Sibling Loss and Fertility Ideals in a High Mortality Context

Kathleen Broussard* and Abigail Weitzman
Population Research Center, University of Texas at Austin

*Corresponding author:
Kathleen Broussard
Population Research Center, University of Texas at Austin
305 E 23rd St, RLP 3.306
Austin, TX 78712

Rkbroussard@prc.utexas.edu
(281) 636-3129

Abstract

Demographers have long investigated the causes of fertility transition. Classic models of demographic transition suggest that declines in infant mortality lead women to subsequently bear fewer children. Very little is known, however, about the way fertility may vary with other types of mortality. Integrating diverse theoretical perspectives, we explore the relationship between sibling mortality and women's fertility ideals, focusing on the high-mortality context of Peru. Using nationally representative data from Peruvian Demographic and Health Surveys, we examine the effects of sibling loss and three important sources of heterogeneity: women's age at time of loss, sibling age at time of death, and sex of deceased siblings. Results indicate that, on average, women who have lost siblings have higher odds of desiring any children than do women who have not. Moreover, this effect is similar in magnitude to the effect of child loss. Women who have lost siblings also report higher numbers of ideal children overall compared to women who have not lost siblings. Much of the association between sibling loss and ideal fertility is driven by adult exposure to sibling mortality, the loss of young siblings, and the loss of brothers. These findings, taken together, expand demographic understandings of the relationship between mortality and individual-level fertility ideals and provide a strong basis for the inclusion of a broader range of familial mortality exposures in future studies of fertility transition.

Keywords: *Sibling mortality, ideal family size, fertility, Peru*

Introduction

The relationship between mortality and fertility is central to demographic transition theory, which describes falling fertility after initial declines in the mortality rate (Davis 1963; McFalls 2007; Montgomery and Cohen 1998; Van Poppel 2012). This sequence of demographic transition—mortality decline followed by fertility decline—has played out in every non-European country in the world (Mason 1997; Kirk 1996). Most studies examining this pattern focus their attention on the fertility consequences of infant and child mortality (Siah and Lee 2015; Van Poppel et al. 2012; Yamada 1985). These studies generally indicate that as infant and child mortality rates decline, confidence in child survival improves, thereby assuaging parents' desire for large numbers of children in anticipation of the death of some (Sandberg 2006).

Although infant and child mortality have remarkable implications for individual-level fertility and population-level demographic change, much less is known about the implications of other mortality exposures. This has recently begun to change, with studies increasingly examining the consequences of paternal loss (Goldberg 2012) and community-level mortality shocks for fertility intentions, reproductive behavior, and pregnancy outcomes (Behrman and Weitzman 2016; Durevall and Lindskog 2016; Nandi, Mazumdar, and Behrman 2018; Nobles, Frankenberg and Thomas 2015). In this study, we further expand extant scholarship on the relationship between mortality and fertility to be inclusive of an alternative and pervasive source of mortality exposure—sibling death. To our knowledge, only one other study specifically focuses on sibling loss, asking whether the death of a sister in childbirth affects the health-seeking behaviors of women during subsequent pregnancies in Indonesia (Finnegan 2016).

Like child loss, sibling loss is likely a significant event in a person's life. However, the two types of loss differ in several meaningful ways. First, sibling loss may occur at any point in someone's life, including prior to her reproductive years. Focusing on sibling loss thus enables us to explore the implications of mortality exposure experienced at different stages of the life course. Second, sibling loss may impact a person's own sense of mortality in a way that child loss does not. That is, women may view children as particularly vulnerable to early mortality and thus not feel that their own mortality is particularly threatened when a child dies. In contrast, a woman's relationship to her siblings may be particularly salient in contexts where extended or composite households are prevalent. Across Latin America, women within a range of unions (single, married, cohabiting) aged 25-29, are more likely to reside with extended family members; in Peru specifically, over 50% of married and cohabiting couples reside in composite households (Esteve, García-Román, and Lesthaeghe 2011). Furthermore, caring for younger siblings is believed to be one of the primary household tasks of adolescent girls in low-income and working families, both in developing countries (Levison and Moe 1998; Zapata Contreras and Kruger 2011), and in the United States (Dodson and Dickert 2004). Women's lifetime of shared history with their siblings may lead them to relate more to siblings' experiences, including death, than to children's. If so, then the loss of a sibling may draw women's attention to their own risk of mortality (Smee 2010; Umberson 2017; Vail et al. 2012). This heightened sense of mortality may alter women's priorities in ways that relate to their fertility. Third, losing a sibling should have a more immediate economic impact on surviving family members than losing a child. This is especially likely when siblings die in adolescence or adulthood and in contexts where extended family members reside in close proximity to each other and share resources across households.

To deepen our understanding of the relationship between sibling loss and fertility, we orient this study around four central questions: *What are the implications of sibling loss for* *women's ideal fertility? How does this compare to the effects of child loss? Are the implications of sibling loss heterogeneous across a woman's age of exposure?* And, *is ideal fertility sensitive to the characteristics of sibling loss, such as sibling sex and age at death?* To answer these questions, we draw on nationally representative data from Demographic and Health Surveys recently collected in Peru, a country where crude death rates remain high despite dramatic declines in mortality over the last several decades (Gonzales 2012; Huicho et al 2009; World Factbook 2017). Moreover, because Peru is still undergoing demographic and epidemiologic transitions (Bongaarts 2006; Huicho et al. 2009), women who were surveyed in recent years were born into periods of high fertility and thus tend to have numerous siblings. Many of these women are likely to have lost a sibling at some point in their lifetime. In such a context, even small effects of sibling loss at the individual level could have sizable impacts in the aggregate.

In the pages that follow, we review dominant theories used to explain the relationship between mortality and fertility. Departing from previous literature, which overwhelmingly focuses on the relationship between *child* loss and fertility, we propose three mechanisms by which exposure to sibling mortality may influence women's fertility ideals. We then empirically test the relationship between sibling mortality and ideal fertility employing a stringent fixed effects approach that accounts for spatiotemporal variation in women's mortality and fertility climate. In addition, we investigate key sources of heterogeneity in this relationship, including respondent's age at the time of sibling loss, siblings' age at time of death, and the sex of deceased siblings. We subject these analyses to a rigorous set of robustness checks to ensure that our conclusions are not biased by women's fertility histories nor by whether sibling loss occurred after childbearing began. Taken together, these analyses broaden demographic conceptualizations of the relationship between familial mortality and individual-level fertility.

Potential Mechanisms to Explain the Relationship between (Sibling) Mortality and Fertility

A large body of literature documents declining fertility rates following declining mortality rates (Angeles 2010; Palloni and Rafalimanana 1999; Reher et al. 2017; Van Poppel et al. 2012). Demographers have applied a number of theories to explain this phenomenon. Below we discuss three of the most prominent theoretical frameworks—life course theory, neoclassical economic theory of fertility, and psychosocial perspectives of morality exposure—highlighting the implications of each one when applied to the case of sibling mortality and women's subsequent fertility ideals.

Life course theory

A life-course approach helps to explain this relationship by positing that individuals' past experiences shape their future trajectories, including the evolution of their attitudes and ideals (Elder 1998). This occurs, in part, by shaping their self-efficacy and perceptions of control in their lives. Individuals from disadvantaged backgrounds often have lower efficacy and higher rates of unintended births (England 2016). Among those from more advantaged backgrounds, periods of instability or major life transitions may lead them to delay childbearing in order to attend college and build economic capital (ibid.). Alternatively, others may intentionally commence childbearing earlier as a way to reduce uncertainty in future life trajectories or to enhance marital solidarity (Friedman et al. 1994; Geronimus 2003). These strategies are more often adopted by those for whom fewer economic prospects exist, or in settings where motherhood is a means of gaining status, either within the community or a relationship (Huinink and Kohli, 2014; Edin and Kefalas 2005).

A substantial amount of research suggests that health and behavioral outcomes in adulthood may be differentially impacted by the timing of adverse events. For example, exposure to poverty in early childhood, but not in late childhood, is associated with an increased risk of aggressive behaviors among adolescents, suggesting that the very-early years of life may be an especially sensitive period of development (Mazza et al. 2017). In line with this research, a study of older adults who experienced a traumatic event during childhood exhibited more symptoms of PTSD and lower self-reported happiness compared to those who experienced a traumatic event during adulthood (Ogle, Rubin, and Siegler 2013). Using a life course perspective, we anticipate that the effect of sibling loss on fertility depends on the timing of the life course in which the death of a sibling occurs.

In a context of high mortality during childhood and adolescence, individuals may extrapolate from past experiences to project future risks of losing a child. This may lead some women to desire greater numbers of children as an "insurance" strategy. Using a life course perspective, we anticipate that these women will be more likely to desire children, and that they will report a larger ideal family size, perceiving higher fertility as a means of ensuring that at least some children will survive to adulthood.

Neoclassical economic theories of fertility

Neo-classical household economic theories of fertility view children as economic agents who have the capacity to either contribute or exact labor, resources, and income within their families' households (Barro and Becker, 1989; Geithman and Carvajal 1975). In pre-transition societies, children may contribute resources and income during their childhood years and are often important sources of care during adulthood for their aging parents (Angeles 2010; Boldrin and Jones 2002; Caldwell 1976; Caldwell 2005; Galor and Weil 1999). Consideration of economic influences on fertility seems especially pertinent in Peru, where over a quarter of children continue to participate in economic activities, oftentimes combining work and school (Boyden 1991; INEI 2015; Myers 1991; US Department of Labor, 2016).

This theory suggests that in high mortality settings, couples may pre-emptively bear more children in anticipation of future mortality risks. Known as a “hoarding” or “insurance” effect, these parents are economically motivated to ensure that they have at least some children who survive to adulthood. Evidence from a range of periods and contexts shows that couples account for their own and community-level child loss in order to achieve their reproductive goals (Mira 2007; Reher et al. 2017; Sandberg 2006). Furthermore, the impact of mortality on fertility may vary depending on sex of the deceased. High rates of HIV-related mortality in Malawi reveal distinct patterns in the ways families regulate fertility in response to increased rates of adult mortality. Fertility declined as a result of exposure to the death of adult women, but increased as a response to the death of adult men (Durevall and Lindskog 2016). Relying on an economic argument, the authors interpret this finding to mean that “women who perceive a high risk of their husbands' or grown-up sons' deaths are likely to want to have more children to ensure future support” (ibid. 2016).

Consistent with a neoclassical economic perspective, we expect that the respondent’s age and stage in the life course will determine the effect of mortality on fertility desires. If a woman loses a sibling during her own childhood, we expect either a neutral effect if she experienced no economic hardship or a positive effect in which she increases her fertility to insure against future risks of loss. Similarly, we anticipate that women’s fertility desires will vary depending on characteristics of the sibling that died. We explore both the sibling’s age at time of death as well as sibling's sex as two sources of heterogeneity. Given that adults, and specifically adult men, are the primary income-earners in Peru, we anticipate that the loss of an adult sibling, especially a brother, will has especially negative economic repercussions on a sister. Consistent with economic theories of fertility and the sustained economic contributions of children in Peru, we anticipate that mortality exposure will be associated with increased fertility ideals among surviving women.

The psychosocial impacts of mortality

The loss of a family member is often an emotionally fraught event (Stroebe, Schut, and Stroebe 2007; Umberson et al 2017; Umberson 2017). It is thus likely the case that exposure to such deaths leaves a strong and lasting impact on surviving individuals, potentially continuing to affect them across the life course (Umberson 2017). By accounting for the emotional impacts of loss, a psychosocial perspective allows us to consider the ways in which fertility may be a response to mortality exposure.

For instance, after bereavement or other mortality exposures, a heightened awareness of death and human frailty may motivate individuals to focus on personal growth and fostering new relationships (Vail et al. 2012; Nobles, Frankenberg, and Thomas 2015), a phenomenon sometimes referred to as "proximity seeking." Following the high mortality shock of the 2004 Indian Ocean tsunami, increases in fertility were found among both women who lost a child in the disaster as well as women who had not born any children prior to the disaster. For the latter group, fertility was higher among those who lived in areas with the greatest mortality exposure (Nobles, Frankenberg, and Thomas 2015). In some sense, this is an extension of child replacement theory, which proposes that bereaved parents may continue to bear children in part to emotionally recover from their loss (Preston 1978; Smee 2010). In the case of sibling loss, a surviving sister may decide to have children as a means of proximity seeking to re-build her family.

Beyond a desire to feel close to others, exposure to death may evoke a heightened awareness of one's own mortality. For example, one study finds that exposure to maternal mortality among sisters alters surviving women's health-seeking behaviors during their own pregnancies (Finnegan 2016). A logical explanation for this response is that women whose sisters die of maternal complications have a heightened sense of risk for their own maternal health, and correspondingly, take steps to offset this risk.

Thus, according to the psychosocial perspective, the untimely death of a sibling should instigate emotional responses that contribute to women's fertility ideals, but our interpretation of these responses should differ according to the specific characteristics of each death. That is, if early exposure to sibling mortality is positively associated with fertility ideals much later in life, this could signify that women carry the resultant perception of risk and uncertainty into their reproductive years, leading them to desire multiple children to insure the survival of at least some. Meanwhile, an association between exposure to sibling mortality during adulthood—amidst her reproductive years—could more likely indicate a process of proximity seeking in which women's fertility ideals are sensitive to their recent grief. To the extent that women may feel closer to their sisters or at least relate more to their sister than to their brothers, this perspective also predicts that sister loss may have a greater effect than brother loss.

Hypotheses

Based on the theoretical perspectives described above, we derive a series of hypotheses about the relationship between sibling mortality and fertility ideals, including variation across when it takes place in a surviving sister's life and variation across deceased siblings' characteristics. These hypotheses, and the mechanisms by which sibling mortality may impact fertility ideals, are summarized in Table 1.

[Table 1]

Data and Methods

Sample

We leverage nine years of cross-sectional data from the Peruvian Demographic and Health Surveys (DHS) collected continuously between 2004 and 2012. The DHS surveys all women between the ages of 15 and 49 in participating households and uses a stratified random sampling design to yield a nationally representative sample of women of reproductive age. Because missing information is rare in the DHS (<0.40% of respondents were missing information on variables pertinent to this study), we rely on listwise deletion when conducting our analyses. This yields a final sample of 135,017 women.

Measures

Ideal fertility. All women in the DHS were asked: "If you could (go back to the time you did not have any children and could) choose exactly the number of children to have in your whole life, how many would that be?" Respondents typically provided an answer ranging between 1 and 3. Respondents that provided a non-numeric response are excluded from this analysis.[1] Because previous research indicates that motivations for bearing *any* children are

[1] Such a small number of observations (n=492; >.01%) is insufficient to yield reliable estimates of the effect of sibling loss on non-numeric fertility ideals.

qualitatively different from motivations for bearing specific numbers of children (Bulatao 1981), we treat desiring at least one child and overall number of desired children as separate outcomes. We define the former as (0) if a woman reports 0 children as her ideal and (1) if she reports any greater number. Overall, the vast majority of women—97%-—desired at least one child (Table 1).[2] Among these women, we operationalize the number of ideal children with a count variable in which we collapse responses of 5 children or more.[3] This variable thus ranges between 1 and 5, with a mean of 2.43 (Table 2).

Sibling mortality. The Peruvian DHS included a special sibling survivorship module that asked respondents to report on the year of birth, sex, and survival status of all brothers and sisters, including any that died before a woman herself was born (Hill and Trussell 1977; Rutstein and Way 2014). For siblings that died, respondents were also asked to provide the year of the sibling's death. We use this information to (1) count respondents' total number of siblings, (2) identify their birth order relative to their siblings, (3) determine whether they had been exposed to sibling mortality (including deaths that predated their birth), (4) sum their total number of deceased siblings, (5) assess whether they were 12 years or older at the time of first sibling death; (6) separately determine whether they had lost any siblings who were in early childhood (<5 years), later childhood (5-11 years), or adulthood (>=12 years) at death, and (7) separately determine whether they had lost any brothers and any sisters.

On average, women in our sample reported having 5.36 siblings (Table 2). However, respondents' number of siblings declined with birth cohort (Figure 1) reflecting declining fertility rates in Peru over time. Forty-two percent of our sample had been exposed to the death

---

[2] Although the desire for no children is a somewhat a rare event, given the large sample size, the absolute number was 3,891—an adequate number for logistic regression analysis (Allison, 2012).
[3] Only 2% (n=3354) of women reported ideal fertility above 5.

of at least one sibling (Table 2). Among these women, a total of 2 deceased siblings was the mean (Table 2). Given their longer duration of exposure, older women had higher rates of sibling loss than did younger women (Figure 2). For instance, almost 50% of women >=35 years had experienced sibling mortality, whereas only half as many—approximately 25%—of women <20 years had experienced the same (Figure 2). This trend also corresponds to differences across cohorts (Figure 3). Consistent with declining mortality rates in Peru over the last several decades, women from earlier birth cohorts had higher rates of exposure than did women from later cohorts (Figure 3). Given these trends in sibship size and exposure rates, we control for respondents' age and include dummies for birth cohort as well, as described below. This strategy takes into account any systematic differences across age and cohort that may contribute to both sibling loss and fertility ideals. Among the full sample, 32% of women lost a sibling aged 0-4 years, 6% lost a sibling aged 5-11 years, and 13% lost a sibling aged 12 years or older (Table 2). Since a respondent may have experienced the death of more than one sibling, these percentages are not mutually exclusive. We assume that the sex of the deceased sibling only matters for fertility ideals to the extent that a respondent was alive at the same time as their sibling. Therefore, we report the sex proportion of siblings that died during the respondent's lifetime. For this group, 44% of deceased siblings were female (sisters).

Child mortality. Given that women's fertility ideals may also be sensitive to the loss of children (Montgomery and Cohen 1998; Preston 1978; Smee 2010; Van Poppel et al. 2012), we adjust for whether respondents have experienced the death of any of their children before the age of 5. Doing so has the additional benefit of allowing us to compare the magnitude of the effect of sibling mortality to the magnitude of the effect of child mortality.

Controls. Life expectancy (and thus mortality) in Peru is stratified by socioeconomic status, ethnicity, and geographic location (Gonzales 2012; Ministerio de Salud 2013). To capture socioeconomic status, we control for respondent's highest education level (none, primary, secondary, or higher) and wealth quintile. The DHS wealth quintile is constructed using information on household assets, such as appliances and vehicles, and characteristics such as availability of electricity and access to drinking water, and conveys a respondent's household's wealth relative to all other households. To account for ethnicity we control for respondent's ethno-linguistic group (Spanish, Quechua, and Aymara or other indigenous). Finally, to capture their location, we control for urban residence (versus rural) and include a series of dummies indicating respondent's district (the equivalent of a county in the United States). The gap in average life expectancy across states in Peru differs by a dramatic 25 years, with life expectancy much lower in the Andes and Amazon—where indigenous communities are concentrated—than along the coast (Gonzales, 2012). While infectious diseases are still the leading cause of death in Peru (Ministerio de Salud 2013), another contributor to high mortality includes the estimated 70,000 deaths, mostly of rural indigenous Peruvians, that resulted from the armed internal conflict between 1980 and 2000 (Ball et al. 2003). Our district-fixed effects approach accounts for any unobserved differences across districts that may simultaneously contribute to a woman's exposure to sibling loss and her ideal fertility.

In addition to these controls, we adjust for respondent's age at survey and include dummies for her birth cohort, for reasons explained above. To take into account a woman's risk of exposure, we also control for her total number of siblings and birth order.

Analytic Approach

Our analysis has three components. In each component we use logistic regression to estimate reporting an ideal fertility of at least one child and Poisson regression to estimate the total number of ideal children among those reporting an ideal of >=1.

In the first component, we address this study's overarching question of whether women's fertility ideals vary with exposure to sibling mortality. To do so, we estimate the association between having ever lost a sibling and our indicators of ideal fertility:

eq. 1 $$Y_{idc} = \beta_1 S_{idc} + \beta_2 C_{idc} + \beta_3 X_{idc} + +\beta_4 B_c + \beta_5 D_d + \varepsilon_{idc}$$

where Y_{idc} is the ideal fertility of respondent *i* in district *d* born in cohort *c; S_{idc}* is respondent's exposure to sibling mortality; C_{idc} is her exposure to child mortality; X_{idc} is a vector of respondent's background characteristics (number of siblings, birth order, education, wealth quintile, ethno-linguistic group, urban/rural residence, and age); B_c is a set of dummy indicators of her birth cohort that capture secular trends in mortality and fertility across time; D_d is a set of dummy indicators of her district that capture unobserved variation in mortality and fertility across space; and ε_{idc} is an error term. This component also helps to address our second question of how the effects of sibling mortality compare to that of child mortality. To more formally compare the two, we implement post-estimation Wald tests that compare the magnitude of coefficients on these two mortality variables.

In the second component, we address the question of whether the effects of sibling loss vary according to the period of the surviving sibling's life course during which it occurred. Here we estimate a model similar to the one above, but replace our dichotomous indicator of exposure to sibling mortality with two indicators denoting whether any of respondents' siblings died before she (the respondent) turned 12 and whether any of her siblings died since turning 12:

$$\text{eq. 2} \quad Y_{idc} = \beta_1 Sibling\ loss\ before\ she\ turned\ 12_{idc} + \beta_2 Sibling\ loss\ after\ she\ turned\ 12_{idc} + \beta_3 C_{idc} + \beta_4 X_{idc} + +\beta_5 B_c + \beta_6 D_d + \varepsilon_{idc}$$

Finally, in the third component, we answer our remaining question of whether the effects of sibling mortality vary with two characteristics of deceased siblings—sex and age at death, which we model separately. our dichotomous indicator of exposure to sibling mortality with two indicators denoting whether any of respondents' siblings died before she (the respondent) turned 12 and whether any of her siblings died since turning 12:

$$\text{eq. 3} \quad Y_{idc} = \beta_1 Any\ sibling\ died\ at\ age\ 0-4\ _{idc} + \beta_2 Any\ sibling\ died\ at\ age\ 5-11_{idc} + \beta_3 Any\ sibling\ died \geq age\ 12_{idc} + \beta_4 C_{idc} + \beta_5 X_{idc} + +\beta_6 B_c + \beta_7 D_d + \varepsilon_{idc}$$

$$\text{eq. 4} \quad Y_{idc} = \beta_1 Lost\ a\ sister_{idc} + \beta_2 Lost\ a\ brother_{idc} + \beta_3 C_{idc} + \beta_4 X_{idc} + +\beta_5 B_c + \beta_6 D_d + \varepsilon_{idc}$$

For the ease of interpretation, we exponentiated all regression results such that values greater than 1 indicate a positive association and values less than 1 indicate a negative association. To ensure the representativeness of our findings, we weight all analyses using DHS survey weights.

Results

What are the implications of sibling loss for women's ideal fertility? How does this compare to the effects of child loss?

Table 3 presents the results of models estimating the association between having ever lost a sibling and ideal fertility (at least one child and overall number of children among those reporting an ideal >=1). The results of Model 1 indicate that women who lost a sibling have 21% higher odds of idealizing at least one child, relative to women who did not lose a sibling. In comparison, losing a child (under age 5) is associated with 16% higher odds of an ideal fertility >=1. A Wald post-estimation test of sibling loss and child loss shows the difference between these coefficients to be insignificant. Nevertheless, these results indicate that the loss of a sibling is associated with an effect on fertility ideals that is similar in magnitude to the loss of a child.

The effects of sibling loss in Model 2 reveal a similarly positive, albeit much smaller, association between sibling loss and women's overall number of ideal children. Specifically, they suggest that losing a sibling is associated with a 1% higher incidence rate of ideal fertility. Whereas the association between child mortality and ideal fertility was equivalent to the association with sibling mortality in Model 1, in Model 2 it is significantly larger ($p<.001$)—associated with an 8% higher incidence rate (Table 3).

In addition to sibling and child loss, several other factors are significantly associated with ideal fertility. Number of siblings is positively associated with number of ideal children, while birth order is negatively associated with this number, though the magnitudes of both associations are small (Table 3). Women's age is also positively associated with ideal number of children, but again is small in magnitude. Both indicators of socioeconomic status suggest that an ideal of at least one child is more common among women with higher status (more education or greater household wealth), but that women with higher socioeconomic status tend to report lower overall numbers of ideal children than do women with lower status (when their ideal is at least one). Ethnicity follows a similar pattern: ethno-linguistic minorities (indigenous language speakers) have lower odds of idealizing at least one child than do women from the dominant group of Spanish speakers (Table 3). However, in terms of overall ideal number of children, Quechua speakers tend to report fewer numbers than do Spanish speakers, whereas Aymara speakers tend to report more. Women residing in urban areas report lower ideal numbers of children than do rural women (Table 3).

In sum, the results of Models 1 and 2 yield two important findings. One is that the effects of sibling and child mortality are similar but distinct. That is, both are positively associated with idealizing at least one child and a woman's overall number of ideal children, but sibling loss has an equal effect on idealizing *any* children compared to child loss, whereas child loss has a larger effect on overall ideal fertility. The other is that although differences in ideal fertility between women who have and have not lost a sibling are more modest than socioeconomic and ethno-linguistic differences, sibling mortality has a comparable or larger effect than other key background characteristics such as age, number of siblings, birth order, and urbanicity. Taken together, these findings highlight sibling mortality as an important but overlooked source of variation in women's fertility ideals.

[Table 3]

Are the implications of sibling loss heterogeneous across a woman's age of exposure?

Table 4 provides the results of models in which we examine the effects of sibling mortality occurring at a particular stage in a woman's life. Because women may be exposed before age 12 and then again after, these two indicators are not mutually exclusive. The results in Model 3 suggest that sibling loss before age 12 is not associated with idealizing at least one child. In contrast, however, sibling loss as an adult (at age 12 or later) is associated with 21% higher odds of idealizing >=1 child compared to not losing a sibling during this stage. Likewise, the results in Model 4 indicate that sibling loss occurring before age 12 is not associated with women's overall number of ideal children, yet sibling loss experienced as an adult is associated with a 2% higher incidence rate of ideal fertility. Consequently, a life course perspective does not appear to be helpful for understanding the relationship between sibling loss and fertility ideals, since the loss of a sibling during a woman's own childhood does not lead to greater fertility ideals in her adult life. Rather, our findings are consistent with a psychosocial theory of loss. The death of a sibling during the respondent's adulthood is likely to have a strong emotional impact, heightening a woman's personal sense of mortality during her own reproductive years, when bearing children as an emotional response to loss may be an actual possibility.

[Table 4]

Is ideal fertility sensitive to the characteristics of sibling loss, such as sibling sex and age at death?

Our last analytic component takes on the question of whether the effects of sibling loss differ contingent on the characteristics of deceased siblings. Again considering that women may lose multiple siblings who share different characteristics—for instance, 14% of our sample lost both a brother and a sister (analysis not shown)—indicators are not mutually exclusive.

We begin with the age of the sibling at time of death, presented in Table 5. Consistent with psychosocial theories of loss, the results suggest that losses of siblings who were in early childhood (under 5 years) and late childhood (5-11 years) are associated with 19% and 16% higher odds of idealizing >=1 child, respectively, compared to not losing siblings of these ages (Model 5). The loss of siblings aged 12 and older is not significantly associated with idealizing at least one child. Both the loss of siblings aged 5-11 and the loss of siblings aged >=12 are associated with 1% higher incidence rates of overall ideal fertility compared to not losing siblings in these age groups.

[Table 5]

Given an increase in fertility ideals among women who lost siblings during adulthood and those who lost child-age siblings, we wondered whether or not there was an interactive relationship between the age of the sibling at time of death and the woman's age when she lost a sibling. We ran a model with interactions between these variable sets, but results were not significant (not shown). To examine this relationship in a different way, we compared the effects of the loss of an older sibling to those of a younger sibling (Appendix A). Similar to our analysis of the sex of a deceased sibling, these categories are not mutually exclusive since a woman could have lost both a younger and an older sibling. A Wald post-estimation test confirmed that the desire for any children among the two groups did not differ significantly. Loss of an older sibling, however, had a positive and significant effect on women's ideal family size, while the effects of the loss of a younger sibling were null.

Taken together, these results suggest suggests that the loss of a young sibling between the ages of 0-11 significantly effects a woman's desire for any children, regardless of her birth order relative to the deceased sibling. A previous analysis of retrospective pregnancy intentions shows that mothers are less likely to report that their deceased children came from unintended pregnancies (Smith-Greenaway and Sennott 2016). We suspect that a woman's fertility ideals are influenced by her relationship to the deceased sibling, but also by a positive shift in values towards children that a family may adopt after a child's death.

Turning our attention to the sex of deceased siblings, the results in Table 6 suggest that only the loss of brothers is associated with idealizing any children. Specifically, losing a brother is associated with 21% higher odds of an ideal of at least 1 child (Model 7). When we examine ideal number of children in Model 8, however, we find that losing a brother and losing a sister are similarly associated with a 1% higher incidence rate of ideal fertility each.

[Table 6]

Sensitivity Analysis

The primary challenge this study faces is that ideal fertility was retrospectively reported among women who had begun or even completed childbearing by the time of survey. This poses two interrelated dilemmas. First, women may revise their fertility ideals as a function of pregnancy or childrearing experiences (Smith-Greenaway and Sennott 2016). This could bias our results if sibling loss influenced women's ideal fertility prior to childbearing but this influence was modified by subsequent events during pregnancy or parenthood. To gain some insight into this possibility, we re-estimate our models from Table 2, estimating an interaction between sibling loss and parity (0-5). The interaction coefficients are largely insignificant (Appendix B). This suggests that the number of children a woman currently has does not moderate the effect of sibling loss on fertility ideals. The one exception suggests that sibling loss reduces the likelihood that a woman will desire at least one child if she has lost a sibling and currently has 5 children or more (β = .79; p<.10). Interestingly, the inclusion of a woman's parity in the model causes the effect for ideal family size to become insignificant (Appendix B, Model 2), while the effect of losing a sibling on desiring any children maintains its magnitude and significance (Appendix B, Model 1).

Second, for some women, exposure to sibling mortality occurred during or after the childbearing years. These women may attenuate our results if the effect of sibling loss is smaller once women have already born children. We test this by re-estimating our models from Table 2 again, this time using a predictor made up of the following categories: 1) women that never lost a sibling 2) women who lost a sibling after having at least one child 3) women who lost a sibling before having any children (Appendix C). Compared to women who never experienced sibling loss, women in both of the categories who lost siblings are more likely to desire at least 1 child, but the results are significant and stronger (OR = 1.24, α=.001) for women who lost a sibling before they had children. Among women whose ideal is to have at least one child, the loss of a sibling is only associated with a desire for greater numbers of children if she experienced sibling loss after the birth of a first child. Loss of a sibling before having a first birth was not associated with a desire for higher-order parities.

Discussion

For decades, demographers have examined the relationship between infant and child mortality and fertility. The effects of other forms of mortality exposure have received less attention but may further illuminate the fertility transitions of countries, such as many throughout Latin America, where changes in child mortality had only a minimal impact on the process of fertility decline (Palloni and Rafalimanana 1999). This leaves open the possibility that other forms of mortality may additionally shape fertility ideals and corresponding behaviors, particularly in Latin American countries like Peru. Taking into consideration the fact that women in Peru often live in households with extended family members even after union formation (Esteve, García-Román, and Lesthaeghe 2012), we examined an alternative and pervasive source of mortality exposure in women's lives—sibling mortality. Because the untimely death of a sibling may influence an individual's worldview, sense of personal mortality, and economic stability, we hypothesized that the experience of sibling loss would be related to women's subsequent fertility ideals. In keeping with this hypothesis, we found that women who had lost a sibling were more likely to idealize having any children and reported a higher number of ideal children overall than did women who had not lost a sibling.

To put these effects in context, we further compared the effects of sibling loss to those of child loss. Results indicated that sibling mortality shared an equal association with a desire for at least one child compared to child mortality. This finding is particularly striking given the logical assumption that most women who lost a child originally had a desire to bear children in the first place, whereas no such assumption may exist for women who lost a sibling. In contrast, child mortality shared a larger association with women's overall ideal number of children (among those whose ideal was >=1) than did sibling mortality. We interpret this reversal in light of the qualitative differences between these two outcomes. That is, previous research indicates that people possess different rationales for having a first child versus higher-parity births (Bulatao 1981). Couples' first and second-born children tend to be desired for affective reasons such as 'wanting to love and care for them', while higher-order children tend to be desired for resource-related reasons, such as 'economic help' and 'help in old age'. Taken in conjunction with this study's results, this leads us to believe that the effect of sibling mortality on ideals of having at least one child are likely tied to psychosocial needs and proximity seeking after sibling loss, whereas the effect of sibling mortality on overall ideal number of children is more likely to reflect the economic impact of a sibling's death on the surviving family.

An additional novelty of this study was to explore the effects of sibling loss occurring at specific points in a woman's life, namely before age 12 and then after. Our results indicated that the loss of a sibling during adulthood, but not the loss of a sibling during childhood, is predictive of women's fertility ideals. Furthermore, this suggests that life course theory may not aptly describe the relationship between sibling mortality and fertility, though future studies are needed to further confirm this possibility.

Beyond respondent's age of exposure, we explored variation by sibling characteristics. Our findings suggest that the death of a sibling between the ages of 0-11 and the loss of a sibling during the respondent's adult years were independently associated with an increase in fertility intentions of the surviving sister. Furthermore, the effects of sibling loss for both brothers and sisters on ideal family size are small, but positive, lending credence to replacement theory both within economic and psychosocial frameworks.

The results of this study have important implications for future investigations of the relationship between mortality and fertility. High rates of mortality persist in the developing world, particularly among poor and indigenous communities, which represent almost half of Peru's total population (Gonzales, 2012; Pan American Health Organization, 2012; Montenegro and Stephens 2006). Exposure to the death of family members may be especially salient in countries such as Peru that have a higher rate of composite and extended family households (Esteve, García-Román, and Lesthaeghe 2011). Our findings suggest that variation in mortality, when occurring among siblings, may partially explain variation in fertility across these demographic groups and geographic regions.

In fact, given the prevalence of sibling loss and the results presented in Table 2, we estimate that if women's fertility ideals were realized, Peru would have an additional 78,312[4] children as a result of women's exposure to sibling mortality. While fertility ideals of course do not perfectly predict each woman's realized fertility, this large number nevertheless underscores the potentially powerful implications of sibling loss for *ideal* fertility and its sequelae.

This study has implications for fertility and population in developed countries as well, particularly where large demographic differences exist between subpopulations. For instance, large disparities in mortality exposure exist between blacks and whites in the United States (Umberson et al, 2017). This differential exposure may have ramifications for fertility desires, but this relationship remains to be explored

Despite the notable contributions of our study, we face several limitations. In particular, estimated relationships between sibling loss and a respondent's ideal fertility were potentially biased by the retrospective reporting of ideal fertility among women who had previously born children. A series of sensitivity tests nevertheless yielded little evidence in differential effects of sibling loss across parity or by the timing of such losses in relation to a woman's fertility history. In addition, fertility ideals may be downwardly biased by social desirability bias, particularly among women whose true ideal number of children is fewer than the number they have born. Lastly, our data did not contain information related to the cause of death of siblings. Previous research indicates that the death of a woman in childbirth has implications for the health-seeking behaviors of surviving sisters (Finnegan 2016), so we suspect that other causes of death may

---

[4] To calculate this number, we multiplied the number of women aged 15-54 in Peru in 2017 (*CIA World Factbook*) by the rate of sibling loss in our sample to estimate the number of women in the population who have experienced sibling loss: 9,322,959 x .42 = 3,915,642; We then multiplied the product by the increased desire for number of children: 3,915,642 x .02 = 78,312

have variable impacts on fertility desires. We hope the current study will spur future inquiry into the ways different forms of mortality exposure impact fertility desires and behaviors.

This study contributes to the nascent but growing body of scholarship considering the reproductive implications of mortality exposures beyond infant and child mortality. Our findings highlight the critical role that sibling mortality plays in women's fertility ideals even net of child mortality. These findings draw attention to the importance of considering a wider range of mortality exposures in order to more wholly explain the relationship between mortality and fertility.

Figure 1: Average Number of Siblings, by Birth Cohort

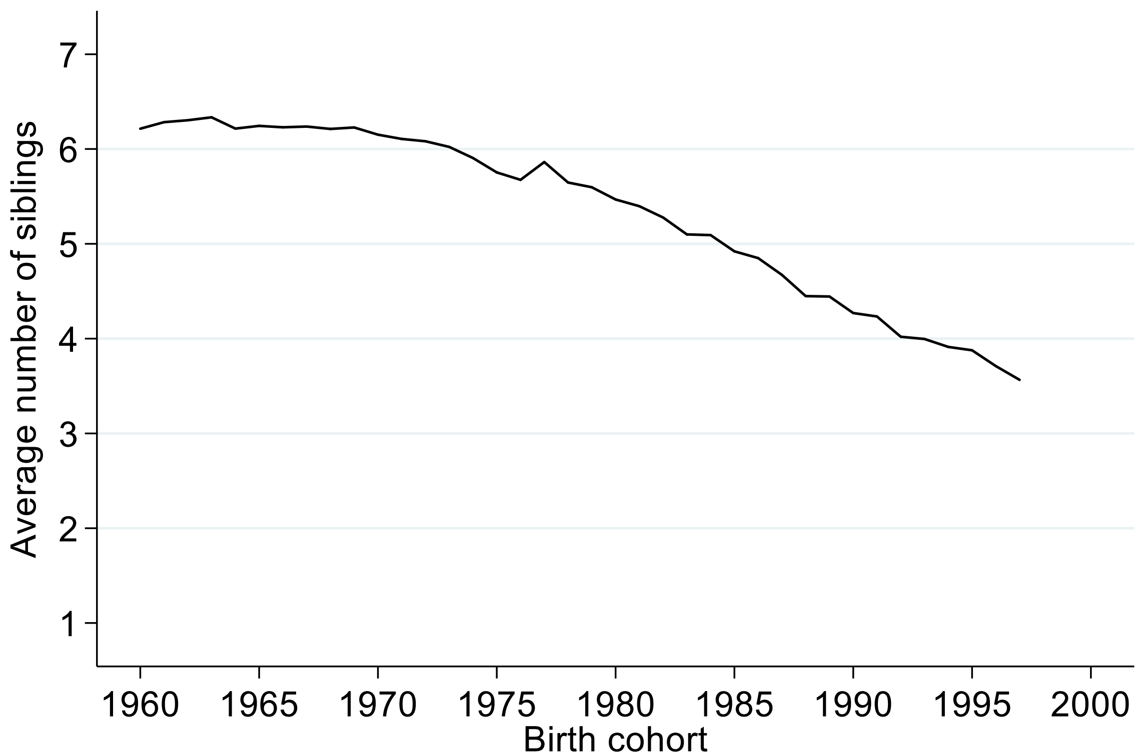

Figure 2: Prevalence of Sibling Loss, by Respondent's Age at Survey

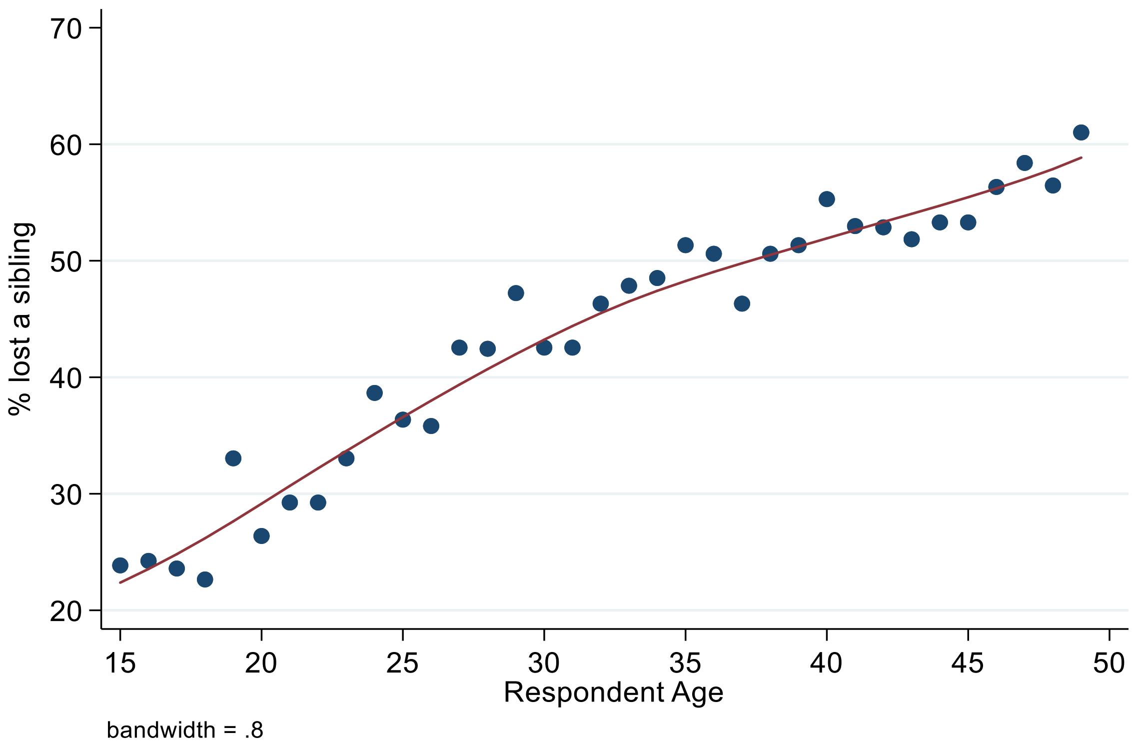

Figure 3: Prevalence of Sibling Loss, by Respondent's Birth Cohort

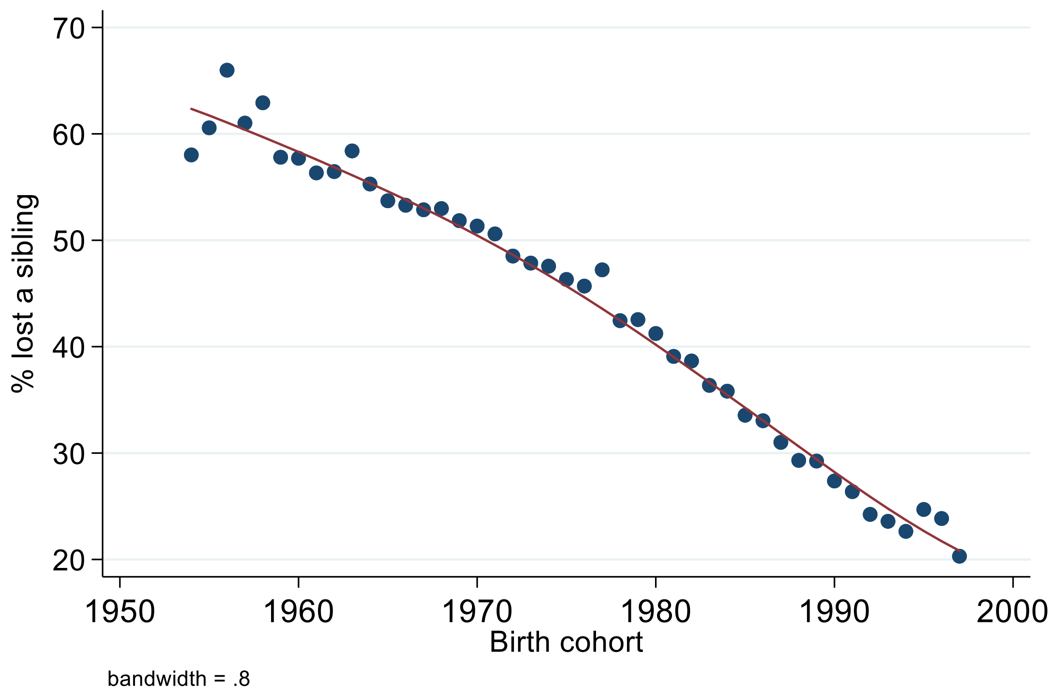

Table 1: Summary of Hypothetical Mechanism Derived from Three Theoretical Frameworks

Theoretical framework	Event	Rationale	Hypothesized effects on fertility ideals
Life Course theory	H_1: Sibling loss during childhood	Mortality exposure during childhood will impact perceptions of control, risk, and uncertainty during adulthood.	+
Neoclassical Economics of fertility	H_2: Loss of sibling during childhood	'insurance' effect → desire for more children to reduce financial risks of future mortality (economic impact may be limited)	~ +
	H_3: Loss of an adult sibling (specifically, a brother)	greater negative economic impact on household; replacement effect	+
Psychosocial theories of loss	H_4: Loss of any sibling	proximity seeking and replacement of lost sibling	+
	H_5: Loss of a sister	heightens a woman's sense of own mortality; fertility as means of proximity seeking and thinking of future	+
	H_6: Loss of a brother	Desire to re-build the family and carry on family name	+

Table 2: Descriptive Statistics (N= 135,017)

	Mean	SD
Ideal fertility		
At least 1 child	.97	
…Number of ideal children	2.43	1.14
Actual fertility		
Proportion currently mothers	.69	
Exposure to sibling mortality		
Lost any sibling	.41	
... number of siblings lost	2.00	1.38
Lost a sibling during own lifetime	.25	
…when respondent was 0-12 years	.34	
… when respondent was 12+ years	.75	
Lost a sibling aged 0-4 years	.32	
Lost a sibling aged 5-11 years	.06	
Lost an adult sibling (12+ years)	.13	
Lost a sister (during lifetime)	.13	
Lost a brother (during lifetime)	.16	
Exposure to other mortalities		
Lost a child	.09	
Controls		
Number of siblings	5.36	2.98
Birth order	3.78	2.57
Education		
None	.03	
Primary	.28	
Secondary	.44	
Higher	.25	
Household wealth		
Lowest	.18	
Lower	.23	
Middle	.23	
Higher	.20	
Highest	.16	
Age	30.4	
Ethno-linguistic group		
Spanish	.89	
Quechua	.09	
Aymara or other indigenous	.02	
Urban	.65	

Table 3: Results of Logistic and Poisson Regressions Estimating the Effect of Sibling Loss on Ideal Fertility

	Ideal is >=1 child (N=117,918)			Ideal number among those whose ideal is >=1 (N=127,661)		
	Model 1			**Model 2**		
	β	OR	Sig	*β*	IRR	Sig
Exposure to mortality						
Sibling loss	.19	1.21	***	.01	1.01	*
	(.05)			(.00)		
Child loss	.15	1.16	*	.08	1.08	***
	(.08)			(.01)		
Controls						
Number of siblings	.00	1.00		.00	1.00	***
	(.01)				(.00)	
Birth order	.00	1.00		-.00	1.00	*
	(.01)				(.00)	
Education (ref: no education)						
Primary	.53	1.71	***	-.05	.95	***
	(.09)			(.01)		
Secondary	1.05	2.86	***	-.09	.91	***
	(.10)			(.01)		
Higher	1.21	3.37	***	-.10	.91	***
	(.12)			(.00)		
Household wealth (ref: 1, poorest)						
2	.26	1.30	***	-.01	.99	*
	(.07)			(.01)		
3	.28	1.32	***	-.02	.98	***
	(.09)			(.01)		
4	.20	1.22	*	-.01	.99	
	(.11)			(.01)		
5	.51	1.67	***	.01	1.01	
	(.13)			(.01)		
Age	.02	1.02	*	.01	1.01	***
	(.01)			(.00)		
Ethno-linguistic group (ref: Spanish)						
Quechua	-.33	.72	***	-.02	.98	***
	(.09)			(.01)		
Aymara or other	-.40	.67	*	.05	1.05	*
	(.21)			(.03)		
Urban residence	-.07	.93		-.03	.97	***
	(.09)			(.01)		
Constant	3.26	25.98	**	.73	2.08	***
	(.95)				(.06)	

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4: Logistic and Poisson regression estimates of sibling loss on ideal fertility, by respondent's age when sibling died

	Ideal is to have at least one child (N=117,918)			Ideal number of children, among those whose ideal is >=1 (N=127,661)		
	Model 3			**Model 4**		
	β	Odds Ratio	Sig	β	IRR	Sig
Respondent age at time of sibling loss						
Childhood (0-11 years)	.12	1.12		.00	1.00	
	(.08)			.01		
Adulthood (12+ years)	.19	1.21	***	.02	1.02	***
	(.06)			(.00)		
Constant	1.95	7.01	**	.83	2.29	***
	(.98)			(.06)		

Note: All models control for respondents' education, age, ethnicity, urbanicity, wealth quintile, district, total number of siblings, birth order, experience of child loss, and community rate of sibling mortality. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5: Logistic and Poisson regression estimates of ideal fertility, by age of sibling at time of death

	Ideal is to have at least one child (N=117,918)			Ideal number of children, among those whose ideal is >=1 (N=127,661)		
	Model 5			**Model 6**		
	β	Odds Ratio	Sig	*β*	IRR	Sig
Sibling age at death						
0-4 years	.17	1.19	***	.00	1.00	
	(.06)			(.00)		
5-11 years	.15	1.16	*	.01	1.01	*
	(.10)			(.01)		
12+ years	.08	1.09		.01	1.01	***
	(.07)			(.01)		
Constant	3.28	26.47	***	.73	2.08	***
	(.95)			(.06)		

Note: All models control for respondents' education, age, ethnicity, urbanicity, wealth quintile, district, total number of siblings, birth order, experience of child loss, and community rate of sibling mortality. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6: Logistic and Poisson regression estimates of ideal fertility, by sex of deceased siblings

	Ideal is to have at least one child (N=117,918) **Model 7**			Ideal number of children, among those whose ideal is >=1 (N=127,661) **Model 8**		
	β	Odds Ratio	Sig	β	IRR	Sig
Sibling sex						
Brother	0.19	1.21	***	0.01	1.01	*
	(.06)			(.00)		
Sister	0.09	1.09		0.01	1.01	***
	(.06)			(.00)		
Constant	3.26	25.95	***	0.73	2.08	***
	(.95)			(.06)		

Note: All models control for respondents' education, age, ethnicity, urbanicity, wealth quintile, district, total number of siblings, birth order, experience of child loss, and community rate of sibling mortality.

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Appendix A: Logistic and Poisson regression estimates of ideal fertility, by sex of deceased siblings *accounting for the death of an older or younger sibling*

	Ideal is to have at least one child (N=120,860) **Model 8**			Ideal number of children, among those whose ideal is >=1 (N=130,533) **Model 9**		
	β	Odds Ratio	Sig	β	IRR	Sig
Older sibling died	0.17	1.19	**	.02	1.02	***
	(.08)			(.01)		
Younger sibling died	.13	1.14	**	.01	1.01	
	(.06)			(.00)		
Constant	1.82	6.15	**	0.80	2.22	***
	(.91)			(.06)		

Note: All models control for respondents' education, age, ethnicity, urbanicity, wealth quintile, district, total number of siblings, birth order, experience of child loss, and community rate of sibling mortality.

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

† Sibling loss in this model only includes the death of siblings that occurred during a woman's lifetime (rather than before she was born).

Appendix B: Results of Logistic and Poisson Regression Estimating Ideal Fertility *By Parity at Survey*

	Ideal is >=1 child (N=117,918)			Ideal number among those whose ideal is >=1 (N=127,661)		
	Model 1			**Model 2**		
	β	OR	Sig	*β*	IRR	Sig
Exposure to mortality						
Sibling loss	.20	1.23	**	0.00	1.00	
	(.09)			(0.01)		
Child loss	.01	1.01		0.02	1.02	***
	(.08)			(0.01)		
Parity (0 ref)				(.00)		
1	0.61	1.84	***	0.02	1.02	***
	(0.10)			(0.01)		
2	0.74	2.09	***	0.12	1.13	***
	(0.12)			(0.01)		
3	0.77	2.16	***	0.21	1.23	***
	(0.13)			(0.01)		
4	1.09	2.97	***	0.26	1.30	***
	(0.16)			(0.01)		
5+	1.14	3.12	***	0.30	1.35	***
	(0.15)			(0.01)		
Sibling loss*parity						
Sibling loss*1 child	0.22	1.24		0.02	1.02	**
	(0.16)			(0.01)		
Sibling loss*2 children	-0.05	0.95		0.03	1.03	***
	(0.16)			(0.01)		
Sibling loss*3 children	0.06	1.06		0.02	1.02	**
	(0.16)			(0.01)		
Sibling loss*4 children	0.04	1.04		-0.00	1.00	
	(0.18)			(0.01)		
Sibling loss*5+ children	-0.24	0.79	*	-0.01	0.99	
	(0.14)			(0.01)		
Constant	1.86	6.42		0.79	2.19	***
	(.96)			(0.07)		

Note: All models control for respondents' education, age, ethnicity, urbanicity, wealth quintile, district, total number of siblings, birth order, experience of child loss, and community rate of

sibling mortality.
Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Appendix C: Results of Logistic and Poisson Regression Estimating Ideal Fertility *depending on motherhood status at time of sibling loss*

	Ideal is >=1 child (N=96,634)			Ideal number among those whose ideal is >=1 (N=127,661)		
	Model 1			**Model 2**		
	β	OR	Sig	*β*	IRR	Sig
No sibling loss *(n=79409)*	REF	1.00	--	REF	1.00	--
Sibling died after first birth *(n=4628)*	.13 (.12)	1.14		.04	1.04	***
Sibling died before first birth *(n= 28683)*	.22	1.24	***	.00	1.00	
Constant	3.47 (1.31)	32.17	***	.84 (.07)	2.31	***

References

Allison, Paul. 2012. "Logistic Regression for Rare Events". Statistical Horizons blog. Accessed online July 2018. https://statisticalhorizons.com/logistic-regression-for-rare-events

Angeles, Luis. 2010. "Demographic Transitions: Analyzing the Effects of Mortality on Fertility." *Journal of Population Economics* 23(1):99–120.

Angeles, Gustavo, David K. Guilkey, and Thomas A. Mroz. 2005. "The Determinants of Fertility in Rural Peru: Program Effects in the Early Years of the National Family Planning Program." *Journal of Population Economics* 18(2):367–89.

Ball, Patrick, Jana Asher, David Sulmont, and Daniel Manrique. 2003. "How Many Peruvians Have Died?--An Estimate of the Total Number of Victims of the Internal Armed Conflict, 1980-2000" Human Rights Data Analysis Group of the American Association for the Advancement of Science (HRDAG). Washington D.C. https://www.aaas.org/sites/default/files/migrate/uploads/Peru2003.pdf

Barro, Robert J. and Gary S. Becker. 1989. "Fertility Choice in a Model of Economic Growth" *Econometrica* Vol 57(2).

Behrman, Julia Andrea. 2015. "Does Schooling Affect Women's Desired Fertility? Evidence from Malawi, Uganda, and Ethiopia" Demography 52(3):787-809.

Behrman, Julia Andrea and Abigail Weitzman. 2016. "Effects of the 2010 Haiti Earthquake on Women's Reproductive Health" *Studies in Family Planning* 47(1):3-17.

Boldrin, Michele and Larry E. Jones. 2002. "Mortality, Fertility, and Saving in a Malthusian Economy." Review of Economic Dynamics 5(4):775–814.

Bongaarts, John. 2006. "The Causes of Stalling Fertility Transition" *Studies in Family Planning.* Vol 37(1):1-16.

Boyden, Jo and Pat Holden. 1991. *Children of the Cities.* Zed Books Limited. London.

Buhr, Petra and Johannes Huinink. 2014. "Fertility Analysis from a Life Course Perspective" *Advances in Life Course Research* 21:1-9.

Caldwell, John C. 1976. "Toward a Restatement of Demographic Transition Theory" *Population and Development Review*, Vol. 2(3/4).

Caldwell, John C. 2005. "On Net Intergenerational Wealth Flows: An Update" *Population and Development Review*, Vol. 31(4).

Carbajal Chirinos, Carlos. June 1988. Peruvian Demographic Transition. Boletin: Consejo Nacional de la Poblacion (13):16-7.

Casterline, John B. and Samuel Agyei-Mensah. 2017. "Fertility Desires and the Course of Fertility Decline in Sub-Saharan Africa" Population and Development Review 43(S1):84-111.

Davis, Kingsley. 1963. "The Theory of Change and Response in Modern Demographic History

Population Index Vol. 29(4):345-366.

Dodson, Lisa and Jillian Dickert. 2004. "Girls' Family Labor in Low-Income Households: A Decade of Qualitative Research" *Journal of Marriage and Family* Vol 66(2): 318-332.

Doepke, Matthias. 2005. "Child Mortality and Fertility Decline: Does the Barro-Becker Model Fit the Facts?" Journal of Population Economics 18:337-366.

Durevall, Dick and Annika Lindskog. 2016. "Adult Mortality, AIDS, and Fertility in Rural Malawi." *The Developing Economies* 54(3):215–42.

Edin, Kathryn, and Maria Kefalas. 2005. Promises I can keep: why poor women put motherhood before marriage. Berkeley: University of California Press.

Elder, Glen H. 1998. "The Life Course as Developmental Theory." *Child Development* 69(1):1–12.

England, Paula. 2016. "Sometimes the Social Becomes Personal" *American Sociological Review* 81(1):4-28.

Esteve, Albert, Joan García-Román, and Ron Lesthaeghe. 2011. "The Family Context of Cohabitation and Single Motherhood in Latin America" *Population and Development Review* 38(4):707-727.

Finnegan, Amy. 2016. "Dying to Give Birth: The Effect of a Sister's Death in Childbirth on Reproductive Behaviors in Indonesia" Unpublished manuscript. Presented at 2016 Annual Meeting of the Population Association of America.

Friedman, Debra, Michael Hechter, and Satoshi Kanazawa. 1994. "A Theory of the Value of Children" *Demography*. Vol 31(3).

Galor, Oded and David N. Weil. 1999. "From Malthusian Stagnation to Modern Growth." The American Economic Review 89(2):150–154.

Geithman, David T. and Manuel J. Carvajal. 1975. "Population and the Economist The New Economic Approach to Fertility." Social Science 204–212.

Geronimus, Arline T. 2003. "Damned if You Do: Culture, Identity, Privilege and Teenage Childbearing in the United States" Social Science and Medicine 57(5):881-893.

Goldberg, Rachel E. 2012. "Family Instability and Early Initiation of Sexual Activity in Western Kenya." *Demography* 49(4).

Gonzales, Fernando. 2012. Analisis de Situacion de Salud del Peru. Ministerio de Salud del Peru. Accessed online 2 January 2018. http://www.ins.gob.pe/repositorioaps/0/0/jer/maestria_2012/An%C3%A1lisis%20de%20situaci%C3%B3n%20de%20salud%20en%20el%20Per%C3%BA.pdf

Hill, K. and J. Trussell. 1977. “Further Developments in Indirect Mortality Estimation.” Population Studies 31(2):313–34.

Huicho, Luis, Miguel Trelles, Fernando Gonzales, Walter Mendoza and Jaime Miranda. 2009. “Mortality profiles in a country facing epidemiological transition: An analysis of registered data” *BMC Public Health* (9):47.

Huinink, Johannes and Martin Kohli. 2014. “A life-course approach to fertility” *Demographic Research,* Vol. 30: 1293-1326.

INEI. 2015. “Magnitud y Características del Trabajo Infantil en Peru” Ministerio de Trabajo y Promoción del Empleo. Organización Nacional del Trabajo. Accessed online March 2018. file:///C:/Users/rbroussard/Downloads/Peru_NCLS_2015_Web%20(1).pdf

Kirk, Dudley. 1996. “Demographic Transition Theory” *Population Studies* 50(3):361-387.

Levison, Deborah and Karine S. Moe. 1998. “Household Work as a Deterrent to Schooling: An Analysis of Adolescent Girls in Peru” *The Journal of Developing Areas* Vol 32(3):339-356.

Mason, Karen Oppenheim. 1997. "Explaining Fertility Transitions." *Demography* 34:443-454.

Mazza, Julia Rachel S.E., Jean Lambert, Maria Victoria Zunzunegui, Richard E. Tremblay, Michel Boivin, and Sylvana M. Cote. 2017. “Early adolescence behavior problems and timing of poverty during childhood: A comparison of lifecourse models” *Social Science and Medicine* 177:35—42.

McFalls Jr., Joseph A. 2007. “Population: A Lively Introduction” *Population Bulletin* Vol 62(1):3-31.

Ministerio de Salud. 2013. “Análisis de Situación de Salud del Peru” Direccion General de Epidemiología. http://www.dge.gob.pe/portal/docs/intsan/asis2012.pdf Accessed online 31 August, 2018.

Mira, Pedro. 2007. “Uncertain Infant Mortality, Learning, and Life-Cycle Fertility.” *International Economic Review* 48(3):809–846.

Montenegro, Raul A. and Carolyn Stephens. 2006. “Indigenous Health in Latin America and the Caribbean” *The Lancet.* 367:9525.

Montgomery, Mark R. and Barney Cohen (Eds). 1998. *From Birth to Death: Mortality Decline and Reproductive Change.* National Academy Press.

Morgan, S. Philip. 2003. “Is Low Fertility a Twenty-First-Century Demographic Crisis?” *Demography* Vol. 40(4):589-603.

Myers, William E. (Ed) and Jocelyn Boyden. 1991. *Protecting Working Children.* Zed Books Limited. London.

Nandi, Arindam, Sumit Mazumdar, and Jere R. Behrman. 2018. "The Effect of Natural Disaster on Fertility, Birth Spacing, and Child Sex Ratio: Evidence from a Major Earthquake in India" *Journal of Population Economics* 31(1):267-293.

Nobles, Jenna, Elizabeth Frankenberg, and Duncan Thomas. 2015. "The Effects of Mortality on Fertility: Population Dynamics After a Natural Disaster." Demography 52(1):15–38.

Ogle, Christin M., David C. Rubin, and Ilene C. Siegler. 2013. "The Impact of the Developmental Timing of Trauma Exposure on PTSD Symptoms and Psychosocial Functioning Among Older Adults" *Developmental Psychology* 49(11).

Palloni, Alberto and Hantamala Rafalimanana. 1999. "The Effects of Infant Mortality on Fertility Revisited: New Evidence from Latin America." *Demography* 36(1):41–58.

The Pan American Health Organization. 2012. Peru. Health in the Americas, 2012 Edition: Country Volume. Accessed online 2 January 2018. http://www.paho.org/salud-en-las-americas-2012

Preston, Samuel H. 1978. The Effects of Infant and Child Mortality on Fertility. Academic Press. University of Minnesota.

Reher, David Sven, Glenn Sandström, Alberto Sanz-Gimeno, and Frans W. A. Van Poppel. 2017. "Agency in Fertility Decisions in Western Europe During the Demographic Transition: A Comparative Perspective." *Demography* 54(1):3–22.

Rutstein, Shea O. and Ann Way. 2014. The Peru Continuous DHS experience, DHS Occasional Paper 8. United States Agency for International Development (USAID). Rockville, Maryland.

Sandberg, John. 2002. "Child Mortality, Family Building and Social Learning in a Nepalese Mountain Community." Ph.D. dissertation, Department of Sociology, University of Michigan, Ann Arbor, MI.

Sandberg, John. 2006. "Infant Mortality, Social Networks, and Subsequent Fertility Decline" *American Sociological Review.* Vol 71 (April: 288-309).

Siah, Audrey K. L. and Grace H. Y. Lee. 2015. "Female Labour Force Participation, Infant Mortality and Fertility in Malaysia." *Journal of the Asia Pacific Economy* 20(4):613–29.

Smee, Nancy. 2010. "Child Replacement Theory as a Tool for Understanding Fertility Behavior Among HIV-Infected Sub Saharan Women." International Journal of Interdisciplinary Social Sciences 5(3).

Smith-Greenaway, Emily and Christie Sennott. 2016. "Death and Desirability: Retrospective Reporting of Unintended Pregnancy After a Child's Death." *Demography* 53(3):805–34.

Stroebe, Margaret, Henk Schut, and Wolfgang Stroebe. 2007. "Health Outcomes of Bereavement" *The Lancet.* 370(9603):1960-73.

Umberson, Debra. 2017. "Black Deaths Matter: Race, Relationship Loss, and Effects on Survivors" *Journal of Health and Social Behavior* Vol. 58(4).

Umberson, Debra et al. 2017. "Death of Family Members as an Overlooked Source of Racial Disadvantage in the United States." Proceedings of the National Academy of Sciences 114(5):915–20.

United Nations, Department of Economic and Social Affairs, and Population Division. 2015. Trends in Contraceptive Use Worldwide, 2015. New York: United Nations, Department of Economic and Social Affairs, Population Division.

United Nations, Department of Economic and Social Affairs, Population Division (2017). World Contraceptive Use 2017 (POP/DB/CP/Rev2017).

US Department of Labor, 2016. "Child Labor and Forced Labor Reports." Bureau of International Labor Affairs. Accessed online June 19, 2018. https://www.dol.gov/agencies/ilab/resources/reports/child-labor/peru

Vail III, Kenneth E. et al. 2012. "When Death Is Good for Life: Considering the Positive Trajectories of Terror Management." Personality and Social Psychology Review 16(4):303–329.

Van Poppel, Frans, David S. Reher, Alberto Sanz-Gimeno, Maria Sanchez-Dominguez, and Erik Beekink. 2012. "Mortality Decline and Reproductive Change during the Dutch Demographic Transition: Revisiting a Traditional Debate with New Data." *Demographic Research* 27:299.

World Factbook, 2017. Peru. Accessed online January 2018. https://www.cia.gov/library/publications/the-world-factbook/geos/print_pe.html

Yamada, Tadashi. 1985. "Causal Relationships between Infant Mortality and Fertility in Developed and Less Developed Countries." *Southern Economic Journal* 52(2):364.

Zapata, Daniela, Dante Contreras, and Diana Kruger. 2011. "Child Labor and Schooling in Bolivia: Who's Falling Behind? The Roles of Domestic Work, Gender, and Ethnicity" *World Development* Vol 39(4):588-599.