village in an arbitrary way.

$$?_{icvt} = a_{ct} + ß_{ct}M_v^{93} + ?_{ct}M_v^{97} + d'_{ct}X_{ivt} + e_{ivt} \quad [1]$$

Denoting the time of the baseline measure (in 1993) as 0 and the first follow-up (in 1997) as 1, estimates of ?$_{c0}$ are measures of the relationship between child height in 1993 and the introduction of a midwife between 1993 and 1997 relative to never having a midwife in the community. Since the midwife was introduced after height was measured, the effects should be zero for both the older cohort, O, (?$_{O0}$=0) and the middle cohort, M, (?$_{M0}$=0). If they are negative, they provide evidence that midwives were introduced between 1993 and 1997 to communities where children were in poorer health; if the effects are positive, they suggest midwives went to communities where children were in better health.

Estimates of ß$_{c0}$ are measures of the relationship between child height and having a midwife in the community in 1993, relative to never having a midwife. To interpret these estimates, we draw on the biology of child growth discussed above. Because the midwife program was only established in 1989 and was very small until the early 1990s, midwives who were present in 1993 had not been in the community for very long. In fact, for over 50 per cent of the communities in which a midwife was in place by 1993, the midwife arrived in 1992 or 1993. Children in the older cohort, O, were age 5 to 8 in 1993 and so they would not have been exposed to the midwife during the vulnerable early years, Their height should not have been affected by the midwife and thus ß$_{O0}$ should be zero. Again, deviations from zero would be indicative of program placement effects.

Predictions for children in the middle cohort are ambiguous. Some of these children will have been exposed to the midwife during the vulnerable years and this should be captured in the estimates. In the absence of program placement effects, if midwives benefit child health, the estimate should be positive. Since, on average, most children will have been only partially exposed to the midwife during the vulnerable years, this provides a lower bound estimate of the program effect. These predictions are summarized in Figure 1B.

Following the same logic for estimates based on the 1997 survey (t=1), children in the middle cohort would have been age 5 through 8 in 1997 and would, therefore, have been too old to benefit from a village midwife who was introduced between 1993 and 1997. Thus ?$_{M1}$ should be zero. This cohort of children living in communities with a midwife in 1993 would have had partial exposure during the vulnerable years and this should be captured in ß$_{M1}$ which (like ß$_{M0}$) is a lower bound estimate of the effect of the midwife program.

Children in the younger cohort, Y, were born between 1992 and the end of 1995 and, on average, would have been partially exposed to a midwife during the vulnerable years if she was introduced between 1993 and 1997. The relationship with child height, ?$_{Y1}$, provides a lower bound estimate since exposure was partial. In contrast, those children living in communities that had a midwife in 1993 are likely to have been fully exposed to the midwife. If program placement were not a concern, this effect, ß$_{Y1}$, would be a measure of the impact of the village midwife program.

Difference-in-difference estimates

All of the estimates discussed above are likely to be contaminated by selective program placement. However, differences in the estimated effects across equations sweeps out the impact of program placement and pins down the causal effect of the midwife program on child nutritional status. Consider children who live in communities that have had a midwife since 1993. In 1997, children in the younger cohort will have been fully exposed to the program whereas the middle cohort would have only been partially exposed. The difference between these effects, ß$_{Y1}$-ß$_{M1}$, provides a difference-in-difference estimate of the effect of full relative to partial exposure, after sweeping out the impact of program placement (under the assumption its effect is linear and additive in [1]). More formally, if unobserved heterogeneity can be separated into two parts, one that is due to program placement, μ_v, and one that is not, ?$_{ivt}$, then rewrite unobserved heterogeneity in [1] as

$$e_{ivt} = ?_{ivt} + \mu_v \quad [2]$$

Since μ_v is common across equations it is swept out of the difference-in-difference estimates.

Standardized height-for-age tends to decline with age until weaning, bounces back slightly and then remains approximately constant. This complicates our comparison of older with younger children measured at a point in time. Exploiting the panel dimension of IFLS, an alternative estimate of the effect of having a midwife in the community by 1993 is provided by the difference between the effect on the height-for-age of the younger cohort measured in 1997 (when they were age 1 through 4) with the effect on the middle cohort measured in 1993 (when they were also age 1 through 4). This difference-in-difference, $ß_{Y1}$-$ß_{M0}$, is another measure of the effect of being fully exposed to village midwife relative to partial exposure among children living in communities that had a midwife by 1993.

The late 1980s and mid 1990s was a period of economic growth in Indonesia and a time when other policies that sought to improve the health and human capital of the population were introduced. These may have resulted in improved child health and nutrition among later cohorts. This time effect complicates our comparison of the middle and younger cohort. Its influence can be assessed by comparing children age 5 through 8 in the middle cohort (measured in 1997) with children the same age in the older cohort (measured in 1993). Whereas the middle cohort children were partially exposed to the midwife program during their vulnerable years, the older cohort was not and so this difference-in-difference, $ß_{M1}$-$ß_{O0}$, is an estimate of the combination of the time effect and the effect of partial exposure.

Recall that $ß_{Y1}$-$ß_{M0}$ is an estimate of the effect of the midwife program, the time effect and the effect of partial exposure. Assuming secular changes in child height are linear in time, then the difference-in-difference-in-difference ($ß_{Y1}$-$ß_{M0}$)-($ß_{M1}$-$ß_{O0}$) is an estimate of the causal effect of having a village midwife in 1993 taking into account the possible role of selective program placement. Intuitively this estimate of the program effect comprises two parts. First, the difference in the height-for-age of the younger cohort relative to the middle cohort when both were 1-4 years old in communities with a village midwife in 1993, is contrasted with the same difference among children in communities that did not have a village midwife by 1997. Second, this difference-in-difference is contrasted with a similar difference in difference between the middle and older cohort, when they were age 5 through 8.

Within communities served by a village midwife by 1993, unobserved characteristics may affect both child height and the allocation of midwives. For example, if midwives were allocated to the poorest communities and the poorest communities subsequently grew faster than other communities and this resulted in improved child nutrition, the difference-in-difference-in-difference estimate of the effect of the village midwife program would be biased upwards. As a second example, if midwives were allocated to the poorest communities and if there is measurement error in targeting so that some of those communities were going through a bad patch at the time the allocation of midwives was determined but the communities were not (in the long run) as poor as they appeared, then because of regression to the mean, those communities will subsequently perform better than other communities and child nutrition of the younger cohort will be better than that of the middle and older cohorts.

All time-invariant, unobserved community-specific factors that have a linear and additive effect on child height-for-age can be absorbed by combining equations [1] and [2]:

$$?_{icvt} = \alpha_{ct} + \beta_{ct} M_v^{93} + ?_{ct} M_v^{97} + \delta'_{ct} X_{ivt} + \mu_v + ?_{ivt} \qquad [3]$$

where μ_v is a community-specific fixed effect. This amounts to stacking the four cohort-time combinations and estimating a fully saturated model. This approach has been used extensively in the program evaluation literature (for a discussion see Heckman and Robb 1985). The conceptual experiment involves contrasting, within a community, the health of the middle and younger cohorts of children with the health of the older cohort of children. One of the cohort-time pairs serves as a reference group and all estimates are relative to that group. The difference-in-difference estimates are directly comparable with those from model [1] and thus provide a check on the robustness of our estimates to this form of community-specific unobserved heterogeneity.

The discussion thus far has focused on the effect of having a midwife by 1993. The same logic applies to estimation of the impact of the introduction of a midwife between 1993 and 1997 except that, by 1997, there are no children in the study sample who were fully exposed to the midwife. In this case, as shown in Figure 1B, it is only possible to estimate the effect of partial exposure to the program.

RESULTS

Results of estimating models [1] and [3] are reported in Table 3. Panel A reports the differences between the height of children in communities with a midwife in 1993 and those in communities with no midwife by 1997 (ß, in columns 1 and 3) and the effect of gaining a midwife between 1993 and 1997 relative to not having a midwife by 1997 (?, in columns 2 and 4). Difference-in-difference estimates are reported in Panel B. Standard errors are below least squares regression coefficients and are corrected for clustering and arbitrary forms of heteroskedasticity (Huber 1973). Controls are included for maternal education (which is 5.7 years on average), for maternal and paternal height (which averages 150 and 161 centimeters, respectively), for whether each of the parents is in the household, and for the child's age and gender. Additional community-level controls are included in Panel A.

The second column reports the conditional correlation between child height and the introduction of a midwife to the community after 1993. The first row reports an estimate of $?_{O0}$ which is based on height measured in 1993 for the older cohort of children (age 5 to 8). It is negative, large and significant. Clearly this cannot be causal since the midwives were introduced to the community after height was measured. The same logic applies to the second row which is based on the middle cohort of children measured in 1993: $?_{M0}$ is also large and negative. We conclude that between 1993 and 1997 midwives were assigned to communities in which, prior to their arrival, children's nutritional status was poorer than in communities that did not get a midwife by 1997.

Children in the middle cohort were re-measured in 1997 (reported in row 3) and the correlation should again be zero: it is negative and significant. Children in the younger cohort were partially exposed to the village midwife and so the fourth row reports this effect in combination with program selectivity. This estimate is slightly smaller than the other three (in absolute value) but not significantly different. If there are benefits of partial exposure, they are swamped by the purposive placement of midwives in areas where child nutrition is poorer. The results unambiguously demonstrate that selective program placement is not just a theoretical nicety but an important empirical reality in this context.

Estimates of the correlation between child height and the presence of a midwife in 1993 are reported in the first column. The older cohort was age 5 through 8 years in 1993 and was not exposed to the midwife during the vulnerable years and so $ß_{O0}$ should be zero: it is negative which we interpret as indicative of purposive program placement. The middle cohort would have been partially exposed. The estimates in the second and third rows are also negative and indicate that any benefits of partial exposure are swamped by program placement effects.

The younger cohort of children would have been fully exposed to the midwife during the vulnerable years and so we expect $ß_{Y1}$ in the fourth row to be positive. It is: the estimated effect is 0.23 (p-value is 0.06). However, this is likely to be an underestimate of the effect of the program because it is contaminated by selective program placement.

The difference-in-difference estimates that address this concern are reported in Panel B of the table. Comparing the younger with the middle cohort measured at the same time (in 1993, row 5), the estimated effect of the program is 0.37 and significant. This is an unbiased estimate of the program if there are no age effects and if partial exposure has no impact on child height. The age effects can be taken into account by contrasting the younger cohort with the middle cohort measured when they were the same age (1 through 4, row 6). The estimated program effect is 0.43 and significant. However, this estimate is potentially contaminated by a time effect (which is likely to be positive) and the effect of partial exposure (which is also likely to be positive). An estimate of those two effects is provided by comparing the middle cohort with the older cohort at the same age (5 through 8 years, row 7). The effect is -0.01 indicating that both the time effect and the effect of partial exposure are negligible. The difference-in-difference-in-difference estimate of the effect of living in a community that had a village midwife in 1993 is reported in the final row. It is 0.44 and significant.

Results from models that include community fixed effects are reported in columns 3 and 4 of the table. Estimates in Panel A are relative to the reference category of the older cohort of children measured in 1993. The difference-in-difference estimates in row 8 are directly comparable with those in the first two columns. Comparing columns 1 and 3, there is evidence that unobserved characteristics at the community level affect child height and the OLS estimate of the effect of the village midwife program in column 1 is biased upwards. After taking this form of unobserved heterogeneity into account, the program effect is estimated to be 0.35.[1] That is, children in communities with a village midwife in 1993 are about one-third of a standard deviation taller than they would be if they lived in communities that did not have a village midwife. This is not only significant, it is substantively large. For a 4 year old child, this is equivalent to 1.5 cm in height.

Results in row 7 of columns 1 and 3 indicate that partial exposure to the village midwife program construes no benefits in terms of improved child nutrition. Since we are only able to measure the effect of partial exposure to a midwife who is introduced to a community between 1993 and 1997, we expect that effect to be zero. This is confirmed by the estimates in columns 2 and 4 which indicate that the time effect and the effect of partial exposure are zero (row 7) and the effect of partial exposure is zero (row 8). Why partial exposure construes no benefit is unclear, although it is possible that it takes time for a village midwife to build up a practice in a community.

Distribution of benefits across the spectrum of socio-economic status

One goal of the village midwife program is to improve the health of the relatively under-served. To provide some insights into whether this has been achieved, the models have been extended by including an interaction between maternal education and the presence of a village midwife. Analysis is limited to children age one to four in 1997 who were fully exposed (had a village midwife by 1993) relative to those never exposed (did not have a village midwife by 1997). Maternal education is specified as an indicator variable for completing more than primary school (6 years of schooling) which accounts for about one third of the mothers. In terms of height, children whose mothers are less well educated benefit more from having a midwife in the village than other children. The regressions include community fixed effects, and so the result reflects variation in socio-economic status within the village and indicates that the worst off children benefit the most

---

[1]

from the village midwife. We do not detect similar patterns for two other indicators of socio-economic status, maternal height and household expenditure.

Mechanisms underlying program benefits

Why do village midwives affect child height? To provide some insights into this question, we exploit the richness of IFLS and examine program impact on health behaviors. Using data from IFLS2 on receipt of immunizations and vitamin A for children less than five, we examine (with logistic regression) whether immunization and micronutrient uptake rates differ depending on whether children live in communities with program midwives. Outcomes tested include receipt of vaccinations to protect against polio; tuberculosis; diphtheria, pertussis, and tetanus; and measles. The results provide no evidence of variation in uptake rates of immunization by the presence of a program midwife, but with outcome data from only 1997 we can say nothing about how the midwife's presence may have influenced change in immunization uptake over time.

We turn next to feeding practices. To test whether exposure to a midwife is associated with differences in feeding behavior over time, we estimate Cox proportional hazards models, in which the dependent variable is the age at introduction of supplementary food or at cessation of breastfeeding. We stratify children into groups based on whether and when a midwife was posted to the village and estimate the impact of exposure to the program on the hazard rate.

Because IFLS provides information on feeding practices for children under five in both 1993 and 1997, it is possible to examine changes over time in feeding behaviors for children from the middle and young cohorts. The first column of Table 4 presents the median ages (in months, which is the reporting unit for most respondents) at which food is introduced and at which breastfeeding stops. Complementary food is introduced at a median age of three months. Breastfeeding is stopped at a median age of 24 months.

Subsequent columns provide information on feeding patterns stratified by presence of a village midwife and cohort. Ages in months corresponding to the 25th, 50th, and 75th percentiles of the distributions are presented. Column 7 contains an estimate of the relationship between being in the young cohort and the hazard of the event occurring at time *t*.

With respect to introduction of complementary food, for children in the communities in which no midwife was present, the distributions of ages at which complementary food is introduced do not vary by cohort, nor is the impact of being in the young cohort on the hazard of food introduction statistically significant. For children in the communities in which a midwife was present by 1993, however, a shift across cohorts does occur. For the middle cohort the median age at introduction of supplementary feeding is three months, while for the young cohort it is four months: this difference is significant. In Column 7, for any time *t*, being in the young cohort is associated with a reduction in the hazard that supplementary food will have been introduced by that time.

With respect to age at cessation of breastfeeding, breastfeeding occurs for longer in communities into which a midwife was introduced than in communities in which no midwife was present, regardless of cohort. The duration of breastfeeding has increased significantly across the two cohorts in communities that have never had a midwife. No changes in the duration of breastfeeding, which is already quite long, have occurred in the communities into which midwives were introduced by 1993.

We also investigated whether children are more likely to visit midwives for outpatient care (in the four weeks before the interview) in the communities to which village midwives have been assigned. We find that in 1993 children between the ages of one and four were more likely to visit a midwife in they lived in a community to which a village midwife had been assigned.

Likewise, in 1997 children in this age range were more likely to visit a midwife if they lived in a community to which a midwife had been posted between 1993 and 1997.

DISCUSSION

Poor nutritional status, which is associated with elevated risks of mortality, poor cognitive development, and impaired functioning in later life, remains common among children in the developing world. Yet preventive behaviors and interventions can improve children's nutritional outcomes. In most less developed countries the public health sector plays a key role in making immunizations, micronutrient supplements, and rehydration solutions available, as well as providing information to mothers about the importance of preventive care and proper feeding practices. Relatively few analyses, however, have been able to document a clear positive impact on children's health status of the general availability of health services. Most macro-level studies find that the impact of public spending on health is limited (Musgrove 1996; Filmer and Pritchett 1999). At the micro level, a few studies document a positive causal effect of provision of services on health outcomes (see Caldwell 1986; Jamison et al. 1993; and, for an analysis of the impact of the village midwife program on women's health and pregnancy outcomes, Frankenberg and Thomas 2001). More commonly, however, the conclusions indicate little or no impact on health of increases in public spending. In some cases, public-sector investments are even associated with poorer health outcomes (Strauss and Thomas 1995, provide a discussion).

A critical problem in this literature is that public health investments are rarely located randomly with respect to health outcomes. When public services are placed disproportionately in areas where health is poor, estimates of the correlation between access to services and health outcomes will be biased downward. For example, Rosenzweig and Wolpin (1986) show that in a cross-section regression, children's nutritional status is negatively associated with exposure to public health programs in Laguna, The Philippines. A positive and significant effect emerges, however, when they examine how changes in nutritional status respond to changes in exposure to public health programs. The authors attribute the negative correlation in the cross-section estimates to non-random placement of programs.

This paper examines the link between children's health outcomes and the expansion of maternal and child health services provided by trained midwives in Indonesia. We address the issue of non-random program placement by constructing several estimates of the program's effect, based on differences across children with varying degrees of exposure to the program, but with other factors in common, such as age or time at measurement. Each estimate involves a different assumption about possible sources of bias. The estimates of the causal effect of full exposure to the program since birth on the height-for-age z-score of children age one to four years range from 0.35 to 0.44 standard deviations.

Our results provide strong support for the hypothesis that the midwife program benefits children who were fully exposed to a midwife during early childhood. These children are taller than their same-age peers who live in communities without a midwife. They are also taller, given age, than children from the same communities, who were born prior to the arrival of the midwife. Finally, within communities, the improvement across cohorts in the nutritional status of children measured at one to four years of age is greater in the communities in which midwives were introduced than in the communities in which they were not.

Although health interventions are often implemented in hopes that they will benefit children from the most disadvantaged backgrounds, that goal is not always realized. Families with more resources or with more education may be more aware of the benefits of use of care, they may be better able to afford the costs of using health services, they may be more confident in interactions with providers, and they may be more effective at translating advice into practices that improve health. We find, however, that it is particularly the children whose mothers have an elementary school education or less that benefit most from exposure to midwives.

We go on to consider possible mechanisms through which exposure to a midwife affects nutritional status, including uptake of immunizations and micronutrients, breastfeeding patterns, and use of health care. Although it does not appear that children in the communities in which midwives are present are more likely to be immunized or to receive micronutrient supplements such as Vitamin A, uptake of these interventions may have increased more rapidly in the communities into which midwives were introduced than in communities without program midwives—something we cannot consider without data on changes in these behaviors over time. Our results show that the presence of a midwife is associated with a significant increase in the duration of unsupplemented breastfeeding. This increase is potentially quite important for children's nutritional status, because too early introduction (i.e. before six months of age) of poor quality complementary food can have negative consequences for growth (Frongillo and Habicht 1997; Onyango, Koski, and Tucker 1998). We also find evidence that among young children use of midwives for outpatient care rises after their introduction to a community. Finally, our earlier work shows that the addition of a village midwife to a community is accompanied by an increase in birthweight, relative to the birthweight of children in that community whose mothers were pregnant before the midwife arrived (Frankenberg and Thomas 2001). From these results it appears that the routes by which midwives result in improvements in height-for-age during early childhood involve increases in unsupplemented breastfeeding and in use of outpatient care, and possibly better nutritional status at birth.

CONCLUSIONS

Outreach programs are a common strategy that governments use to improve access to health services. In the 1990s Indonesia embarked on an ambitious effort to provide communities with trained midwives capable of providing a variety of maternal and child health services. We conclude that this effort has had a positive impact on children's height. Moreover, the benefits are greatest for children from the lower three-quarters of the socioeconomic spectrum.

NOTES

1. Elizabeth Frankenberg is in the Department of Sociology, UCLA, Box 951551, Los Angeles, CA 90095. E-mail address is efranken@soc.ucla.edu. Wayan Suriastini is at SurveyMETER, Pogung Kidul, Yogyakarta, Indonesia and a Ph.D. candidate at the Univeristy of Gadjah Mada, Yogyakarta, Indonesia. E-mail address is wayan@chaka.sscnet.ucla.edu. Duncan Thomas is in the Department of Economics, UCLA, Box 951477, Los Angeles, CA 90095. E-mail address is dt@ucla.edu.

2. This work was supported by NICHD grants R01HD40384, P01HD28372, NSF award 0075058, and the William and Flora Hewlett Foundation. We gratefully acknowledge the comments of John Haaga.

REFERENCES

Angeles, Gustavo, David Guilkey, and Thomas Mroz. 1998. "Purposive Program Placement and the Estimation of Family Planning Program Effects in Tanzania." *Journal of the American Statistical Association* 93(443):884–99.

Bang, A., R. Bang, and P. Sontakke. 1994. "Management of childhood pneumonia by traditional birth attendants. The SEARCH Team." *Bulletin of the World Health Organization*. 72(6): 897-905.

Berman, Peter. 2000. "Organization of Ambulatory Care Provision: a Critical Determinant of Health System Performance in Developing Countries." *Bulletin of the World Health Organization*. 78(6): 791-802.

Caldwell, John C. 1986. "Routes to Low Mortality in Poor Countries." *Population and Development Review* 12(2):171–220.

Chowdhury, A. Mushtaque R., Fazlul Karim, S. K. Sarkar, Richard Cash, and Abbas Bhuiya. 1997. "The Status of ORT in Bangladesh: how widely is it used?" *Health Policy and Planning*. 12(1): 58-66.

Claeson, Mariam and Ronald Waldman. 2000. "The Evolution of Child Health Programmes in Developing Countries: from Targeting Diseases to Targeting People." *Bulletin of the World Health Organization*. 78(10): 1234-1245.

Cutts, Felicity T., Margaret Phillips, Simone Kortbeek, and Apolinario Soares. 1990. "Door-to-door canvassing for immunzation program acceleration in Mozambique: achievements and costs." *International Journal of Health Services*. 20(4): 717-25.

Filmer, Deon and Lant Pritchett. 1999. "The Impact of Public Spending on Health: Does Money Matter?" *Social Science and Medicine* 49:1309–23.

Frankenberg, Elizabeth and Lynn Karoly. 1995. "The 1993 Indonesian Family Life Survey: Overview and Field Report." Santa Monica: RAND.

Frankenberg, Elizabeth and Duncan Thomas. 2000. "The Indonesia Family Life Survey (IFLS): Study Design and Results From Waves 1 and 2." Santa Monica: RAND.

Frankenberg, Elizabeth and Duncan Thomas. 2001. "Women's Health and Pregnancy Outcomes: Do Services Make a Difference?" *Demography*. 38(2): 253-265.

Frongillo, Edward and Jean-Pierre. Habicht. 1997. "Investigating the Weanling's Dilemma: Lessons from the Honduras." *Nutrition Reviews*. 55(11): 390-395.

Gani, Ascobat. 1996. "Improving Quality in Public Sector Hospitals in Indonesia." *International Journal of Health Planning and Management* 11:275–96.

Handayani, Lestari, Lestari Wilujeng, Suharti Sukirno, Setia Pranata, and Daryadi. 1997. "Menuju pelayanan persalinan terpadu." Report, Population Studies Center, Gajah Mada University and the Ford Foundation.

Heckman, James J. and Richard Robb. 1985. "Alternative Methods for Evaluating the Impact of Interventions." Pp. 156–245 in *Longitudinal Analysis of Labor Market Data*, edited by James J. Heckman and Burton Singer. New York: Cambridge University Press.

Hull, Terrence, Widayatun, Aswatini Raharto, and Bayu Setiawan. 1998. "Village Midwives in Maluku." Policy Paper 1, Center for Population and Manpower Studies, Indonesia Institute of Sciences, Jakarta.

Huber, Peter. 1973. "Robust Regression: Asymptotics, Conjectures, and Monte Carlo." *Annals of Statistics*. 1(6): 799-821.

Jamil, Kanta, Abbas Bhuiya, Kim Streatfield, Nitai Chakraborty. 1999. "The Immunization Programme in Bangladesh: Impressive Gains in Coverage but Gaps Remain." *Health Policy and Planning*. 14(1): 49-58.

Jamison, Dean T., William H. Mosley, Anthony R. Meashem, and Jose-Luis Bobadilla, eds. 1993. *Disease Control Priorities in Developing Countries*. New York: Oxford University Press.

Karlberg, J., F. Jalil, B. Lam, L. Low, and C. Yeung. 1994. "Linear Growth Retardation in Relation to the three phases of Growth." *European Journal of Clinical Nutrition* 48.S1: S25-S44.

Liu, Y., F. Jalil, and J. Karlberg. 1998. "Risk Factors for Impaired Length Growth in Early Life Viewed in Terms of the Infancy-Childhood-Puberty (ICP) Growth Model." *Acta Paediatrica*. 87(3): 237-43.

Martorell, Reynaldo and Jean-Pierre Habicht. (1986) "Growth in early childhood in developing countries", in Frank Falkner and J.M. Tanner, eds., Human Growth: A Comprehensive Treatise, Volume 3, New York: Plenum Press.

Martorell, Reynaldo and. Guillermo Arroyave. 1988. "Malnutrition, Work Output, and Energy Needs." In *Capacity for Work in the Tropics*. Society for the Study of Human Biology Symposium 26. Eds: K. J. Collins and Derek F. Roberts. Cambridge: Cambridge University Press, 1988, pp. 57-76. {NB REF is Martorell and Arroyave not Martorell and Guillermo I think.)

Ministry of Health (MOH). 1994. "Pedoman pembinaan teknis bidan di desa." Report, Directorate General of Community Health, Republic of Indonesia, Jakarta.

———. 2000. "Indicators for the Third Evaluation of HFA 2000." Report, Republic of Indonesia, Jakarta.

Musgrove, Phillip. 1996. "Public and Private Roles in Health: Theory and Financing Patterns." Discussion Paper 339, World Bank, Washington, DC.

Onyango, Adelheid, Kristine G. Koski, and Katherine L. Tucker. 1998. "Food Diversity versus Breastfeeding Choice in Determining Anthropometric Status in Rural Kenyan Toddlers." *International Journal of Epidemiology*. 27(3): 484-489.

Perra, A. and A. Costello. 1995. "Efficacy of outreach nutrition rehabilitation centers in reducing mortality and improving nutritional outcome of severely malnourished children in Guinea Bissau." *European Journal of Clinical Nutrition*. 49(5): 353-59.

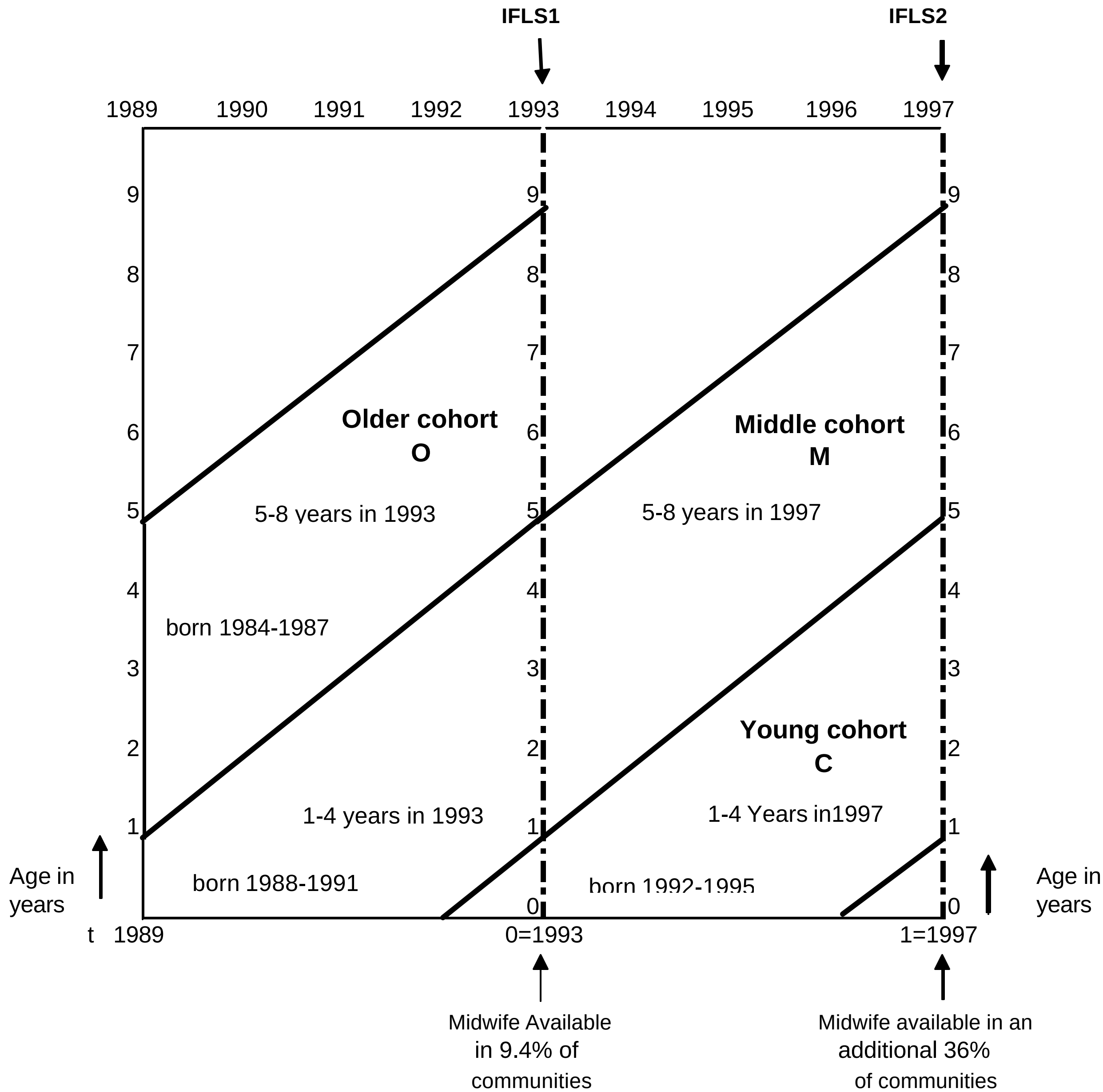
Rosenzweig, Mark and Kenneth Wolpin. 1986. "Evaluating the Effects of Optimally Distributed Public Programs." *American Economic Review* 76:470–82.

Strauss, John and Duncan Thomas. 1995. "Human Resources: Empirical Models of Household Decisions." Pp. 1885–2023 in *Handbook of Development Economics,* Vol. IIIA, edited by J.R. Behrman and T.N. Srinivasan. Amsterdam: North Holland.

Sweet, Betty, Valerie Tickner, and Gaynor Maclean. 1995. "Midwifery in Indonesia: A Professional Snapshot." *Modern Midwife* 5(6):8–13.

Figure 1
Village midwives and child height in Indonesia: Timing of events

A. Lexis diagram of cohorts, ages, and dates of measurement of child height



B. Expected effects of village midwives in the absence of selective program placement

Year measured:	1993 t=0		1997 t=1	
Effect of Midwife:	Present in 1993 ß	Gained between 1993 and 1997 ?	Present in 1993 ß	Gained between 1993 and 1997 ?
Cohort				
Older O	Zero	Zero	·	·
Middle M	Partial	Zero	Partial	Zero
Younger Y	·	·	Full	Partial

Table 1
Availability of health providers and services in Indonesia

A. Availability and prices of services by provider type

	Village midwives	Private midwives	Doctors and clinics
Type of service (per cent offering)			
General care			
Curative care	99	88	99
Stitch wounds	75	46	56
Children's immunizations	46	59	33
Drugs			
Antibiotics	98	93	95
Cough medicine	96	81	94
Oral rehydration solution	95	82	80
Iron tablets	93	90	68
Vitamin A	86	75	60
Median service price (Rp)[1]			
General care			
Exam only	2,000	3,000	5,000
Exam/shot/medicine	3,500	5,000	8,000
First stitch	2,500	4,000	8,000
Measles immunization	500	3,000	5,000
Drugs			
Antibiotic (ampicillin)	400	450	600
Oral rehydration solution	1,500	3,000	4,000

B. Co-existence of village midwives and private providers

	Communities	
	With a village midwife	without a village midwife
Per cent of those communities with a		
Doctor	15	62
Private midwife	9	15

[1] Median drug prices based on a standardized quantity. In 1997, the exchange rate was about 2,400 Rupiah per U.S. dollar.

Source: Panel A: 1997 Indonesia Family Life Survey Facility Survey (N=148 for village midwives, 519 for private midwives, and 672 for doctors and clinics). Panel B: 1997 Indonesia Family Life Survey Community Survey.

Table 2
Multinomial logistic regression relating the presence of a village midwife to observed community characteristics

	Model 1 Infrastructure & economic status		Model 2 Health status		Model 3 All Characteristics	
	midwife present in 1993	midwife came between 1993 & 1997	midwife present in 1993	midwife came between 1993 & 1997	midwife present in 1993	midwife came between 1993 & 1997
	(1)	(2)	(3)	(4)	(5)	(6)
Infrastructure						
(1) if primary road is paved	-1.53	-0.23			-1.55	-0.29
	(0.56)	(0.38)			(0.57)	(0.38)
(1) if community has public	-2.74	-1.31			-2.92	-1.19
telephone	(1.11)	(0.38)			(1.14)	(0.39)
(1) if community has sewage	-0.96	-0.23			-1.02	-0.21
system	(0.61)	(0.35)			(0.62)	(0.36)
Distance to nearest government	0.11	0.35			0.12	0.32
health clinic	(0.20)	(0.15)			(0.21)	(0.16)
Economic status						
Years of education (adults)	-0.27	-0.19			-0.33	-0.13
(community average)	(0.18)	(0.69)			(0.19)	(0.11)
Per head expenditure	0.19	-0.37			0.33	-0.31
(community average)	(0.69)	(0.44)			(0.71)	(0.45)
Health status						
Height for age z-score			-0.19	-0.75	0.56	-0.31
(Children age 6-9 years)			(0.33)	(0.23)	(0.42)	(0.25)
Body mass index $\geq$18.5			-4.61	-7.97	1.97	-3.40
(% of adults in community)			(2.54)	(1.77)	(3.02)	(2.03)
Province fixed effects	Yes		Yes		Yes	
Pseudo R^2	0.26		0.12		0.28	
?^{2} test (infrastructure)	37.04		.		34.00	
(p value)	(0.00)				(0.00)	
?^{2} test (economic status)	9.40		.		5.69	
(p value)	(0.05)				(0.22)	
?^{2} test (health status)			36.50		10.21	
(p value)			(0.00)		(0.04)	
?^{2} test (all covariates)	95.57		52.84		101.52	
(p value)	(0.00)		(0.00)		(0.00)	

Communities that did not have a midwife by 1997 are the reference category in each of the three multinomial logit models. Robust standard errors in parentheses below regression coefficients.
Source: Indonesia Family Life Survey Community Surveys, 1993 and 1997.

Table 3

Estimates of effect of presence of village midwife on child height for age z-scores (with robust standard errors)

					Model 1: OLS		Model 3: Community FE	
					ß	?	ß	?
					Effect of midwife		Effect of midwife	
Panel A					present	gained between	present	gained between
Notation	Cohort	Measured at			in 1993	1993 and 1997	in 1993	1993 and 1997
		Time	Age		(1)	(2)	(3)	(4)
1.	O0	Older	1993	5-8 yrs	-0.13 (0.10)	-0.21 (0.07)	.	.
2.	M0	Middle	1993	1-4 yrs	-0.20 (0.14)	-0.17 (0.10)	-0.07 (0.11)	0.04 (0.07)
3.	M1	Middle	1997	5-8 yrs	-0.14 (0.09)	-0.16 (0.07)	-0.01 (0.10)	0.03 (0.64)
4.	Y1	Younger	1997	1-4 yrs	0.23 (0.12)	-0.11 (0.08)	0.27 (0.12)	0.00 (0.07)
Panel B: Difference-in-difference								
	Notation	Interpretation						
5.	Y1-M1	Program effect if no age effect & no effect of partial exposure			0.37 (0.14)	0.05 (0.10)	0.28 (0.12)	-0.03 (0.09)
6.	Y1-M0	Program effect if no time effect & no effect of partial exposure			0.43 (0.19)	0.06 (0.11)	0.34 (0.13)	-0.04 (0.10)
7.	M1-O0	Time effect & effect of partial exposure			-0.01 (0.20)	0.05 (0.08)	-0.01 (0.15)	0.03 (0.07)
8.	(Y1-M0)-(M1-O0)	Program effect (Full effect for ß Partial effect for ?)			0.44 (0.21)	0.01 (0.18)	0.35 (0.16)	-0.07 (0.12)

Communities that did not have a midwife by 1997 are the reference category. Differences relative to children in those communities are reported in Panel A. Difference in differences are reported in Panel B. Regressions also control child gender, age in months, mother's education, mother's and father's height, presence of mother and father in household. Columns (1) and (2) also control urban residence, province of residence and levels of health infrastructure (distance to public clinics and whether the community health worker makes monthly visits to the community); columns (3) and (4) include community fixed effect.

Source: 1993 and 1997 Indonesia Family Life Survey (N=9,445 children)

Table 4
Summary statistics and Cox proportional hazards model results for child feeding patterns by presence of a village midwife and cohort

	Overall	By presence of midwife and cohort					
				Summary statistics (Age in months)			Hazards model:
	Median age (in months)	Midwife in 1993	Cohort	25th percentile	50th percentile	75th percentile	Cohort effect[1]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Introduction of food	3						
		No	Middle	2	3	5	
		No	Younger	2	3	5	.94
		Yes	Middle	1	3	6	
		Yes	Younger	1	4	6	.76*
Cessation of breastfeeding	24						
		No	Middle	12	18	24	
		No	Younger	14	24	24	.70*
		Yes	Middle	18	24	30	
		Yes	Younger	18	24	30	.87

[1] The coefficient represents the impact on the hazard at time *t* of being in the late cohort of children relative to the early cohort of children, where a value of less than one indicates a reduction in risk of the event.
* p<.05
Source: as in Table 3 (N=2,39)