

The Intergenerational Transmission of Health Disadvantage: Can Education Disrupt It?

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Abstract

In low-income countries, intergenerational processes can culminate in the replication of extreme forms of health disadvantage between mothers and adult daughters, including experiencing a young child's death. The preventable nature of most child deaths raises questions of whether social resources can protect women from enduring this adversity like their mothers. This study examined whether education—widely touted as a vehicle for social mobility in resource-poor countries—disrupts the intergenerational cycle of maternal bereavement. We estimated multilevel discrete-time survival models of women's hazard of child loss using Demographic and Health Survey Program data (N = 195,744 women in 345 subnational regions in 32 African countries). Women's educational attainment minimizes the salience of their mothers' bereavement history for their own probability of child loss; however, mothers' background becomes irrelevant only among women with ≥ 10 years of schooling. Education's neutralizing influence is most prominent in the highest mortality-burdened communities.

Keywords

bereavement, child death, education, health disadvantage, intergenerational inequality

Increasingly, sociologists studying population health inequality recognize family bereavement—the experience of losing a family member to death—as a fundamental yet historically overlooked by-product of health disparities. At the core of this research is a simple fact: Inequalities in mortality rates across social and economic groups give way to corresponding inequalities in the likelihood of family bereavement (Umberson et al. 2017). Complementing a growing literature emphasizing the concentration of family bereavement among racially marginalized groups in the United States (Umberson 2017), recent research on low-income countries has outlined the vertical clustering of these experiences across generations of disadvantaged families: Having a mother who was bereaved by a young child's death increases a woman's probability of

also suffering a young child's death (Smith-Greenaway et al. 2024). This “intergenerational transmission” of maternal bereavement is observable across low-income countries in six world regions. The preventable nature of most child deaths matched with evidence of the severe and long-term implications that they can have for parents' and

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siblings' health and social and economic well-being (Stroebe and Schut 2001; Stroebe, Schut, and Stroebe 2007) mandate an understanding of what—if anything—can protect a woman from “inheriting” an elevated risk of child loss, replicating her mother's past disadvantage.

Education is widely touted as a promising route for girls in low-income countries to escape their disadvantaged origins and to achieve a more healthful, stable life than their parents. Investment in the expansion of school systems has become a de facto development strategy, one that girls themselves have wholeheartedly embraced (Frye 2012). This leads us to ask whether education can disrupt the intergenerational transmission of maternal bereavement.

Social scientists have long acknowledged education's major role in the reproduction of social stratification (Blau and Duncan 1967), yet most research has theorized the transmission of educational attainment itself (Alesina et al. 2021; Azomahou and Yitbarek 2016) or has conceptualized education as a vehicle through which other social statuses or resources transmit across generations. Extending beyond conceptualizations of education as part and parcel to the reproduction of the social hierarchy, inequality scholars have also conceptualized education among the first or second generations as an equalizer that can disrupt intergenerational transmission processes (Mikkonen et al. 2020). Some studies have focused principally on the moderating influence of parents' education, and others have considered the moderating influence of adult children's education as a safeguard against their parents' disadvantage (Andersen et al. 2021; Bloome, Dyer, and Zhou 2018; Rauscher 2016).

Whether the protective nature of education extends to the case of the intergenerational transmission of maternal bereavement in low-income regions like sub-Saharan Africa, where education has expanded swiftly, often outpacing concomitant improvements in infrastructural provisions and economic resources, remains an unanswered question. Even so, education is a key source of women's upward social and economic mobility (Tembon and Fort 2008) and a major determinant of improved maternal and child health outcomes (Gakidou et al. 2010). Thus, to assess the potential for education to disrupt the intergenerational transmission of maternal bereavement, we use Demographic and Health Survey (DHS) Program data from 32 African countries. We study adult daughters born in the 1980s and 1990s—the first cohorts to experience widespread access to schooling, yet among whom social and economic inequality have given way to high

levels of educational inequality (Eloundou-Enyegue and Davanzo 2003). We examine if the intergenerational transmission of maternal bereavement is weakened among women who have achieved higher levels of education, and we assess the stability of these patterns across diverse mortality landscapes.

BACKGROUND

The Intergenerational Transmission of Maternal Bereavement

A vast body of social science research demonstrates that experiences, behaviors, and statuses tend to persist from one generation in a family to the next. From status-oriented outcomes, like socioeconomic achievement and place of residence (Sharkey 2008), to more intimate experiences, like family formation processes (Axinn, Clarkberg, and Thornton 1994; Barber 2000) and health behaviors (Kalmijn 2022), individuals' experiences and outcomes often mirror those of their parents. As such, processes of intergenerational transmission are instrumental to the reproduction of social, economic, and health inequalities.

Historically, sociological research on intergenerational processes has focused on high-income countries, but a growing number of studies have investigated intergenerational transmission in low-income countries undergoing social, demographic, and political change. Some research suggests that intergenerational associations are weaker in contemporary low-income countries relative to high-income ones (Murphy 2012). Conversely, other studies emphasize that even in developing economies where the social and economic opportunities are widely dissimilar between generations, intergenerational transmission persists (Alesina et al. 2021; Azomahou and Yitbarek 2016). Intergenerational transmission is especially strong between mothers and daughters (Emran and Shilpi 2015; Ranasinghe 2015; Thomas 1996) and can manifest in the replication of extreme forms of health disadvantage, including the death of a young child: Women whose mothers have experienced a young child die have higher odds of eventually suffering the same fate (Smith-Greenaway et al. 2024).

An expansive body of psychology research demonstrates that experiencing a young child's death is a life-altering experience that can produce a host of short- and longer-term adversities for bereaved parents (Rogers et al. 2008). Mothers who experience a child's death have worse mental health

outcomes that can persist for years, even decades (for a review, see Stroebe and Schut 2001). The often severe psychological reactions to a child's death can "get under the skin," acting as a precursor to physical health problems (for a review, see Stroebe et al. 2007). Related to the adverse effects of child loss on parents' mental and physical health, a child's death is also associated with declines in the strength and quality of parents' social and marital relationships. Having a child die can be an isolating experience. Bereaved parents tend to withdraw from social networks because they believe others discount their grief (Meyer, Opoku, and Gold 2018), feel ashamed or stigmatized (Hastings 2000), or are too mentally fatigued to engage socially (McBride and Toller 2011). A child's death also corresponds with lower levels of marital satisfaction and higher rates of marital conflict and dissolution (Rogers et al. 2008).

Although most evidence of the severe parental consequences following child death originates from North America and Western Europe, select anthropological studies of high-mortality contexts across Asia, Africa, and Latin America echo the general conclusion that the death of a child is a stress-inducing parental experience that comes with adverse psychological, social, and relational consequences (Einarsdóttir 2005; Smørholm 2016). Reinforcing evidence from these small-scale, localized studies, a survey-based, multicountry study demonstrates the consequential nature of child death for mothers' well-being in Africa (Weitzman and Smith-Greenaway 2020). Using data from multiple African countries, the study shows that child death can precipitate the onset of mothers being victimized by intimate partner violence, presumably due to the conflict, maternal blame, and stress that accompany child loss.

Together, cross-contextual evidence of the severe consequences of a child's death raises questions of what social factors can protect women from the replication of this distinctly disadvantaging parental experience. Given that early childhood deaths in low-income regions are almost always due to preventable causes, such as pneumonia, diarrhea, or malaria (Liu et al. 2016), and thus are, by extension, socially and economically patterned, there is reason to anticipate that adult daughters' socioeconomic resources could disrupt the intergenerational transmission of maternal bereavement. That is, because the intergenerational linkages in bereavement are presumably driven by mothers' and daughters' similar (disadvantaged) positioning in the socioeconomic strata and their tendency to

have comparable fertility, maternal, and child health care behaviors, a bereaved mother's adult daughter becoming more highly educated could disrupt transmission processes as the adult daughter assumes a higher social positioning and adopts dissimilar behaviors. In the next section, we outline three pathways by which education could act as a counterweight to a woman's family past—minimizing the extent to which her mother's reproductive experiences are foretelling of her own.

Education and the Disruption of Intergenerational Transmission of Maternal Bereavement: Upward Mobility and Behavioral Change

A burgeoning literature has leveraged the implementation of universal school policies and compulsory attendance laws to infer education's causal effects on women's lives (Behrman 2015a, 2015b; Grépin and Bharadwaj 2015; Ozier 2018; Weitzman 2017, 2018). This literature suggests that there are at least three viable routes by which education could reduce the likelihood that a woman experiences a young child's death like her mother. The first is through the social and economic mobility that education affords women, including those who come from disadvantaged families. Adult daughters occupying the same disadvantaged position in the socioeconomic strata as their bereaved mothers is hypothesized to be one reason why they "inherit" an elevated risk of child loss. Achieving high levels of education, however, can generate better employment opportunities for women and result in their marrying more highly educated partners, which can lead to their living in more resourced homes and neighborhoods relative to those of their mother (Psacharopoulos and Patrinos 2004). Indeed, the economic security that more highly educated women enjoy is a principal reason why their children survive at higher rates relative to the children of their less educated peers (Grépin and Bharadwaj 2015). Thus, the resources that more highly educated women can access may lessen the significance of their mothers' past adversity for their own maternal experiences.

Second, research suggests that educational attainment may encourage women to charter distinct reproductive paths relative to their bereaved mothers, which could further impede the transmission of child loss. For example, women's education can disrupt intergenerational associations in women's fertility: Adult daughters' years of education weakens the correlation between their own and

their mothers' fertility (Murphy 2012). Thus, achieving higher levels of education may lead women to have fertility trajectories that are both distinct from those of their bereaved mothers and correspond with higher child survival. That is, women who continue further in school tend to have lower rates of early marriage and childbearing (Koski et al. 2018; Ozier 2018; Timæus and Moultrie 2015), fewer closely spaced or unintended pregnancies, and ultimately fewer children (Bongaarts 2003; Shapiro 2012)—each of which lowers their young children's risk of death (Grépin and Bharadwaj 2015).

Third, educational attainment may encourage women to adopt distinct health-related behaviors relative to their bereaved mothers—further weakening the salience of their mothers' past for their own experiences. Although many maternal practices, from birthing to infant feeding, are influenced by women's family background, the potentially countervailing influence of women's education could temper these correlations. Women's education is associated with health-related behaviors that promote child survival, like the use of antenatal care (Weitzman 2017) and better maternal health (Behrman 2015b; De Neve et al. 2015; Grépin and Bharadwaj 2015; Weitzman 2018). As such, education could disrupt the tendency for mothers' and daughters' maternal behaviors—and by extension, maternal health outcomes—to repeat.

In sum, due to the potential for education to facilitate a woman's socioeconomic mobility and drive changes in her fertility and health-related behaviors relative to those of her mother, achieving higher levels of education may significantly reduce the predictive nature of mothers' past for women's own reproductive experiences, thereby resulting in women's risk of experiencing a child's death more closely mirroring that of their peers from more advantaged backgrounds. Together, this implies that women's education could dilute the predictive value of their mothers' bereavement on their own likelihood of child loss.

Education and the Disruption of Intergenerational Transmission of Maternal Bereavement: A contextually dependent process?

The previous discussion pertains to differences between individual women in terms of both their family history and their educational attainment. Women's maternal experiences are, however, also strongly patterned by the broader context in which

they reside. Women in African countries are collectively navigating motherhood in settings where their risk of experiencing a child's death is at a global high (Smith-Greenaway and Trinitapoli 2020; Smith-Greenaway et al. 2021). Yet African countries are notoriously diverse, with dramatic inequality in the local burden of maternal bereavement (Weitzman and Smith-Greenaway 2020). For example, many women in our sample live in settings where upward of one-half of mothers have experienced a child's death, whereas others reside in contexts where just 1 in 10 mothers have.

As such, it is possible that the broader mortality contexts in which women live affect both the extent of intergenerational transmission of maternal bereavement and the potential for education to disrupt it. For example, living in a lower mortality context, wherein infrastructural provisions and the overall health environment are, by extension, more favorable, the relevance of women's family background—including mothers' bereavement history—may be of less relevance to women's risk of child loss regardless of their educational attainment. In such environments, women may collectively benefit from shared resources, thereby reducing between-family inequalities, ultimately weakening the relevance of family background and individual resources for child well-being. Alternatively, in high-mortality contexts, where child death remains an ever-present threat, it may be only the most resourced mothers that can evade child loss; thus, the neutralizing effect of mothers' education may be formidable. In these settings, only the most highly educated women may be able to guard against the elevated risk that can correspond with both a disadvantaged family history and a hostile health context.

DATA AND METHODS

Data and Sample

We used data from the DHS Program (<http://www.dhsprogram.com>), a long-running, international survey program that collects reproductive and child health data from women age 15 to 49 years old in dozens of low- and middle-income countries. The DHS Program collects detailed birth histories from women, including information about deceased children. In many countries, the DHS Program also includes a sibling history module, with the intention of tracking adult mortality in countries that lack civil registration and vital statistics data (Feehan and Borges 2021; Masquelier 2013; Obermeyer

et al. 2010). Together, these sibling and birth history data allowed us to investigate intergenerational linkages in child death and to analyze whether and where adult daughters' educational attainment moderated them.

The standardized DHS Program questionnaires make them ideal for our multicountry study design. In total, we used data for the 32 countries in sub-Saharan Africa where the DHS Program implemented the sibling history module in recent surveys. Within these 32 focal countries, we analyzed data from the most recent round of surveys, collected between 2010 and 2020 and focused on women born in the 1980s and 1990s—cohorts that came of age as school access expanded dramatically in the region, giving way to large educational inequality. Following past multinational research (Kravdal 2002; Molitoris, Barclay, and Kolk 2019), we pooled the data. Note that we adjusted the DHS Program survey weights by multiplying them by a survey-specific constant to equalize the effective weighted sample size across all countries. Our pooled data set includes information on 195,744 women in 345 subnational regions who contributed 1,444,340 person-years to our multivariable hazard model analyses. Appendix A in the online version of the article provides a complete list of countries and key sample information.¹

Study Measures

Hazard of child loss. Given that most preventable child deaths occur before a child's fifth birthday, our key outcome was a measure of whether the focal woman ever experienced an under-five child death.² We derived this information from the detailed birth histories that women provided, which included information on each child's birth year and vital status and for deceased children, year of death. We used this information to calculate whether a woman ever experienced an under-five child's death and if so, the year she experienced it in relation to her first birth. We then modeled this outcome in a hazard framework, with person-years as our unit of analysis and the hazard beginning at the year of a woman's first birth.

We coded each person-year a mother contributed as 0 if she had not yet experienced an under-five child death and 1 in the year she experienced an under-five child death. Even though some women in our data reported multiple under-five child deaths, we estimated single-event hazard models, meaning a woman no longer contributed observations after she experienced a first under-five

child death. For example, a 35-year-old woman who had her first child at age 20 and had a child die when she was 30 years old contributed 11 person-years to the analysis before exiting (=1)—even if she eventually endured another loss. Some women in our data were never bereaved, having all their children survive to the time of the survey. These women exited the hazard at their age at the time of the survey. For example, a 30-year-old woman who had her first child at age 24 and whose children all survived was right-censored and contributed 7 person-years to the analysis before exiting (=0).

Mothers' bereavement history. The key independent variable was a measure of whether the focal woman's mother was bereaved by an under-five child's death. In several countries, the DHS Program incorporated a sibling history module with the primary goal of tracking adult mortality conditions in countries lacking civil registration and vital statistics data (Obermeyer et al. 2010). The sibling history module collects information on each of the respondent's siblings born to the same mother, including the sibling's birth year, vital status, and for deceased siblings, year of death. With this information, we generated a binary indicator of whether the focal respondent's mother was ever bereaved by an under-five child's death. To ensure the focal woman's mother's bereavement preceded her own experience of child death, we only considered deaths that occurred prior to the year the focal woman had her first birth and thus, the time at which she became at risk of losing a child herself.³

It is important to note that women's retrospective sibling mortality data are likely to suffer from reporting error. Women may not have been aware of some sibling deaths, and some respondents may fail to recall sibling deaths they were once aware of (Bicego 1997; Masquelier and Dutreuilh 2014; Timæus and Jasseh 2004). As such, we discuss the implications of reporting errors for our results (see the "Discussion" section). Even so, the data women did provide about their siblings were notably complete, with <1% of respondents having incomplete information (e.g., on time of death). We excluded these cases.

Women's educational attainment. To assess the potential for education to moderate the intergenerational linkages between mothers' and their adult daughters' bereavement, we used a continuous measure of adult daughters' educational attainment. DHS Program interviewers asked women the highest level of school they had completed, ranging from

0 to 24 years. Although we modeled the variable continuously in the main multivariable hazard models, to depict key findings, we graph separately the predicted probability of maternal bereavement by women's mother's history for those at opposing ends of the educational spectrum in our data: those who have never attended formal school, which represent approximately 35% of the women in our sample, versus those who have attended ≥ 8 years of school—denoting their completion of primary school/secondary school attendance. Approximately 30% of women in our sample had attended ≥ 8 years of school. Note that we also made comparisons with even more highly educated women—including those with ≥ 10 years of education—and with women who have only 1 or more years of school and report the findings in the following.

Mothers' bereavement history $\times$ women's educational attainment. To examine the potential for women's education to condition the intergenerational association in maternal bereavement, we interacted women's education with mothers' bereavement history.⁴

Mothers' bereavement $\times$ women's educational attainment $\times$ child mortality context. To examine for possible cross-contextual variation in the intergenerational transmission of child loss and the potential for education to neutralize it, we created a three-way interaction term. Specifically, we tested whether there was significant cross-contextual variation in the moderating association according to the overall burden of child loss in women's subnational region. Subnational regions represent a combination of political districts and administrative or geographic boundaries, depending on the country. Quantifying the mortality conditions of the 345 subnational regions in our data allowed us to account for the dramatically disparate environments in which women navigate motherhood. To generate the three-way interaction term, we first calculated the percentage of women (age 15–49 years) in each subnational region who had ever experienced an under-five child death among women who had at least one child. We expressed this burden of child death as a percentage, which ranged from 3% to 57% in our data. We then created a three-way interaction between women's mothers' bereavement history, women's educational attainment, and the percentage of women bereaved in their subnational region. Note that although we modeled women's educational attainment and the mortality context continuously in all multivariable hazard models, to illustrate

key findings, we graphically present the results by comparing the intergenerational transmission patterns among women living in the lowest (30th percentile, where one in five or fewer mothers have experienced a child die) and highest (70th percentile, where one-third or more of mothers have experienced a child die) child-death-burdened subnational regions. Furthermore, we again depicted the results for women who have never attended formal school versus those who have attended ≥ 8 years of school—denoting their completion of primary school/secondary school attendance.

Controls. In all hazard models, we included control variables that are associated with women's family background, educational attainment, and child death and thus could drive spurious associations. These included time-invariant measures of women's birth cohort and age at first birth and a time-varying indicator of the total number of children women had at each person-year of observation. Additionally, we controlled for women's marital status at the time of the survey (never been in a union, married/living together, or divorced/separated/widowed) and a DHS Program-constructed household wealth index that captures household assets.⁵ We also included a measure of whether the woman resides in a rural or urban household. To account for women's differential risk of having a bereaved mother, we controlled for women's number of siblings ever born and birth order. Finally, to further account for socioeconomic conditions in women's broader subnational region, alongside the mortality context, we calculated the percentage of households the DHS Program classified as being in the wealthiest quintile (for their country) in women's subnational region.

Statistical Models

We estimated a series of multilevel discrete-time survival models using a logit link. In all multivariable, discrete-time hazard models, person-years were the unit of observation, and the hazard of under-five child loss began at the year of the respondent's first birth (and continued until failure or censoring at the time of the survey).⁶ This strategy addressed the right-censoring of our dependent variable (women's loss of an under-five child) and the hierarchical structure of our data, where multiple mothers lived in the same subnational region, which are nested within countries. We included a subnational-region level random effect and a country-level fixed effect to account for unobserved

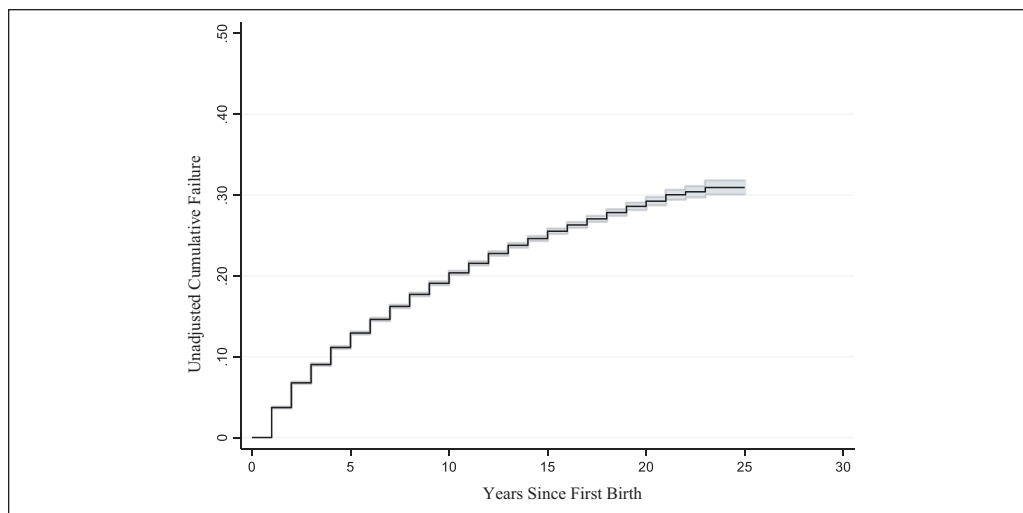


Figure 1. Unadjusted Cumulative Probability of Child Loss among Women in 345 Subnational Regions in 32 African Countries.

Note: Estimates based on Demographic and Health Survey Program data on 195,744 women in 345 subnational regions in 32 sub-Saharan African countries (contributing 1,443,928 person-years of data). Gray shading represents 95% confidence interval.

heterogeneity between countries. Due to the proportional odds assumption, every independent variable was modeled using only one parameter and thus treated as proportional over time.⁷ The hazard was expressed as the conditional probability that an event will occur in each interval given that the event had not already occurred. We expressed the model results as odds ratios, which we labeled as hazard-odds ratios.

In Model 1, we estimated the relationship between having a bereaved mother and women's hazard of child loss net of their years of education and additional sociodemographic characteristics. In Model 2, we included an interaction term between having a bereaved mother and women's years of education to assess if any intergenerational patterning of child loss was distinct in size and significance according to women's educational attainment. Given the documented issues of interpreting interaction results in logistic regression models (Long and Mustillo 2021), we used the *margins* command in Stata to plot the adjusted conditional predicted probabilities of child death by women's mothers' bereavement status and educational attainment. Furthermore, we conducted postestimation Wald tests to examine if the differences in the probability of child death by women's mothers' bereavement status for the least and most educated women were significantly different from one another.

In Model 3, we included a three-way interaction term between having a bereaved mother and women's years of education and the subnational region burden of child loss to assess if any key results vary across distinct mortality-burdened contexts. Again, to interpret the significance and magnitude of the findings, we plotted the adjusted conditional predicted probabilities of child death by women's mothers' bereavement status, women's educational attainment, and mortality context. And again, we conducted postestimation Wald tests to examine whether the differences by women's mothers' bereavement status for the least and most educated women were statistically significant.

RESULTS

Sample Characteristics

Figure 1 depicts the unadjusted, cumulative probability of child death experienced among the focal women in our data—women born in the 1980s and 1990s. As shown, over their reproductive years, approximately one-third (31%) of women experienced an under-five child's death—attesting to the incredibly high burden of maternal bereavement that women in contemporary Africa bear and the need to understand what social resources can lessen women's probability of being affected personally.

Table 1. Descriptive Statistics of Key Study Variables for 195,744 Women in 345 Subnational Regions in 32 Sub-Saharan African Countries.

	Mean (SD)/%
Mother bereaved	25.3
Women's educational attainment	5.4 (4.9)
Individual characteristics	
Cohort	
1980s	59.3
1990s	40.7
Age at first birth	19.1 (3.5)
Total number of children	3.0 (1.9)
Marital status	
Never in union	9.9
Married/living together	81.9
Divorced/separated/widowed	8.2
Number of siblings before first birth	5.4 (2.5)
Birth order	3.5 (2.3)
Household wealth index	
Poorest	19.5
Poor	20.2
Middle	20.0
Rich	20.4
Richest	19.9
Place of residence	
Rural	63.2
Urban	36.8
Regional characteristics	
% Rich households	40.1 (22.6)
% Women bereaved	27.2 (10.2)

Note: Estimates based on Demographic and Health Survey Program (DHS) data from the 32 countries listed in Appendix A in the online version of the article. $N = 195,744$. Following convention, we adjusted the DHS survey weights for our pooled sample by multiplying them by a survey-specific constant to equalize the effective weighted sample sizes across all countries. The total number of children is presented as a mean shown at the time of the survey; however, this measure is treated as time-varying in multivariable hazard models shown in Table 2.

Note that Appendix C in the online version of the article offers country-specific estimates of the percentage of women in our data who have ever been affected by child loss (at the time of the survey—not accounting for the censored nature of the outcome). As shown, the percentages of women who have experienced a young child's death are consistently high but vary notably across countries.⁸

Table 1 offers weighted descriptive statistics to further characterize the pooled sample. As shown, upward of 25% of women have bereaved mothers. On average, women attended just over five years of school. The average woman had her first child just after her 19th birthday. Most women reside in rural areas with considerable inequality in their

household resources, and they live, on average, in subnational regions with exceedingly high burdens of child loss (27% of women have experienced child death on average).⁹

This summary statistic, however, conceals the sizeable variation in the mortality landscapes in which women in our sample are navigating motherhood. Thus, Figure 2 maps the unequal burdens of child loss across subnational regions—variation that may pattern intergenerational linkages and the extent to which women's education neutralizes them. As shown, in several subnational regions, fewer than one in five women have ever experienced child loss. Conversely, in numerous other regions, more than one-third of women have

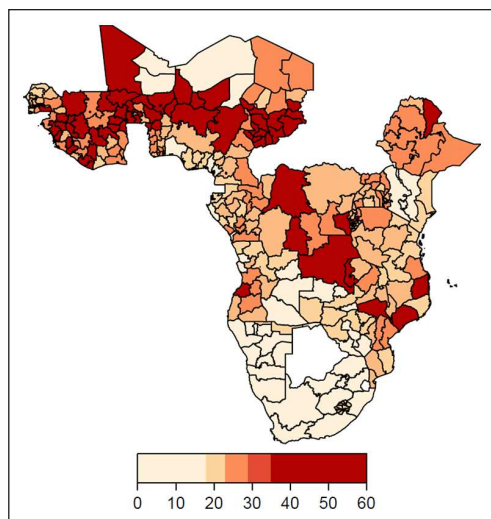


Figure 2. Contextual Inequality in Burden of Child Loss in 345 Subnational Regions in 32 Sub-Saharan African Countries.

Note: Estimates based on Demographic and Health Survey (DHS) Program data. The figure presents the percentage of all mothers in the subnational region that have experienced an under-five child death for 324 regions. The analysis, however, uses 345 regions because subnational boundaries of Tanzania (2015–2016) are provided by the DHS Spatial Data Repository on nine zones, but 30 regions are coded in the DHS recode file. The detailed boundaries of the 30 regions, nested within the nine zones, can be found in Tanzania 2015–2016 DHS and Malaria Indicators Survey (MIS) country report.

experienced child loss, with nearly one-half of women bereaved, on average.

Intergenerational Transmission of Maternal Bereavement

To examine inequalities in women's probability of child loss by their mothers' background and to examine potential moderation by women's educational attainment, we turn to the results of our multilevel discrete-time hazard models, shown in Table 2. Model 1 affirms the intergenerational association in maternal bereavement, as documented by past research: Women with bereaved mothers have 24% higher odds of experiencing the death of an under-five child relative to women who do not have bereaved mothers net of sociodemographic controls.

To depict the magnitude of this inequality over women's reproductive lives, Figure 3 plots the covariate-adjusted predicted conditional probabilities of child

loss, disaggregated by their mothers' history of bereavement. Again, the probabilities express the likelihood of the event in each discrete time interval, conditional on the event had not already occurred. At each year following women's first birth, respondents with bereaved mothers have a significantly higher conditional probability of child loss relative to women who do not have a bereaved mother, demonstrating the intergenerational transmission in maternal bereavement—an extreme form of health disadvantage. Although the differences between the predicted conditional probabilities are <2 percentage points in any single year, they sum to sizeable total inequalities over women's reproductive lives. That is, summing these inequalities over the full observation period, women with bereaved mothers have an 8 percentage point higher probability of child death relative to women without bereaved mothers (45% adjusted cumulative probability for women with bereaved mothers vs. 37% among women without bereaved mothers). Having a bereaved mother thus corresponds with an approximately 22% increase in the adjusted cumulative probability (.45/.37) of experiencing a child's death, emphasizing the need to understand whether modifiable resources, like education, can offset this disparity.

Returning to Table 2, Model 1 shows the strong, negative association between women's years of education and their odds of child loss, contrasting the elevated risk of child loss that corresponds with having a bereaved mother. Each year of women's education corresponds with 4% lower odds that women experience child loss. This countervailing association raises questions of whether the protective nature of women's education also neutralizes the outsized risk of bereavement among women with bereaved mothers, thus curtailing the transmission of child loss from one generation to the next. To test this, Model 2 includes an interaction term between mothers' bereavement and women's educational attainment, which is negative and statistically significant.

Given the well-known issues of interpreting interaction results in logistic regression models (Long and Mustillo 2021), we again calculate adjusted predicted conditional probabilities by mothers' bereavement status and educational attainment. Extending Figure 3's depiction of the adjusted predicted conditional probabilities of child loss among women by their mothers' history of bereavement, Figure 4 regraphs these probabilities separately for women with no years of education versus those with ≥ 8 years of education. As shown in the

Table 2. Multilevel Discrete-Time Hazard Model Results of Women's Hazard of Child Loss.

	Hazard-odds ratios (95% confidence interval)		
	Model 1	Model 2	Model 3
Maternal bereavement	1.24 (1.20, 1.27)	1.26 (1.22, 1.31)	1.35 (1.20, 1.52)
Women's education (in years)	.96 (.96, .96)	.96 (.96, .97)	.96 (.95, .97)
Women's education × Maternal bereavement history		.99 (.98, .99)	1.01 (.99, 1.03)
Women's education × Maternal bereavement history × Child mortality context			
% Women bereaved in subnational region			1.03 (1.03, 1.04)
Maternal bereavement × % women bereaved			.99 (.99, 1.00)
Women's education × % women bereaved			1.00 (.99, 1.00)
Women's education × Maternal bereavement × % women bereaved			.99 (.99, .99)
Controls			
1990s cohort (reference = 1980s)	.67 (.65, .69)	.67 (.65, .69)	.67 (.65, .69)
Age at first birth	.93 (.92, .93)	.93 (.92, .93)	.93 (.92, .93)
Total number of births (time variant, by time at risk)	1.57 (1.54, 1.59)	1.57 (1.54, 1.59)	1.57 (1.54, 1.59)
Marital status (reference = never in union)			
Married/living together	1.41 (1.32, 1.51)	1.41 (1.32, 1.51)	1.40 (1.31, 1.50)
Divorced/separated/widowed	1.49 (1.38, 1.61)	1.49 (1.38, 1.61)	1.48 (1.37, 1.59)
Number of siblings before first birth	1.01 (1.00, 1.02)	1.01 (1.00, 1.02)	1.01 (1.00, 1.01)
Birth order	.99 (.98, .99)	.99 (.98, .99)	.99 (.98, .99)
Household wealth index (reference = poorest)			
Poor	.97 (.94, 1.00)	.97 (.94, 1.00)	.97 (.94, 1.01)
Middle	.89 (.86, .93)	.89 (.86, .93)	.89 (.86, .92)
Rich	.82 (.79, .85)	.82 (.79, .85)	.81 (.78, .85)
Richest	.68 (.64, .72)	.68 (.64, .72)	.67 (.64, .71)
Urban residence (reference = rural)	.93 (.90, .96)	.93 (.90, .96)	.94 (.91, .97)
% Rich households	.99 (.99, 1.00)	.99 (.99, 1.00)	1.00 (1.00, 1.00)
Years since first birth (dummy variables)	Included	Included	Included
σ Subnational region	.25 (.23, .28)	.25 (.23, .28)	.09 (.08, .11)
ICC	.02	.02	.02
Country-level fixed effects	Included	Included	Included
Model fit (Wald χ^2)	10,467.81***	10,486.75***	12,690.92***

Note: Estimates modeled using the logit function. Results based on Demographic and Health Survey Program data on 195,744 women in 345 subnational regions in 32 sub-Saharan African countries who contributed 1,443,928 person-years of data to the models. All models control for country-level fixed effects and time at risk (years since first birth; coefficients not shown). ICC = intraclass correlation coefficient.

*** $p < .001$.

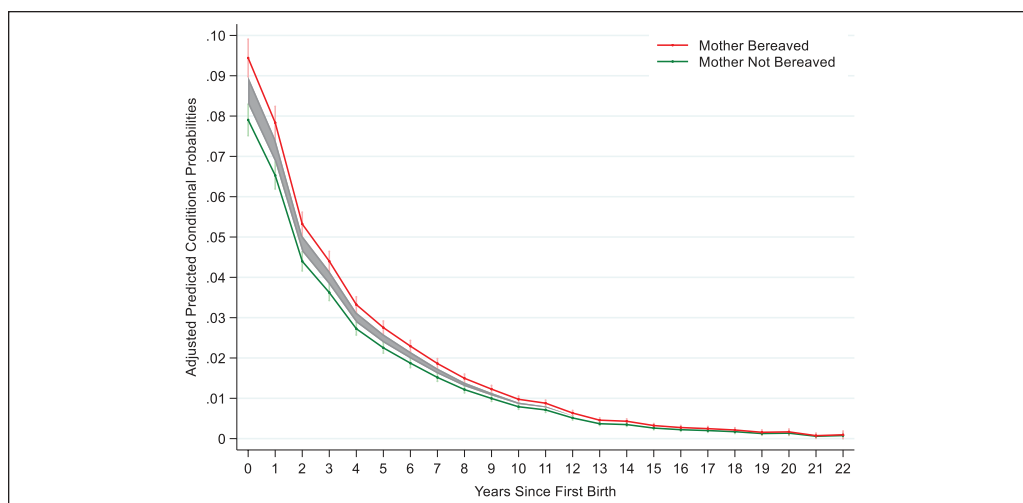


Figure 3. Predicted Conditional Probabilities of Child Loss over Women's Reproductive Years, by Their Mothers' History of Bereavement.

Note: Estimates based on Demographic and Health Survey Program data on 195,744 women in 345 subnational regions in 32 sub-Saharan African countries. The gray area represents the total difference in the conditional probabilities of child loss by mothers' bereavement status over their reproductive lives. Results produced using the *margins* postestimation command in Stata, adjusting for all covariates shown in Model 1 of Table 2.

left panel, among women with no formal education, the results produce an exaggerated portrait of inequality in the probability of child loss by mothers' bereavement history. Again, although the differences between the adjusted conditional probabilities in the risk of child loss are <3 percentage points at any given year, they accumulate to represent notable inequalities over women's reproductive lives. Specifically, among women with no formal education, inequalities in the adjusted conditional probabilities total to an 11 percentage point higher probability of child death for women with bereaved mothers (cumulative adjusted probability = .39) versus those without bereaved mothers (cumulative adjusted probability = .50). This means that for the least educated women, having a bereaved mother corresponds with an approximately 28% increase in the adjusted cumulative probability (.50/.39) of experiencing a child's death.

A Wald test confirms that these differences in the conditional probabilities by mothers' bereavement status are significantly different than those observed for women with ≥ 8 years of school ($p < .001$).¹⁰ As shown in the right panel of Figure 4, the inequalities by mothers' bereavement status are dramatically smaller for women with ≥ 8 years of education. The observed differences in the adjusted conditional probabilities sum to a total difference of only 4 percentage points—more than a halving in

the difference by mothers' bereavement history relative to that observed among women with no formal education. Additional analyses demonstrate that among women with 10+ years of education, which constitutes 15% of the sample, the inequality by mothers' bereavement history become statistically indistinguishable at every year following women's first birth (results not shown but available on request).

The intersecting influence of women's family background and social resources on their likelihood of maternal bereavement could present dissimilarly across diverse mortality landscapes. Thus, to test the universality of these patterns, Model 3 in Table 2 includes a three-way interaction between mothers' bereavement history, educational attainment, and the mortality context in which women are navigating motherhood.

To illustrate the interaction, Figure 5 replicates Figure 4 but further plots the inequalities for women living in the lowest and highest mortality-burden contexts. Overall, Figure 5 demonstrates that the intergenerational transmission of bereavement observed among educationally disadvantaged mothers is present in high-mortality settings but not low-mortality ones.

Beginning with the top panel of Figure 5, in subnational regions with the lowest child mortality burden (where one in five or fewer mothers have

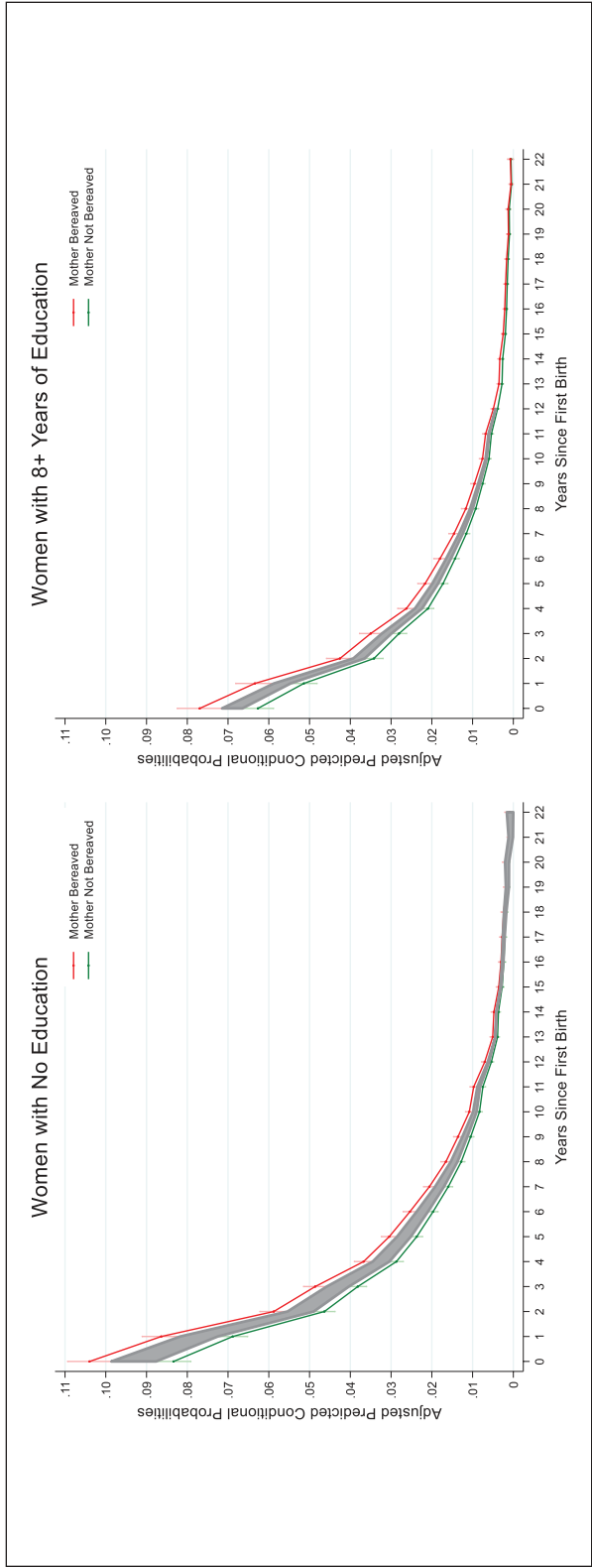


Figure 4. Predicted Conditional Probabilities of Child Loss for Women with No Formal Education versus Those with 8+ Years of Education, by Their Mothers' History of Bereavement.

Note: Estimates based on Demographic and Health Survey Program data on 195,744 women in 32 sub-Saharan African countries. Results produced using the *margins* postestimation command in Stata, adjusting for all covariates shown in Model 2 of Table 2. The gray area represents the total difference in the conditional probabilities of child loss by mothers' bereavement status over their reproductive lives. A Wald test confirms the size of the differences shown in the two panels are significantly different ($p < .05$).

experienced a child die), the inequality in the probability of child loss by mothers' bereavement history is nonsignificant—regardless of women's education. In no single year interval are the differences by mothers' bereavement status significant for women with no school or for their peers with ≥ 8 years of schooling. Moreover, a Wald test confirms that the differences (or lack thereof) depicted in the two top panels of Figure 5 are not significantly different than one another ($p < .05$). Together, the lower probability of child loss for all women, regardless of family background or educational level, suggests that all women benefit from living in a lower mortality environment.

The bottom panel of Figure 5 focuses on women living in subnational regions with the highest child mortality burden (where one-third or more of mothers have experienced a child die). In these high-mortality-burdened subnational regions, the inequality by mothers' bereavement history for the least educated women is notable. As shown in the bottom left panel of Figure 5, in these contexts, women with bereaved mothers have a 15 percentage point higher probability of child loss relative to their peers. A Wald test confirms that this inequality is significantly different from the nonsignificant inequality in the probability of child loss by mothers' bereavement status among women with ≥ 8 years of education ($p < .05$). Together, these results suggest that in higher-mortality-burdened contexts, a disadvantaged family background combined with their educational disadvantage can leave women at especially high risk of bereavement.

Supplementary Analyses

The intergenerational association in bereavement raises questions of the possible relevance of educational transmission as a driver: It is plausible that the intergenerational association in health disadvantage is simply approximating the intergenerational association in educational (dis)advantage. Thus, in supplementary analyses, we examine the stability of the results to the inclusion of women's mothers' education. Because we lack education data on women's mothers among the full sample, we used demographic and relational data collected on household members of the focal women to identify the subsample living with their mothers and thus for whom we have education data.¹¹ In total, 11% of the sample ($N = 20,761$) of focal women lived with their mothers at the time of interview, allowing us to reestimate models while controlling for mothers' education. As shown in Model 1 of Appendix E in the

online version of the article, the discrete-time hazard model results confirm the intergenerational persistence of child loss (hazard-odds ratio = 1.32) even after accounting for both women's and their mothers' education—with the latter not significantly associated with women's hazard of child loss. Indeed, among this subsample, the association between mothers' bereavement history and women's hazard of child loss is larger in magnitude—presumably due to the shared social, economic, and behavioral factors that correspond with their shared residence. Model 2 of Appendix E in the online version of the article offers no evidence that mothers' education moderates the intergenerational association—a finding that persists across diverse mortality environments (Model 3) and is robust to our calculating adjusted predicted conditional probabilities as analogous to those shown in Figures 3 through Figure 5.

DISCUSSION

Extensive research on the intergenerational transmission of social and health (dis)advantages demonstrates the instrumental role of education in the reproduction of inequalities across generations. Here, we extend these models to study the potential moderating influence of education. We asked whether education neutralizes the replication of disadvantage between mothers and adult daughters, focusing on the case of maternal bereavement—an extreme indicator of health disadvantage that a large share of women continue to endure in contemporary low-income countries. We also examined if any equalizing effect of education is universal across Africa's highly dissimilar mortality landscapes: Is the health mobilizing potential of women's education concentrated in the most threatening mortality environments where the risk of child death is endemic?

Our results echo emerging evidence that having a bereaved mother corresponds with women's higher risk of enduring a child's death: Across 32 countries in Africa, having a bereaved mother corresponds with an 8 percentage point higher probability of child loss relative to women whose mothers never experienced a child's death. Amid the already high probability of child death experienced by all women, this amounts to a 22% increase in women's probability of child death over their reproductive lives. Yet women's education can act as an important equalizer, disrupting the salience of women's family history for their—and their children's—future health experiences. Of note, however, is that only at the highest levels of educational attainment, upward of 10+ years of schooling, does

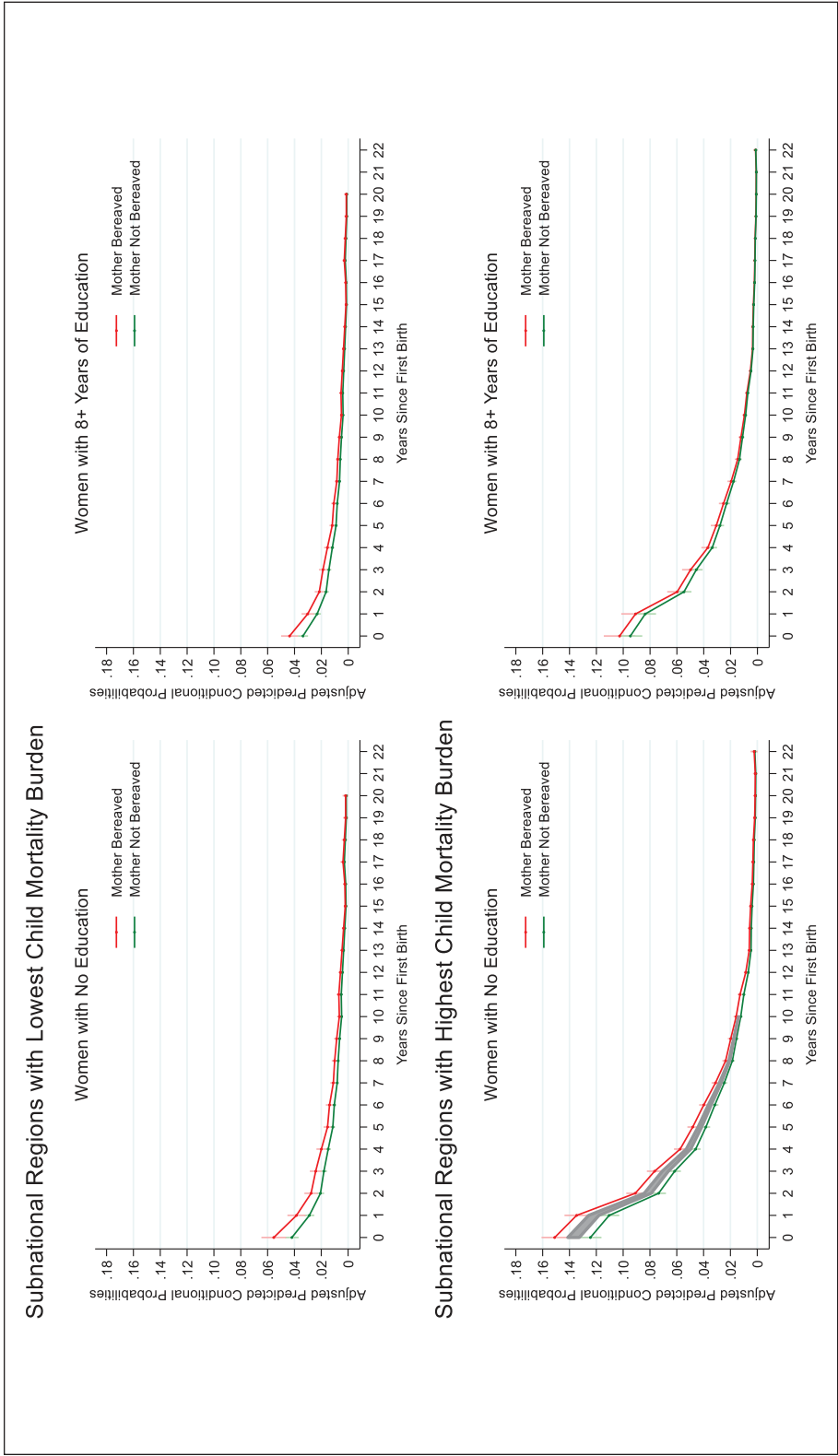


Figure 5. Predicted Conditional Probabilities of Child Loss for Women with No Formal Education versus 8+ Years of Education, by Their Mothers' History of Bereavement and Mortality Context.

Note: Estimates based on Demographic and Health Survey Program data on 195,744 women in 345 subnational regions in 32 sub-Saharan African countries. Results produced using the *margins* postestimation command in Stata, adjusting for all covariates shown in Model 3 of Table 2. The gray area represents the total difference in the conditional probabilities of child loss by mothers' bereavement status over their reproductive lives. A Wald test confirms the differences shown in the bottom panels are significantly different ($p < .05$); the differences in the probabilities shown in the top panels are not statistically different.

the intergenerational transmission of maternal bereavement become nonsignificant. Even so, each year of education significantly reduces the salience of women's family background, emphasizing its neutralizing force even at low levels of schooling.

Although education can neutralize the salience of women's family background, there is some indication that its potential to do so is heightened in especially threatening mortality contexts. In the highest mortality settings, the least educated women are particularly susceptible to reliving their mothers' reproductive disadvantage. In the lowest mortality-burden contexts, however, inequalities in child loss by mothers' background and education are nonsignificant.

Due to data limitations, our study is unable to resolve questions of *how* women's education lessens the vertical clustering of child loss. We are thus unable to test the relative influence of the specific mechanisms that we propose here, leaving questions about the relative influence of socioeconomic resources, fertility, and health behaviors open for future investigation. Although the social patterning of under-five mortality as a mostly preventable form of health inequality leads us to believe the results are driven by social mechanisms, epigenetic factors could, presumably, play a role.

Indeed, the generational correlations could be causal in nature, driven by the fact that having a bereaved mother—and having experienced a sibling's death—precipitates subsequent experiences in women's lives that ultimately put them at higher risk of losing a child. Education could be disrupting causal pathways linking child death across generations by providing individuals with the resources and capital to offset the subsidiary hardship that accompanies a sibling's death. Education generally smooths individuals' life paths, both by reducing their exposure to adversity and by increasing their access to resources to cope with adversities that do arise, such as a family member's premature death (Mirowsky and Ross 2007). Thus, it is possible that education helps women weather their mothers' bereavement—and their own sibling bereavement—and all that it portends for their own transition to adulthood. Future efforts to identify the mechanisms linking mothers' and daughters' experiences of child death and the potential for daughters' education to influence them will offer foundational insights into the long reach of a mother's bereavement.

Data constraints also mean that our study offers only a cross-sectional snapshot—a single window into the potential for education to break intergenerational cycles of disadvantage. Moreover, information was collected only from women, so the relative importance of transmission through men's and

women's lineages cannot be addressed—attesting to the value of future efforts to collect basic demographic data on both women's and men's family backgrounds.

In addition to the limited scope of the data that we analyze, the data may also be incomplete or biased. We make use of observational data reported by a single generation of women to understand processes across three generations, leaving open the possibility of reporting error. Of particular concern is that women underreport their deceased children. This possibility has long vexed demographers interested in child mortality. There is some supposition that the least educated women may be most inclined to omit reports of deceased children (Ware 1984). Such reporting error would mean that our estimates of the levels of bereavement and the protective influence of women's education are conservative.

There is also the potential for women to underreport their mothers' bereavement. Such omissions may not result from women's conscious desire to conceal a death but because they are simply unaware of the death. If that is the case, we suspect such underreporting is likely to be random or potentially skewed to less advantaged women who are more likely to have prematurely deceased mothers, come from large families, and be of higher birth order—each of which may decrease the likelihood that they learned of their mothers' history of child loss. Systematic unawareness of mothers' bereavement among less advantaged women—who are more likely to have experienced a child die themselves—would similarly lead to more conservative results. Of course, it is also possible that if women do consciously omit reports of deceased siblings just as they underreport their deceased children because of feelings of shame or embarrassment, not wanting to talk about the deceased, or simply wanting to hurry the interview along, the same women would be prone to underreporting deceased siblings and children. This would underestimate the level of bereavement but would not bias the key association of interest.

Limitations notwithstanding, the results attest to the stubbornly persistent nature of the reproduction of social and health disadvantage yet also suggest that education has the potential to detach women's maternal experiences from their social origin, significantly weakening intergenerational patterns of health inequality. Improving women's education can help them defy the odds they will lose a child and can loosen the intergenerational cycle of bereavement—especially in the high-mortality-burdened pockets of Africa where this adversity continues to plague many families. As such, intergenerational processes remain a critical component

of health disparities that fundamentally colors women's experiences as mothers, yet education represents an important, countervailing axis.

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SUPPLEMENTAL MATERIAL

Appendices A through E are available in the online version of the article.

NOTES

1. The DHS administered the sibship module to one-half of sampled women in the Kenya (2014) survey; hence, only these women are included here. The DHS collected other data among all women, so we included all women in the generation of contextual variables.
2. Among ever-bereaved women, 94% experienced a child die before age five. Among women with ever-bereaved mothers, 59% experienced a child die before age five. In supplementary analyses, we modeled whether the focal woman's mother was ever bereaved by a child's death at any age and whether the focal woman ever experienced any child death regardless of the child's age. The findings are comparable given that the majority of "any child deaths" are under-five deaths.
3. A mere 4% of bereaved mothers had an under-five child die after the focal woman's first birth.
4. Given that more highly educated women may disproportionately have well-resourced, never-bereaved mothers, there could be few women who both experienced a sibling die and achieved very high levels of education, complicating our ability to understand if the latter lessens the consequences of the former. Appendix B in the online version of the article shows that we do not observe this in our data. In most countries, the difference in women's average educational attainment by their mother's bereavement history is a fraction of a year.
5. A principal component factor analysis of a household's ownership of assets (e.g., radio, television, refrigerator, bicycle, car) and housing characteristics (e.g., availability of electricity, source of drinking water, type of toilet facility, number of rooms) is the basis for categorizing households into five wealth quintiles: poorest, poorer, middle, richer, and richest (Filmer and Pritchett 2001).
6. Women do not exit the hazard at five years following their first birth given that almost all women have additional, higher order births, meaning that even if women's first child did not die within the first five years of their life/the mothers' time as a mother, many women experienced second-, third-, or fourth-born children subsequently die years later. Given mothers' risk of bereavement is highly dependent on their number and spacing of children, as noted, all models include a time-varying covariate of women's number of children.
7. In supplementary analyses, we tested for whether letting covariates vary by time produced significant differences or improved model fit; we found no evidence of violation of the proportional odds assumption, hence our modeling direct associations.
8. Appendix C in the online version of the article demonstrates the differential levels of child loss at the time of the survey as a function of mothers' bereavement history. A consistently higher percentage of women with bereaved mothers have ever experienced child loss relative to those whose mother has no history of child death.
9. Appendix D in the online version of the article provides descriptive statistics disaggregated by whether the focal woman has a bereaved mother, attesting to the need to include controls when studying intergenerational linkages.
10. Additional analyses and Wald tests confirm that the differences in the conditional probabilities by mothers' bereavement status are even significantly different when comparing women with no formal education to those with merely 1+ years of school—attesting to the potential for education to significantly mute intergenerational inequalities.
11. We make these linkages by identifying the focal woman's mother in the household member data files. We code a person as the focal respondent's mother if (1) she is the head and the focal woman is listed as her daughter, (2) the focal woman is the head and she is listed as the head's female parent, or (3) she is the wife of the head, who is listed as the focal respondent's father. We do not make linkages via the focal respondent's father in the case of multiple wives given that we are unable to identify which co-wife is related to the focal respondent.

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