The Village Midwife Program and the Reduction in Infant Mortality in Indonesia.

PAPER PREPARED FOR THE 2007 MEETING OF THE POPULATION ASSOCIATION OF AMERICA
NEW YORK, MARCH 29-31 2007

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February 2007

Abstract

Indonesia introduced over 50,000 midwives in villages across the country in the 1990s to provide primary care to women without easy access to health facilities. Using the Indonesian Family Life Survey (IFLS), this paper estimates the impact of this program on infant mortality. Since women choose the type of assistance during delivery and where they give birth, regressing mortality outcomes against the choice of services will lead to biased estimates due to the correlation between the choice of services and unobserved characteristics of the women. Furthermore, the non-random placement of the program needs to be considered when estimating the program effect. In order to overcome the problem of endogeneity, mortality outcomes and program prevalence are aggregated at the district level and the program effect is estimated taking district fixed effects. The results suggest that the program is associated with a reduction in neonatal mortality, but not with post-neonatal mortality.

I. Introduction

Following the Nairobi conference in 1987, the issue of safe-motherhood gained prominence in Indonesia which led to the implementation of a village midwife program that trained and placed over 50,000 midwives in villages across the country by 1997. As in many developing countries, a majority of village women in Indonesia give birth in their houses relying on traditional birth attendants and midwives for help during delivery making the birth process risky for both mother and child. As maternal health and health care as well as infections contracted during the birth process are important causes of neonatal deaths, a program to introduce skilled birth attendants in villages across Indonesia could have had an impact not only on maternal mortality, but also on the likelihood of infant survival by improving maternal health and the environment in which births take place. This paper studies the impact of the village midwife program on infant mortality in Indonesia.

There is little evidence as to how effective the village midwife program has been in improving birth outcomes. Prior studies have shown an improvement in women's health through increase in body mass index associated with the introduction of the program, as well as improvements in nutrition of children (Frankenberg and Thomas, 2001; Frankenberg, Suriastini, and Thomas, 2005). This paper examines the role of the program in improving the mortality outcomes of infants. Since the main causes of death of neonates are related to maternal health, complications through pregnancy and the birth process, and the care provided to neonates, it is likely that the placement of skilled birth attendants in villages with limited access to health facilities and heavy reliance on traditional birth attendants would cause a decline in infant mortality through reduction in the incidence of neonatal deaths. Safe motherhood initiatives have not emphasized reductions in infant mortality as their primary objective, and this paper analyzes if such initiatives on improving maternal health through community based approaches as the one undertaken in Indonesia can play an additional role in lowering untimely deaths of children.

Conducting empirical analysis on the role of birth facilities on mortality outcomes is difficult because regressing mortality outcomes on the delivery place or choice of help during the delivery process will lead to biased estimates, as these reflect choices made by

the individuals which may be correlated with unobserved individual characteristics. Instead, the program effect is estimated based on the period when a midwife was introduced in the community. But this adds the complication of selective placement of programs in the communities based on community characteristics. The government was more likely to introduce midwives in communities that needed them most, making program placement non-random. To overcome the bias generated by such targeted placement of programs, the program effect will be estimated by aggregating mortality rate at the district level and taking community fixed effects to account for endogenous program placement.

The empirical analysis in this paper is conducted using pregnancy information from all three waves of the Indonesian Family Life Survey (IFLS), which provide detailed information on each pregnancy including the use of health facilities by the woman during the pregnancy. The IFLS also collected information at the community level, interviewing the village-head and head of Family Welfare Associations (PKK) about various aspects of the community and the introduction of government programs in the village, and interviews were also conducted with staff of health and educational facilities in the community. These responses allow us to identify when a village midwife was introduced in a particular community, making it possible to evaluate the program. The results suggest that the village midwife program caused a reduction in neonatal mortality, but there is no relationship between the program and post-neonatal mortality.

The next section provides a brief description of the village midwife program in Indonesia, followed by a discussion on the causes of the death of children in developing countries and the role community based programs such as the village midwife program could play in lowering the mortality rates of children. Section IV discusses some of the prior studies on the effect of the village midwife program in Indonesia on maternal and child health. Section V describes the IFLS and the sample used in the empirical analysis in this paper, followed by a discussion on the descriptive trends in mortality rates and use of birth services in Indonesia as shown by the IFLS sample used in this study. Section VI discusses the empirical methodology and the results.

II. The Village Midwife Program

The village midwife program (bidan di desa) began in 1989 with the aim of making midwives available in all the 68,000 villages in Indonesia to provide women with prenatal care during pregnancy and assistance during delivery. When the program began, there were 13,000 midwives available to village women in Indonesia (World Bank, 1991). By the end of the 1996/1997 budget year, 52,042 midwives were in place, covering 96 percent of the 54,120 villages that had needed midwives in 1989 (Shiffman, 2003). The program was implemented primarily by the Ministry of Health with cooperation with other ministries, especially the Ministry of Home Affairs and Ministry of Women's Roles, and with support from various international donor agencies, such as the World Bank, UNICEF, WHO, and AusAid.

The midwives were recruited from three-year nursing academies and were given an additional year of midwifery training. Once assigned to the community, the midwives were paid a salary for three to six years by the government. They were then expected to start private practice after having built a client base in the village. They had public practice during normal working hours, and were allowed to practice privately after hours. The midwives played a role in promoting community participation in health, providing health and family planning services, working with traditional birth attendants, and referring complicated cases to health centers and hospitals (Frankenberg and Thomas, 2001). Village midwives also had contacts with the community in various other settings which allowed them to impart information on nutrition, food preparation, sanitation and other health-promoting behaviors to the community members.

It is likely that the introduction of midwives in villages led to positive health outcomes in the communities. By providing help during the childbirth process to women who would have otherwise relied on traditional birth attendants, 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 prenatal checkups and referring clients to hospitals and puskesmas (community health centers) in the case of complications, the presence of a midwife in the community could have helped women seek timely help and avoid complicated births in the house, which could have lowered infant mortality risk.

III. Causes of Childhood Deaths

Every year about 10 million children die before the age of 5 years, mostly in developing countries, of which about 37 percent die at the neonatal stage (Black, Morris, and Bryce, 2003). Based on WHO estimates of causes of death of children for 2000-2003, the main causes of death beyond the neonatal stage are due to pneumonia, diarrhea, and malaria which account for 19, 17 and 8 percent, respectively, of all childhood deaths (Bryce, Boschi-Pinto, Shibuya, and Black, 2005). Of the 4 million children that die during the neonatal stage, it is estimated for 2000 that the direct causes of such death are mainly due to birth asphyxia (23%), preterm birth (27%), congenital abnormalities (7%) and infections (36%). Breaking down the neonatal deaths due to infections, sepsis and pneumonia are the direct cause of 26% of such deaths, while tetanus and diarrhea are responsible for 7% and 3%, respectively (Lawn, Cousens, and Zupan, 2005). However, the extent of deaths caused by infections at the neonatal state varies between countries. Countries with high neonatal mortality rates (over 45) have a higher proportion of neonatal deaths caused by infections, almost 50 percent, while those with low neonatal mortality rates have lower incidence of such deaths, less than 20 percent of deaths due to sepsis and pneumonia, with negligible tetanus and diarrhea related deaths (Lawn, Cousens, and Zupan, 2005).

According to the WHO estimates for causes of childhood deaths in Indonesia for 2000-2003, neonatal deaths constitute 38 percent of the total, followed by diarrhea (18%), pneumonia (14%), and measles (5%). Deaths due to malaria and HIV/AIDS are negligible. The main causes of neonatal deaths are preterm birth, birth asphyxia, and severe infections, which include pneumonia, sepsis, meningitis among others. Neonatal tetanus and diarrhea, which are the easily preventable causes of neonatal deaths, each constitute only 1 percent of total neonatal deaths, suggesting that Indonesia has been successful in close to eradicating such deaths among neonates.

Besides the direct causes of death, the major underlying cause of child deaths, especially at the post-neonatal stage, is undernutrition of children which increases their susceptibility to infectious diseases (Black, Morris, and Bryce, 2003). While at the neonatal state, low birthweight of infants, primarily caused by short gestation periods and

intrauterine 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, the birth process, and care provided to neonates play an important role in lowering the risk of neonatal mortality, while nutrition of children is a major determinant of mortality risk at the post-neonatal phase. The placement of village midwives in communities without easy access to health facilities would have improved the mortality situation through their influence on these underlying causes of infant deaths. Given their training, these midwives would have been more effective than the traditional birth attendants at providing antenatal, intrapartum and postnatal care. By lowering the reliance on traditional birth attendants in villages, the presence of midwives would have led to better prenatal care, earlier detections of birth complications and timely referrals to health facilities, and provided better care for neonates which are likely to have lower neonatal mortality. Furthermore, the presence of midwives could have played an important role in lowering the incidence of tetanus infections of neonates through the use of a sterilized knife to cut the umbilical cord after birth, a practice that traditional births attendants may have been more negligent about. The midwives effect on post-neonatal mortality would be through their involvement in community health activities, promoting vaccination, and providing better nutrition information to parents. Since the quality of nutrition of children is also driven by the economic status of households, the midwives' influence will primarily be on the factors responsible for deaths of neonates, so the village midwife program is likely to have a larger effect on the reduction of neonatal mortality than on post-neonatal mortality.

IV. Literature Review

Frankenberg and Thomas (2001) study the impact of the midwife program on adult health as well as birth-weights of children using the IFLS1 and IFLS2. Since the midwives were not placed randomly, and were more likely to be assigned in poorer communities and in those that were at a greater distance from health centers, testing the impact of the policy needs to take the endogeneity of program placement into consideration. They use a quasi-experiment comparing the health status in communities

that gained a village midwife with those that did not. Since midwives are likely to affect 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 health of other adults in the same community. They use adult BMI (body mass index) as the health outcome variable of interest.

Furthermore, they consider the impact of the village midwife program on birth-weights of children. They use community fixed effects and controls for pregnancy-specific, mother-specific variables. The results suggest that birth-weights in a community after the introduction of a midwife are greater than before. However, not all births are weighed in Indonesia, and births in the presence of medical staff are more likely to be weighed than those delivered at home with the help of a traditional birth attendant. Their analysis does not account for this possible sample selection of births.

Frankenberg, Suriastini, and Thomas (2005) analyze the impact of the midwife program on the nutrition of children. Their dependent variable are z-scores for children's height for age created by comparing the height of children in the IFLS sample with the NCHS anthropometric reference for a well-nourished child of the same age and sex. As midwives also provided basic preventive care and nutrition information, immunization, and some basic curative cares, it is likely the village midwife program would have an effect on children health. In order to account for the potential selective placement of midwives into communities, they look at the difference in outcomes for various 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 that had full exposure to the midwife program is better than those in the same cohort in communities with lower level of exposure to the program.

Both these studies look at health outcomes for adults and children using IFLS1 and IFLS2, but do not directly study the impact of the midwife program on the birth process itself, which was in fact the main objective of the midwife program. Their sample is restricted to the first two waves of the IFLS. It is likely that the impact of the program will be stronger as the midwives spent more time in the village and establish themselves in the communities rather than the periods immediately following their placement. Including responses from IFLS3 would allow us to study the longer run impact of the

program. Furthermore, if the midwives made a positive impact on improving survival of infants, their results would underestimate the true impact of the program on child health, as it would imply that the program increased survival rates of children with lower health status.

V. Data

The Indonesian Family Life Survey (IFLS) is an ongoing longitudinal survey with three main waves conducted so far: in 1993, 1997, and 2000. For IFLS1, the first wave of the survey conducted in 1993, various members of 7224 different households were interviewed, totaling over 22,000 individuals. The households were drawn from 312 different enumeration areas from 13 out of the 27 provinces in Indonesia, which represent 83 percent of the Indonesian population. The re-contact rates were high for the IFLS with 94.4% IFLS1 households re-contacted in IFLS2, while 95.3% were re-contacted in IFLS3. Nearly 91% of IFLS1 households were interviewed in all three waves.

The survey consists of detailed interviews with the household head and their spouse and other select members of the household including children. At the household level, detailed data was collected on household consumption, income, assets, as well as household characteristics. Information was also collected from individuals on education, employment, marriage, migration, health status, knowledge and use of contraceptives, and fertility, which also includes a retrospective history of pregnancies.

In each wave of the IFLS, detailed information was collected about various aspects of the pregnancy, such as prenatal visits, place of delivery, and assistance during delivery for those pregnancies that ended within 5 years prior to the survey. The sample of pregnancies used for the empirical analysis in this paper is drawn from all three waves of the IFLS and restricted to those with detailed information about delivery help and place, and to those that ended in a live birth, while stillbirths and miscarriages are excluded. The mortality outcomes are based on responses on whether the child is still alive, and if not, when or at what age it died. Based on these responses, infant mortality is defined as death within one year of birth, while neonatal mortality is defined as death prior to end of the first month after birth.

Another unique feature about the IFLS is that it collected community level information, which included information on public and private facilities available for health care and schooling. These interviews were conducted with the village heads, heads of village organizations, and authorities at the various community educational and health facilities. The community data also includes questions on the date of introduction of government programs in the community. This feature of the IFLS facilitates evaluation of government interventions and also allows us to control for various community characteristics in the empirical analysis.

The village head and head of women's welfare organization (PKK) were asked about the presence of a village midwife in the community and when she was placed in the village in both the IFLS2 and IFLS3. Their responses were used to determine the year of the introduction of the program in a particular community. In cases where the responses of the village head and the PKK were not consistent, the average of the two was taken. In cases where information was missing in the IFLS2, responses from IFLS3 were used to determine the year of introduction. Using IFLS2 and IFLS3, we are also able to determine if a midwife left the community, which allows us to create a time series of when a particular community was served by a village midwife.

Descriptive Trends

A descriptive analysis of mortality outcomes and delivery mechanisms using information on pregnancy histories of ever-married women from the three waves of the IFLS gives an overall picture of mortality situation in Indonesia and the trends in the usage of reproductive health facilities. The figures show a general decline in infant mortality rates in Indonesia during the 1990s, except during the Indonesian financial crisis in 1997-1998 which caused a stall in the rate of decline. The mortality and use of delivery facilities figures are also presented for the sample consisting only of those communities where midwives were introduced in order to compare their initial conditions and the trends in mortality outcomes and usage of birth facilities in relation to the entire sample. This will also provide an insight into how the village midwife program was targeted to a particular community. The descriptive figures show that a majority of Indonesian women continue to give birth in their house while a large fraction of women

continue to rely on traditional birth attendants, and the mortality risks associated with such births are high. However, the trends suggest that the reliance in traditional birth attendants is falling with an increase in midwife-assisted deliveries. The data also show that the areas where the village midwives were introduced had mortality figures that were higher than on average, and they had a higher reliance on traditional birth attendants.

Table 1: Sample Mortality Rates

	All years	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
A. Full Sample *													
Number of live births	8001	313	665	651	622	744	769	545	758	800	733	599	802
Infant Mortality	50.5	79.9	60.2	66.1	61.1	64.5	52.0	33.0	42.2	40.0	43.7	50.1	32.4
Neonatal Mortality	24.6	41.5	28.6	30.7	30.5	34.9	29.9	14.7	19.8	15.0	19.1	23.4	17.5
Post-Neonatal Mortality	25.9	38.3	31.6	35.3	30.5	29.6	22.1	18.3	22.4	25.0	24.6	26.7	15.0
B. Communities with Village Midwives**													
Number of live births	5466	194	451	430	414	464	546	384	523	564	514	422	560
Infant Mortality	57.1	82.5	84.3	72.1	62.8	73.3	51.3	44.3	42.1	51.4	44.7	54.5	44.6
Neonatal Mortality	25.1	30.9	42.1	27.9	24.2	36.6	23.8	18.2	21.0	17.7	15.6	26.1	23.2
Post-Neonatal Mortality	32.0	51.5	42.1	44.2	38.6	36.6	27.5	26.0	21.0	33.7	29.2	28.4	21.4

Notes:
- * Sample of live births from IFLS1, IFLS2, and IFLS3
- ** Sample of live births from enumeration areas (EAs) where village midwives were placed under the program
- Infant mortality rate defined as number of deaths before age 1 per 1000 live births. Neonatal mortality defined as deaths during the first month per 1000 live births, while post-neonatal mortality rate is defined as the number of deaths after the first month and before the end of the first year

Table 1 presents the infant mortality rates along with its breakdown into neonatal and post-neonatal mortality for the entire sample of live births between 1988 and 1999 using the three waves of the IFLS. Furthermore, the mortality breakdown is also presented after the sample is restricted to births in those communities where village midwives were placed. For the overall sample of 8001 live births, the infant mortality rate for the 1988 to 1999 period is about 50 per 1000 live births, with about half these deaths taking place at the neonatal stage. There is a general decline in the infant mortality rate

over time, but a stall in the fall in mortality rates for births in the later half of the 1990s, which is the time of the Indonesian financial crisis.

Table 2: Percentage of Births By Delivery Place

	All years	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
A. Full Sample *													
Number of live births	7943	309	660	646	617	738	761	535	755	794	729	598	801
House	57.5	63.8	65.5	64.1	63.4	58.9	62.4	57.9	56.2	52.9	50.5	52.0	48.7
Hospital	14.2	12.0	12.4	10.8	11.7	13.8	12.1	13.3	15.8	16.5	17.0	15.7	16.9
Puskesmas	3.7	3.2	4.1	3.6	3.9	3.8	3.7	4.5	3.2	3.7	3.0	3.5	4.1
Midwife' Office	19.8	13.3	12.6	15.0	15.4	18.4	16.8	19.6	21.1	22.5	25.7	25.9	25.7
Physician's Office	2.1	2.9	2.1	2.2	1.6	1.5	1.8	2.4	1.9	2.0	1.8	1.8	3.4
TBA's Office	1.6	1.6	1.2	1.1	1.5	1.2	2.0	2.2	1.9	2.3	1.9	1.0	1.1
B. Communities with Village Midwives**													
Number of live births	5421	190	446	427	411	462	540	375	520	560	510	421	559
House	68.2	79.5	77.8	73.3	74.5	73.8	73.1	68.5	64.6	63.9	60.4	61.3	58.1
Hospital	9.5	5.3	7.4	7.0	7.5	6.3	8.0	9.1	12.5	11.3	12.5	11.2	11.6
Puskesmas	2.7	2.1	3.4	3.0	2.9	2.4	3.5	3.2	2.1	2.0	1.8	2.9	3.2
Midwife' Office	15.8	7.4	7.4	10.8	10.7	13.0	11.5	14.9	17.3	19.3	21.8	23.5	23.6
Physician's Office	1.1	1.1	1.1	1.6	0.7	0.6	1.1	1.6	1.2	0.7	1.4	0.5	2.0
TBA's Office	1.7	1.6	0.9	0.7	1.2	1.5	1.9	2.7	2.3	2.7	2.2	0.7	1.4

Notes:
- * Sample of live births from IFLS1, IFLS2, and IFLS3
- ** Sample of live births from enumeration areas (EAs) where village midwives were placed under the program.

Table 2 presents the breakdown of the births based on their place of delivery. A majority of women in Indonesia continue to give birth in either their own house or the house of a family member. Although the percentage of such births has seen a small decline over the years, it continues to be the most common practice. 57 percent of births took place in the house during the sample period, followed by births in the office of the midwife or the village delivery post with about 20 percent, which has seen the most significant increase over the period. Only 14 percent of births were delivered in hospitals.

The communities that were targeted by the village midwife program were also ones that had lower access to birth facilities. This is apparent from the figures in Table 2, as these communities have a larger fraction of births in the house and have lower than

average reliance on the use of hospitals and midwife services. However, over the course of the sample period, there has been a significant increase in the fraction of births at the office of the midwife, suggesting that the program may have had an impact on the choice of services by women.

Table 3: Percentage of Births By Primary Assistance During Delivery

	All years	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
A. Full Sample *													
Number of live births	7939	309	660	646	616	738	761	537	753	793	728	598	800
Physician	8.6	5.5	6.5	4.8	7.5	8.5	7.0	7.6	9.2	9.5	10.7	10.4	12.6
Midwife	44.7	36.9	34.1	40.7	36.2	42.4	41.1	43.6	47.5	48.9	51.4	51.3	55.0
Nurse	1.3	1.3	1.4	0.6	1.0	1.2	0.9	1.3	2.9	1.5	1.9	0.5	0.9
TBA	41.1	51.5	53.6	48.6	49.7	43.5	47.0	43.4	36.4	36.6	32.1	33.4	27.8
Other	4.3	4.9	4.4	5.3	5.7	4.3	3.9	4.1	4.0	3.5	3.8	4.3	3.8
B. Communities with Village Midwives**													
Number of live births	5422	190	446	427	410	462	540	377	519	560	511	421	559
Physician	5.2	0.0	2.5	3.3	4.1	4.3	3.9	5.6	6.0	6.1	6.1	8.3	8.6
Midwife	38.0	25.3	26.5	30.7	28.0	30.5	34.8	35.8	41.0	42.7	47.9	47.5	51.9
Nurse	1.3	1.6	1.6	0.7	1.0	1.5	0.6	1.1	3.3	1.4	2.2	0.2	0.9
TBA	50.6	67.4	65.5	59.0	60.2	58.4	56.5	53.6	44.9	45.7	39.7	39.2	34.2
Other	4.8	5.8	4.0	6.3	6.6	5.2	4.3	4.0	4.8	4.1	4.1	4.8	4.5

- * Sample of live births from IFLS1, IFLS2, and IFLS3
- ** Sample of live births from enumeration areas (EAs) where the village midwives were placed under the program

A large fraction of births in Indonesia continue to take place with the traditional birth attendants (TBA) as the primary help for delivery. However, the percentage of such births has declined over the years, with midwife-assisted births increasing as a percent of the total. Traditional birth attendants were the primary source of delivery attendance in the early-1990s, but their significance has declined relative to midwives since the mid-90s. For the entire sample, 41 percent of the births were TBA-assisted, while 45 percent were midwife-assisted.

The figures also show that the program was targeted to communities that were underserved by trained health workers. The program communities had higher reliance on TBA than average, with over 50 percent of births delivered by TBAs. However, these communities had a faster decline in the percentage of TBA-assisted births, while they had

a faster increase in the percentage of midwife-assisted births, especially in the later half of the 1990s, which suggests that women switched away from TBAs to trained midwives with the introduction of the village midwife program.

The mortality rates by the place of delivery and the primary source of delivery assistance are presented in Table 4. Infant mortality rates are highest for births delivered in the house followed by those delivered in hospitals, with rates of 60.7 and 52.3,

Table 4: Mortality Rates by Delivery Place and Primary Assistance During Delivery

	Full Sample*				Communities with Village Midwives**			
	Number of live births	**Infant Mortality**	**Neonatal Mortality**	**Post-Neonatal Mortality**	**Number of live births**	**Infant Mortality**	**Neonatal Mortality**	**Post-Neonatal Mortality**
A. By Delivery Place								
House	4567	60.7	24.1	36.6	3695	63.3	24.1	39.2
Hospital	1129	52.3	41.6	10.6	514	64.2	46.7	17.5
Puskesmas	293	30.7	20.5	10.2	147	34.0	20.4	13.6
Midwife' Office	1571	26.7	15.3	11.5	855	31.6	17.5	14.0
Physician's Office	166	18.1	12.0	6.0	62	32.3	16.1	16.1
TBA's Office	126	31.7	15.9	15.9	91	33.0	11.0	22.0
B. By Primary Birth Assistance								
Physician	679	63.3	48.6	14.7	283	91.9	60.1	31.8
Midwife	3552	32.1	16.6	15.5	2063	34.9	16.0	18.9
Nurse	104	76.9	48.1	28.8	73	82.2	41.1	41.1
TBA	3265	67.4	27.9	39.5	2744	69.6	27.3	42.3
Other	339	56.0	26.5	29.5	259	65.6	34.7	30.9

Notes:
- * Sample of live births from IFLS1, IFLS2, and IFLS3
- ** Sample of live births from enumeration areas (EAs) where village midwives were placed under the program
- Infant mortality rate defined as number of deaths before age 1 per 1000 live births. Neonatal mortality defined as deaths during the first month per 1000 live births, while post-neonatal mortality rate is defined as the number of deaths after the first month and before the end of the first year

respectively. The infant mortality rates for births delivered in puskesmas (community health centers) and midwife's offices are significantly lower, 30.7 and 26.7, respectively. These figures become more informative when broken down into neonatal mortality and post-neonatal mortality. The highest neonatal mortality rates are for births in hospitals followed by those delivered in houses. Post-neonatal mortality rates are highest for those born in the house, with little variation among those born in hospitals, puskesmas, or midwives' offices, while those born in physician's office have the lowest post-neonatal mortality rates. The high rates of neonatal mortality for hospital births could either be due to referral of high risk pregnancies, so women with birth complications are being selected

into the sample, or it could also reflect shortcomings in the services provided in hospitals, which cannot be disentangled in the present analysis. The mortality figures are slightly higher when the sample is restricted to communities covered by the village midwife program, with higher overall post-neonatal mortality rates for all categories, which probably reflect the lower level of economic development of places chosen for placement of village midwives.

Infant mortality rates also vary by the type of delivery assistance. The rates for births delivered by midwives are lower than those for any other form of delivery assistance. The infant mortality rate for births delivered by midwives is 32.1 versus those delivered by physicians, nurses, and TBA, which are 63.3, 76.9 and 67.4, respectively. When infant deaths are categorized as neonatal and post-neonatal deaths, the mortality rates for midwife-assisted births remain low in both categories, while there is variation in the two categories for physician- and nurse-assisted births compared to TBA-assisted births. Physician and nurse-assisted births have high neonatal mortality rates, but post-neonatal mortality rates are similar to midwife-assisted births. TBA-assisted births, on the other hand, have lower neonatal mortality rates compared to physician and nurse-assisted births. While the post-neonatal mortality rate is highest for TBA-assisted births compared to the others. The neonatal mortality rates associated with different types of delivery assistance may reflect the quality of prenatal care, delivery services, and intrinsic maternal health as well as the selection of high risk birth towards physician- and nurse-assisted deliveries. While post-neonatal mortality associated with each category may primary reflect an income effect, as non-referral physician deliveries are most likely to be to higher income women, while TBA-assisted births have a selection of lower income women who raise children with fewer resources and lower quality of nutrition, increasing their susceptibility to childhood diseases.

The infant mortality rates are higher for each type of provider for the sample restricted to communities where midwives were introduced, suggesting that the program was targeted to areas with characteristics that lead to higher mortality rates of children. However, the higher mortality rates seem to be due mostly to higher post-neonatal mortality.

VI. Empirical Analysis

Estimating the impact of midwives on mortality risk of children is complicated by the fact that women choose the facilities where they give birth and the type of assistance during delivery. That choice may reflect various characteristics of the individual that are not observed in the data, hence an empirical framework regressing the mortality outcome of births for women against the choice of birth facility or services will lead to biased estimates. Furthermore, there is unobserved frailty of each birth that would affect the choice of services. As is apparent from the descriptive trends presented above, mortality rates are higher for births that were delivered in hospitals and also for those delivered by physicians and nurses. These probably reflect the choice by women with high frailty to use those particular services or that the women with birth complications are being referred to hospitals and physicians, thereby leading to higher mortality rates associated with them.

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

In order to overcome the bias due to unobserved heterogeneity at the individual and community levels, the programmatic effect will be estimated by aggregating birth outcomes at the kabupaten (district) level for each year. Using the timing of placement of midwives in each community, the fraction of communities in each kabupaten with a village midwife can be obtained. A kabupaten fixed effect is used to account for unobserved heterogeneity across the districts that could be correlated with the program placement rule.

$$M_{jt} = \beta_0 + \beta_1 MW_{jt} + \alpha_j + \varepsilon_{jt}$$

where M_{jt} is the mortality rate for births in time t in kabupaten j. MW_{jt} is the fraction of communities in kabupaten j with midwives in year t. α_j is the time-invariant kabupaten specific fixed effect. The sample is further restricted to those communities that received village midwives in order to reduce unobserved heterogeneity across the communities.

Results

The results are presented for aggregate period-specific kabupaten infant mortality rate as the dependent variable, and then for neonatal and post-neonatal mortality rates separately. The results for fixed effects, between effects, and random effects models are presented to account for within-kabupaten effects, between-kabupaten effects and effects associated with a combination of both. The fixed effect model captures the within-kabupaten variation in mortality risks associated with changes in midwife availability over time in the kabupaten, while the between-effect estimator captures the variation across kabupatens with different levels of program effort.

Panel (A) presents the results for the aggregate infant mortality rate at the kabupaten level. The increase in coverage of the village midwife program in the kabupaten is associated with a significant reduction in the infant mortality rate. While the cross-sectional variation in mortality rates across the kabupatens associated with the midwife program is not significant.

Breaking up the aggregate infant mortality rates into the neonatal and the post-neonatal components and estimating the relationship between program effort gives different results for the two. The program effect is significant for neonatal mortality but not for post-neonatal mortality, which supports the argument that the community-based reproductive health efforts affected the mortality risk of children during early infancy through improvements in the health of the mother and by providing a safer environment for births, thereby lowering neonatal mortality risks. The role of midwives in improving post-neonatal mortality would have been through promoting vaccination and better nutrition of children, but the results suggest that the midwife program did not play a major role in this area.

Table 5: Kabupaten Fixed Effects Results

	(A) Infant Mortality			(B) Neonatal Mortality			(C) Post-Neonatal Mortality		
	Fixed Effects (1)	Between Effects (2)	Random Effects (3)	Fixed Effects (4)	Between Effects (5)	Random Effects (6)	Fixed Effects (7)	Between Effects (8)	Random Effects (9)
Fraction of communities with a village midwife	-21.937	-5.880	-21.008	-12.766	-7.981	-12.450	-9.171	2.101	-8.404
	(9.607)*	(39.279)	(9.337)*	(6.350)*	(24.097)	(6.150)*	(7.513)	(28.359)	(7.260)
Constant	68.806	60.441	68.203	31.608	28.521	31.309	37.198	31.919	36.869
	(6.416)**	(19.752)**	(7.132)**	(4.241)**	(12.117)*	(4.503)**	(5.017)**	(14.260)*	(5.301)**
N	1235	1235	1235	1235	1235	1235	1235	1235	1235
Number of Kabupatens	107	107	107	107	107	107	107	107	107
R-Squared	0.004	0.004	0.004	0.003	0.003	0.003	0.001	0.001	
F-stat	5.21	0.02		4.04	0.11		1.49	0.01	
Wald Chi-sq			5.06			4.10			1.34

Notes:
Dependent variables aggregated period-specific mortality rates at the Kabupaten level expressed as deaths per 1000 live births. Standard errors in parentheses
* significant at 5%; ** significant at 1%

VII. Summary

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 studies the role of the village midwife program in Indonesia in lowering the incidence of infant mortality using the Indonesian Family Life Survey (IFLS). Mortality outcomes are aggregated at the community level and program effect is estimated using community fixed effect 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 suggest that it has been effective in lowering the incidence of neonatal mortality, but there has been no significant effect on post-neonatal deaths.

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