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The Educational and Fertility Effects of Sibling Deaths

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The Educational and Fertility Effects of Sibling Deaths

Abstract

An emerging literature finds that childhood exposure to adverse events determines adult outcomes and behavior. We extend this research to understand the influence of witnessing a sibling death as a child on subsequent educational and fertility outcomes in Indonesia. Using panel data and a sibling fixed effects model, we identify this relationship based on variation in the age of surviving children within the same family. Our findings strongly support the importance and persistence of adverse childhood experiences. In particular, for surviving sisters, witnessing a sibling death reduces the years of completed education and the likelihood of completing secondary schooling. The effect on surviving brothers is more muted. A potential channel for this result is that women respond by changing their fertility behavior. While surviving the death of a sibling has little effect on desired fertility levels, we find evidence that surviving sisters start a family about 3-4 years earlier. This suggests that interventions targeted at early-life outcomes may have important ripple effects and that the full impact of health interventions may not be visible until decades afterwards.

JEL Classifications: I10, J13, J16, O53.

Keywords: Child mortality, Siblings, Education, Fertility.

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1. Introduction

Despite tremendous progress in recent decades, early childhood deaths remain relatively common in developing countries.[1] For instance, in 2010, under-5 mortality was still roughly 10 percent in low income countries and 5 percent in middle income countries, relative to 0.6 percent for high income countries (The World Bank, 2012). While these deaths have been widely studied, particularly in the context of demographic transitions (eg: Kabeer, 2000), their direct effects on siblings of families that experienced child deaths are understudied in economics and demography.[2] Yet numerous studies in psychology and economics find that early life experiences play an important role in shaping adult behavior and preferences (Johnson and Schoeni, 2007; Yishay, 2013; Adhvaryu, Fenske and Nyshadham, 2014). Therefore, a large 'shock', such as the death of a sibling, may have large and lasting consequences.

We focus on two interrelated and previously understudied dimensions of early life exposure to sibling deaths: the educational attainment and the fertility behavior of the surviving siblings.[3] Studying the effects of sibling deaths on education and fertility presents several challenges. First, variation in these outcomes can reflect unobserved factors such as income, grieving

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[1] The under-5 mortality rate decreased from 24 to 11 percent between 1968 and 2010 (authors' calculation based on the 2012 World Development Indicators).

[2] For instance, Doepke (2005) studies the child mortality and fertility decline using the Barro-Becker model. Despite the theoretical exploration, the study does not conduct an empirical investigation at the family-level.

[3] We use the term 'surviving siblings' to indicate children who are from families that experienced child death(s). To be specific, at least one sibling (per household) has witnessed a sibling death. Families with no child deaths are not part of our sample for reasons detailed under methodology (Section 2).

behavior by parents, health and sanitation behavior, emphasis on education, or community-level characteristics. Second, the effects of early life shocks may depend on the age of exposure as preferences may become less malleable as "different types of preferences tend to become 'frozen' at different periods in one's life … [leading individuals to] become increasingly inoculated against external influences" (Loewenstein and Angner, 2003, p. 363). Consequently, binary indicators for 'exposure,' as have been used in earlier studies, may mask important heterogeneity across ages.

We overcome these problems by including sibling fixed effects and distinct indicators for age of exposure. As a result, we rely exclusively on the variation in the age of 'exposure' to the death of the sibling. Insofar as the age of the surviving siblings is unrelated to the timing of the sibling's death, this provides a causal estimate of the effects of early life exposure to a sibling death. The sibling fixed effects remove any omitted variables bias arising from family characteristics that do not vary across siblings. Similarly, by estimating separate coefficients for different age groups, we can observe whether exposure in certain periods has a stronger effect and minimize our risk of incorrectly concluding that there is no effect.

Our analysis uses data from the Indonesia Family Life Survey (IFLS), a household panel survey representative of 83 percent of Indonesia. These data offer three particular advantages. First, the length of the panel combined with retrospective fertility histories allows us to match surviving siblings (the second generation) with their mothers' birth histories (the first generation) and then to observe the second generation's education attainment and fertility behavior as an adult. Second, the IFLS follows respondents as they grow up and form new households.[4] In contrast,

[4] As we subsequently discuss, the data follow all individuals who remain in the same geographical areas. While this represents the bulk of respondents, our analysis is only representative of this subsample.

surveys such as the Demographic Health Surveys (DHS) may include fertility histories but do not contain the outcomes for the adult siblings. Lastly, since the panel covers a period during which Indonesia was undergoing its fertility transition (Kim, 1993), there is substantial variation in the birth rates during this period.

We find large effects of sibling deaths on the education of surviving sisters relative to those born after the deaths. Depending on the sister's age at the time of the death, their educational attainment is one to two and a half years lower, or roughly ten to twenty-five percent of the sample average. For certain age groups, surviving sisters are close to thirty percent less likely to complete secondary school. These effects may be due to changes in the fertility behavior of the surviving sisters. In particular, they become pregnant at significantly younger ages. This is not caused by a desire to have more children. Rather, our evidence is consistent with surviving sisters trying to reach their optimal number of children at an earlier age, perhaps allowing for the possibility of child mortality. The effects mainly depend on the gender of the deceased siblings, particularly stronger for deceased brothers.

Our results contribute to an understanding of the effects of child mortality on the adult outcomes of surviving siblings. While the emotional consequences have been studied (Fanos and Nickerson, 1991; Machajewski and Kronk, 2013), little is known about other outcomes. To our knowledge, only Fletcher *et al.* (2013) study the educational consequences of sibling deaths in their study of the United States. We extend this by providing the first study in a developing country where this phenomenon is substantially more common. We also allow exposure to a sibling death to vary by age, rather than combining those exposed in a broad range (0-25) as in Fletcher *et al.* (2013).[5] We find that the magnitude of the effects strongly differs based on the

[5] As we discuss in the conclusion, this may partially explain the much larger effects in our study.

age at the time of the death. We also offer evidence of a potentially different mechanism. Fletcher *et al.* (2013) focus on the bereavement experience of children and adults while we find evidence consistent with changed fertility behavior.[6]

Research on child hoarding or stockpiling suggests that adverse fertility events should increase the family size of the next generation (Olsen, 1983; Zhang, 1990; Sah, 1991; Gupta, 1995; Kalemli-Ozcan, 2003; Doepke, 2005). This theory proposes that parents have more children than desired to insure against children dying young. Since hoarding creates a precautionary demand for children, as pointed out by Sah (1991) and Kalemli-Ozcan (2003), a reduction in child mortality could in fact lead to lower fertility. Studies with data from a single generation struggle to disentangle 'replacement' and 'hoarding' behavior (as outlined by Schultz (1997), both of which imply a positive correlation between fertility and infant mortality. By using child mortality in one generation to predict fertility outcomes in the next generation, this paper is able to separately identify 'hoarding.'

On the other hand, the 'quantity-quality' tradeoff literature would suggest that exposure to fetal and infant loss would decrease fertility in the next generation. The adverse events result in smaller first generation families and, due to the 'quantity-quality' tradeoff, should result in higher education and income levels in the second generation. Whereas the literature typically finds lower birthrates in higher income/education households (Caucutt, et al., 2002; Angeles, et al., 2005), the adversely affected daughters have higher birthrates. Typically, an increase in birthrates despite increased wealth/education is explained via the Easterlin hypothesis (Easterlin 1969, 1973; Mentzakis and Moro 2009). What we find is the evidence to the contrary and

[6] Since we use sibling fixed effects, we are unable to investigate the effects of parental bereavement. However, parents and, more broadly, families may grieve differently in areas depending on the underlying child mortality rates (Heer and Smith, 1968).

plausible explanations are that women substitute fertility to human capital accumulation. Even though the overall fertility preferences (ideal number of children over the course of the life) is not influenced by adverse events in childhood, women go on to have more pregnancies, especially when they observe mother's adverse events at older ages (10 to 14 years) and overall, start families sooner.

The remainder of the paper is structured as follows. Sections 2 and 3 discuss the methodology and data, respectively. Section 4 presents the analysis and Section 5 concludes.

2. Methodology

We estimate the following reduced-form linear probability models for the *i* th surviving sibling (the second generation):

$$(1)\ Outcome_{ijk} = \alpha + Adverse'_i\beta + X'_i\delta + \vartheta_j + \mu_k + \varepsilon_{ijk}$$

$Outcome_{ijk}$ is the adult outcome of surviving sibling *i* in the set of siblings *j* born in birth year *k*. As noted in the introduction, we use the term 'surviving' to indicate a sibling who is from a family that experienced child death(s). While not all the children in our effective sample have necessarily witnessed a sibling death, at least one child per household has lived through a sibling loss.

We use two sets of outcomes. The first set captures educational attainment through total completed years of schooling and a binary indicator for having completed secondary school.[7] The second set of outcomes deals with fertility behavior. Since pregnancy histories are only

[7] We choose secondary school enrollment due to the noticeable decline in the completion rates of primary (93 percent) relative to secondary school (55 percent) in our sample.

available for married women in our dataset (as detailed in Section 3), we estimate effects of adverse outcomes on surviving sisters' fertility levels (total number of pregnancies[8] and the ideal number of pregnancies) and timing of fertility (age at first pregnancy and years between first marriage and first pregnancy. Our sample's fecundity is not necessarily completed[9] and therefore 'total fertility' measures the fertility by a particular age as opposed to lifetime fertility.

$Adverse'_i$ is a set of variables for the number of sibling deaths experienced by the surviving sibling i within each age group.[10] With a limited sample size, we group age of exposure into 4-year intervals: ages 0-3, 4-7, 8-11, and 12-15. β captures the effect of experiencing a sibling death on the subsequent behavior of individual i. Insofar as the age of surviving siblings at the time of a death is – conditional on included covariates – unrelated to the death, we interpret this as a causal estimate.

One strand of the broader literature focuses on 'quantity-quality' tradeoffs where smaller households are able to invest relatively more in the human capital of their children. While the effect of a sibling death clearly extends beyond standard quantity-quality tradeoffs, this may be one of the pathways. However, if we expect that a lower quantity would lead to higher

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[8] Pregnancies are measured as the total number of self-reported pregnancies by the adult daughter. This is the sum of live births, miscarriages, and stillbirths.

[9] The oldest daughter is 31 years of age at the time of the survey and therefore still within her childbearing years.

[10] A handful of individuals experienced multiple sibling deaths. Depending on the timing of these deaths, multiple exposure variables (sibling deaths seen during ages 0-3, 4-7, 8-11, and 12-15) may record a value of one for the surviving siblings.

"quality" outcomes, we would expect to see higher education, but we see the opposite. Miscarriages and stillbirths perhaps offer the ability to separate the effects of quantity from exposure since they decrease the number of children prior to extensive parental investments in the child (which would negatively affect the investments in their siblings). To examine this, we similarly measure 'exposure' to miscarriages and stillbirths using the same age groupings for exposure. Consequently, $Adverse'_i$ also contains a set of binary variables for the age of the surviving sibling at the time of the miscarriage or stillbirth.[11] By comparing the coefficients between the two sets of events (i.e. post-natal deaths and miscarriages/stillbirths), it may be possible to understand the degree to which β reflects quantity-quality tradeoffs.

Since the sibling fixed effects (ϑ_j) control for a variety of family and community characteristics, we use a parsimonious set of individual control variables in X'. In particular, we control for birth order and indicators for being the first-born son and the first-born daughter. Since the resulting patterns of fertility and education may be quite different, we estimate the male and female samples separately. Consequently, with the sibling fixed effects, we compare surviving siblings of the same gender who were in different age groups when their sibling died.[12] Our variation therefore comes in the variation across age groupings at the time of the death and between siblings born before and after the event.[13] The birth year fixed

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[11]Miscarriages and stillbirths are combined since it is not clear how households differentiate between the two events. Moreover, these events are relatively rare individually.

[12] Due to sibling fixed effect any families that do not experience any sibling deaths are dropped from our effective sample.

[13] The use of siblings born after the adverse event raises the possibility of selection into the sample as certain households may choose to not have another child. As a robustness check, we construct a subset of siblings who are from families that had a livebirth after an initial adverse

effects (μ_k) control for national level trends in education and fertility.

3. Data

Our data comes from the Indonesia Family Life Survey, a panel survey representative of about 83% of the Indonesian population with the first four rounds in 1993, 1997, 2000 and 2007. The sample is restricted in several important ways. First, to use the siblings fixed effects, we limit the sample to include only those in families that have lost at least one child with at least two same-gender surviving siblings. Second, the panel tracks the original sample and split-off households only if they remain in the original surveys areas.[14] Consequently, we only use individuals who remain in the same community during the length of the panel. Third, the mother of the siblings must appear in the sample so that we can view her fertility history. Fourth, pregnancy histories are only available for married women. Therefore, when looking at fertility outcomes, we restrict the sample to women who have been married by IFLS 4.

Lastly, we restrict the data to children between the ages of 9 and 17 in the first survey, since we are interested in the fertility behavior of the women (our second set of outcomes) who were children when their siblings died.[15] The lower limit ensures that selected women be at least 23

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event. Understandably the sample size shrinks (n = 384) and even though the coefficients for educational and fertility outcomes are of the expected signs, the magnitudes are not statistically significant (results available upon request).

[14] Approximately 7 percent of the women and 6 percent of the men who meet our selection criteria leave the enumeration areas. We use the IFLS survey weights which accounts for sample attrition.

[15] The 9-17 age restriction for women is not technically required for the men's sample to study their educational outcomes. However, we still use the same age restriction on the men's sample in order for the coefficients of educational outcomes to be comparable across men and women.

years old by IFLS 4. This is old enough that most women are married (the median age of first marriage in the sample is 21) and may have become pregnant, allowing us enough measurement of outcome variables. The upper limit ensures that the majority of the women are not married in IFLS 1.[16] For the sake of comparability, we use the same age restrictions on the men. Our final sample contains 1,054 women and 1,002 men. While the focus of the study is the behavior of the surviving sisters, we present the results for the surviving brothers as a comparison.

Table 1 shows the summary statistics of the key variables. The average sister (brother) in our sample is 26 (27) years of age in 2007. Both brothers and sisters on average has about 10 years of schooling. On average, surviving brothers experience a greater number of adverse events (sibling deaths, stillbirths or miscarriages) in all of the age intervals compared to the sister's sample but these differences are not statistically significant. About 23 percent of the respective sample are the eldest sisters or brothers of their families while the average individual is the second born.

In terms of fertility behavior, at the time of IFLS 4, the average sister in our sample has one child (as well as one pregnancy) and the average age of marriage is 21 (which is also the median). About 32 percent of women had married before their 21st birthday and approximately 8 percent of the sisters' sample is in marriages arranged by their family. Furthermore, there is an average gap of about one year between marriage and first pregnancy,[17] which is consistent with the average age at first pregnancy of 22. Of the sisters who are married, the average husband's age is 31 years and a woman is, on average, about 5 years younger than her husband.

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[16] Only 3 percent of the women of the 9-17 age range are already married in IFLS 1. We treat them as outliers and are therefore excluded from our effective sample.

[17] We use the term 'pregnancy' in order to be consistent with the survey question which is on the timing of the pregnancy (not birth).

The majority of the husbands (83 percent) are employed at the time of the interview in IFLS 4. Similar to the sisters, their husbands have 10 years of schooling on average. We explore this link further in Section 4.

4. Results

We begin by estimating the effects of youth exposure to the loss of a sibling on educational outcomes (Table 2). Columns 1 and 2 present the results on the total years of completed education for surviving sisters and brothers respectively. Similarly, Columns 3 and 4 report the estimated coefficients for the likelihood of completing secondary education for sisters and brothers respectively.

For women, experiencing a sibling death at any age (below the age of 15) strongly impacts the total years of education with estimated coefficients ranging from approximately 1 to 2.5 fewer years of education (relative to a sample average of 10.2 years). With respect to completing secondary school, these effects are limited to the youngest age grouping (0-3) and imply a close to 50 percent reduction relative to the sample mean (-0.286 vs. 0.546). In contrast, the effects of sibling deaths for men are much less apparent with the effects limited to only one age grouping for years of education (12-15 years old). With respect to stillbirths and miscarriages, the effect on sisters is muted. On the other hand, we observe that the brothers' education reduces by about 1 to 1.5 years (Column 2) and secondary school completion reduces by about 20 percent for the youngest cohort (0-3). Considering the relatively low number of reported stillbirths and miscarriages (compared to child deaths) we refrain from over-interpreting these results.[18] More broadly, our results do not appear to reflect quantity-quality tradeoffs as these would normally imply a positive coefficient (due to the relatively higher levels of resources per child in smaller families). Moreover, the estimated coefficients for exposure to stillbirths and miscarriages are generally insignificant and are limited to the male sample.

The strong gender differences on educational outcomes largely parallel the results of Fletcher *et al.* (2013) who only find an effect of sibling mortality on the educational attainment of surviving sisters. The magnitudes of our effects are much larger. This likely reflects a combination of the setting (developing vs developed country) and the broader age range (0-25) examined by Fletcher *et al.* (2013). Since they examine any sibling deaths experienced before the age of 25 using a single variable, their estimated coefficients will tend towards zero if some individuals have already finished their education prior to the sibling death.

4.1 Channels

We next examine some of the potential channels linking early life exposure to sibling deaths with lower educational outcomes, especially among surviving sisters. Due to the broader literature linking early childhood death to fertility behavior (Gupta, 1995; Guinnane, 2011), we focus on the fertility behavior of surviving sisters although we also examine and rule some alternate channels.

During this period, childhood deaths were not uncommon in many developing countries including Indonesia. An extensive literature on the demographic transition links these deaths and concurrent improvement in health and medicine (Teitelbaum, 1975; Galor, 2012; Herzer,

[18] Our results are broadly consistent using alternative age bins (e.g.: 5 year or 6 year intervals). Results are available upon request.

Strulik and Vollmer, 2012) to fertility behavior including hoarding (Olsen, 1983; Zhang, 1990; Sah, 1991; Gupta, 1995; Schultz, 1997; Ozcan, 2003; Conley, Mccord and Sachs, 2007). These studies have typically focused on general country or area-level trends. More recently, however, studies have focused on direct exposure to deaths of children and, more broadly, related to childbearing. These studies have found large impacts from direct exposure above and beyond the general geographic or time trends. For instance, Finnegan (2016) studies the impact of information on maternal mortality on fertility behavior. When a (adult) sister dies during childbirth, surviving sisters change their behavior in subsequent births (although fertility preferences remain unchanged). That is, personal experience above and beyond general (perceived and actual) risks leads to changed behavior.

Similarly, Nobles *et al.* (2015) study the effect of unexpected mortality among children due to the 2004 Indian Ocean Tsunami on subsequent behavior among surviving women. Most relevant to our study, in the most affected communities, women without children initiated their child bearing earlier. Insofar as these communities are small, this suggests that women who personally experienced or witnessed relatively higher levels of destruction and death adjusted their own fertility behavior.

Strong behavioral responses to personal experiences are also consistent with the broader mental health literature of traumatic experiences. For instance, the literature on Post Traumatic Stress Disorder (PTSD) emphasizes the magnitude of the stressor (i.e. dose-response model) (Kardiner, 1941; Wyler, Masuda and Holmes, 1971; Dohrenwend and Dohrenwend, 1974) with stronger effects from direct exposure (Hoge *et al.*, 2004; Goenjian *et al.*, 2005). These effects may be amplified by the duration of the exposure to trauma (Kaysen *et al.*, 2010), such as perhaps prolonged exposure to familial grieving.

We begin by examining whether the fertility levels of surviving sisters are affected (Table 3). Column 1 considers whether the actual fertility levels by the time of the survey are affected. The sample includes both married and unmarried sisters where the latter have an imputed value of zero for the number of pregnancies.[19] Based on the results summarized, only the estimated coefficient for the number of sibling deaths between 12 and 15 is significant. While this estimated coefficient is weakly significant, the overall effect is relatively large and is not statistically different from 1 (the level at which women would be fully compensating for the possibility of a child death). Since the women have aged out of their childbearing years, it is possible that this obscures future fertility. Consequently, Column 2 examines the effect on the ideal number of children (as reported by the married women). None of these coefficients are significant. Taken together, these results suggest very limited responses in (desired or actual) fertility levels.

Next, consistent with Nobles *et al.* (2015), we examine whether fertility behavior, particularly the timing of fertility is affected (Table 4). In particular, we examine the age at first pregnancy (Column 1) and the number of years between the first marriage and the first pregnancy (Column 2).[20] Since the number of year between marriage and pregnancy do not change, this results in women becoming pregnant much earlier – on average 4 years younger for those exposed at age 7 or earlier. Interestingly, there is no effect of exposure to stillbirths or miscarriages which is consistent with Fletcher *et al.* (2013) who point to the emotional consequences due to the

[19] Given the cultural context of Indonesia, unmarried women are unlikely to be mothers. In our sample, the proportion of unwed mothers is only 1.44 percent based on the fertility histories of women who were married at the time of IFLS 4.

[20] As mentioned before, pregnancy before marriage is unlikely in Indonesia. In our effective sample, 1.44 percent of ever married women have a recorded pregnancy before their marriage (i.e. years between marriage and pregnancy is less than 0). We drop these observations to limit outliers.

bonding of siblings. While surviving the death of a sibling has little effect on the total or desired fertility levels, the effects on the timing of children are particularly strong for those exposed before the age of 7. The estimated coefficients are consistent with (albeit larger) than the decreased years of education and the decreased likelihood of completing secondary school (which was limited to those exposed between the ages of 0 and 3).

We also investigate the possibility of marriage market selection in Table 5. The results show that the sisters who have experienced sibling deaths marry men who are more educated (Column 1). We interpret this result as an intra-household human capital optimization where, the sister, who might not have reached her full education potential since she started a family, compensates for her lack of education by marrying a more educated husband. There is evidence in the economic literature that marriage at an earlier age leads to lower female autonomy within marriages (Desai and Andrist, 2010) which, in turn, is linked to lower human capital investment in children, particularly girls (Brunson *et al.*, 2009). While we find evidence that stillbirths and miscarriages lead to daughters marrying older men (Column 2), which increases the age difference between spouses (and likely reduce the intra-household bargaining power) (Column 3), we refrain from over-interpreting the results due to the relatively low number of reported stillbirths and miscarriages (compared to sibling deaths).

4.2 Robustness checks

Another possible explanation for the observed education effects and, potentially, for the changed fertility behavior is the effect of a large shock. For instance, a large income or health shock could result in the death of a child and lead households to pull children from school. Similarly, the shock could lead girls to marry earlier as households cannot afford all of their children. We therefore check for potential health and income shocks in Table 6. Column 1 examines the surviving sister's (adult) height, measured in centimeters. We find no evidence that the surviving sisters are of statistically better health. Next, we explore another health measure – the standardized cognitive ability – in Column 2 where we find no evidence of childhood adverse events influencing the adult cognitive capacity for women. Finally, we address the issue of potential (early) marriages arranged by the family (Column 3) in the event of an income shock. The results show that the families do not necessarily marry their daughters earlier as a result of a death. We conclude that our main results are robust to health and income shock the family might have endured.

4.3 Heterogeneity

In many developing countries, including Indonesia, there are strong preferences for boys. Consequently, we examine whether surviving sisters respond equally to the deaths of brothers and sisters. Since there are relatively few deaths in our data when disaggregated by gender, we are unable to disaggregate exposure by the age of the surviving sisters. We therefore examine the number of deceased siblings by gender before the age of 14. We first consider the effects on education: years of education (Column 1 of Table 7) and likelihood of completing secondary school education (Column 2). The effects of exposure are limited to deceased brothers. In particular, the effect on secondary school education is quite large (-0.41 vs a mean of 0.546). Similarly, for the pregnancy outcomes, the effects are limited to deceased brothers, where we find evidence that the surviving sisters marry about 3 years earlier.[21] This suggests that the effects of losing a sibling in areas without such strong son preference are likely to be much smaller. Similarly, as cultural norms evolve to de-emphasize sons, the educational and fertility behavior effects should decrease.

[21] We do not find evidence on total number of pregnancies or the years lapsed between marriage and pregnancy.

5. Conclusion

In this paper, we build on an emerging literature on the lasting effects of exposure to adverse events in childhood to examine impacts on adult outcomes and behavior. In particular, we focus on the lasting effects of witnessing adverse fertility outcomes (miscarriages and stillbirths) and sibling deaths. We find a consistent and strong effect across a variety of educational and fertility outcomes where the effects are more pronounced for surviving sisters.

The results point to a strong intergenerational effect of early life exposure to adverse events. For the second-generation sisters (who witness the events), we see a strong decrease in educational attainment (compared with brothers with the same exposure) and an increase in fertility behavior. This could indicate a potential human capital loss from affected women cutting off schooling early and starting a family at a younger age. Consequently, this suggests that the effects of health interventions may not be fully realized until subsequent generations.

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Tables

Table 1: Descriptive Statistics of the Sibling Fixed Effects Estimation Sample

	Sisters				Brothers			
Variables	Mean	SD	Min	Max	Mean	SD	Min	Max
Dependent Variables								
Years of education	10.259	3.794	0	16	9.981	3.674	0	18
Likelihood of completing secondary education	0.546	0.498	0	1	0.503	0.500	0	1
Mother's Adverse Fertility Outcomes								
No. of deaths seen during age 0 to 3	0.061	0.276	0	3	0.101	0.455	0	4
No. of deaths seen during age 4 to 7	0.053	0.237	0	2	0.087	0.423	0	4
No. of deaths seen during age 8 to 11	0.038	0.215	0	2	0.067	0.383	0	3
No. of deaths seen during age 12 to 15	0.018	0.140	0	2	0.044	0.303	0	3
No. of stillbr. & miscar. seen during age 0 to 3	0.058	0.257	0	2	0.074	0.277	0	2
No. of stillbr. & miscar. seen during age 4 to 7	0.050	0.239	0	3	0.071	0.290	0	2
No. of stillbr. & miscar. seen during age 8 to 11	0.041	0.207	0	2	0.048	0.223	0	2

No. of stillbr. & miscar. seen during age 12 to 15	0.028	0.164	0	1	0.040	0.224	0	3
Control Variables								
Birth Year	1980	2.515	1,976	1,985	1980	2.519	1,976	1,985
Birth order	2.545	1.317	1	9	2.585	1.343	1	8
Oldest child *(dummy)*	0.230	0.421	0	1	0.232	0.422	0	1
Live births seen during age 0 to 3	1.356	0.823	0	4	1.339	0.828	0	4
Live births seen by during 4 to 7	0.650	0.725	0	3	0.626	0.731	0	3
Live births seen during age 8 to 11	0.365	0.609	0	3	0.327	0.566	0	3
Live births seen during age 12 to 15	0.185	0.439	0	2	0.179	0.421	0	3
Observations		1,054				1,002		

Notes: Sample generated from the sibling fixed effects regression model detailed in Eq. (1) using OLS.

Source: IFLS panel.

Table 2: Education Results

	Years of education		Likelihood of completing secondary education	
	Sisters	Brothers	Sisters	Brothers
Variables	(1)	(2)	(3)	(4)
No. of deaths seen during age 0 to 3	-0.993**	-0.437	-0.286***	0.011
	(0.393)	(0.295)	(0.091)	(0.030)
No. of deaths seen during age 4 to 7	-1.551*	-0.340	-0.128	-0.043
	(0.799)	(0.393)	(0.124)	(0.059)
No. of deaths seen during age 8 to 11	-2.027*	-0.586	-0.171	-0.121
	(1.037)	(0.564)	(0.146)	(0.081)
No. of deaths seen during age 12 to 15	-2.511**	-1.139**	-0.273	-0.074
	(1.163)	(0.550)	(0.177)	(0.070)
No. of stillbr. & miscar. seen during age 0 to 3	0.127	-1.492**	0.166*	-0.203**
	(0.658)	(0.678)	(0.086)	(0.101)
No. of stillbr. & miscar. seen during age 4 to 7	-0.675	-1.267*	-0.105	-0.058
	(0.928)	(0.753)	(0.119)	(0.119)
No. of stillbr. & miscar. seen during age 8 to 11	1.546	-0.892	0.001	-0.087
	(1.026)	(0.786)	(0.127)	(0.117)
No. of stillbr. & miscar. seen during age 12 to 15	-0.255	-0.264	-0.172	-0.162
	(2.005)	(0.692)	(0.239)	(0.114)
Observations	1,054	1,002	1,054	1,002
R-squared	0.893	0.867	0.881	0.865

Notes: Secondary education completion is a binary variable which is equal to 1 if the years of education is greater than or equal to 12 years; 0 otherwise. All the regressions control for birth order, oldest child dummy, mother's no. of live births, birth year and municipality fixed effects and are estimated using the sibling fixed effect model detailed in Eq. (1). All the regressions are estimated using OLS. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: IFLS panel.

Table 3: Fertility Outcomes Results

	Sisters	
	Total no. of pregnancies	Ideal no. of children (conditional on being married)
Variables	(1)	(2)
No. of deaths seen during age 0 to 3	0.021	1.006
	(0.186)	(0.000)
No. of deaths seen during age 4 to 7	-0.199	0.902
	(0.294)	(0.000)
No. of deaths seen during age 8 to 11	-0.328	0.034
	(0.346)	(0.000)
No. of deaths seen during age 12 to 15	0.795*	-0.316
	(0.428)	(0.000)
No. of stillbr. & miscar. seen during age 0 to 3	0.185	-0.598
	(0.147)	(0.000)
No. of stillbr. & miscar. seen during age 4 to 7	0.406*	-0.533
	(0.226)	(0.000)
No. of stillbr. & miscar. seen during age 8 to 11	0.453*	-0.502
	(0.234)	(0.000)
No. of stillbr. & miscar. seen during age 12 to 15	0.148	-0.563
	(0.314)	(0.000)
Observations	1,054	741
R-squared	0.810	0.821

Notes: All the regressions control for birth order, oldest child dummy, mother's no. of live births, birth year and municipality fixed effects and are estimated using the sibling fixed effect model detailed in Eq. (1). Column 1 additionally controls for the sister's own miscarriages and stillbirths. All the regressions are estimated using OLS. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: IFLS panel.

Table 4: Fertility Outcomes Results

	Sisters (conditional on being married)	
	Age at first pregnancy	Years between marriage and first pregnancy
Variables	(1)	(2)
No. of deaths seen during age 0 to 3	-3.085***	-0.734
	(1.045)	(0.493)
No. of deaths seen during age 4 to 7	-3.972***	-0.828
	(1.483)	(0.610)
No. of deaths seen during age 8 to 11	-0.711	-0.364
	(1.541)	(0.668)
No. of deaths seen during age 12 to 15	0.701	0.351
	(2.326)	(0.746)
No. of stillbr. & miscar. seen during age 0 to 3	-0.819	0.111
	(1.091)	(0.513)
No. of stillbr. & miscar. seen during age 4 to 7	-0.965	0.864
	(1.148)	(0.626)
No. of stillbr. & miscar. seen during age 8 to 11	0.309	1.122*
	(1.045)	(0.632)
No. of stillbr. & miscar. seen during age 12 to 15	1.800	0.427
	(1.433)	(1.040)
Observations	696	686
R-squared	0.825	0.768

Notes: All the regressions control for birth order, oldest child dummy, mother's no. of live births, birth year and municipality fixed effects and are estimated using the sibling fixed effect model detailed in Eq. (1). All the regressions are estimated using OLS. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: IFLS panel.

Table 5: Marriage Market Outcomes Results

	Sisters' married partners		
	Years of education	Age (years)	Age difference between husband and wife (years)
Variables	(1)	(2)	(3)
No. of deaths seen during age 0 to 3	3.097	-0.394	-2.803
	(1.944)	(5.218)	(4.615)
No. of deaths seen during age 4 to 7	4.165*	4.649	0.907
	(2.512)	(5.868)	(4.816)
No. of deaths seen during age 8 to 11	5.945***	4.827	-0.289
	(1.989)	(5.075)	(3.330)
No. of deaths seen during age 12 to 15	3.234	7.375	0.060
	(2.200)	(5.948)	(3.081)
No. of stillbr. & miscar. seen during age 0 to 3	-0.191	0.025	-2.543**
	(0.906)	(1.313)	(1.179)
No. of stillbr. & miscar. seen during age 4 to 7	-1.113	2.997*	-1.620
	(0.847)	(1.777)	(1.546)
No. of stillbr. & miscar. seen during age 8 to 11	-1.008	2.586	-4.213**
	(1.141)	(2.330)	(1.679)
No. of stillbr. & miscar. seen during age 12 to 15	4.688*	9.253***	-1.359
	(2.583)	(2.580)	(1.833)
Observations	682	681	681
R-squared	0.821	0.669	0.713

Notes: All the regressions control for birth order, oldest child dummy, mother's no. of live births, birth year and municipality fixed effects and are estimated using the sibling fixed effect model detailed in Eq. (1). All the regressions are estimated using OLS. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: IFLS panel.

Table 6: Selection to Marriage and Better Health

	Sisters		
	Height (cm)	Cognitive ability (Z score)	Arranged marriage
Variables	(1)	(2)	(3)
No. of deaths seen during age 0 to 3	-0.486	0.004	-0.039
	(1.461)	(0.277)	(0.103)
No. of deaths seen during age 4 to 7	-2.180	-0.222	0.014
	(2.315)	(0.356)	(0.106)
No. of deaths seen during age 8 to 11	-2.041	0.078	-0.067
	(3.826)	(0.408)	(0.147)
No. of deaths seen during age 12 to 15	-5.163	0.015	-0.073
	(3.823)	(0.480)	(0.225)
No. of stillbr. & miscar. seen during age 0 to 3	-0.622	-0.149	-0.035
	(1.584)	(0.213)	(0.065)
No. of stillbr. & miscar. seen during age 4 to 7	-0.482	-0.381	-0.084
	(1.931)	(0.279)	(0.072)
No. of stillbr. & miscar. seen during age 8 to 11	0.039	0.262	-0.173
	(2.146)	(0.480)	(0.107)
No. of stillbr. & miscar. seen during age 12 to 15	1.254	-0.069	-0.029
	(2.930)	(0.608)	(0.112)
Observations	986	961	778
R-squared	0.595	0.775	0.776

Notes: Arranged marriage is a binary variable which equals one if the daughter's marriage was arranged by the family; 0 otherwise. All the regressions control for birth order, oldest child dummy, mother's no. of live births, birth year and municipality fixed effects and are estimated using the sibling fixed effect model detailed in Eq. (1). All the regressions are estimated using OLS. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: IFLS panel.

Table 7: Heterogeneity - Gender of the Deceased Sibling

	Sisters				
	Years of education	Likelihood of completing secondary education	Total no. of pregnancies	Age at first pregnancy (conditional on being married)	Years between marriage and first pregnancy (conditional on being married)
Variables	(1)	(2)	(4)	(5)	(6)
No. of deceased sisters	-0.466	0.013	0.223	-1.494	-1.254
	(0.930)	(0.105)	(0.311)	(1.238)	(0.839)
No. of deceased brothers	-1.619***	-0.409***	-0.116	-2.778**	-0.455
	(0.613)	(0.122)	(0.284)	(1.225)	(0.490)
Observations	1,054	1,054	1,054	696	686
R-squared	0.888	0.879	0.803	0.820	0.757

Notes: Secondary education completion is a binary variable which is equal to 1 if the years of education is greater than or equal to 12 years; 0 otherwise. All the regressions control for birth order, oldest child dummy, mother's no. of live births, birth year and municipality fixed effects and are estimated using the sibling fixed effect model detailed in Eq. (1). Column 4 additionally controls for the sister's own miscarriages and stillbirths. All the regressions are estimated using OLS. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: IFLS panel.

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