# Family planning, community health interventions and the mortality risk of children

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**Abstract**

In the last four decades, Indonesia has experienced rapid declines in infant and child mortality alongside active government interventions. The Indonesian government instituted a small family norm through an extensive family planning program and improved access to primary health care through various community-based programs. Using the Indonesian Family Life Survey (IFLS), this paper studies the impact of the national family planning program on the decline in mortality rates of children. First, using the difference in the timing of introduction of the family planning program in two sets of provinces, a difference-in-difference approach shows that mortality rates of children fell in provinces where the program was introduced. Second, the relationship between contraceptive acceptance by the woman and the mortality risk of subsequent births is examined. A bivariate probit framework is used to overcome the bias that would arise in a single equation framework due to correlation between contraceptive use and unobserved individual characteristics of the woman. The results show a 5 percent reduction in the risk of child mortality after a woman has used contraceptives, but there is no such effect of contraceptive use on infant mortality. The results also suggest that monthly community health gatherings, *posyandus*, are associated with lower infant and child mortality.

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## 1. Introduction

The family planning program in Indonesia is regarded as being very effective in increasing contraceptive usage within a short period of time and contributing towards lowering the fertility rate. Total fertility rate for Indonesia dropped from 5.2 in 1971-75 to 2.7 by 1995-97. Similarly, the usage of modern contraceptives for married women between ages 15-49 increased from 17% in 1976 to over 51% percent in 1997. Between the same time periods, the infant mortality rate fell from 145 to 52 deaths per 1000 live-births, while the child mortality rate dropped from 218 to 70 deaths for 1000 live-births (BPS, 1998). In the three decades since the introduction of the family planning program, Indonesia has also seen an increase in school enrollment, rise in income levels, increase in life expectancy, and increase in the age of marriage, all indicative of rise in the level of economic development. There is considerable debate whether the reduction in the fertility rate is the outcome of a successful family planning program or whether the change in fertility behavior is the outcome of economic development which led to the reduction in the demand for children and the subsequent adoption of contraceptives to realize smaller desired family size (Gertler and Molyneaux 1994; Pritchett, 1994; Freedman, 1997; Tsui, 2001). Whether the family planning program induced a desire for smaller families or filled an existing demand for contraceptives, there can be little debate that it made contraceptives widely available and increased contraceptive prevalence. This paper analyzes another question which is part of the debate on the effects of family planning programs: do these programs have an impact on infant and child mortality?

Access to modern contraceptive methods allows couples to effectively regulate the fertility process, thereby lowering the likelihood of unwanted pregnancies. Avoidance of excess fertility and smaller deviations from the optimal spacing between births can lead to better health outcomes for children, as the couple can avoid having a stock of children which places excessive pressure on the household budget constraint. As the main causes of death of children differ during early infancy and later childhood, another question of interest is whether family planning programs have a differential impact on infant and child mortality. As the reduction of infant and child mortality is a major policy goal in developing countries, understanding the relationship between family planning and mortality risk has important policy implications.

The empirical analysis is conducted using the 1993 round of the Indonesian Family Life Survey (IFLS). The IFLS is an extensive survey that collected information on a wide array of socioeconomic variables including the fertility history for married women. Besides information at the individual and household levels, information on various aspects of the community was also collected. The wide range of questions on the survey allows us to control for a larger set of determinants of infant and child mortality risk, which will mitigate the impact of the omitted variable bias in the empirical analysis. Usually, empirical studies on infant mortality are hindered due to small sample sizes with few realizations of infant deaths that produce insignificance of estimated coefficients. The sample used in this paper consists of over 13 thousand births, of which there were 1201 infant deaths.

Two different approaches are taken to study the impact of the family planning program on mortality risk of children. First, a direct approach is used to estimate the impact of the program by using the different phases of the introduction of the program in different provinces across Indonesia. Since the program was first introduced in the provinces of Java and Bali and then introduced in provinces in the outer islands in the next five year phase, this difference in timing of program introduction allows for a difference-in-difference approach to estimate the program effect by aggregating outcomes at the provincial level. Second, the relationship between contraceptive acceptance by an individual and the subsequent mortality risk of births is investigated. Since a single equation framework to estimate such a relationship leads to biased results due to the endogeneity of contraceptive use, this relationship is estimated using a bivariate probit structure controlling for province and period effects. The results suggest that women who have used contraceptives prior to a birth have a lower child mortality risk for that birth, but no such relationship exists when solely considering the risk of infant mortality.

The next section motivates the role of family planning and contraceptive use on mortality risk of children. Section 3 gives a brief overview of the Indonesian family planning program and discusses the difference-in-difference approach and the results using aggregated provincial mortality rates. Section 4 describes the bivariate probit framework to study the relationship between contraceptive acceptance and mortality risk. Section 5 concludes with a discussion of the results and potential for future research.

## 2. Role of Family Planning on Mortality Risk of Children

Demographic studies have shown that higher mortality risks are associated with shorter spacing between births, low age of mother at birth, and first order and higher order births (Bongaarts, 1987). The negative impact of closely spaced births on infant and child mortality arises due to maternal depletion and competition for limited resources to be devoted to each child (Hobcraft, McDonald and Rutstein, 1985). Successive childbearing without enough time for recovery can physically deplete the mother, leading to infants with lower birth weight, who are more vulnerable to disease. Closely spaced births also lead to competition in the allocation of resources between children.

In a situation where modern contraceptives are not available, some amount of birth spacing can also be attained through breast-feeding. The infecundable period following birth averages about 1.5 months without lactation, but with continued breastfeeding, the infecund period can be extended up to two years (Bongaarts, 1978). In developing countries like Indonesia, breast-feeding is common, which provides a natural means to space births. Higher levels of development are also associated with reduction in the duration of breast-feeding, which shortens the infecundable period, whereby contraceptive use becomes more important in effectively spacing between births.

According to Bongaarts (1987), family planning programs could also lead to an increase in the infant mortality rate due to changes in family building practices as contraceptive prevalence increases in a society. Mortality risks are high for births of first order, births of high order, births in low ages, and short spacing between births. As a country moves to higher levels of contraceptive prevalence, the proportion of births in each of these excess mortality risk categories changes. It is likely that lower infant mortality due to fewer higher order births and fewer births at low maternal ages could be offset by high mortality risk due to high proportion of first order births and lower birth orders with small amount of spacing between them.

Potter (1988) highlights three other ways that family planning programs could affect infant and child mortality. First, in the initial stages of the family planning program, it is likely that the increase in contraceptive usage will be among educated women at a higher socioeconomic bracket, who are low risk women. The share of births of these women would fall relative to the rest of the population thereby the overall infant mortality rate may not fall. As the program matures and a larger number of women become contraceptive users, the infant mortality rate could fall. Second, the increase in contraceptive prevalence due to family planning programs would give women with high mortality risks the ability to avoid births. And third, it is also likely that as couples have fewer children, there is a change in family relationships with parents investing more per child, thereby reducing the likelihood of death.

This paper will look at the aggregate variation in mortality rates over time as well as the infant and child mortality risks of individual births and their relationship with contraceptive acceptance. Parents derive lifecycle costs and benefits from children and make fertility decisions conditional on the constraint placed by their income stream. As the natural fertility process is characterized by uncertainty in the probability of conception, access to modern contraceptive methods provides a couple with the means to control this process more effectively. Given that children are costly in their earlier years, unplanned births can place severe pressure on the ability of the family to allocate the necessary resources for raising children, thereby lowering the quality of the stock of children and increasing their mortality risk. A couple that is better able to control the fertility process has a lower likelihood of observing deviations from its desired number of births and the optimal spacing between them, and consequently faces a lower mortality risk for children, ceteris paribus.

The main causes of infant and child deaths in developing countries are acute respiratory diseases, diarrhea, and infectious diseases. A large fraction of neonatal deaths are due to infections related to the birth process itself as most rural areas lack health facilities that provide sanitary conditions and trained staff to supervise the birth process, making the childbearing process risky for mother and child. Post neonatal deaths are also primarily caused by infectious diseases, but their incidence is indirectly related to environmental factors and malnutrition of children. Given the differences in the major causes of death at the neonatal stage and during later infancy and childhood, contraceptive use could affect infant and child mortality differently.

Since early infant deaths are primarily related to the birth process, the role of contraceptive use in reducing the likelihood of infant deaths is through the avoidance of risky births by the mother and the improvement in maternal health due to adequate spacing between births. Contraceptive use could have a larger effect in the case of child mortality as mortality in later ages is influenced by the allocation of resources towards the upbringing of the child. Unplanned pregnancies and the subsequent deviation from the optimal timing and spacing of births could affect the ability of families, especially those with fewer means, to allocate necessary resources to raise healthy children. As long as there is no significant improvement in the conditions in which the birth process takes place, the risk of death in early infancy remains high whether or not the pregnancy is planned. However, the choice of couples to control the fertility process through the use of contraceptives could effectively avoid unwanted pregnancies and avoid a situation of suboptimal age distribution of children or excess fertility, allowing adequate allocation of resources to children and lowering the child mortality risk. Hence it is likely that in the initial stages of development, the increase in contraceptive prevalence will lower child mortality to a greater extent than infant mortality.

Studying the role of family planning programs can be complicated by the non-randomness in the allocation of program resources which leads to biased estimates of the impact of program variables on outcomes of interest. Prior studies on the relationship between family planning and fertility have highlighted that if programs are placed in the area where there is high demand for contraceptives, it leads to overestimation of the program effect, while targeting of such programs to areas that have historically low usage of contraceptives and high birth rates leads to an underestimate of program effect on contraceptive use and fertility rates (Rosenzweig and Wolpin, 1986). Gertler and Molyneaux (1994) take into account that family planning program effort may be directed towards areas of greatest need in Indonesia. They use a fixed effects approach to control for nonrandom program placement to estimate the impact on community birth rates using community level data from 1982 to 1987. Their results suggest that economic development explains most of the fertility decline in Indonesia, while family planning program effort working through the contraceptive use channel explains only a small part of the fertility decline.

The fixed effects approach only controls for the bias due to selective placement of program if allocation decisions are based only on time invariant community characteristics not observed by the researcher. However, if program placement rules change over time, the fixed effects approach does not rectify the problem caused by endogeneity. In a subsequent paper, Molyneaux and Gertler (2000) specify the family planning resource allocation rule across the districts in Indonesia, and show that it depends on the demand for contraceptive supplies in the adjoining districts. Each administrative unit has a specified allocation for the year to distribute to lower units and the distribution of resources across districts will depend on the relative demand for contraceptive supplies among them. Variables reflecting the demand situation in surrounding districts are used as instruments to control for the endogeneity problem caused by time-varying program placement rules.

The time-frame for study in Molyneaux and Gertler (2000) is from 1986 to 1994, which is over 15 years since the inception of the family planning program when the program was already mature. They show that allocation of family planning program expenditures to districts varies over time and is responsive to demand for contraceptives in the locality. The analysis in this paper, on the other hand, uses retrospective pregnancy histories to study the impact of the program at the time of its introduction. To overcome the problem of targeted program placement, a difference-in-difference approach is used with aggregated mortality outcomes to estimate the impact by taking the difference in the timing of introduction of the program in various provinces. The problem of endogeneity would be more severe in estimating the impact of family planning on fertility as the government placement rule would be guided by the prevailing contraceptive prevalence rate. Furthermore, it is difficult to disentangle the direction of causality as women who want to limit fertility may be more likely to use family planning methods, so it is difficult to identify whether the family planning program led to a decline in fertility rates or whether other factors led to a reduction in demand of children, which in turn led women to become contraceptive acceptors. This paper studies the mortality risk of individual births, so the problem of endogeneity lies in the correlation of unobserved individual characteristics that affect mortality with the likelihood of contraceptive acceptance. This is accounted for using a multi-equation empirical framework which will be discussed in Section 5.

## 3. The Family Planning Program and Aggregate Mortality Trends

Given the systematic spread of the family planning program in five year phases across the archipelago, the impact of the family planning program on mortality will be estimated using a direct approach. During the first five year plan (1970-1974), the family planning program was only introduced in the 6 provinces of Java and Bali. The program extended to another 10 provinces, which were classified as Outer Islands I, in the next phase (1975-79), and finally covered the remaining provinces (classified as Outer Islands II) during the third phase (1980-84). This systematic introduction of the family planning program allows us to estimate the effect of the family planning program using a difference-in-difference strategy by aggregating mortality outcomes at the province level.

The Indonesian Family Life Survey (IFLS) consists of households drawn from 13 provinces: six in Java and Bali and seven from those in Outer Islands I. None of the provinces that fall in the Outer Island II category where the family program was introduced in the third phase were covered in the survey. Henceforth, I will refer to the six provinces in Java and Bali as *Java-Bali* and the seven provinces from Outer Islands I covered in the IFLS as *Outer-Islands* for convenience. Using the retrospective fertility history of ever-married women from the IFLS, the mortality rates of children for each province is computed for five periods corresponding to the different phases of the family planning program: 1960-1969, 1970-1974, 1975-1979, 1980-1984, and 1985-1989. Mortality rates for the provinces are computed as the number of deaths per 1000 live births in the province for each five year period. Infant mortality, child mortality and neonatal mortality are defined as death before the age of one year, five years, and one month, respectively.

Table 1 presents the sample mortality rates from the IFLS for the six provinces in Java-Bali and the seven provinces in the Outer-Islands. Both Java-Bali and the Outer-Islands show a decline in mortality rates over time. However, Java-Bali as a whole is clearly a superior health producer relative to the Outer-Islands as it continues to have lower mortality rates over time. There is also a wide variation in the child and infant mortality rates across the provinces as shown on Table.2. The mortality rates in West Java, West Sumatra, West Nusa Tenggara, and South Kalimantan are higher than in the rest of the country. There is also a difference between urban and rural places. Jakarta and Yogyakarta, which are more urban, have lower infant and child mortality rates.

| | Full Sample | | | Java-Bali | | | Outer-Islands | | |
|---|---|---|---|---|---|---|---|---|---|
| Period | Live Births | Infant Mort | Child Mort | Live Births | Infant Mort | Child Mort | Live Births | Infant Mort | Child Mort |
| 1960-1969 | 1155 | 116.9 | 169.7 | 706 | 111.9 | 169.9 | 449 | 124.7 | 169.3 |
| 1970-1974 | 2023 | 106.3 | 150.8 | 1166 | 87.5 | 125.2 | 857 | 131.9 | 185.5 |
| 1975-1979 | 3132 | 91.6 | 117.2 | 1760 | 82.4 | 106.3 | 1372 | 103.5 | 131.2 |
| 1980-1984 | 3696 | 82.3 | 108.5 | 2115 | 70.9 | 89.4 | 1581 | 97.4 | 134.1 |
| 1985-1989 | 3364 | 77.3 | 92.2 | 1844 | 66.2 | 75.4 | 1520 | 90.8 | 112.5 |
| All periods | 13370 | 89.8 | 118.1 | 7591 | 78.8 | 102.9 | 5779 | 104.3 | 138.1 |

Notes:
Mortality rates are defined as the number of deaths per 1000 live births.
*Java-Bali* consists of the provinces of Jakarta, West Java, Central Java, Yogyakarta, East Java, and Bali.
*Outer-Islands* consist of the provinces of North Sumatra, West Sumatra, South Sumatra, Lampung, West Nusa Tenggara, South Kalimantan, and South Sulawesi.

Table 1: Sample Mortality Rates

| | Live Births | Infant Mortality Rate | Child Mortality Rate |
|---|---|---|---|
| Jakarta | 1316 | 56.9 | 78.3 |
| W. Java | 2123 | 122 | 160.2 |
| Central Java | 1568 | 65.7 | 91.8 |
| Yogyakarta | 485 | 41.2 | 51.6 |
| E. Java | 1467 | 69.5 | 81.1 |
| Bali | 632 | 61.7 | 79.1 |
| N. Sumatra | 1219 | 69.7 | 100.9 |
| W. Sumatra | 774 | 100.8 | 135.7 |
| S. Sumatra | 818 | 66 | 100.2 |
| Lampung | 668 | 89.8 | 116.8 |
| W. Nusa Tenggara | 924 | 180.7 | 232.7 |
| S. Kalimantan | 630 | 147.6 | 173 |
| S. Sulawesi | 746 | 88.5 | 115.3 |

Note: Mortality rates defined as the number of deaths per 1000 live births. The sample consists of live births between 1960 to 1989 of ever-married women respondents in IFLS93.

Table2: Sample Provincial Mortality Rates

If the family planning program did affect the mortality risk of children, we should observe a relative decline in mortality rates in the provinces of Java-Bali compared to the provinces in the Outer-Islands during the period 1970 to 1974 when the family planning program was only introduced in Java and Bali. In the subsequent period, as the family planning program is introduced in the provinces in the Outer-Islands, the mortality rate in these provinces should fall in relation to Java and Bali. Figure 1 plots the period specific aggregated child mortality rates for Java-Bali and the Outer-Islands. We do observe a fall in the child mortality rate in Java-Bali for the period 1970-74 compared to the preceding decade, while there is no noticeable decline for the Outer-Islands for the same period. The Outer-Islands, however, observe a decline in mortality rates in the subsequent period which also coincides with the introduction of the family planning program in those provinces.

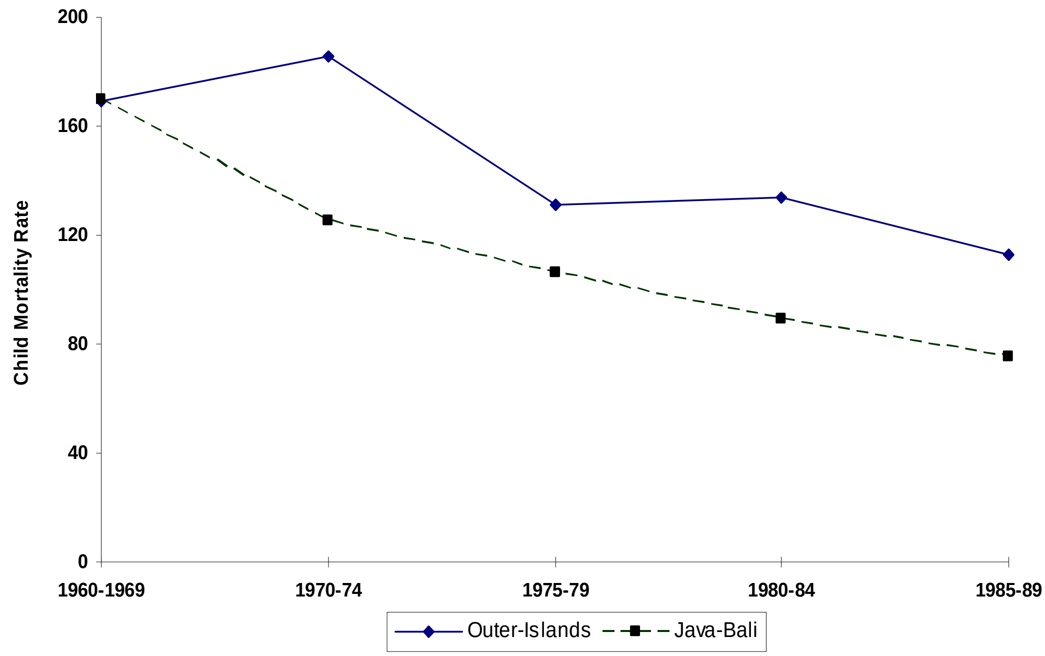


Figure 1: Child Mortality Rates for Java-Bali and the Outer-Islands

The differences in the mortality rates in the Outer-Islands compared to Java-Bali are plotted in Figure 2. The trends support the story that the introduction of the family planning program had a positive impact on mortality rates of children. The relative mortality rate in the Outer-Islands increased in the period 1970-1974 when the program was only ongoing in Java-Bali. With the introduction of the program in the Outer-Islands in the period 1975-1979, the relative mortality rates in these provinces as a whole fell. As the family planning program matured throughout the country in the subsequent periods, the fluctuations in relative mortality between the two sets of provinces are not as strong, with a relative improvement in the mortality situation in Java-Bali compared to the Outer-Islands.

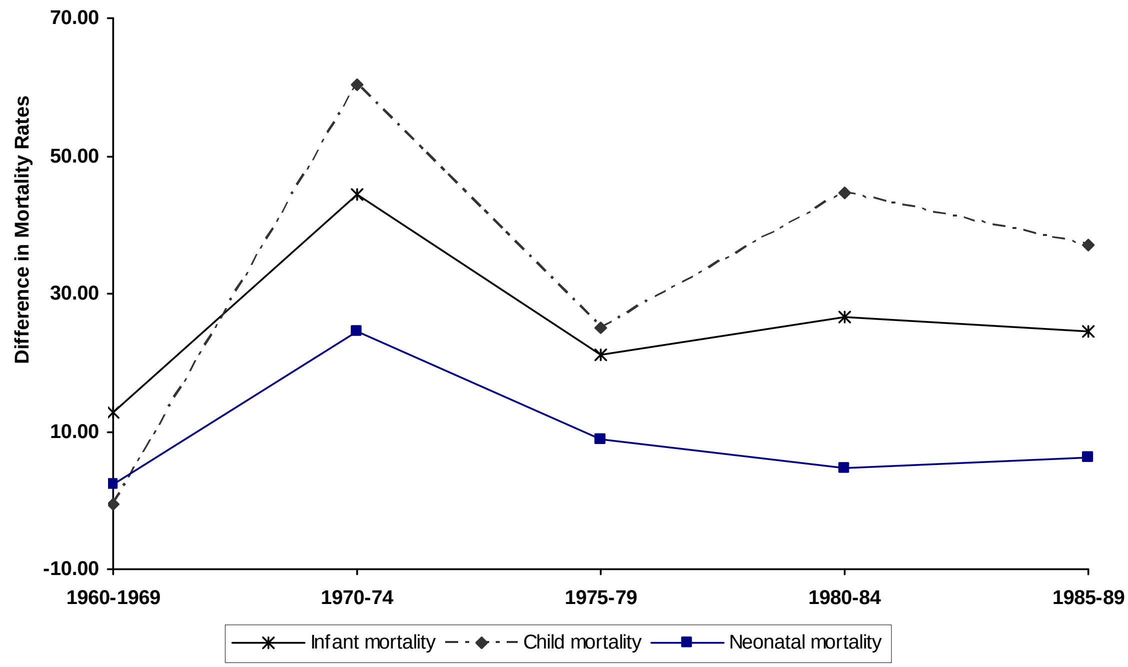


Figure 2: Difference in Mortality Rates for Births in the Outer-Islands and Java-Bali

I will use a difference-in-difference approach to test whether there is a significant effect of the introduction of the family planning program by comparing mortality rates in Java-Bali relative to the Outer-Islands during the first phase of the family planning program. The second test is to see whether the introduction of the family planning program in the Outer-Islands led to a relative improvement in their mortality position compared to Java Bali. If there is indeed an effect of the family planning program on mortality outcomes, it is also of interest whether the effect is greatest during the initial stages of introduction of the program, or as the program matures over time.

The evolution of the family planning program over time should also be considered when analyzing the empirical results. The program changed from a clinic based approach to a community based approach over time. During the second phase when the program was first introduced in the Outer-Islands as a clinic-based program, Java-Bali had moved to a community-based approach with an emphasis on involving community institutions to take a direct role in promoting the concept of the small family norm and increasing contraceptive acceptance. The community-based approach was undertaken in the Outer-Islands only during the third phase of the family planning program. It is likely that the relative improvement in the mortality outcomes in the Outer-Islands compared to Java-Bali due to the introduction of the program may be lower due to the increase in intensity of the program in Java-Bali during that phase.

### 3.1 Empirical Model of Aggregate Trends

The sample used in this analysis consists of live births born between 1960 and 1989 reported in the retrospective fertility history of ever-married women in IFLS93, giving us 13370 observations after taking into account inconsistent responses. The births are divided into five periods based on year of birth corresponding to the different phases of the family planning program: 1960-1969, 1970-1974, 1975-1979, 1980-1984, and 1985-1989. The births are divided into the provinces where they took place and mortality rates for the provinces are computed as the number of deaths per 1000 livebirths in each period. Given the 13 provinces covered in the IFLS, we get 65 province/period cells for the empirical analysis.

The impact of the program is estimated using the following specification:

$$Mortality_{pt} = \beta_1 JavaBali_p \times \tau_{70-74} + \beta_2 JavaBali_p \times \tau_{75-79} + \beta_3 JavaBali_p \times \tau_{80-84} + \beta_4 JavaBali_p \times \tau_{85-89} + \beta_5 \delta_p + \beta_6 \tau_t + \varepsilon_{pt}$$

where $Mortality_{pt}$ is the mortality rate for province $p$ in period $t$, $JavaBali_p$ is the dummy for whether the province is in Java-Bali, and $\tau_{70-74}$, $\tau_{75-79}$, $\tau_{80-84}$,and $\tau_{85-89}$ are dummies for the corresponding five year periods. $\delta_p$ and $\tau_t$ refer to the set of province and period dummies, respectively.

$\beta_1$ is equivalent to the difference-in-difference estimate of the effect of the program on the treated during the first phase, which is Java-Bali in this case. $\beta_2$, $\beta_3$, and $\beta_4$ give the difference in mortality rates in Java-Bali in relation to the Outer-Islands in periods 1975-79, 1980-84, and 1985-89, respectively. $\beta_1$-$\beta_2$ gives the effect of the introduction of the family planning program in the Outer-Islands during 1975-79. The period and province dummies in the specification account for period-specific and time-invariant province specific effects.

A shortcoming in this approach is that it does not account for any time varying province specific effects. If the provinces were undergoing changes that led to differing mortality trends, such factors would not be accounted for. Furthermore, the introduction and extension of the family planning program went hand in hand with the five-year development plans initiated by the Indonesian government that set various development goals for each five year period. The results of the impact of the family planning program in the above analysis will be confounded by other development factors if the regional emphasis of the development plans coincided with that of the family planning program.

For instance, if the government placed heavy emphasis in implementing development activities in Java and Bali during the first five year development plan and the Outer-Islands during the second five year plan, then $\beta_1$ would not only reflect the impact of the family planning program, but also of those development programs focused in Java-Bali during 1970-74. However, those concerns should be mitigated in this case because the other five year development plans had a national scope, while the family planning program expanded in a systematic manner. The first five year development plan focused on rice self sufficiency, providing grants to communities to build infrastructure, and increase industrial development. The five year development plans also sought to reduce regional disparities by giving grants directly to the provinces, districts and villages, and it is less likely that these projects would have a systematically disproportionate effect on one region over another that coincided with the expansion of the family planning program.

### 3.2 Results for Model of Aggregate Trends

The results are presented in Table 3 for each mortality category. They show that mortality rates declined in both Java-Bali and Outer-Islands coinciding with the introduction of the family planning program in these provinces. The introduction of the family planning program led to a reduction in infant mortality by 39 per 1000 live births, child mortality by 53 per 1000 live births and neonatal mortality by 23 per 1000 live births in Java-Bali. Only the coefficients for child mortality are statistically significant at the 10 percent level. The relative advantage in mortality rates of Java-Bali falls for 1975-79 period after the introduction of the program in the Outer-Islands. The impact of the introduction of the program in the Outer-Islands, given by $\beta_1$-$\beta_2$, is a fall in infant mortality by 34, a fall in child mortality of 45 and neonatal mortality of 25 per 1000 live births, which is similar to the impact of the program in Java-Bali in the previous period. The results also show wide provincial variation in mortality rates (not reported in Table 3), with Yogyakarta being a superior health producer, while West Java, West Nusa Tenggara, and South Kalimantan have higher mortality rates of children.

An additional shortcoming of this methodology is that it does not account for any compositional change in demographic aspects in the sample. Any provincial demographic trends such as delaying marriage and age at first birth, and parity levels of women that affect mortality risk are not accounted for. In the next section, an empirical framework analyzing individual births will be used to study the relationship between contraceptive acceptance and the mortality risk faced by subsequent births of the woman controlling for various demographic factors.

| | Infant Mortality | Child Mortality | Neonatal Mortality |
|---|---|---|---|
| Java-Bali* $\tau_{70-74}$ | -39.405 | -53.042 | -23.706 |
| | (28.743) | (32.202) | (21.056) |
| Java-Bali* $\tau_{75-79}$ | -5.076 | -7.213 | 1.222 |
| | (22.413) | (28.022) | (12.291) |
| Java-Bali* $\tau_{80-84}$ | -14.719 | -32.589 | 6.198 |
| | (21.022) | (26.433) | (13.172) |
| Java-Bali* $\tau_{85-89}$ | -15.968 | -27.197 | -0.441 |
| | (24.702) | (28.873) | (15.832) |
| $\tau_{60-69}$ | excluded | excluded | excluded |
| $\tau_{70-74}$ | 15.567 | 21.571 | 7.065 |
| | (24.521) | (29.029) | (16.353) |
| $\tau_{75-79}$ | -22.105 | -39.161 | -24.31 |
| | (20.375) | (25.593) | (11.781) |
| $\tau_{80-84}$ | -26.446 | -34.041 | -23.969 |
| | (18.789) | (24.478) | (10.856) |
| $\tau_{85-89}$ | -30.979 | -54.091 | -23.2 |
| | (22.264) | (26.572) | (14.702) |
| Constant | 105.704 | 155.562 | 54.517 |
| | (14.577) | (17.329) | (9.58) |
| N | 65 | 65 | 65 |
| $R^2$ | 0.72 | 0.74 | 0.66 |

Notes: Robust Standard Errors in Parenthesis. $\tau$ are the period dummies. *Java-Bali* refers to the six provinces in the islands of Java and Bali: Jakarta, West Java, Central Java, Yogyakarta, East Java, and Bali. *Outer-Islands* consist of North Sumatra, West Sumatra, South Sumatra, Lampung, West Nusa Tenggara, South Kalimantan, and South Sulawesi. Controls for provinces included in the regression. West Java, West Nusa Tenggara, and South Kalimantan have significantly higher mortality rates.

Table 3: Difference-in-Difference Results

## 4. Contraceptive Acceptance and Subsequent Birth Outcomes

### 4.1 A Reduced Form Empirical Model

The relationship between contraceptive acceptance and mortality outcomes for children is modeled using a mortality production function in line with the proximate determinants approach (Schultz, 1984; Mosley and Chen, 1984). The mortality risk for each birth faced by a woman is dependent on demographic variables, economic endowments of the household including education and income, regional and community characteristics that reflect the level of development, as well as unobserved health endowments of the mother. Furthermore, contraceptive usage by the woman is assumed to be a proximate determinant of the mortality process. Individuals choose whether or not to contracept, and this choice depends on some of the endowments and community characteristics that affect the mortality process, as well as prices and availability of contraceptives in the locality.

Estimating the relationship between contraceptive use and infant and child mortality using a single equation estimation procedure generates biased estimates due to the potential endogeneity of contraceptive use. There are two possible scenarios working in opposite directions that could lead to biased estimates. First, it is likely that there may be intrinsic qualities in each woman not captured by education that makes her a low infant mortality risk individual. Those same qualities may also make her one who is more likely to seek information on various contraceptives techniques and apply one that is most suited for her needs. Such a scenario implies that low mortality risk women select themselves into being contraceptive users, thereby the estimate of the impact of contraceptive use on mortality can be biased. Second, it is also likely that women who consider themselves to be in the high mortality risk category may be more likely to use contraceptives in order to avoid unplanned births as their perceived probability of infant death is high. Such unobserved health endowments of women and unmeasured ability leads to correlation between contraceptive use and the error term in a single equation model, so a multiple equation model for contraceptive use and mortality allowing for correlation between the error structures is required to overcome the bias.

A reduced form bivariate probit model is used to empirically test the relationship between contraceptive use and mortality outcomes. The mortality production function is expressed as a function of demographic and economic determinants as well as the contraceptive usage of the woman and is expressed as follows:

$$m_{ij}^{*} = X_1\beta_1 + \gamma c_{ij} + \mu_p + \delta_t + e_{ij}, \qquad m_{ij} = 1\left[m_{ij}^{*} > 0\right]$$

where $m_{ij}^{*}$ is the mortality risk experienced for birth *i* by woman *j* in province *p* in period *t*. $X_1$ is a set of exogenous variables that reflect individual, household, and community level economic and demographic characteristics. These variables include the age of the mother at time of birth, education level of the mother, whether the household is in a rural area, availability of piped water and sewage system, health care services in the area etc. $c_{ij}$, is an indicator variable for whether or not woman *i* used contraceptives prior to the birth of child *j*. The coefficient on the contraceptive use variable captures the impact of contraceptive usage on mortality risk controlling for other economic and demographic factors. The contraceptive function for the mother is also determined by individual, household, and community characteristics, as well as the price and ease of availability of contraceptives.

$$c_{ij}^{*} = X_2\beta_2 + \mu_p + \delta_t + \upsilon_{ij}, \qquad\qquad c_{ij} = 1\left[c_{ij}^{*} > 0\right]$$

where $c_{ij}^{*}$ is the likelihood of contraception by woman $i$ prior to birth $j$ and $X_2$ is a set of exogenous variables that influence the contraception decision.

The sample of births used for the empirical analysis encompasses births over three decades and across the Indonesian archipelago. In order to control for heterogeneity due to geographical location, dummies are created for the 13 provinces included in the IFLS. Provinces may differ due to cultural differences, geographical characteristics that could potentially affect the incidence of diseases, and differences in health and development infrastructure The province effect is captured by $\mu_p$ for each province, $p$. Mortality risk could also be affected by the general increase in the level of economic development over time, so 5 period dummies are used to control for the general rise in residual technology over time. The period effects are captured by $\delta_t$ and the sample has been divided into five periods: 1960-69, 1970-74, 1975-79, 1980-84, and 1985-89. The province dummy for Central Java and the period dummy for births before 1975 have been excluded in the empirical specification, so the coefficients should be interpreted relative to births in Central Java and in periods prior to 1975.

In the data we observe whether a child $i$ born to woman $j$ survived past its first or fifth year. Infant mortality is given by $m_{ij}$=1, when a child death is realized at or before it is one year old, and $m_{ij}$=0, when the child survives past the first year. Similarly, child mortality is defined based on whether the child dies at or before its fifth year. Infant and child deaths are assumed to be generated by a mortality production function given by a latent variable model such that infant/child death is realized ($m_{ij}$=1) when $m_{ij}^{*} \geq 0$. Similarly, using the responses on when the woman first used modern contraceptives, we can observe for each birth whether or not the woman has had prior contraceptive usage. Using the latent variable model, contraceptive use for woman *j* prior to the birth of child *i* is observed ($c_{ij}$=1) when $c_{ij}^{*} \geq 0$. The error terms follow a standard normal distribution and are potentially correlated with each other such that Var($e_{ij}$)=Var($\upsilon_{ij}$)=1 and Cov($e_{ij}$, $\upsilon_{ij}$)=$\rho$. The estimation procedure for the model involves maximizing the likelihood function based on the joint distribution of the error terms. The likelihood function is the sum of the log of probabilities of realizing a particular combination of mortality experience and contraceptive use for the entire sample of births,

$$L(\beta_1, \beta_2, \gamma, \mu, \delta) = \sum \log P(m_{ij} = 1, c_{ij} = 1) + \sum \log P(m_{ij} = 1, c_{ij} = 0) + \\ + \sum \log P(m_{ij} = 0, c_{ij} = 1) + \sum \log P(m_{ij} = 0, c_{ij} = 0)$$

Identification of the model requires an exclusion restriction, a variable included in $X_2$ but not in $X_1$. Information on whether or not a family planning post was established in the village prior to the birth is the exclusion restriction for identification in this model. Family planning posts were set up in villages in order to make contraceptives more accessible to the population, and hence they are likely to have lowered the transaction costs of obtaining contraceptives for residents. The establishment of the family planning posts directly affects contraceptive use and can only affect infant and child mortality through contraceptive use, so it provides an exclusion restriction to identify the model.

### 4.2 Data

The IFLS 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. Another unique feature about the IFLS is that it also 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, midwives, heads of village organizations, and responsible authorities at the various facilities. The community data also includes questions on water and sanitation, transportation, and the date of introduction of facilities and government programs in the community.

The sample for the empirical analysis is restricted to birth between 1960 and 1989 using the responses of ever-married women in IFLS93. After deleting observations with inconsistent responses, the sample consists of a total of 13370 live births from 4010 women. There were 1201 realized infant deaths, i.e. deaths of children at or before the age of one and 378 cases of the child dying between the ages of one and five. For the entire sample, the infant mortality rate is about 89 per 1000 live births, while the child mortality rate (death before the age of five) is 118 per 1000 live births.

Education dummies are created for various education levels attended by the woman and her husband. Four levels of education are used: primary, junior secondary, senior secondary, and college. In Indonesia, primary education consists of the first six years of school, while junior and senior secondary levels consist of three years each, and college refers to post-high school education both in universities or technical colleges. Husband's level of education is used to proxy for household income level.

Two measures of access to contraception and health facilities in the community are used in the empirical analysis: posyandus and family planning posts In order to make contraceptives more easily accessible, family planning posts (also known as village contraceptive distribution centers or Pos KB) were set up in villages to facilitate the distribution of contraceptives to the local population. Posyandus are community health posts which are not permanently staffed. They are usually monthly activities with participation of health workers from nearby community health centers and they provide mother and child services and also distribute contraceptives. The information on family planning posts and posyandus were obtained from the responses of village-heads and heads of the PKK (women's organization) in the village from IFLS93 and IFLS97.

Some respondents were not able to provide information on when the first family planning post or posyandu was set up in the village and in some cases there was inconsistency between the responses of the village-head and the head of PKK in the community. In order to construct the list of dates of the introduction of family planning clinics and posyandus, missing values in the village-head responses were supplemented with responses from the head of PKK. When both responses were available and not consistent with one another, the mean of the two values was taken. The IFLS93 was the primary source to construct the date of introduction of these facilities. For those communities with missing or inconsistent values in both the village-head and head of PKK responses in IFLS93, the IFLS97 responses were used to get the years of first introduction of these facilities.

The measure for contraceptive use is only confined to the usage of four modern methods: pills, IUD, implants, and injections. Only these methods were included because their use is controlled by the woman and they provide effective contraception for the medium or long term. The IFLS allows us to create various measures of contraceptive use. One is simply whether the woman has ever used contraceptives till the time of the survey. The survey also collected information on when the woman first used various types of modern contraceptives and where she obtained the method. Based on these responses, the first time that the woman used one of these four methods can be obtained. The empirical analysis will use this as the cutoff date for her use of modern contraceptives.

Provincial per capita income is obtained from BPS (1990). The regional per capita income excluding oil related products for 1983 and 1989 are used to calculate the annual regional economic growth. Using this growth rate, the figures for regional per capita income for the previous periods are imputed at five year intervals.

Table 4 gives the means and standard deviations of the variables used in the empirical analysis. For the sample of live births, 11 percent died before the age of 5, while 9 percent of births led to death before the age of 1. About 1 percent of the births led to multiple births, i.e. twins, and the sample is evenly divided into boy and girl births. 21 percent of the births took place after the introduction of the posyandu in the village, while 40 percent of births took place after a family planning post was introduced in the village. However, only 13 percent of the births took place after the woman had used one of the four modern contraceptive methods.

| | N | Mean | Std. dev. |
|---|---|---|---|
| Infant mortality | 13370 | 0.089 | 0.286 |
| Child mortality | 13370 | 0.118 | 0.323 |
| Birth age | 13370 | 23.77 | 5.65 |
| Male | 13370 | 0.503 | 0.5 |
| First birth | 13370 | 0.293 | 0.455 |
| Parity | 13370 | 1.854 | 1.939 |
| Prior infant mortality | 13370 | 0.174 | 0.379 |
| Tobacco | 13370 | 0.06 | 0.238 |
| Multiple births | 13370 | 0.014 | 0.119 |
| Rural | 13370 | 0.537 | 0.499 |
| Sewage | 13370 | 0.217 | 0.412 |
| Piped water | 13370 | 0.171 | 0.376 |
| Log provincial per capita income | 13370 | 5.736 | 0.53 |
| Posyandu | 13370 | 0.215 | 0.411 |
| Family planning post | 13370 | 0.404 | 0.491 |
| Contraceptive use | 13370 | 0.132 | 0.339 |
| *Woman's education* | | | |
| Primary | 13370 | 0.577 | 0.494 |
| Jr. secondary | 13370 | 0.107 | 0.309 |
| Sr. secondary | 13370 | 0.078 | 0.268 |
| College | 13370 | 0.018 | 0.133 |
| *Husband's education* | | | |
| Primary | 13370 | 0.486 | 0.499 |
| Jr. secondary | 13370 | 0.112 | 0.315 |
| Sr. secondary | 13370 | 0.107 | 0.309 |
| College | 13370 | 0.039 | 0.195 |

Notes: The sample consists of births between 1960 and 1989 of ever-married women from IFLS93. Contraceptive use refers to whether the woman has used one of four modern methods (pills, IUD, implants, and injections) prior to the birth. Posyandus are activities held once a month in the village by the Dept. of Health along with the family planning field-workers. The posyandu variable is a dummy for whether a posyandu exists in the village prior to the birth.

Table 4: Descriptive Statistics

| | Infant Mortality | | Child Mortality | | Contraceptive Use | |
|---|---|---|---|---|---|---|
| | Marginal Effects | S.E. | Marginal Effects | S.E. | Marginal Effects | S.E. |
| Birth age | -0.011 | (0.003) | -0.016 | (0.003) | 0.011 | (0.003) |
| Birth age sq | 0.000 | (0.000) | 0.0002 | (0.000) | 0.000 | (0.000) |
| Male | 0.016 | (0.004) | 0.012 | (0.005) | | |
| First birth | 0.022 | (0.007) | 0.014 | (0.008) | -0.109 | (0.004) |
| Parity | 0.004 | (0.002) | 0.006 | (0.002) | 0.009 | (0.001) |
| Prior mortality experience | 0.064 | (0.009) | 0.058 | (0.009) | -0.024 | (0.004) |
| Multiple births | 0.177 | (0.033) | 0.197 | (0.035) | | |
| Tobacco | 0.018 | (0.01) | 0.026 | (0.012) | | |
| Rural | 0.011 | (0.005) | 0.008 | (0.006) | -0.009 | (0.004) |
| Sewage | -0.004 | (0.006) | -0.006 | (0.007) | | |
| Piped water | -0.009 | (0.007) | -0.01 | (0.009) | | |
| Posyandu | -0.019 | (0.007) | -0.026 | (0.008) | 0.01 | (0.006) |
| Family planning post | | | | | 0.015 | (0.005) |
| Log province per capita income | -0.031 | (0.028) | -0.029 | (0.033) | 0.028 | (0.028) |

Table 5: Single Equation Probit Results

Table 5 (continued)

| | Infant Mortality | | Child Mortality | | Contraceptive Use | |
|---|---|---|---|---|---|---|
| | Marginal Effects | S.E. | Marginal Effects | S.E. | Marginal Effects | S.E. |
| *Woman's education* | | | | | | |
| Primary | -0.006 | (0.006) | -0.005 | (0.007) | 0.062 | (0.006) |
| Jr. secondary | -0.026 | (0.008) | -0.032 | (0.01) | 0.176 | (0.019) |
| Sr. secondary | -0.049 | (0.008) | -0.059 | (0.01) | 0.198 | (0.024) |
| College | -0.052 | (0.012) | -0.063 | (0.017) | 0.151 | (0.036) |
| *Husband's education* | | | | | | |
| Primary | -0.004 | (0.007) | -0.01 | (0.008) | -0.013 | (0.008) |
| Jr. secondary | -0.032 | (0.008) | -0.045 | (0.009) | -0.002 | (0.009) |
| Sr. secondary | -0.013 | (0.01) | -0.032 | (0.011) | -0.005 | (0.009) |
| College | -0.014 | (0.015) | -0.042 | (0.015) | 0.025 | (0.015) |
| Contraceptive use | 0.006 | (0.008) | -0.001 | (0.009) | | |
| N | 13370 | | 13370 | | 13352 | |
| Pseudo $R^2$ | 0.081 | | 0.081 | | 0.233 | |

Notes: Robust standard errors in parenthesis. Sample consists of live births between 1960 and 1989 for ever-married women in IFLS93. Province and period fixed effects included in the empirical specification, but are not reported. Missing values for education, husband's education, posyandu and family planning post are accounted for using dummies. Contraceptive use refers to the use of one of four modern methods (pills, IUD, implants, and injection) prior to birth.

### 4.3 Results

The results from a single-equation probit framework are presented in Table 5, while the bivariate probit results for infant mortality and contraceptive use are presented in Table 6 and results for the case of child mortality are presented in Table 7. The dependent variable for each of the mortality equations is a dummy indicating whether the child survived the first year or the fifth year for the case of infant and child mortality, respectively. The set of regressors include demographic variables such as the age of the mother at the time of birth, whether the child is male, and the order of birth. A dummy to indicate whether the woman has had prior infant mortality experience is included to capture woman specific mortality risks and a dummy for tobacco use is also included as a proxy for the health of the mother. Variables are included for whether or not health facilities are accessible to the community at the time of birth. Posyandu is a dummy for whether or not these health activities exist in the village at the time of birth. Similarly, Family planning post is a dummy for whether or not a family planning distribution center exists in the community at the time of birth. Contraceptive use is a dummy for whether or not the woman has had prior use of the four modern methods of contraceptives by the time of birth. Dummies are also included to control for province and period effects.

The results on the impact of demographic variables are as expected. Infant and child mortality risks have a quadratic relationship with the age of the mother at birth. Mortality risk is high at low birth ages and increases again for a woman's later ages. The likelihood of infant mortality is higher for male births, which conforms to the relative biological weakness of the male child at birth, and also suggests that sex preferences in terms of selective discrimination against the girl child is not prevalent in Indonesia. The first birth has a higher likelihood of infant mortality than non-first births, while mortality risk also increases for higher parity births. The first birth has about a 0.018 higher probability of infant death than non-first births. However, when considering child mortality, the mortality risk for first birth is not significantly higher. This may reflect the effect of experience in conducting the birth process. Inadequate knowledge about how to provide effective care for new-born babies due to lack of prior experience may increase the mortality rate among newborns.

The individual health of the woman and the mortality risk that she faces are proxied with dummies for tobacco usage and whether she has experienced infant mortality in earlier births. The estimated coefficients for both these variables are significant and positively related to infant and child mortality risk.

Provincial per capita income and husband's education level are used as proxies for community and household income levels, respectively. Husband's education level is significant and negatively related to mortality risk, while provincial per capital income is not significant but has a negative coefficient. The effect of the introduction of piped water or a sewage system to the community is not significant. Out of the thirteen provinces in the sample, the provinces of West Sumatra, West Java, West Nusa Tenggara, South Kalimantan, and South Sulawesi are low health achievers with significantly higher infant and child mortality rates relative to the other provinces.

As in other studies on infant and child mortality, the education level of the woman is negatively related to infant and child mortality risk. Higher levels of education are associated with lower mortality risks, but the coefficient for primary school is not significant, implying that there is no significant change in mortality risk for women who attend primary school in relation to women with no formal education.

There is a significant effect of posyandus on the health outcomes of children. These monthly activities conducted at the village level involve weighing of children and providing basic nutrition advice to mothers, and also involve the participation of staff from the community health centers which are at the subdistrict level. The family planning program also uses these posyandus for distribution of contraceptives. The results show lower infant and child mortality risks after the introduction of the posyandu in the community.

For the contraceptive use equations given in column (2) on Tables 6 and 7, access to posyandus and family planning posts increases the likelihood of the woman using contraceptives. Higher educated women are more likely to use contraceptives, but there is no relationship between contraceptive use and husband's education, unless the husband attends college, which then predicts a higher likelihood of contraceptive use.

Comparing the coefficients of contraceptive use in the mortality equations in Tables 6 and 7 suggest differential impacts of contraceptive use on mortality risks of children of various ages. The results suggest that there is no significant relationship between contraceptive use and infant mortality. Most importantly, a Wald test to test the null hypothesis that correlation between the error terms, $\rho$, is zero cannot be rejected for the infant mortality case. Unobserved individual factors related to infant mortality are not related to the decision to contracept, hence the bivariate probit framework is not necessary when only considering infant mortality.

| | Infant Mortality | | | Contraceptive Use | | |
|---|---|---|---|---|---|---|
| | Coeff. | S.E. | Marginal Effects | Coeff. | S.E. | Marginal Effects |
| Constant | 0.625 | (1.065) | | -4.752 | (1.234) | |
| Birth age | -0.079 | (0.019) | -0.011 | 0.091 | (0.025) | 0.011 |
| Birth age sq | 0.001 | (0.000) | 0.0001 | -0.002 | (0.000) | -0.0002 |
| Male | 0.114 | (0.032) | 0.016 | | | |
| First birth | 0.127 | (0.052) | 0.018 | -1.224 | (0.072) | -0.108 |
| Parity | 0.034 | (0.015) | 0.005 | 0.078 | (0.012) | 0.009 |
| Prior mortality experience | 0.377 | (0.047) | 0.063 | -0.224 | (0.045) | -0.024 |
| Multiple births | 0.079 | (0.105) | 0.177 | | | |
| Tobacco | 0.117 | (0.063) | 0.018 | | | |
| Rural | 0.079 | (0.039) | 0.011 | -0.078 | (0.036) | -0.009 |
| Sewage | -0.03 | (0.047) | -0.004 | | | |
| Piped water | -0.065 | (0.055) | -0.009 | | | |
| Posyandu | -0.14 | (0.058) | -0.018 | 0.083 | (0.045) | 0.01 |
| Family planning post | | | | 0.125 | (0.041) | 0.015 |
| Log province per capita income | -0.209 | (0.203) | -0.029 | 0.238 | (0.229) | 0.028 |

Table 6: Bivariate Probit - Infant Mortality and Contraceptive Use

Table 6 (continued)

| | Infant Mortality | | | Contraceptive Use | | |
|---|---|---|---|---|---|---|
| | Coeff. | S.E. | Marginal Effects | Coeff. | S.E. | Marginal Effects |
| *Woman's education* | | | | | | |
| Primary | -0.029 | (0.045) | -0.004 | 0.543 | (0.053) | 0.061 |
| Jr. secondary | -0.185 | (0.078) | -0.023 | 0.892 | (0.069) | 0.175 |
| Sr. secondary | -0.441 | (0.106) | -0.047 | 0.948 | (0.08) | 0.196 |
| College | -0.535 | (0.217) | -0.051 | 0.758 | (0.125) | 0.15 |
| *Husband's education* | | | | | | |
| Primary | -0.029 | (0.053) | -0.004 | -0.11 | (0.063) | -0.013 |
| Jr. secondary | -0.262 | (0.078) | -0.031 | -0.018 | (0.077) | -0.002 |
| Sr. secondary | -0.102 | (0.081) | -0.013 | -0.046 | (0.08) | -0.005 |
| College | -0.095 | (0.127) | -0.012 | 0.178 | (0.099) | 0.025 |
| Contraceptive use | -0.137 | (0.188) | -0.018 | | | |
| N | 13370 | | | | | |
| ρ | 0.102 | (0.107) | | | | |

Wald Test of $\rho=0$; $\chi^2(1)=0.899$, prob>$\chi^2=0.343$

Notes: Robust standard errors of the estimated coefficients are in parenthesis. Sample consists of live births between 1960 and 1989 for ever-married women in IFLS93. Province and period fixed effects included in the empirical specification, but are not reported. Missing values for education, husband's education, posyandu and family planning post are accounted for using dummies. Contraceptive use refers to the use of one of four modern methods (pills, IUD, implants, and injection) prior to birth.

| | Child Mortality | | | Contraceptive Use | | |
|---|---|---|---|---|---|---|
| | Coeff. | S.E. | Marginal Effects | Coeff. | S.E. | Marginal Effects |
| Constant | 0.798 | (0.988) | | -4.717 | (1.23) | |
| Birth age | -0.091 | (0.018) | -0.016 | 0.09 | (0.025) | 0.011 |
| Birth age sq | 0.001 | (0.000) | 0.0002 | -0.001 | (0.000) | -0.0002 |
| Male | 0.071 | (0.029) | 0.013 | | | |
| First birth | 0.042 | (0.049) | 0.008 | -1.227 | (0.072) | -0.108 |
| Parity | 0.04 | (0.013) | 0.007 | 0.078 | (0.012) | 0.009 |
| Prior mortality experience | 0.277 | (0.044) | 0.055 | -0.224 | (0.045) | -0.024 |
| Multiple births | 0.753 | (0.101) | 0.197 | | | |
| Tobacco | 0.135 | (0.058) | 0.026 | | | |
| Rural | 0.042 | (0.036) | 0.007 | -0.079 | (0.036) | -0.009 |
| Sewage | -0.033 | (0.043) | -0.006 | | | |
| Piped water | -0.056 | (0.051) | -0.01 | | | |
| Posyandu | -0.143 | (0.054) | -0.024 | 0.084 | (0.045) | 0.01 |
| Family planning post | | | | 0.127 | (0.041) | 0.015 |
| Log province per capita income | -0.142 | (0.188) | -0.025 | 0.235 | (0.228) | 0.028 |

Table 7: Bivariate Probit - Child Mortality and Contraceptive Use

Table 7 (continued)

| | Child Mortality | | | Contraceptive Use | | |
|---|---|---|---|---|---|---|
| | Coeff. | S.E. | Marginal Effects | Coeff. | S.E. | Marginal Effects |
| *Woman's education* | | | | | | |
| Primary | -0.009 | (0.041) | -0.002 | 0.544 | (0.053) | 0.062 |
| Jr. secondary | -0.16 | (0.072) | -0.026 | 0.89 | (0.069) | 0.174 |
| Sr. secondary | -0.389 | (0.098) | -0.055 | 0.949 | (0.08) | 0.197 |
| College | -0.465 | (0.205) | -0.061 | 0.758 | (0.125) | 0.15 |
| *Husband's education* | | | | | | |
| Primary | -0.061 | (0.049) | -0.011 | -0.112 | (0.063) | -0.013 |
| Jr. secondary | -0.294 | (0.071) | -0.045 | -0.02 | (0.077) | -0.002 |
| Sr. secondary | -0.201 | (0.076) | -0.032 | -0.049 | (0.08) | -0.006 |
| College | -0.268 | (0.125) | -0.04 | 0.175 | (0.099) | 0.024 |
| Contraceptive use | -0.31 | (0.174) | -0.047 | | | |
| N | 13370 | | | | | |
| ρ | 0.177 | (0.099) | | | | |

Wald Test of ρ=0; $\chi^2(1)=3.023$, prob>$\chi^2=0.082$

Notes: Robust standard errors of the estimated coefficients are in parenthesis. Sample consists of live births between 1960 and 1989 for ever-married women in IFLS93. Province and period fixed effects included in the empirical specification, but are not reported. Missing values for education, husband's education, posyandu and family planning post are accounted for using dummies. Contraceptive use refers to the use of one of four modern methods (pills, IUD, implants, and injection) prior to birth.

The bivariate probit estimates for child mortality and contraceptive use equations, however, give different results. First, the Wald test for no correlation between the error terms can be rejected, suggesting that unobserved individual characteristics affecting child mortality risks are also correlated with the likelihood to use contraceptives. Second, the coefficient on contraceptive use in the mortality equation is negative and significant at the 0.1 level. Prior contraceptive use lowers child mortality risk of individual births by almost 5 percent. Comparing the results from the single equation probit framework with that from the bivariate framework, the single equation model underestimates the effect of contraceptive use on the mortality risk of children.

The results from this framework give the net effects of contraceptive use on mortality risk of children, but do not identify the mechanism through which contraception affects child survival. The multifaceted approach taken by the family planning program to expand in rural communities led to its integration with other development programs and initiatives by the health department which could potentially confound the results. If women who became contraceptive users were also likely to get better nutrition information and benefit from mother and child health services, the contraception coefficient may not only be capturing the effect of fertility regulation on mortality risk but also the effects of better nutrition and involvement in other health activities. Since the nutrition program morphed into the posyandu system which also provided weighing services to children and other primary health care, controlling for whether or not the posyandu has been introduced in the community at the time of birth should account for some of the confounding effects of the nutrition channel within this framework.

## 5. Conclusion

This paper examined the role of the Indonesian family planning program on infant and child mortality risk using the IFLS. A difference-in-difference approach taking into account the different times of introduction of the program suggests an improvement in mortality rates of children after program introduction. The results are significant for the case of child mortality but not for infant and neonatal mortality. Furthermore, the relationship between contraceptive acceptance by a woman and mortality rate of subsequent births was modeled using the proximate determinants framework. A bivariate probit structure was used to account for the potential correlation between unobserved individual characteristics and contraceptive use. The existence of a family planning post in the community was used for identification. The results show that contraceptive use is not associated with infant mortality, but associated with child mortality. Furthermore, the introduction of community health posts, posyandus, led to a reduction in the mortality rates of children. As in prior studies on mortality of children, a large part of the reduction in mortality risk is associated with the level of education of the mother and demographic variables.

The findings in this paper imply that the introduction of family planning programs during the early stages of economic development contributed to the improvements in child survival rates in these societies. Ease of access to modern contraceptives gave couples better control over the fertility process. By lowering the likelihood of unwanted births, contraceptive use would have allowed couples to avoid excess fertility and space births effectively. This would have led to better allocation of resources in the upbringing of children, thereby lowering the likelihood of child mortality. Even though longer duration of spacing between births through use of modern contraceptives could lead to improvements in the mother's health at the time of delivery and subsequently improve the health of the infant, the empirical results in this paper suggest that there was no reduction in infant mortality risk associated with contraceptive use. Since a majority of Indonesian women in rural areas give birth in their houses without access to skilled help, they face high infant mortality risk due to factors related to birth practices. In such a scenario, infant mortality risk will remain high whether or not couples have the ability to plan births using modern contraceptives. This suggests that significant reduction in infant mortality in developing countries also requires improvements in the environment in which births take place alongside access to modern contraceptives.

Building upon this research, another topic of interest is the relationship between infant/child mortality and fertility. The decline in fertility rates experienced by a society during the demographic transition is considered to be an outcome of declining mortality rates. From a public policy standpoint, an understanding of the relationship between mortality and fertility in developing countries has implications on the importance of provisions of public health services that affect child mortality, as this could subsequently affect household fertility behavior. This paper does not attempt to answer the question of how fertility responds to infant and child mortality. Given its historically high infant and child mortality rates and a rapid decline in the last four decades, Indonesia makes a good candidate to study this relationship between the risk and realization of child mortality and fertility behavior.

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