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# *The Effects of Education on Fertility and Child Mortality: Evidence from the free secondary education policy in the Philippines*

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# The Effects of Education on Fertility and Child Mortality: Evidence from the free secondary education policy in the Philippines

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## Abstract

The Philippines implemented the free secondary education policy in 1988, which offers a natural experiment to explore the effects of maternal education on fertility and child mortality. Exploiting age-specific exposure to this educational reform through the use of fuzzy regression discontinuity design, this study finds that on average, there is an increase of 0.536 year of schooling in for the cohort of women who had been affected by the policy. Moreover, the results of this study reveal that increasing education by one year reduces 0.829 child born per woman, and decreases child mortality by 1.659%. The empirical evidence supports that increasing opportunities for women to enter and complete secondary education can reduce fertility rates and cause a significant decline in child mortality in developing countries.

*Keywords*: maternal education, fertility, child mortality, regression discontinuity, the Philippines

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# 1. INTRODUCTION

## 1.1. Overview

Developing countries have experienced persistently high fertility and child mortality rates, as well as a disproportionate share in the burden of diseases. In recent years, the growth of global population is driven by the developing countries, as many of them still have relatively high fertility rates (United Nations, Department of Economic and Social Affairs, Population Division, 2019). Among the developing countries with high fertility rates, they are also often suffered from a high burden of child mortality. For instant, the under-five mortality rate in the least developed countries is 1.57 times higher than the world average, and around 80% of the under-five deaths happened in sub-Saharan Africa and Southern Asia (UNICEF, 2017).

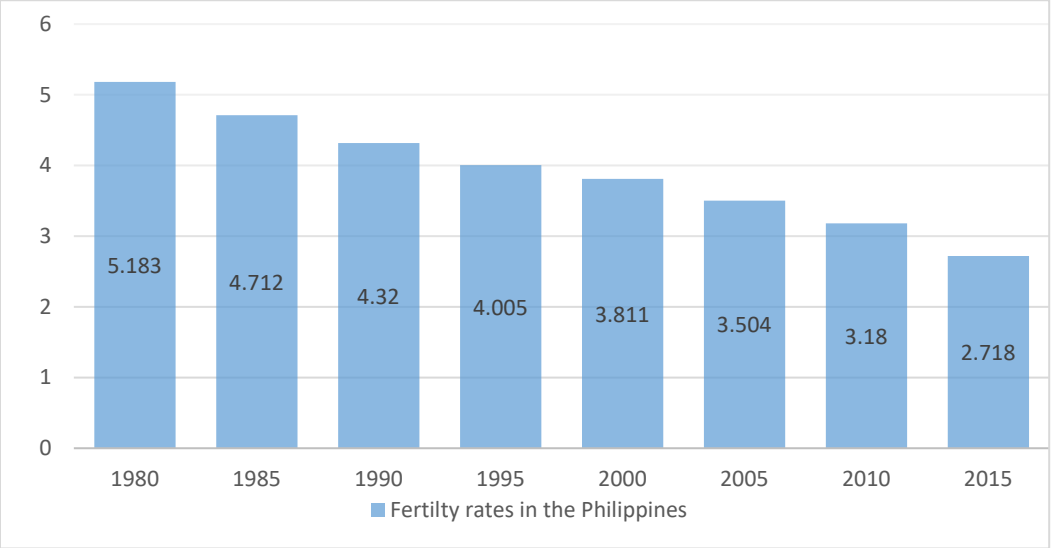
Education has long been supported by empirical evidence as a critical factor influencing the fertility rate and child health. Becker and Lewis (1973) proposed the quantity-quality trade-off model which predicts that education can increase a woman's earning and hence alter her fertility choice to opt for fewer children with higher quality. Moreover, education improves a woman's knowledge and ability to plan and execute her fertility choices, and to make better health investment on herself and her children. Martin and Juarez (1995) explained that education has an impact on women's reproductive health because of the three dimensions of education: as a transformer of attitudes, source of knowledge, and vehicle of socioeconomic development. The existing body of empirical evidences support the significant impact of maternal education on reducing child mortality (Strauss & Thomas, 1995). On the other hand, fertility rate can be influenced by women's knowledge about maternal health, which is correlated with their educational level. Therefore, women with higher levels of education could be better prepared for effective family planning, and having the desired number of children, compared with those who are less educated. Many studies across the world have revealed that the higher level the people are educated, the healthier and longer lives they tend to live. As a consequence, the birth rates of the people with more education are lower and their children are healthier (Grossman, 2006).

It is not surprising that many countries may promote maternal education to help reduce child mortality. The Sustainable Development Goals (SDGs) were initiated by the United Nation in 2015 as a call to action to end poverty and improve well-being. Among the 17 SDGs, Goal 4 is dedicated to permit all children to complete the primary and secondary education, and Goal 3 is dedicated to

promote well-being and ensuring healthy lives for all. Under Goal 3 of the SDGs, expanding knowledge about reproductive health, reducing adolescent pregnancy, and lowering mortality rates of both infants and children under five are included as indicators for fertility and child mortality rates (Desa, 2016).

The Philippines, although has experienced a gradual decline in fertility rates in the last twenty years (see Figure 1), still stands as the thirteenth most populated country in the world and the second most populated country in Southeast Asia. In 2015, the total fertility in the Philippines is 2.718 per woman which is still higher that the global total fertility of 2.5 children per woman (United Nations, 2015).

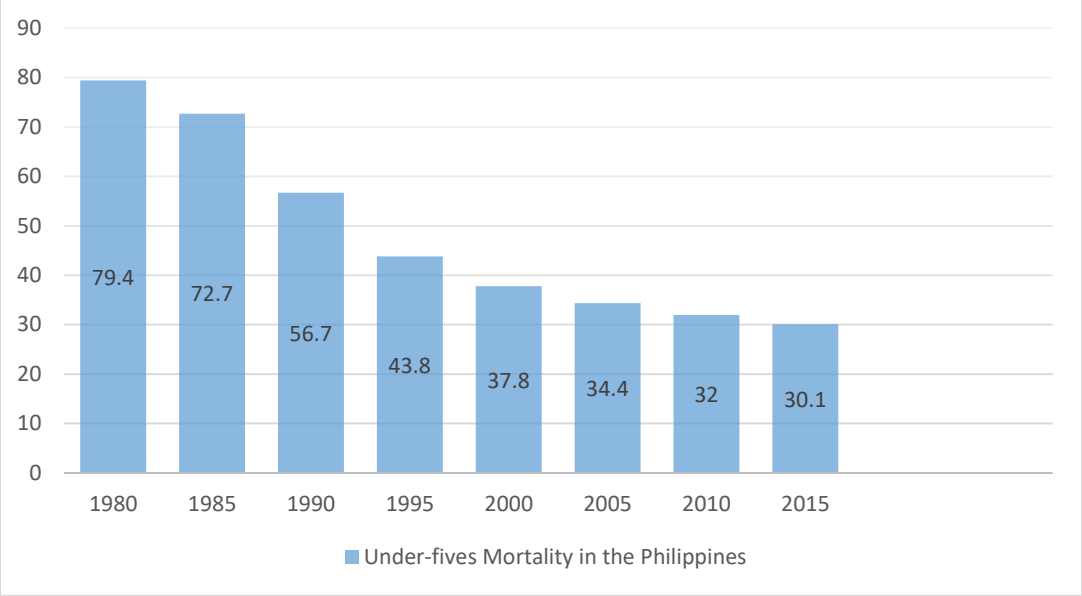
**Figure 1. Fertility rates in the Philippines (1980-2015)**




Source: World Bank (2019)

Along with the decrease in fertility rates, the Philippines has also experienced a gradual decline in the child mortality rate. Figure 2 shows that the under-five mortality rates in the Philippines had decreased from 79.4 to 30.1 per 1,000 live births between 1980 and 2015. However, similar to other developing countries which in general have higher mortality rates compared to the developed countries, the child mortality rate of the Philippines is still relatively high in the world. For instant, the under-five mortality rate of the high-income countries in 2015 is 5 per 1,000 live births, which is only one-sixth of that of the Philippines.

**Figure 2. Under-fives mortality (per 1,000 live births) in the Philippines (1980-2015)**




Source: World Bank (2019)

Most of the leading causes of child mortality in developing countries are preventable and treatable with simple and affordable interventions. As maternal education plays an important role on fertility and human capital formation, it is necessary to get a better understanding of the influence of education on fertility and child health. In 1988, the government of Philippines established a law to provide free secondary education and all the children in the Philippines could attend the primary and secondary education without facing difficulties in paying the school fees. As an exogeneous shock, the implement of that new policy can be treated as a natural experiment to help explore the effects of education on fertility and child mortality. This paper aims to examine the impacts of women's education on fertility and child mortality in the Philippines by using the 5-year datasets from the Philippines National Demographic and Health Surveys. Our results indicate that on average, the years of education increased by 0.536 year for the women who were covered by the free secondary education policy. Moreover, the results reveal that a one-year increase in education is going to reduce 0.829 child born per woman and decrease child mortality by 1.659%. However, the education effects are heterogeneous with respect to the differences in the geographic characteristics and wealth status of the women.

## 1.2. Institutional background

In the Philippines, the central government is the main responsible body for public elementary and secondary basic education by the virtue of the Constitution of 1987, which mentions that “Free public education to Filipinos shall be guaranteed” (Lazo, 2009, p.50). In 1988, the Free Secondary Education Act (Republic Act No.6655) was passed which states that “it is the policy of the State to provide a free public secondary education to all qualified citizens” (Congress of the Philippines ,1988, pp.1). The Philippines government mandated several educational reforms and policies for development aligned with political, economic, and cultural concerns. Concerning progress in the education sector, the gross enrollment ratio for secondary education in 1986 was 63.648%, which is quite low compared to the gross enrollment ratio of 86.163% in 2017 (School enrollment, secondary (% gross), n.d.). Moreover, the total percentage of educational attainment for completion of upper secondary education was 20.70% in 1970 and 56.77% in 2013 (“Philippines - Educational attainment,” n.d.).

Under the Philippines education system, the entry age year for basic education is six years old. The primary education was for 6 years and the secondary education was for 4 years. The total duration of basic education was 10 years (Musa & Ziatdinov, 2012). In 2012, the DepEd reformed the duration of basic education by adding two additional years at the secondary level (K to 12 Basic Education Program). Then, the total duration of reformed education is 12 years (UNESCO, 2017).

The language policies for classroom instruction are frequently changing due to economic, cultural, and political concerns (International Bureau of Education, n.d.). The Department of Education institutionalized Mother-Tongue Based Multilingual Language Education in 2009, by conducting a pilot project where 8 local languages were taught from Grades 1 to 3 and Filipino and English have been used in the bilingual language education system in schools (Philippines Department of Education, 2009). Concerning public budget funding, total government expenditure on the education sector fluctuated from 1995 to 2009, where the peak value was 18.18% to the total government expenditure in 1998 and the lowest was 12.42% to the total government expenditure in 2005. Total government expenditure on secondary education increased at varying rates from 1980 to 2009, where the highest value was 29.69% in 2009 and the lowest was 10.20% in 1982 (“Philippines - Public Spending on Education,” n.d.).

Since the school entry age is 6 years old and primary education lasts for 6 years, whether adolescent girls might be affected by the free secondary education policy would be dependent on how old they were in 1988: students aged from 9 to 13 would be totally affected by the new policy, those aged from 14 to 16 would be partially affected due to a relaxation of that policy, and those aged 17 and above would be less likely to be effected by that policy. Therefore, we are able to explore the age-specific pattern of school enrollment under the new educational policy, by instrumenting for education exploiting the age of the women in 1988, to test whether maternal education attainment is associated with the changes in fertility and child mortality.

The remainder of the paper is organized as follows: Section 2 presents the data. Section discusses the empirical approach. Section 3 discusses the empirical approach. Section 4 reports the results, and Section 5 concludes.

## 2. DATA

### 2.1. The Demographic and Health Survey

This paper utilized five waves of the cross-sectional datasets of the Demographic and Health Survey (DHS) from the Philippines. All datasets are obtained from the national representative surveys which were conducted in 1998, 2003, 2008, 2013, and 2017 under the authority of the Philippines Statistics Authority (PSA). The Philippines National Demographic and Health Surveys (NDHS) were financially and technically supported by the Government of the Philippines and USAID (the United States Agency for International Development) under the DHS program of ICF (Inner City Fund) international (Philippines Statistics Authority, 2020).

The core objective of the NDHS is to provide the key indicators for the living conditions and health status of households, men, women, and children according to the different demographics at the national level in rural and urban areas of the Philippines. Specifically, the NDHS provides information on fertility levels and preferences, marriage and sexual activity, the social situation of men, women, and children, maternal and child health, breastfeeding, and child mortality. The NDHS datasets were collected via a two-step process where the primary sampling units were randomly sampled from the Census of Population and Housing data files, first by using the Master Sample Frame designed by the PSA. In the second step, the sample household units

were chosen from each sampled primary sampling unit by applying systematic random sampling (Philippines Statistics Authority, 2020). The NDHS data includes four main datasets: household dataset, man dataset, woman dataset, and child dataset. The dataset for this study is generated by combining the woman datasets (within a reproductive age range of 15-49) from each of the five-year surveys. Since this study focuses on the free secondary education policy from 1988, the final dataset for this study only includes the women who were born between 1967 and 1979 from the above-mentioned datasets. After pooling across all the five surveys, the sample consists of 20,649 women whose ages were 9-21 in 1988. We classified the women who were aged 13 or below in 1988 as the treatment group since they could be benefited from the new policy during the whole period of their primary education. Therefore, the treatment and control group in our analysis covers the women who were aged 9-13 and 17-21 in 1988 respectively. In total, there are 20,649 women in our consolidated dataset, with 11,366 observations in the treatment group and 9,283 observations in the control group. For the women who were aged 14-16 in 1988, we defined them as the partially treated group since they have been benefitted from the new policy for some but not all years during their primary education period. The dataset consists of the vital information on the fertility history, child health and social demographic characteristics of the women. The variables to be used in the analysis are introduced and discussed in next section.

## 2.2. Variables

Following Grépin & Bharadwaj (2015), we adopted six outcome variables regarding fertility decision and child mortality. The dependent variables for fertility decision include total number of children born to a woman, mother's age at first birth, and teenage pregnancy. For child mortality, the outcome variables are number of child deaths, percentage of child deaths, and infant mortality.

The variable of interest of this study is the years of schooling of women. In the model, we also apply various control variables including the household wealth index, accessibility of electricity, and region. A description of all the variables is presented in Table 1.

**Table 1. Definitions of variables**

<table>
<tr><th>Variables</th><th>Description</th></tr>
<tr><td>Children</td><td>Total number of children ever born.</td></tr>
<tr><td>Age1stBirth</td><td>The age of a women when she gave birth of her first child.</td></tr>
<tr><td>Preg19</td><td>Teenage pregnancy; =1 if the woman got pregnant at age 19 or below=1, and =0 otherwise.</td></tr>
<tr><td>Child Deaths</td><td>Total number of children deaths.</td></tr>
<tr><td>Pct Deaths</td><td>Percentage of children deaths.</td></tr>
<tr><td>InfMort</td><td>Infant Mortality; =1 if the child died before the age of 1, and =0 otherwise.</td></tr>
<tr><td>Edu</td><td>Years of education.</td></tr>
<tr><td>Urban</td><td>=1 if the woman lives in urban area, and =0 if the woman lives in rural.</td></tr>
<tr><td>Electricity</td><td>= 1 if the household can access electricity, and =0 otherwise.</td></tr>
<tr><td>Wealth Index<br>Poorest (Base)<br>Poorer<br>Middle<br>Richer<br>Richest</td><td><br>If the household of woman is in the poorest wealth quintile.<br><br>If the household of woman is in the poorer wealth quintile.<br>If the household of woman is in the middle wealth quintile.<br>If the household of woman is in the richer wealth quintile.<br>If the household of woman is in the richest wealth quintile.</td></tr>
<tr><td>Age88</td><td>Age of the woman in 1988 (Policy initiated year).</td></tr>
<tr><td>TG</td><td>Treatment group dummy; =1 if the woman aged 9-13 in 1988, and =0 otherwise.</td></tr>
<tr><td>Byr</td><td>The sequence numbers of birth year, which equals to 0-4 for birth years in 1967-1971, and equals to 5-9 for birth years in 1975-1979. The values assigned for each birth year are listed below.
<table>
<tr><td>Birth Year</td><td>1967</td><td>1968</td><td>1969</td><td>1970</td><td>1971</td><td>1975</td><td>1976</td><td>1977</td><td>1978</td><td>1979</td></tr>
<tr><td>Byr</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
</table>
The women who were born between 1972-1974 are excluded since it is the transition period for the partially treated group.</td></tr>
</table>

Table 2 shows the summary statistics of the variables used in the estimations. The sample dataset consists of 20,649 women whose ages were 9-13 and 17-21 in 1988, when the free secondary education policy was initiated. The treatment group includes the women aged 9-13 in 1988, the control group includes those aged 17-21 in 1988. The partially treated group, that is for those who were aged 14-16 in 1988, is excluded from the analysis since it is hard to identify the impact of the new policy on the years of education on this group. The treatment group was fully exposed to the 1988 policy reform, so this group was able to gain benefit from that policy. As the control group was not covered by the new policy at all, their school attainment would not be

affected. Therefore, the age specificity of schooling in 1988 can be the instrumental variable for the years of education and hence the impacts on fertility and child mortality can be estimated.

**Table 2. Summary statistics (overall)**

| | Overall | | | | |
|---|---|---|---|---|---|
| **Variables** | **Obs.** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| *Children* | 20,649 | 2.732 | 2.284 | 0 | 14 |
| *Age1stBirth* | 16,600 | 22.381 | 4.536 | 11 | 46 |
| *Preg19* | 20,649 | 0.313 | 0.464 | 0 | 1 |
| *Child Deaths* | 20,649 | 0.124 | 0.428 | 0 | 8 |
| *Pct Deaths* | 16,600 | 3.405 | 10.860 | 0 | 100 |
| *InfMort* | 56,421 | 0.013 | 0.112 | 0 | 1 |
| *Edu* | 20,648 | 9.992 | 4.119 | 0 | 25 |
| *Urban* | 20,649 | 0.454 | 0.498 | 0 | 1 |
| *Electricity* | 20,258 | 0.833 | 0.373 | 0 | 1 |
| *Wealth Index* | 16,499 | 2.985 | 1.422 | 1 | 5 |
| *Age88* | 20,649 | 14.438 | 4.088 | 9 | 21 |
| *TG* | 20,649 | 0.550 | 0.497 | 0 | 1 |

Table 3 presents the summary statistics for treatment and control groups respectively. There are 11,366 women in the treatment group and 9,283 in the control group. Specifically, the average education years for the treatment group is 10.339 years while that for the control group is 9.567 years.

**Table 3. Summary statistics (for treatment and control groups)**

| | Treatment | | | | | Control | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **Obs.** | **Mean** | **Std. Dev.** | **Min** | **Max** | **Obs.** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| *Children* | 11,366 | 2.218 | 2.042 | 0 | 14 | 9,283 | 3.363 | 2.404 | 0 | 14 |
| *Age1stBirth* | 8,434 | 22.100 | 4.261 | 11 | 41 | 8,166 | 22.672 | 4.786 | 11 | 46 |
| *Preg19* | 11,366 | 0.300 | 0.458 | 0 | 1 | 9,283 | 0.328 | 0.469 | 0 | 1 |
| *Child Deaths* | 11,366 | 0.079 | 0.327 | 0 | 5 | 9,283 | 0.177 | 0.521 | 0 | 8 |
| *Pct Deaths* | 8,434 | 2.721 | 10.147 | 0 | 100 | 8,166 | 4.111 | 11.509 | 0 | 100 |
| *InfMort* | 25,205 | 0.010 | 0.102 | 0 | 1 | 31,216 | 0.014 | 0.119 | 0 | 1 |
| *Edu* | 11,365 | 10.339 | 4.005 | 0 | 25 | 9,283 | 9.567 | 4.217 | 0 | 25 |
| *Urban* | 11,366 | 0.462 | 0.499 | 0 | 1 | 9,283 | 0.444 | 0.497 | 0 | 1 |
| *Electricity* | 11,108 | 0.841 | 0.366 | 0 | 1 | 9,150 | 0.823 | 0.381 | 0 | 1 |
| *Wealth Index* | 9,070 | 2.969 | 1.422 | 1 | 5 | 7,429 | 3.004 | 1.423 | 1 | 5 |
| *Age88* | 11,366 | 10.951 | 1.415 | 9 | 13 | 9,283 | 18.708 | 1.264 | 17 | 21 |
| *TG* | 11,366 | 1 | 0 | 1 | 1 | 9,283 | 0 | 0 | 0 | 0 |

The average number of children ever born per woman in the treatment group is 2.218, which is less than that in the control group (3.363). Regarding the child mortality, the percentages of child deaths in the treatment group and control group are 2.721% and 4.111% respectively. Concerning the variables of age at first birth, teenage pregnancy, and infant mortality, the mean values of the treatment group and control group are similar to each other. For instant, the percentage of teenage pregnancy is 30% in the treatment group and 32.8% in the control group.

Among the control variables of *Urban*, *Electricity*, and *Wealth Index*, there is no substantial differences between the treatment and control group. Consider the location of residence, 46.2% of the women in the treatment group and 44.4% of the women in the control group are living in urban areas. The average accessibility to electricity in both the treatment and control groups are 84.1% and 82.3% respectively. The overall average of wealth index for the sample is about 2.985, where the average for the treatment group is 2.969 and that for the control group is 3.004.

## 3. EMPIRICAL APPROACH

This paper aims to investigate the impact of maternal education on fertility and child motality. However, educational level is considered as endogenous since it is correlated with other unobserved individual characteristics such as inner ability. To overcome the omitted-variable bias,

we utilize an exogenous change in the educational years of women generated by the Philippines free secondary education law from 1988 as the instrumental variable (IV). The basic idea is that the duration of a woman's education is greatly affected by her age in 1988 as it determines whether she could be benefitted by the free-education policy or not. Therefore, this study applies the age-specific nature of school enrolment as the identification strategy since the birth year of a woman is a crucial and exogenous driver to a woman's school attendance. According to Grépin & Bharadwaj (2015), the age cut-off indicator can cat as an excluded instrument for two-stage least squared (2SLS) models under the fuzzy regression discontinuity design (RDD).

The following states the reduced form equation for the first stage regression:

$$Edu_i = \pi_o + \pi_1 TG + \pi_2 Byr + \pi_3 Byr^2 + \boldsymbol{X}_i'\boldsymbol{\delta} + v_i \qquad (1)$$

And the second stage regression equation are presented below:

$$y_i = \beta_0 + \beta_1 \widehat{Edu}_i + \beta_2 Byr + \beta_3 Byr^2 + \boldsymbol{X}_i'\boldsymbol{\theta} + u_i \qquad (2)$$

where $y_i$ are the outcome variables for woman $i$. The outcome variables associated with fertility include the total number of children ever born, age of women at their first birth, and the probability of being a teenage pregnant mother. The outcome variables associated with child mortality include the total number of child deaths, percentage of child deaths, and infant mortality. $Edu_i$ is the years of education of woman $i$. $Byr$ is the sequence of birth year from 0 to 9 (where the sequence numbers of birth year are equal to 0-4 for birth years in 1967-1971, and equal to 5-9 for birth years in 1975-1979), $Byr^2$ is the squared term of $Byr$, and $\boldsymbol{X}$ is a vector of woman $i$'s socio-demographic characteristics which include whether she lives in urban area, availability of electricity, and wealth index of the household. $TG$ is a dummy variable of being in the treatment group.

As argued by Gelman and Imbens (2019), higher order polynomials, that is, the third or above order should not be avoided in RDD since it would cause noisy estimates and poor coverage of confidence intervals. Therefore, we utilize a quadratic polynomials approximation of age by using birth year on both sides of the cut-off. The predicted value of $Edu_i$ from equation (1) is used in the final second-stage estimation. In the equation of the second stage regression, the coefficient value of $Edu_i$ can be interpreted as the causal effect of maternal education on outcomes.

## 4. FINDINGS

### 4.1. The Impact of Free Secondary Education Policy on Education

The results from estimating the first stage regression of equation (1) are presented in Table 4. After controlling the other independent variables, being covered by the free-secondary education policy is associated with a rise of 0.536 years of schooling. Moreover, Table 4 demonstrates that the results of the first stage are stronger for the women from the households in the low wealth quintiles.

**Table 4. Results from the first stage regressions for maternal education**

| **Samples** | **Coefficient estimate of Years of Education** |
|---|---|
| Full sample | 0.536*** |
| | (0.117) |
| Observations | 15,676 |
| R-squared | 0.345 |
| Urban area only | 0.537*** |
| | (0.176) |
| Observations | 6,926 |
| R-squared | 0.264 |
| Rural area only | 0.535*** |
| | (0.156) |
| Observations | 8,750 |
| R-squared | 0.339 |
| Low Wealth quintiles | 0.622*** |
| | (0.185) |
| Observations | 6,423 |
| R-squared | 0.139 |
| High Wealth quintiles | 0.437*** |
| | (0.182) |
| Observations | 6,235 |
| R-squared | 0.073 |

Robust standard errors are in parentheses. Control variables in each specification are: quadratic polynomials approximation on both sides of the cutoff point of age 16, dummies for urban status and electricity, and wealth index. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

### 4.2. The Impacts of years of education on fertility

Tables 5, 6, and 7 compare the estimated results for the fertility related outcome variables using OLS and 2SLS, either with or without controlling for the socio-demographic characteristics of the individuals.

**Table 5. Women's education and total number of children ever born**

| | OLS | | IV | |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Edu | -0.184*** | -0.122*** | -1.625*** | -0.829*** |
| | (0.004) | (0.005) | (0.470) | (0.200) |
| Byr | -0.176*** | -0.134*** | 0.155 | 0.015 |
| | (0.021) | (0.022) | (0.126) | (0.057) |
| $Byr^2$ | 0.000 | -0.004* | -0.014* | -0.008** |
| | (0.002) | (0.002) | (0.008) | (0.004) |
| Urban | | -0.142*** | | -0.193*** |
| | | (0.034) | | (0.058) |
| Electricity | | 0.440*** | | 1.141*** |
| | | (0.068) | | (0.223) |
| Poorer | | -0.715*** | | 0.727* |
| | | (0.064) | | (0.418) |
| Middle | | -1.236*** | | 1.022 |
| | | (0.068) | | (0.646) |
| Richer | | -1.651*** | | 1.793* |
| | | (0.069) | | (0.978) |
| Richest | | -1.874*** | | 2.812** |
| | | (0.071) | | (1.327) |
| Constant | 5.391*** | 5.835*** | 18.690*** | 9.510*** |
| | (0.058) | (0.075) | (4.339) | (1.040) |
| N | 19774 | 15676 | 19774 | 15676 |
| R-squared | 0.171 | 0.25 | | |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

Table 5 shows that regarding the OLS results, one extra year of education significantly reduces childbirth by 0.184 child per woman without considering the control variables, and 0.122 child per woman after controlling for the socio-demographic characteristics. The results from the IV estimations reveal a larger negative impact from the years of education: a one-year increase in

education significantly reduces childbirth by 0.829 child per woman after controlling for the socio-demographic characteristics. The results indicate that the OLS coefficient of $Edu$ tends to under-estimate the negative impact of education years on the number of children a woman has.

Concerning the age at first child birth, Table 6 indicates that though the OLS estimations show a positive impact from the years of education, this effect becomes negative and insignificant after we applied the IV in the regression. Hence, the IV results imply that education years do not impose significant impact on the age when a woman gives birth to her first child.

**Table 6. Women's education and age at first child birth**

| | **OLS** | | **IV** | |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Edu | 0.427*** | 0.401*** | -0.948 | -0.272 |
| | (0.008) | (0.011) | (0.587) | (0.320) |
| Byr | -0.102** | -0.061 | 0.159 | 0.084 |
| | (0.045) | (0.051) | (0.139) | (0.096) |
| $Byr^2$ | -0.005 | -0.009* | -0.016 | -0.014** |
| | (0.005) | (0.005) | (0.010) | (0.007) |
| Urban | | -0.105 | | -0.174* |
| | | (0.082) | | (0.099) |
| Electricity | | 0.524*** | | 1.194*** |
| | | (0.126) | | (0.351) |
| Poorer | | -0.533*** | | 0.816 |
| | | (0.126) | | (0.657) |
| Middle | | -0.514*** | | 1.556 |
| | | (0.140) | | (0.998) |
| Richer | | -0.162 | | 3.036** |
| | | (0.152) | | (1.532) |
| Richest | | -0.034 | | 4.394** |
| | | (0.162) | | (2.116) |
| Constant | 18.849*** | 19.101*** | 31.295*** | 22.577*** |
| | (0.114) | (0.143) | (5.314) | (1.655) |
| N | 15920 | 13670 | 15920 | 13670 |
| R-squared | 0.153 | 0.146 | | |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

Though there is no evidence support that the years of education affect the age of a woman at her first birth, it seems that education does reduce teenage pregnancy. Table 7 shows that a one-year increase in women's education lowers the probability of pregnancy at age 19 or lower by 4.7% and this impact is statistically significant.

**Table 7. Women's education and teenage pregnancy**

| | OLS | | IV | |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Edu | -0.039*** | -0.036*** | -0.041 | -0.047* |
| | (0.001) | (0.001) | (0.032) | (0.027) |
| Byr | 0.004 | 0.004 | 0.005 | 0.006 |
| | (0.004) | (0.005) | (0.009) | (0.008) |
| $Byr^2$ | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.001) | (0.001) | (0.001) |
| Urban | | 0.002 | | 0.002 |
| | | (0.008) | | (0.008) |
| Electricity | | -0.025* | | -0.015 |
| | | (0.014) | | (0.031) |
| Poorer | | 0.026* | | 0.048 |
| | | (0.014) | | (0.058) |
| Middle | | 0.016 | | 0.051 |
| | | (0.015) | | (0.089) |
| Richer | | -0.025* | | 0.028 |
| | | (0.015) | | (0.134) |
| Richest | | -0.039** | | 0.034 |
| | | (0.016) | | (0.183) |
| Constant | 0.699*** | 0.689*** | 0.717** | 0.746*** |
| | (0.011) | (0.015) | (0.297) | (0.143) |
| N | 19774 | 15676 | 19774 | 15676 |
| R-squared | 0.124 | 0.127 | | |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

### 4.3. The Impact of years of education on the child mortality

The outcome variables used to measure child mortality include the total number of child deaths, percentage of child deaths, and infant mortality. The comparisons of estimation results on child mortality by using both OLS and IV are presented in Tables 8 to 10.

The results from the OLS estimations in Table 8 and 9 show that that one additional year of education decreases child deaths by 0.020 child per woman and by 0.265 percentage point per woman. Similar to the results for the total number of children a woman has, the OLS estimators tend to under-estimate the magnitude of the impacts of education. The IV results in Table 8 and 9 indicates that a one-year increase in maternal education significantly reduces child deaths by 0.154 child per woman and by 1.659 percentage points per woman respectively. In Table 10, it is found that the results from the OLS and IV estimations indicate a negative impact of education on the probability of infant mortality. However, this effect is statistically insignificant in the IV estimation.

**Table 8. Maternal education and total number of children deaths**

| | **OLS** | | **IV** | |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Edu | -0.020*** | -0.015*** | -0.154*** | -0.103*** |
| | (0.001) | (0.001) | (0.052) | (0.035) |
| Byr | -0.015*** | -0.015*** | 0.015 | 0.004 |
| | (0.004) | (0.005) | (0.015) | (0.011) |
| $Byr^2$ | 0.000 | 0.000 | -0.001 | 0.000 |
| | (0.000) | (0.001) | (0.001) | (0.001) |
| Urban | | -0.012 | | -0.019* |
| | | (0.007) | | (0.010) |
| Electricity | | -0.004 | | 0.084** |
| | | (0.018) | | (0.040) |
| Poorer | | -0.073*** | | 0.108 |
| | | (0.016) | | (0.073) |
| Middle | | -0.102*** | | 0.181 |
| | | (0.017) | | (0.113) |
| Richer | | -0.136*** | | 0.295* |
| | | (0.016) | | (0.172) |
| Richest | | -0.125*** | | 0.461** |
| | | (0.017) | | (0.233) |
| Constant | 0.393*** | 0.454*** | 1.625*** | 0.914*** |
| | (0.015) | (0.022) | (0.483) | (0.184) |
| N | 19774 | 15676 | 19774 | 15676 |
| R-squared | 0.05 | 0.061 | | |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

**Table 9. Maternal education and percentage of child deaths**

| | OLS | | IV | |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Edu | -0.358*** | -0.265*** | -2.635** | -1.659** |
| | (0.023) | (0.030) | (1.176) | (0.749) |
| Byr | -0.169 | -0.214* | 0.265 | 0.087 |
| | (0.113) | (0.123) | (0.280) | (0.221) |
| $Byr^2$ | -0.003 | 0.000 | -0.021 | -0.01 |
| | (0.012) | (0.013) | (0.020) | (0.016) |
| Urban | | -0.442** | | -0.584** |
| | | (0.198) | | (0.234) |
| Electricity | | -0.104 | | 1.284 |
| | | (0.362) | | (0.822) |
| Poorer | | -0.545* | | 2.252 |
| | | (0.331) | | (1.535) |
| Middle | | -1.129*** | | 3.162 |
| | | (0.359) | | (2.339) |
| Richer | | -1.447*** | | 5.18 |
| | | (0.382) | | (3.593) |
| Richest | | -1.219*** | | 7.957 |
| | | (0.412) | | (4.953) |
| Constant | 7.684*** | 8.046*** | 28.314*** | 15.252*** |
| | (0.312) | (0.403) | (10.643) | (3.899) |
| N | 15920 | 13670 | 15920 | 13670 |
| R-squared | 0.022 | 0.026 | | |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

**Table 10. Maternal education and infant mortality**

| | OLS | | IV | |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Edu | -0.002*** | -0.001*** | -0.007 | -0.005 |
| | (0.000) | (0.000) | (0.005) | (0.004) |
| Byr | 0.000 | 0.000 | 0.001 | 0.000 |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| $Byr^2$ | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Urban | | 0.002 | | 0.002 |
| | | (0.001) | | (0.001) |
| Electricity | | -0.001 | | 0.003 |
| | | (0.002) | | (0.005) |
| Poorer | | -0.006*** | | 0.002 |
| | | (0.002) | | (0.009) |
| Middle | | -0.007*** | | 0.006 |
| | | (0.002) | | (0.013) |
| Richer | | -0.010*** | | 0.009 |
| | | (0.002) | | (0.020) |
| Richest | | -0.008*** | | 0.018 |
| | | (0.002) | | (0.028) |
| Constant | 0.027*** | 0.029*** | 0.072* | 0.047** |
| | (0.002) | (0.003) | (0.039) | (0.020) |
| N | 54415 | 48650 | 54415 | 48650 |
| R-squared | 0.004 | 0.004 | | |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

## 4.4. Heterogeneous effects

### 4.4.1. Effects of education in rural and urban areas

Further to the main model, we have investigated the heterogenous effects of education on fertility and child mortality in rural and urban areas. The rural-urban differential is a common concern since compared to the women who live in urban area, the opportunity costs of attending school tend to be higher for the women who live in the rural area. Such rural-urban inequality raises the concern of the heterogeneous effects of education in different areas. The disaggregated results for the statistical analysis of educational effects on fertility are shown in Table 11, and child mortality based on geographical area (urban vs. rural) are presented in Table 12.

As shown in Table 11, the impacts of maternal education on total number of children born per woman are similar in both urban and rural areas, which are -0.914 and -0.759 respectively. Concerning the outcome variable of age at first birth, the effect of maternal education is insignificant in both areas. The estimate of the probability of teenage pregnancy is significantly reduced by 9.5 percentage points in urban areas while this effect is insignificant in the rural are.

**Table 11. IV estimation results for fertility by location**

| | **Children** | | **Age at First Birth** | | **Teenage Pregnancy** | |
|---|---|---|---|---|---|---|
| **Location** | **Urban** | **Rural** | **Urban** | **Rural** | **Urban** | **Rural** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Edu | -0.914*** | -0.759*** | 0.348 | -0.843 | -0.095** | -0.009 |
| | (0.318) | (0.257) | (0.387) | (0.570) | (0.044) | (0.039) |
| Byr | 0.105 | -0.053 | -0.078 | 0.154 | 0.02 | 0.000 |
| | (0.107) | (0.062) | (0.144) | (0.135) | (0.014) | (0.009) |
| $Byr^2$ | -0.015** | -0.003 | -0.008 | -0.011 | -0.001 | 0.000 |
| | (0.007) | (0.005) | (0.011) | (0.010) | (0.001) | (0.001) |
| Electricity | 0.873*** | 1.150*** | 0.731** | 1.832*** | 0.007 | -0.053 |
| | (0.319) | (0.301) | (0.369) | (0.659) | (0.045) | (0.045) |
| Poorer | 0.745 | 0.6 | -0.13 | 1.907* | 0.098 | -0.021 |
| | (0.650) | (0.532) | (0.777) | (1.156) | (0.090) | (0.081) |
| Middle | 1.156 | 0.82 | 0.159 | 3.114* | 0.137 | -0.045 |
| | (0.985) | (0.837) | (1.140) | (1.795) | (0.135) | (0.127) |
| Richer | 2.11 | 1.433 | 0.284 | 5.999** | 0.218 | -0.159 |
| | (1.495) | (1.288) | (1.754) | (2.825) | (0.205) | (0.195) |
| Richest | 3.246 | 2.423 | 0.474 | 8.440** | 0.306 | -0.207 |
| | (2.066) | (1.713) | (2.479) | (3.821) | (0.283) | (0.260) |
| Constant | 10.061*** | 9.170*** | 18.960*** | 25.507*** | 1.064*** | 0.544*** |
| | (1.777) | (1.329) | (2.152) | (2.927) | (0.244) | (0.202) |
| N | 6926 | 8750 | 5775 | 7895 | 6926 | 8750 |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

The results for child mortality conditional on location are presented in Table 12. The effects of education on number of child deaths is stronger in rural than urban area. Similarly, on average, education reduces the percentage of child deaths by 2.184 percentage points in rural area which is larger in magnitude than that in urban area. No significant effect from education years is found on the probability of infant mortality.

**Table 12. IV estimation results for child mortality by location**

| | Child Deaths | | Percentage of Deaths | | Infant Mortality | |
|---|---|---|---|---|---|---|
| **Location** | **Urban** | **Rural** | **Urban** | **Rural** | **Urban** | **Rural** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Edu | -0.084** | -0.118** | -1.091 | -2.184* | -0.004 | -0.006 |
| | (0.043) | (0.054) | (0.859) | (1.228) | (0.005) | (0.006) |
| Byr | 0.006 | -0.001 | 0.052 | 0.056 | -0.001 | 0.001 |
| | (0.016) | (0.013) | (0.312) | (0.293) | (0.002) | (0.001) |
| $Byr^2$ | -0.001 | 0.000 | -0.011 | -0.002 | 0.000 | 0.000 |
| | (0.001) | (0.001) | (0.023) | (0.022) | (0.000) | (0.000) |
| Electricity | 0.061 | 0.103* | 1.144 | 1.806 | 0.003 | 0.004 |
| | (0.051) | (0.063) | (0.966) | (1.390) | (0.008) | (0.007) |
| Poorer | 0.002 | 0.149 | -0.234 | 3.56 | -0.007 | 0.005 |
| | (0.090) | (0.110) | (1.787) | (2.476) | (0.010) | (0.013) |
| Middle | 0.051 | 0.244 | -0.062 | 5.2 | -0.007 | 0.012 |
| | (0.133) | (0.174) | (2.583) | (3.867) | (0.014) | (0.021) |
| Richer | 0.139 | 0.385 | 1.083 | 8.234 | -0.005 | 0.018 |
| | (0.201) | (0.268) | (3.919) | (6.095) | (0.023) | (0.032) |
| Richest | 0.272 | 0.574 | 2.804 | 12.004 | 0.002 | 0.03 |
| | (0.277) | (0.357) | (5.507) | (8.253) | (0.033) | (0.044) |
| Constant | 0.831*** | 0.998*** | 12.427*** | 18.000*** | 0.050* | 0.052* |
| | (0.237) | (0.278) | (4.815) | (6.331) | (0.027) | (0.031) |
| N | 6926 | 8750 | 5775 | 7895 | 17997 | 30653 |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01

### 4.4.2. Effects of education and household wealth

Studies found that both maternal education and household wealth have significant effect on fertility and child health in developing countries (Fuchs et al., 2010). Hence, it would be important to examine the relative impact of education on fertility and child health conditioning on the household wealth as it may influence how policy makers should allocate resources and formulating policies to achieve their policy objectives. Therefore, we have estimated the IV regression model on the sub-samples of the individuals from the relatively low and high wealth households. We defined the low and high wealth households as the households in the lowest two wealth quintiles and highest wealth quintiles respectively. The findings on the effects of education on fertility and child mortality conditional on the wealth distribution are presented in Tables 13 and 14.

**Table 13. IV estimation results for fertility by household wealth**

| | Total No. of Children | | Age at First Birth | | Teenage Pregnancy | |
|---|---|---|---|---|---|---|
| **Wealth quintile** | **Low** | **High** | **Low** | **High** | **Low** | **High** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Edu | -0.943*** | -0.480* | -0.31 | -0.745 | -0.038 | 0.002 |
| | (0.313) | (0.255) | (0.480) | (0.618) | (0.041) | (0.048) |
| Byr | -0.056 | 0.012 | -0.013 | 0.301 | 0.01 | -0.006 |
| | (0.082) | (0.075) | (0.128) | (0.213) | (0.010) | (0.014) |
| $Byr^2$ | 0.001 | -0.011** | -0.002 | -0.031* | 0.000 | 0.000 |
| | (0.007) | (0.005) | (0.009) | (0.017) | (0.001) | (0.001) |
| Urban | -0.075 | -0.165** | -0.128 | -0.613** | 0.018 | 0.018 |
| | (0.122) | (0.076) | (0.169) | (0.258) | (0.016) | (0.014) |
| Electricity | 1.277*** | 1.878** | 1.249** | 0.532 | -0.024 | 0.076 |
| | (0.332) | (0.949) | (0.504) | (2.794) | (0.043) | (0.147) |
| Constant | 10.233*** | 6.938** | 22.897*** | 33.815*** | 0.672*** | 0.083 |
| | (1.618) | (3.078) | (2.440) | (8.102) | (0.213) | (0.570) |
| N | 6423 | 6235 | 6032 | 4977 | 6423 | 6235 |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

**Table 14. IV estimation results for child deaths by household wealth**

| | Child Deaths | | Percentage of Deaths | | Infant Mortality | |
|---|---|---|---|---|---|---|
| **Wealth quintile** | **Low** | **High** | **Low** | **High** | **Low** | **High** |
| | **(1)** | **(2)** | **(3)** | **(4)** | **(3)** | **(4)** |
| Edu | -0.146** | -0.03 | -2.088 | -0.949 | -0.012 | -0.002 |
| | (0.065) | (0.032) | (1.319) | (0.992) | (0.008) | (0.004) |
| Byr | 0.000 | -0.002 | 0.038 | 0.139 | 0.001 | 0.000 |
| | (0.018) | (0.010) | (0.349) | (0.338) | (0.002) | (0.001) |
| $Byr^2$ | 0.000 | 0.000 | 0.002 | -0.021 | 0.000 | 0.000 |
| | (0.001) | (0.001) | (0.025) | (0.027) | (0.000) | (0.000) |
| Urban | 0.014 | -0.014 | 0.109 | -0.723 | 0.007** | -0.001 |
| | (0.024) | (0.009) | (0.471) | (0.443) | (0.003) | (0.002) |
| Electricity | 0.130* | 0.102* | 1.839 | 2.893 | 0.01 | 0.003 |
| | (0.069) | (0.055) | (1.357) | (1.943) | (0.009) | (0.005) |
| Constant | 1.161*** | 0.37 | 17.520*** | 12.221 | 0.080** | 0.025 |
| | (0.335) | (0.367) | (6.730) | (12.410) | (0.040) | (0.051) |
| N | 6423 | 6235 | 6032 | 4977 | 26188 | 13393 |

Robust standard errors are in parentheses. *$p$<0.1, **$p$<0.05, ***$p$<0.01.

The estimated results for fertility based on wealth index indicate that total number of children born is reduced more among households in low wealth quintiles than in high wealth quintiles with respect to the increase in education years. On the other hand, concerning the child mortality, we only observe the significant impact of education on reducing the number of child deaths among the households in low wealth quintiles. The results for percentage of child death and infant mortality are negative yet insignificant.

## 5. CONCLUSION

Many studies have postulated that education is one of the channels through which women can gain knowledge on reproductive health, fertility, the prevention of teenage pregnancy, making decisions regarding their desired number of children, and child healthcare. Moreover, better healthcare knowledge could promote health-seeking behavior, which can in turn reduce the number of child deaths. Most of the previous studies have demonstrated that the relationships between years of education, fertility, and child mortality are strongly inversed. However, findings from the recent studies of Braakmann (2011), and Fort et al. (2011), based on the evidence of developed countries including those in Europe, show that extended compulsory education has a significant effect on increasing the number of child births.

The educational reform in the Philippines in 1988 ensures free secondary education in all public schools, which expands educational opportunities for all students. Since the cost of schooling is lowered by the waiving of tuition and other school fees, the free secondary education policy provides great opportunities for many school children to attend and complete high school education. Therefore, this paper investigates the effect of maternal education generated by the Philippines free education law from 1988 on fertility and child mortality by using 5-year NDHS datasets. This study applies the age-specific nature of school enrolment to detect the discontinuity between old and young cohort groups, and that discontinuity in maternal education is associated with a significant increase of 0.536 years of education.

Our findings show that the years of education has a negative impact on fertility and a significant improvement on child mortality, which are consistent with those of other previous papers. Since both fertility and child mortality are important issues concerning population and health of a country,

while developing related policies, policy makers may need to aware the dual role played by education that can be the driver for improving child mortality as well as reducing fertility.

Furthermore, our study incorporates geographic and wealth variables for additional analysis. The results from the sub-sample analysis reveal the disaggregated educational effects on rural and urban areas, and on women with different household wealth. In general, the women in urban and rural areas are benefitted from the new education policy in different aspects and to different extents. The estimated results of total number of children ever born are significantly reduced in both geographical locations, and the results of teenage pregnancy are only significantly reduced in urban areas by 9.5%. Moreover, the estimates of total number of child deaths are significantly decreased in both areas but with larger extent in the rural area. Regarding the wealth index, the fertility related measures are significantly reduced for women from both poor and rich households while the estimates of child mortality are only strongly reduced from women from low wealth households. Such findings may help in formulating effective education and health policies to reduce the disparities between groups of people who are at different relative positions in the society according to geographic location and wealth.

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