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THE VILLAGE MIDWIFE PROGRAM AND INFANT MORTALITY IN INDONESIA

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Indonesia introduced over 50,000 midwives into villages in the 1990s to provide primary care to women lacking easy access to health facilities. It seems plausible to argue that the significant reduction in infant mortality that occurred from about 1993–94 was a consequence of this. The paper estimates the village midwife program's impact on infant mortality, using data from the Indonesia Family Life Survey. Regressing mortality outcomes against choice of services would lead to biased estimates because of the correlation between service choice and unobserved individual characteristics. Furthermore, non-random placement of midwives could bias estimates of their impact on infant mortality. This study overcomes such endogeneity problems by aggregating mortality outcomes and program prevalence at district level and taking account of district fixed effects in estimating the program's impact. Surprisingly, the results do not support the hypothesis that the midwife program was responsible for the observed decline in infant mortality.

INTRODUCTION

Following the Nairobi Safe Motherhood Conference in 1987, the issue of safe motherhood gained prominence in Indonesia. This led to the implementation of a village midwife program, which by 1997 had trained over 50,000 midwives and placed them in villages across the country. As in many developing countries, a majority of women in rural villages in Indonesia give birth in their homes, relying on traditional birth attendants (TBAs) for help during delivery. Poor maternal health and health care, and infections contracted during the birth process, are important causes of neonatal deaths. A program to introduce trained midwives in villages across Indonesia is therefore likely to have affected not only maternal mortality but also the likelihood of infant survival, by improving maternal health and the environment in which births take place.

Prior studies have shown an association between the introduction of Indonesia's village midwife program and improvements in women's health (through increases in body mass index) and in the nutrition of children (Frankenberg and Thomas 2001; Frankenberg, Suriastini and Thomas 2005). However, there is little evidence about the program's effectiveness in improving birth outcomes. This paper examines the role of the program in influencing the mortality outcomes of infants. The main causes of neonatal deaths are related to maternal health, complications during pregnancy and the birth process, and the poor quality of care provided to neonates. It is therefore likely that the placement of trained midwives in villages

where there is limited access to health facilities and a heavy reliance on TBAs would cause a decline in infant mortality through reduced incidence of neonatal deaths. Although safe motherhood initiatives have not emphasised a reduction in infant mortality as their primary objective, this paper analyses whether initiatives to improve maternal health through community-based approaches, such as that undertaken in Indonesia, can play an additional role in lowering child death rates.

Empirical analysis of the influence of birth facilities on infant mortality outcomes is difficult for various reasons. Regressing mortality outcomes on the choice of delivery facility or delivery assistant will lead to biased estimates, because these individual choices may be correlated with individual characteristics not observed in the data. For instance, the level of a woman's understanding of health issues is not observed, but may be related to the likelihood of her consulting a trained midwife or a physician and using modern birth facilities, as well as to her intrinsic mortality risk. More knowledgeable women may be more likely to use modern facilities and may also have lower intrinsic mortality risk. Such unobserved characteristics, if not accounted for in the empirical specification, would lead to biased estimates of the effect of use of birth facilities on the mortality risk of infants. Risks associated with each pregnancy that affect choice of services are also not observed. It is likely that women with pregnancy complications choose trained midwives and are referred to physicians and modern facilities, while those with low-risk pregnancies give birth in the home without formally trained help. These unobserved risks, if not accounted for in the empirical specification, would lead to spurious correlation between infant mortality outcomes and choice of birth facilities.

The empirical analysis in this paper is conducted using pregnancy information from three waves of the Indonesia Family Life Survey (IFLS, an ongoing longitudinal survey described in detail below). The IFLS data provide detailed information on each pregnancy – including the use of health facilities by women during pregnancy. In addition, the survey collects information at the community level through interviews with the village head and the head of the local Family Welfare Association (Pembinaan Kesejahteraan Keluarga, PKK) about various aspects of the community and about the introduction of government programs in the village; it also interviews staff of health and educational facilities in the community. Their responses allow us to identify when a village midwife was introduced in each community, making it possible to evaluate the effects of the program.

The next section briefly discusses the village midwife program, the causes of child deaths in developing countries and the role that community-based initiatives such as the village midwife program could play in lowering the mortality rates of children. The following section surveys some previous studies of the effect of Indonesia's village midwife program on maternal and child health. The paper then describes the IFLS – whose sample is used for the empirical analysis – and the trends in mortality rates and use of birth services shown by this sample. The final section discusses the empirical methodology and presents the results.

EXPECTED EFFECTS OF THE VILLAGE MIDWIFE PROGRAM

The village midwife program (Bidan di Desa; literally 'Midwives in Villages') began in 1989, with the aim of making midwives available in all of Indonesia's 68,000 villages to provide women with pre-natal care and assistance during

FIGURE 1 *Average Sample Infant Mortality Rates,^a 1988–90
(deaths per 1,000 live births)*

^a Infant mortality is the sum of neonatal and post-neonatal mortality. For definitions of mortality types, see footnote 1.

^b Communities targeted by the village midwife program.

Source: Data from the 1993, 1997 and 2000 waves of the Indonesia Family Life Survey.

delivery. The program was implemented by the Ministry of Health in cooperation with other ministries – especially the Ministry of Home Affairs and the Ministry of Women's Roles – and with the National Family Planning Coordinating Board (Badan Koordinasi Keluarga Berencana Nasional, BKKBN). It was supported by various international donor agencies such as the World Bank, the United Nations Children's Fund (UNICEF), the World Health Organization (WHO) and the Australian Agency for International Development (AusAID). When the program began there were only 13,000 midwives available to village women in Indonesia (World Bank 1991). By the end of the 1996/97 budget year, 52,042 midwives were in place, covering 96% of the 54,120 villages that had been deemed to be in need of midwives in 1989 (Shiffman 2003).

Figure 1 shows infant mortality rates¹ for sample communities, averaged for the years 1988 through 1990 (that is, when the program was just beginning), with the communities disaggregated according to whether they were included in the program at any time during the years 1988–99. This suggests that the communities selected for inclusion (hereafter referred to as 'program communities') had much higher levels of infant mortality than those not included in the program (80 per 1,000 compared with 46 per 1,000). In turn, this was the consequence of

1 The infant mortality rate is defined as the number of deaths before the age of one per 1,000 live births. It is the sum of the neonatal mortality rate, defined as deaths during the first month per 1,000 live births, and the post-neonatal mortality rate, defined as the number of deaths per 1,000 live births after the first month and before the end of the first year.

program communities having post-neonatal mortality rates three times those of non-program communities (46 per 1,000 compared with just 15 per 1,000); by contrast, neonatal mortality was roughly the same in program and non-program communities.²

The midwives were recruited after completing three years of study at nursing academies, and were given an additional year of midwifery training. The government assigned them to communities under a limited-term contract of three years, with the possibility of extension to six years; the midwives were then expected to start private practice after having built a client base in the village (Hull et al. 1998). They conducted public practice during normal working hours and were allowed to practise privately after hours. The midwives played a role in promoting community participation in health, providing health and family planning services, working with TBAs, and referring complicated cases to health centres and hospitals (Frankenberg and Thomas 2001). Village midwives also had contact with the community in various other settings, allowing them to impart information to community members on nutrition, food preparation, sanitation and other health-promoting behaviours.

It seems plausible that the introduction of midwives in villages would have led to positive health outcomes in the communities in question. By providing help during the childbirth process to women who would otherwise have relied on TBAs, the midwives would have improved the environment in which women give birth in villages, especially in those communities that did not have easily accessible health facilities. By encouraging pre-natal check-ups and referring clients to hospitals and *puskesmas* (community health centres) in case of complications, a midwife based in the community could have helped women to obtain timely assistance and to avoid having complicated births at home, thus lowering infant mortality risk.

Of the estimated 10 million children worldwide who die every year before the age of five, mainly in developing countries, about 37% die at the neonatal stage (Black, Morris and Bryce 2003). WHO estimates of the causes of child deaths in 2000–03 show that the main causes of death beyond the neonatal stage are pneumonia, diarrhoea and malaria, which account for 19%, 17% and 8%, respectively, of all childhood deaths (Bryce et al. 2005). Of the four million children who die during the neonatal stage, it is estimated for 2000 that the direct causes of such deaths are infections (36%), pre-term birth (28%), birth asphyxia (23%) and congenital abnormalities (7%) (Lawn, Cousens and Zupan 2005). Sepsis and pneumonia are the direct cause of 26% of neonatal deaths due to infections, while tetanus and diarrhoea are responsible for 7% and 3%, respectively (Lawn, Cousens and Zupan 2005). The extent of deaths caused by infections at the neonatal stage varies between countries, however. Countries with high neonatal mortality rates (over 45 per 1,000 live births) have a higher proportion of neonatal deaths caused by infections (almost 50%); those with low neonatal mortality rates have a lower incidence of such deaths – less than 20% due to sepsis and pneumonia, and negligible tetanus- and diarrhoea-related deaths (Lawn, Cousens and Zupan 2005).

2 The terms 'village' and 'community' are used interchangeably here, although some of the communities in the sample were actually in urban areas.

According to WHO estimates of the causes of under-five child deaths in Indonesia for 2000–03, neonatal deaths constitute 38% of the total, followed by post-neonatal diarrhoea (18%), pneumonia (14%) and measles (5%). The number of deaths due to malaria and HIV/AIDS is negligible (WHO 2006). The main causes of neonatal deaths are pre-term birth, birth asphyxia and severe infections (including pneumonia, sepsis and meningitis). Indonesia has been successful in nearly eradicating neonatal deaths from tetanus and diarrhoea: these easily preventable conditions each now cause only 1% of total neonatal deaths (WHO 2006).

Besides the direct causes of death, the major underlying cause of child deaths around the world, especially at the post-neonatal stage, is under-nutrition, which increases children's susceptibility to infectious diseases (Black, Morris and Bryce 2003). At the neonatal stage, low birth-weight of infants, caused primarily by short gestation period and intra-uterine growth retardation, is an important indirect cause of death (Lawn, Cousens and Zupan 2005).

The breakdown of both direct and indirect causes of child deaths suggests that improvements in maternal health and the birth process, and care provided to neonates, can play an important role in lowering the risk of neonatal mortality, while nutrition of children is a major determinant of mortality risk in the post-neonatal phase. The placement of village midwives in communities without easy access to health facilities can be expected to have improved mortality levels through the midwives' influence on these underlying causes of infant deaths. Given their training, the midwives are likely to have been more effective than TBAs in providing ante-natal, intra-partum and post-natal care. By lowering the reliance on TBAs in villages, the presence of midwives is likely to have led to better pre-natal care, earlier detection of birth complications and timely referral to health facilities, and to have provided better care for neonates – all of which seem likely to have lowered neonatal mortality. Furthermore, midwives could have played an important role in lowering the incidence of tetanus infection in neonates through the use of a sterilised knife to cut the umbilical cord after birth, a practice about which TBAs are likely to have been more negligent. In the case of post-neonatal mortality, the midwives' potential impact would arise from their involvement in community health activities, promoting vaccination and providing better nutrition information to parents. Since the economic status of households is a strong driver of the quality of child nutrition, the midwives' influence would act primarily on the factors responsible for the deaths of neonates rather than of older infants. The village midwife program therefore seems likely to have had a stronger impact on neonatal than on post-neonatal mortality.

However, it is also possible that the increase in the supply of midwives brought about by the program may not have led to the expected improvements in the quality of health services available in rural areas. The initial impact of the midwives on health outcomes may have been limited by their inexperience and by their being placed in unfamiliar environments that could have affected their performance. Furthermore, concerns remain about the quality of pre-service and in-service training for health workers in Indonesia. Inadequate training could have adversely affected the quality of the services provided by the midwives (Rokx et al. 2010).

LITERATURE REVIEW

Frankenberg and Thomas (2001) studied the impact of the midwife program on adult health and on the birth-weights of children, using the first and second waves of the IFLS (IFLS1 and IFLS2). Since the midwives were not placed randomly, and were more likely to be assigned to poorer communities and those at a greater distance from health centres, testing the impact of the policy needs to take the endogeneity of program placement into consideration. Frankenberg and Thomas (2001) use a quasi-experiment to compare health status in communities that gained a village midwife and in those that did not. Since midwives are likely to influence the health of women more than that of men, women are considered the treatment group, and changes in their health are compared with changes in the health of other adults in the same community. The authors use adult body mass index (weight divided by height squared) as the health outcome variable of interest. Furthermore, they consider the impact of the village midwife program on the birth-weights of children, using community fixed effects and controlling for pregnancy-specific and mother-specific variables. The results suggest that there was an increase in birth-weights in a community after the introduction of a midwife.

Frankenberg, Suriastini and Thomas (2005) analyse the impact of the midwife program on the nutrition of children. Their dependent variable is the z-scores (computed as the deviation from the reference median divided by the reference standard deviation) for children's height for age, created by comparing the height of children in the IFLS sample with the US National Center for Health Statistics (NCHS) anthropometric reference for a well-nourished child of the same age and sex. As midwives also provided basic preventive care and nutrition information, immunisation and some basic curative care, it could be expected that the village midwife program would have had an effect on children's health. In order to account for the potential selective placement of midwives into communities, the authors look at the difference in outcomes for several cohorts of children surveyed in IFLS1 and IFLS2 that had varying degrees of exposure to the midwife program. Their results suggest that the nutrition status of children who had full exposure to the midwife program is better than that of children in the same cohort in communities that had lower levels of exposure to the program.

Both the Frankenberg and Thomas (2001) and the Frankenberg, Suriastini and Thomas (2005) studies use data from IFLS1 and IFLS2 to look at health outcomes for adults and children. However, they do not directly investigate the impact of the village midwife program on the birth process itself. This impact was in fact the main objective of the midwife program, and it is the focus of the present study. It is also likely that, once the midwives had spent longer in the villages and established themselves in the communities, the program would come to have a stronger impact than in the period immediately following their placement. By including responses from IFLS3 we are able to study the longer-run impact of the program. Furthermore, if the presence of midwives improved the survival of infants, the results of the above studies would under-estimate the true impact of the program on child health, because the improvement would imply that the program increased survival rates of children who had lower health status.

DATA

The empirical analysis in this paper is conducted using the first three waves of the IFLS. For IFLS1, conducted in 1993, various members of 7,224 households were interviewed, totalling over 22,000 individuals. The sample households were drawn from 312 enumeration areas in 13 of the 27 provinces in Indonesia at that time, and represent 83% of the population (Frankenberg and Karoly 1995).³ Subsequent waves of the IFLS conducted in 1997 and 2000 sought to interview the original IFLS1 households as well as new households formed when the original households split. The re-contact rates were high, with 94.4% of IFLS1 households re-contacted in IFLS2, and 95.3% of the original IFLS1 households re-contacted in IFLS3. Nearly 91% of IFLS1 households were interviewed in all three waves (Frankenberg and Thomas 2000; Strauss et al. 2004).

In each wave of the IFLS, detailed information was collected about various aspects of each pregnancy that ended during the five years before the survey; this included data on pre-natal visits, place of delivery and assistance during delivery. The sample of pregnancies used for the empirical analysis in this paper is drawn from the 1993, 1997 and 2000 waves of the survey, and is restricted to pregnancies on which there is detailed information about delivery assistance and place of delivery, and to pregnancies that ended in a live birth. Stillbirths and miscarriages are excluded. The mortality outcomes are based on responses about whether the child is still alive, and if not, when or at what age it died.

Another unique feature of the IFLS is that it generates community-level information, including details about public and private facilities available for health care and schooling, collected from interviews with village heads, heads of village organisations, and authorities at the various community educational and health facilities. The community data also include the date of introduction of government programs in the community. This information facilitates evaluation of government interventions and allows us to control for various community characteristics in the empirical analysis.

In both IFLS2 and IFLS3, the village head and the head of the PKK were asked about the presence of a village midwife in the community, and when she was placed in the village. Their responses were used to determine the year of introduction of the program in each community. In cases where the responses of the village head and the PKK head were not consistent, the average of the two was taken. In cases where information was missing in the IFLS2 data, responses from IFLS3 were used to determine the year of introduction. Using IFLS2 and IFLS3 data made it possible to determine whether a midwife left the village, which allowed us to create a time series of the periods when each community was served by a village midwife.

Trends in infant mortality and the use of birth facilities

We begin with a descriptive analysis of infant mortality outcomes and delivery mechanisms, using information on the pregnancy histories of 'ever-married' women from the three waves of the IFLS. This gives an overall picture of the infant mortality situation in Indonesia and of trends in the use of reproductive health facilities. Figure 2 presents infant, neonatal and post-neonatal mortality

3 Indonesia Family Life Survey, <<http://www.rand.org/labor/FLS/IFLS/>>.

FIGURE 2 Mortality Rates^a for Full Sample^b
(deaths per 1,000 live births)

^a See figure 1, note a.

^b The full sample includes communities targeted and not targeted by the village midwife program.

Source: As for figure 1.

rates for the full sample of births from 1988 to 1999. It indicates a noticeable fall in infant mortality around 1993–94, coinciding with the large-scale introduction of midwives through the program into communities across Indonesia. Neonatal mortality fell by about the same amount as post-neonatal mortality during the period shown (notwithstanding some temporary divergence in the two series during the years 1996–97).

The picture differs in many respects if we focus on the program and non-program sample communities, as would be expected given their very different initial conditions. Figures 3a and 3b present infant mortality data for the two groups separately. Since there is considerable year-to-year volatility, three-year rolling average mortality rates are shown for greater clarity.⁴ It can be seen that a decline in infant mortality is common to both groups, although it is much more tightly concentrated in the middle of the 1990s in the non-program communities.

Since infant mortality is the sum of neonatal and post-neonatal mortality, it is mainly of interest to focus on the latter two measures. Both neonatal and post-neonatal mortality declined steadily and significantly over the period through to about 1996–97 in the program group. By contrast, nearly all the decline in infant mortality in the non-program group is accounted for by declining neonatal mortality: its rate was similar for the program and non-program groups in 1990, but by 1999 it was significantly lower in the non-program group (16.3 per 1,000, compared with 21.8 per 1,000 in the program group). Although there was some

4 The raw data, including number of live births and standard errors for each mortality rate in each year, are contained in appendix 1.

FIGURE 3a Mortality Rates^a for Midwife Program Communities^b
(deaths per 1,000 live births; 3-year rolling average)

^a See figure 1, note a.

^b Communities targeted by the village midwife program.

Source: As for figure 1.

FIGURE 3b Mortality Rates^a for Non-Program Communities^b
(deaths per 1,000 live births; 3-year rolling average)

^a See figure 1, note a.

^b Communities not targeted by the village midwife program.

Source: As for figure 1.

TABLE 1 *Births by Delivery Place*
(%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	All Years
Program communities^a													
Home	77.8	77.1	72.8	73.9	73.5	72.6	67.3	64.2	63.6	59.7	61.1	58.2	67.7
Midwife clinic	7.2	7.3	10.7	10.6	13.0	11.5	14.7	17.2	19.3	21.8	23.5	23.5	15.7
Hospital	5.2	7.3	7.0	7.5	6.1	7.9	8.9	12.4	11.3	12.7	11.1	11.5	9.4
<i>Puskesmas</i> ^b	2.1	3.3	3.0	2.9	2.4	3.5	3.1	2.1	2.0	1.8	2.8	3.2	2.7
Physician clinic	1.0	1.1	1.6	0.7	0.7	0.9	1.6	1.1	0.7	1.0	0.5	2.0	1.1
TBA premises ^b	1.6	0.9	0.7	1.2	1.5	1.8	2.6	2.3	2.7	2.2	0.7	1.4	1.7
Non-program communities^a													
Home	38.7	39.7	45.7	40.9	33.5	36.0	33.1	37.5	26.4	26.9	30.1	26.9	34.4
Midwife clinic	22.7	23.4	23.1	24.5	27.3	29.3	30.7	29.4	30.2	34.7	31.3	30.6	28.2
Hospital	22.7	22.9	18.1	19.7	26.3	22.1	23.1	22.9	28.9	27.8	26.7	28.9	24.4
<i>Puskesmas</i> ^b	5.0	5.6	4.5	5.8	6.1	4.1	7.5	5.5	7.7	6.0	5.1	6.2	5.8
Physician clinic	5.9	4.2	3.2	3.4	2.9	3.6	4.4	3.4	5.1	2.8	5.1	6.6	4.1
TBA premises ^b	1.7	1.9	1.8	1.9	0.7	2.3	1.3	0.9	1.3	1.4	1.7	0.4	1.4

^a 'Program communities' are communities targeted by the village midwife program; 'non-program communities' are those not targeted by the program.

^b *Puskesmas* = *pusat kesehatan masyarakat* (community health centre). TBA = traditional birth attendant.

Source: As for figure 1.

catch-up in the post-neonatal mortality rate by the program group, this measure remained much lower in the non-program group at the end of the period (12.2 per 1,000 compared with 28.5 per 1,000 in the program group).

The pattern of births by place of delivery differs greatly between the two groups (table 1). In terms of rough averages over the whole period, the proportion of births at home in the program group was twice as high as that in the non-program group, and the proportion in midwives' clinics only a little over half. Accordingly, deliveries in hospitals, *puskesmas* and physicians' clinics were 2–4 times more likely in the non-program group. The relative importance of births in *puskesmas*, physicians' clinics and TBAs' premises was always small for both groups.

Trends over time also differed considerably. A decline in the prevalence of home births was common to both groups, but was much stronger in the program group, where the initial level was twice as high. This trend was reflected in an increase in deliveries at midwives' clinics – again, much more pronounced in the program group – suggesting that the program had a strong impact on the choice of services by women. Both groups made increasing use of hospitals for deliveries, and again this trend was more pronounced in the program group.

Table 2 shows that although a large fraction of births continue to take place with TBAs as the primary source of help for delivery, the percentage of such births roughly halved over the period in question for both groups, while remaining nearly three times as high for the program group by the end of the period.

TABLE 2 *Births by Primary Assistance during Delivery (%)*

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	All Years
Program communities^a													
Midwife	24.7	26.2	30.5	27.8	30.4	34.8	35.3	40.7	42.7	47.8	47.4	51.9	37.8
TBA ^b	66.0	64.9	58.6	59.7	58.0	56.0	52.9	44.6	45.5	39.5	39.1	34.1	50.3
Physician	0.0	2.4	3.3	4.1	4.3	3.7	5.5	6.0	6.1	6.1	8.3	8.4	5.2
Other	5.7	4.0	6.3	6.5	5.2	4.3	3.9	4.8	3.9	4.0	4.7	4.5	4.7
Nurse	1.6	1.6	0.7	1.0	1.5	0.6	1.0	3.3	1.4	2.0	0.2	0.9	1.3
Non-program communities^a													
Midwife	55.5	50.0	59.7	51.9	61.9	55.9	61.9	61.7	63.4	58.8	60.2	62.0	58.8
TBA ^b	26.1	29.0	28.1	28.4	18.0	23.9	19.4	17.5	14.5	13.9	19.9	12.8	20.6
Physician	14.3	14.9	7.7	13.9	15.5	14.4	12.5	16.2	17.5	21.8	15.3	21.9	15.7
Other	3.4	5.1	3.2	3.8	2.9	3.2	4.4	2.1	2.1	3.2	3.4	2.1	3.2
Nurse	0.8	0.9	0.5	0.9	0.7	1.8	1.9	2.1	1.7	1.4	1.1	0.8	1.2

^a See table 1, footnote a.

^b TBA = traditional birth attendant.

Source: As for figure 1.

This is reflected in large increases in the proportions of midwife- and physician-assisted births. By the end of the period, midwife-assisted deliveries accounted for more than half the total in the program group and nearly two-thirds in the non-program group. The data in table 2 suggest that the program was targeted to communities that were under-served by trained health workers. Program communities had much higher reliance on TBAs on average for the whole period, with over 50% of births assisted by them, compared with just 21% in non-program communities. The fact that program communities saw a larger decline in the percentage of TBA-assisted births, and a larger increase in the percentage of midwife- and physician-assisted births, suggests that women switched away from TBAs to trained midwives and doctors after the introduction of the village midwife program.

Average infant mortality rates for 1988–99 by place of delivery and primary source of delivery assistance are presented in table 3 for both the program and non-program sample communities.⁵ For both groups, infant mortality rates are highest for births in the home, followed by those in hospitals, and in both cases the rates are much higher in the program group. The overall infant mortality rate in program communities for births in midwives' clinics is similar to that for births at TBA premises and *puskesmas*.

5 A degree of caution is needed in interpreting the figures for some of the providers presented on the table, as they are based on a small sample of births. This leads to a lack of precision and high variability in the estimates of the mortality rates.

TABLE 3 *Infant Mortality Rates by Delivery Place and Primary Assistance during Delivery, 1988–99^a*
(%)

	Program Communities ^b				Non-program Communities ^b			
	Live Births ^c	Mortality			Live Births ^c	Mortality		
		Infant	Neonatal	Post-neonatal		Infant	Neonatal	Post-neonatal
By delivery place								
Home	3,679	65.5 (4.1)	24.2 (2.5)	41.3 (3.3)	866	49.7 (7.4)	24.3 (5.2)	25.4 (5.4)
Hospital	512	64.5 (10.9)	46.9 (9.4)	17.6 (5.8)	613	42.4 (8.1)	37.5 (7.7)	4.9 (2.8)
<i>Puskesmas</i> ^d	146	34.3 (15.1)	20.5 (11.8)	13.7 (9.7)	146	27.4 (13.6)	20.6 (11.8)	6.8 (6.8)
Physician clinic	59	33.9 (23.8)	16.9 (16.9)	16.9 (16.9)	104	9.6 (9.6)	9.6 (9.6)	– –
TBA premises ^d	89	33.7 (19.2)	11.2 (11.2)	22.5 (15.8)	35	28.6 (28.6)	28.6 (28.6)	– –
Midwife clinic	852	31.7 (6.0)	17.6 (4.5)	14.1 (4.0)	713	21.0 (5.4)	12.6 (4.2)	8.4 (3.4)
By primary birth assistance								
Physician	281	92.5 (17.3)	60.5 (14.2)	32.0 (10.5)	396	42.9 (10.2)	40.4 (9.9)	2.5 (2.5)
Nurse	71	84.5 (33.2)	42.3 (24.0)	42.3 (24.0)	31	64.5 (44.9)	64.5 (44.9)	– –
TBA ^d	2,730	72.2 (4.9)	27.5 (3.1)	44.7 (4.0)	519	55.9 (10.1)	30.8 (7.6)	25.1 (6.9)
Other	257	66.2 (15.5)	35.0 (11.5)	31.1 (10.9)	80	25.0 (17.6)	– –	25.0 (17.6)
Midwife	2,055	35.5 (4.1)	16.1 (2.8)	19.5 (3.1)	1,485	28.3 (4.3)	17.5 (3.4)	10.8 (2.7)

^a Standard errors are shown in parentheses. In some cases standard errors are the same as the mortality rate as a consequence of there being only a single death recorded. '–' = no deaths recorded in this category.

^b See table 1, note a.

^c The sum of live births by delivery place in this table does not match that by birth assistance, because mortality rates for the small number of births in the 'other' category for delivery place are not reported here. Total live births in this table do not equal the totals in appendix 1, because the latter includes births with missing delivery place or delivery help information, whereas table 3 does not.

^d See table 1, note b.

Source: Author's calculations.

The figures become more informative when neonatal and post-neonatal mortality are separated. In both the program and non-program communities, by far the highest neonatal mortality rates are for births in hospitals, while post-neonatal mortality rates are highest for those born in the home. The high rates of neonatal mortality for hospital births could be due to the referral of high-risk pregnancies – women with birth complications being selected into this sample – or it could reflect shortcomings in the services provided in hospitals; these alternatives cannot be disentangled in the present analysis. Most of the mortality figures are higher for the communities covered by the village midwife program. These communities show higher post-neonatal mortality rates for all categories, probably reflecting the lower level of economic development of areas chosen for placement of village midwives.

Infant mortality rates also vary by the type of delivery assistance. In both the program and non-program communities, the overall infant mortality rate is lower for babies delivered by midwives than for those delivered by physicians, nurses and TBAs. Neonatal mortality rates for midwife-assisted births remain much lower than those for TBA-assisted births in both types of communities. The post-neonatal mortality rate is higher for TBA-assisted births than for other categories, while neonatal mortality rates are highest for babies delivered by physicians and nurses.

The neonatal mortality rates associated with different types of delivery assistance may reflect the quality of pre-natal care, delivery services or intrinsic maternal health, as well as the tendency for high-risk deliveries to be assisted by physicians and nurses. On the other hand, the post-neonatal mortality rates associated with each category may reflect an income effect, especially in the non-program communities: physician-assisted deliveries are most likely to be to higher-income women, while TBA-assisted births tend to be the choice of lower-income women, who raise children with fewer resources and lower-quality nutrition, increasing their susceptibility to childhood diseases. The infant mortality rates are higher for each type of provider in the sample restricted to communities where midwives were introduced, suggesting that the program was targeted to areas with characteristics that lead to higher child mortality rates.

EMPIRICAL ANALYSIS

Estimating the impact of midwives on the mortality risk of children is complicated by the fact that women choose the facility where they give birth and the type of assistance they receive during delivery. That choice may reflect various characteristics of the individual that are not observed in the data, so an empirical framework regressing the mortality outcome of births against the choice of birth facility or services will lead to biased estimates. Furthermore, there is an unobserved degree of frailty for each birth that would affect the choice of services. As is apparent from the descriptive trends presented above, for example, mortality rates are higher for babies delivered in hospitals and also for those delivered by physicians and nurses. This probably reflects the choice made by women with high frailty to use these services, or the fact that the women with birth complications are likely to be referred to hospitals and physicians, causing higher mortality rates to be associated with these providers.

The task of estimating the impact of the village midwife program on child mortality risk is further complicated by the fact that the midwives were not randomly assigned to villages. Poorer communities and those located further away from health centres were likely to be targeted earlier under this program than other communities (Frankenberg and Thomas 2001). A program effect estimated by directly regressing infant mortality outcomes against the presence of midwives in the community will be biased, since the placement of a midwife in a particular community may be dependent on unobserved community characteristics.

In order to overcome bias due to unobserved heterogeneity at the individual and community levels, the programmatic effect is estimated here by aggregating birth outcomes at the *kabupaten* (district) level for each year.⁶ Using data on the timing of midwife placement in each community, we can obtain the fraction of communities in each *kabupaten* that had a program midwife for each year. A *kabupaten* fixed effect is used to account for unobserved heterogeneity across districts that could be correlated with the program placement rule. Changes over time not related to the program could also affect infant mortality rates across all districts. Economic growth or increased levels of economic development, as well as rises in education levels and awareness about health issues over time, could have contributed to lower infant mortality rates. Demographic changes associated with reduced fertility rates, such as reductions in high-parity births⁷ (as families stop child-bearing after having fewer children owing to a decline in desired family size), increases in maternal age, and longer spacing between births could also be associated with the infant mortality reductions. These time-specific effects are incorporated into the empirical framework through the use of dummy variables for each year to capture variation from one year to the next, as shown in equation (1), and of a time-trend variable to capture an upward or downward trend in infant mortality rates over time, as shown in equation (2):

$$M_{jt} = \beta_0 + \beta_1 MW_{jt} + \alpha_j + \gamma_t + \epsilon_{jt} \quad (1)$$

$$M_{jt} = \beta_0 + \beta_1 MW_{jt} + \alpha_j + \beta_2 \tau + \epsilon_{jt} \quad (2)$$

where M_{jt} is the mortality rate for births during year t in *kabupaten* j ; MW_{jt} is the fraction of communities in *kabupaten* j that had midwives in year t ; α_j is the time-invariant *kabupaten*-specific effect; γ_t is the location-invariant time effect; and τ is the time-trend variable that takes values incrementing by one for each subsequent year. The estimated coefficient β_1 is the effect of the village midwife program on the mortality rate for births, and can be interpreted as the change in the mortality rate in a *kabupaten* when it goes from not having a village midwife program in any of its communities to having the program in all its communities. The

6 For urban areas, the aggregation is at the level of the *kota* (municipality), the urban equivalent of the *kabupaten*. For simplicity, I refer to all such aggregations as being at the *kabupaten* level.

7 The term 'parity' is used in demographic and medical literature to indicate the number of times a woman has given birth. Parity 1 refers to the first birth, parity 2 to the second, and so on. High-parity births of order 7 and over are associated with higher infant mortality risks (Hobcraft, McDonald and Rutstein 1985).

TABLE 4 *Regression Results with Kabupaten-specific Effects^a*

	Infant Mortality		Neonatal Mortality		Post-neonatal Mortality	
	OLS ^b	Fixed Effects	OLS ^b	Fixed Effects	OLS ^b	Fixed Effects
Fraction of communities with village midwife	3.38 (8.93)	-20.70* (12.22)	-6.71 (5.33)	-12.90* (7.69)	10.09 (7.20)	-7.79 (9.82)
Constant	50.42*** (4.37)	57.24*** (5.29)	26.00*** (3.06)	27.75*** (3.59)	24.42*** (3.11)	29.49*** (4.06)
R-squared	0.001	0.003	0.001	0.003	0.001	0.001

^a Dependent variables are aggregated, period-specific mortality rates at the *kabupaten* level, expressed as deaths per 1,000 live births. Robust standard errors are shown in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

Number of *kabupaten*: 149. Number of observations: 1,590 (not all *kabupaten* observed a birth in all 12 years [1988–99] in the sample).

^b OLS = ordinary least squares.

Source: Author's calculations.

estimated coefficient β_2 can be interpreted as the change in mortality rate per year associated with changes in unobserved variables across the *kabupaten* over time.

RESULTS

The results are presented for the aggregate period-specific *kabupaten* infant mortality rate as the dependent variable, and then for neonatal and post-neonatal mortality rates separately. Table 4 first presents the results for ordinary least squares (OLS) regressions without the fixed and time-specific effects and then presents the results with the inclusion of fixed effects without time-specific effects. Table 5 presents the fixed-effects results with the inclusion of time-specific effects.

Table 4 presents the results for the aggregate infant mortality rate and its two components at the *kabupaten* level as the dependent variables. The estimated coefficients for midwife coverage in the OLS regressions are positive for infant mortality and post-neonatal mortality and negative for neonatal mortality, but none of them is statistically significant. The OLS specification does not account for *kabupaten* fixed effects, and therefore does not account for the endogeneity of program placement. By contrast, the fixed-effects results suggest that once time-invariant *kabupaten*-specific effects are taken into account, there are negative and weakly significant relationships between the coverage of the village midwife program in the *kabupaten* and the infant and neonatal mortality rates; the relationship with the post-neonatal rate remains insignificant.

The estimated fixed-effects coefficients suggest that full coverage of a *kabupaten* by the program is associated with a decline in infant mortality rate of 20.7, of

TABLE 5 *Fixed Effects Controlling for Time-specific Effects*^a

	Infant Mortality		Neonatal Mortality		Post-neonatal Mortality	
	Time Dummy	Time Trend	Time Dummy	Time Trend	Time Dummy	Time Trend
Fraction of communities with program village midwife	3.29 (15.42)	-2.43 (15.06)	6.86 (10.26)	2.81 (10.11)	-3.56 (11.66)	-5.24 (11.4)
1990	-4.38 (16.27)		-8.00 (9.88)		3.62 (12.23)	
1991	-6.64 (15.17)		-2.05 (11.95)		-4.59 (10.51)	
1992	5.43 (15.73)		6.94 (12.53)		-1.51 (10.64)	
1993	6.27 (19.34)		2.39 (12.68)		3.88 (14.95)	
1994	-35.46** (14.98)		-24.88*** (9.24)		-10.58 (12.11)	
1995	-23.47 (15.97)		-10.76 (12.02)		-12.71 (9.93)	
1996	-29.16** (13.70)		-25.08*** (9.31)		-4.09 (10.74)	
1997	-18.31 (14.05)		-17.24* (9.79)		-1.06 (10.86)	
1998	-23.14 (14.86)		-20.14** (9.76)		-2.99 (11.33)	
1999	-29.58** (14.05)		-25.83*** (9.60)		-3.75 (10.63)	
Time trend		-2.695*** (1.137)		-2.319*** (0.847)		-0.377 (0.767)
Constant	63.71*** (9.87)	69.81*** (7.55)	32.62*** (7.23)	38.57*** (5.64)	31.08*** (7.32)	31.24*** (5.20)
R-squared	0.01	0.005	0.013	0.007	0.003	0.001

^a Number of *kabupaten*: 149. Number of observations: 1,590. Robust standard errors are shown in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

Source: Author's calculations.

which 12.9 is at the neonatal stage and 7.8 at the post-neonatal stage. The presence of midwives would have improved post-neonatal mortality through the promotion of vaccination and better nutrition of children, but the results suggest that the program did not have a significant effect in lowering later infant mortality.

Table 5 presents estimates for the *kabupaten* fixed-effects specifications that include controls for period-specific effects, using time dummies and a time trend separately. When time dummies are used to control for period-specific effects, the results show a loss of significance in the relationship between the midwife program and infant and neonatal mortality, with the coefficients becoming positive. The coefficient on midwife program coverage remains negative in the case of post-neonatal mortality and it is not statistically significant. These results do not support the hypothesis that the program had a significant effect on infant mortality rates, but suggest, rather, that the observed fall in mortality rates is associated primarily with changes across the *kabupaten* over time that are not identified in the model. The estimated coefficients for the dummies for 1994 and later years suggest that there were significant reductions in infant mortality during these periods relative to 1988 and 1989, which are the excluded years. This reduction was primarily through lower neonatal mortality rates, there being no significant declines in post-neonatal mortality. Similarly, the results for the fixed-effects specification with the time-trend suggest a significant yearly rate of decline in infant mortality over time, without any significant relationship between program effort and infant mortality rates. In short, it is difficult to identify the main driving factors behind the fall in infant mortality rates within these empirical specifications.

CONCLUSIONS

Reducing the number of child deaths is a major policy objective in developing countries. Since neonatal deaths constitute a significant portion of such deaths, it is important to understand their determinants and propose effective policy measures to lower their incidence. This paper used data from the Indonesia Family Life Survey to study the role of Indonesia's village midwife program in lowering the incidence of infant mortality. Mortality outcomes were aggregated at the district level and the program effect was estimated using district fixed effects to account for non-random program placement. Although the primary purpose of this community-based program was to promote safe motherhood and lower maternal mortality, the results from using only a fixed-effects specification suggest an association between the program and lower neonatal mortality rates, without any significant effect on post-neonatal deaths. However, once time-specific effects are included in the empirical specification, the coefficient on the effect of program effort on infant mortality loses significance. The results do not support the hypothesis that the program had a significant effect in lowering infant mortality rates during the 1990s. The decline in infant mortality is therefore attributed primarily to unexplained changes over time.

REFERENCES

- Black, Robert E., Morris, Saul S. and Bryce, Jennifer (2003) 'Where and why are 10 million children dying every year?', *Lancet* 361: 2,226–34.
- Bryce, Jennifer, Boschi-Pinto, Cynthia, Shibuya, Kenji and Black, Robert E. (2005) 'WHO estimates of the causes of death in children', *Lancet* 365: 1,147–52.
- Frankenberg, E. and Karoly, L. (1995) *The 1993 Indonesian Family Life Survey: Overview and Field Report*, RAND Corporation, Santa Monica CA.

- Frankenberg, Elizabeth and Thomas, Duncan (2000) 'The Indonesia Family Life Survey (IFLS): study design and results from waves 1 and 2', DRU-2238/1- NIA/NICHD, RAND Corporation, Santa Monica CA.
- Frankenberg, Elizabeth and Thomas, Duncan (2001) 'Women's health and pregnancy outcomes: do services make a difference?', *Demography* 38 (2): 253-65.
- Frankenberg, Elizabeth, Suriastini, Wayan and Thomas, Duncan (2005) 'Can expanding access to basic healthcare improve children's health status? Lessons from Indonesia's "midwife in the village" program', *Population Studies* 59 (1): 5-19.
- Hobcraft, J.N., McDonald, J.W. and Rutstein, S.O. (1985) 'Demographic determinants of infant and early child mortality: a comparative analysis', *Population Studies* 39 (3): 363-85.
- Hull, Terence H., Widayatun, Raharto, A. and Setiawan, B. (1998) 'Village midwives in Maluku', Center for Population and Manpower Studies, Indonesian Institute of Sciences, and Demography Program, Research School of Social Sciences, Australian National University, Canberra, for the Australian Agency for International Development (AusAID).
- Lawn, Joy E., Cousens, Simon and Zupan, Jelka (2005) '4 million neonatal deaths: when? where? why?', *Lancet* 365: 891-900.
- Rokx, Claudia, Giles, John, Satriawan, Elan, Marzoeqi, Puti, Harimurti, Pandu and Yavuz, Elif (2010) *New Insights into the Provision of Health Services in Indonesia: A Health Workforce Study*, World Bank, Washington DC.
- Shiffman, Jeremy (2003) 'Generating political will for safe motherhood in Indonesia', *Social Science and Medicine* 56: 1,197-207.
- Strauss, J., Beegle, K., Sikoki, B., Dwiyanto, A., Herawati, Y. and Witoelar, F. (2004) *The Third Wave of the Indonesia Family Life Survey (IFLS): Overview and Field Report*, WR-144/1- NIA/NICHD, RAND Corporation, Santa Monica CA.
- WHO (World Health Organization) (2006) *World Health Statistics 2006*, WHO, Geneva.
- World Bank (1991) *Staff Appraisal Report Indonesia: Fifth Population Project (Family Planning and Safe Motherhood)*, Washington DC.

APPENDIX 1 *Sample Infant Mortality Rates*^{a, b}

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	All Years
Program communities^c													
Number of live births	194	450	430	414	460	541	382	523	560	504	422	557	5,437
Infant mortality	82.5 (19.8)	84.4 (13.1)	72.1 (12.5)	62.8 (11.9)	73.9 (12.2)	59.2 (10.2)	44.5 (10.6)	42.1 (8.8)	51.8 (9.4)	51.6 (9.9)	54.5 (11.1)	44.8 (8.8)	58.7 (3.2)
Neonatal mortality	30.9 (12.5)	42.1 (9.5)	27.9 (7.9)	24.2 (7.6)	37.0 (8.8)	24.0 (6.6)	18.3 (6.9)	21.0 (6.3)	17.9 (5.6)	15.9 (5.6)	26.1 (7.8)	23.3 (6.4)	25.2 (2.1)
Post-neonatal mortality	51.5 (15.9)	42.2 (9.5)	44.2 (9.9)	38.6 (9.5)	37.0 (8.8)	35.1 (7.9)	26.2 (8.2)	21.0 (6.3)	33.9 (7.7)	35.7 (8.3)	28.4 (8.1)	21.5 (6.2)	33.5 (2.4)
Non-program communities^d													
Number of live births	119	214	221	208	278	222	160	235	235	216	176	242	2,526
Infant mortality	75.6 (24.3)	9.3 (6.6)	54.3 (15.3)	57.7 (16.2)	50.4 (13.1)	54.1 (15.2)	6.3 (6.3)	42.6 (13.2)	12.8 (7.3)	41.7 (13.6)	39.8 (14.8)	4.1 (4.1)	36.4 (3.7)
Neonatal mortality	58.8 (21.7)	0.0 -	36.2 (12.6)	43.3 (14.1)	32.4 (10.6)	45.1 (14.0)	6.3 (6.3)	17.0 (8.5)	8.5 (6.0)	27.8 (11.2)	17.1 (9.8)	4.1 (4.1)	23.8 (3.0)
Post-neonatal mortality	16.8 (11.8)	9.3 (6.6)	18.1 (8.9)	14.4 (8.3)	18.0 (8.0)	9.0 (6.4)	- ^e - ^e	25.5 (10.3)	4.3 (4.3)	13.9 (8.0)	22.7 (11.3)	- ^e - ^e	12.7 (2.2)

^a As for figure 1.^b Standard errors are shown in parentheses.^c Sample of live births from enumeration areas where village midwives were placed under the program at any time during the study time-frame (1988–99).^d Sample of live births from enumeration areas where no village midwives were placed under the program during the study time-frame (1988–99).^e '-' indicates that no deaths were recorded in this category for the year in question.

Source: As for figure 1.