Trends in Sibling Mortality in Low- and Middle-Income Countries

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Introduction

Over the past several decades, substantial progress has been made in reducing child mortality globally. Recent data shows that the number of child deaths (under age 5) has declined from 12.8 million in 1990 to 5.0 million in 2021 (UN Inter-agency Group for Child Mortality Estimation 2023). However, 99% of these deaths still occur in LMICs, with the highest concentrations in sub-Saharan Africa and South Asia (UN Inter-agency Group for Child Mortality Estimation 2023). Children in low-income countries (LICs) are 15 times more likely to die before the age of five compared to their peers in high-income countries (HICs) (Sharrow et al. 2022). While under-five mortality has received considerable attention, mortality among older children, adolescents, and youth (5-24 years) remains a pressing concern, particularly in LICs where rates are several times higher than in HICs (United Nations Inter-agency Group for Child Mortality Estimation 2023). Historically, communicable and infectious diseases were the leading causes of death, but there has been a growing shift toward non-communicable diseases and external causes, such as accidents, violence, and suicide (World Bank 2014).

In LMICs, where elevated child mortality rates make sibling death a common experience, research on sibling mortality during childhood and early adulthood remains scarce. A key exception is a study by Smith-Greenaway and Weitzman, which used women's retrospective reports of sibling deaths from the Demographic and Health Surveys (Smith-Greenaway and Weitzman 2020) to provide the first prevalence estimates of sibling mortality across 43 lower-income countries. This study estimated that nearly one-third of young women born between 1985 and 2003 reported the death of a sibling before age 25. While this research is a critical starting point for understanding the magnitude of sibling mortality in LMICs, these estimates likely understate the true prevalence, as some women may be unaware of deaths that occurred before their own birth or early in their childhood. In addition, this study does not capture trends over time. This is particularly important given demographic shifts toward lower fertility and smaller family sizes, which may influence the prevalence and consequences of sibling death.

Most of our understanding of the effects of sibling mortality stems from research conducted in HICs, where such events are relatively rare. These studies have shown that sibling loss can lead to a range of adverse outcomes, including negative effects on cognitive, psychological, and physical health, disruptions in schooling, and an increased risk of teenage pregnancy (Bolton et al. 2016; Fletcher et al. 2013; Fletcher, Vidal-Fernandez, and Wolfe 2018). Long-term impacts are also significant, with adults who lose a sibling during childhood more likely to face challenges such as reduced earning potential, greater reliance on social assistance, higher rates of psychiatric institutionalization, and elevated mortality compared to those who have not experienced such a loss (Fletcher et al. 2013; Rostila et al. 2019; Yu et al. 2017).

Given the lack of empirical research on sibling mortality in LMICs, this project seeks to address this gap in the literature. Drawing on data from the Demographic and Health Surveys and Multiple Indicator Cluster Surveys (MICS), we aim to provide a comprehensive portrait of

sibling mortality in 39 LMICs. Focusing on cohorts born between the 1970s and 2000s, we will explore trends in the prevalence of sibling deaths, estimate the likelihood of experiencing such a loss before age 25, and develop sociodemographic profiles of both bereaved and deceased siblings. A deeper understanding of the prevalence, timing, and evolution of sibling mortality in LMICs is important for informing programs and policies designed to mitigate the negative consequences of sibling death on children's well-being and future prospects.

Proposed Data and Methods

This study uses data from the DHS and MICS to examine patterns of sibling mortality during childhood and early adulthood in LMICs. Both the DHS and MICS are nationally representative, household-level surveys that employ a two-stage sampling design in which clusters are selected first, followed by individual households within those clusters. In each household, the head of the household reports on characteristics of the household, as well as its members. This data is then used to identify women of reproductive age (15-49 years) who are eligible to participate in the individual questionnaire.

Since the 1980s and 1990s, the DHS and MICS have been conducted in 91 and 123 LMICs, respectively, with most countries participating in multiple rounds at five-year intervals. This study focuses on 39 countries selected based on data availability for cohorts born between the 1970s and 2000s (Appendix 1). These countries span low- , lower-middle-, and upper-middle-income classifications and represent all regions where LMICs are located. The survey data were collected between 1986 and 2023, with a median duration of 27 years across the countries in our sample. We will analyze data from both household and individual women's questionnaires, applying survey weights to produce nationally representative estimates.

The analytic sample will consist of children listed in women's birth histories who were born between 1970 and 2009, grouped into 10-year birth cohorts (1970s, 1980s, 1990s, 2000s). The birth histories provide information on both living children and those who have died. Birth and death dates will be used to determine whether a child has a deceased sibling and, if so, whether the sibling died before the focal child was born or during their lifetime. This analysis will focus on sibling deaths that occurred before a child turned age 25. We will compare these measures across cohorts to assess trends over time and determine whether sibling deaths are increasingly occurring during a child's lifetime.

To estimate the probability of experiencing sibling loss between birth and age 25, we will apply a hazard function, which accounts for right censoring (i.e., when a sibling death has not occurred by the time of the survey. A 'failure event' will be defined as the first sibling death during the child's lifetime. The dataset will be restructured so that each child contributes multiple person-years from birth until a sibling's death, their own death, or the survey date. All children listed in women's birth histories, including those who died before the survey, will be included in the analysis.

To develop comprehensive profiles of bereaved children and their deceased siblings, we will generate descriptive statistics for both groups by birth cohort. These statistics will include age, gender, birth order, and the total number of siblings at the time of the sibling's death. Given the rarity of experiencing more than three sibling deaths, profiles will be limited to the third death. Additionally, we will explore whether the nature of sibling mortality is shifting, particularly as its prevalence decreases and a larger share of deaths occur among older children

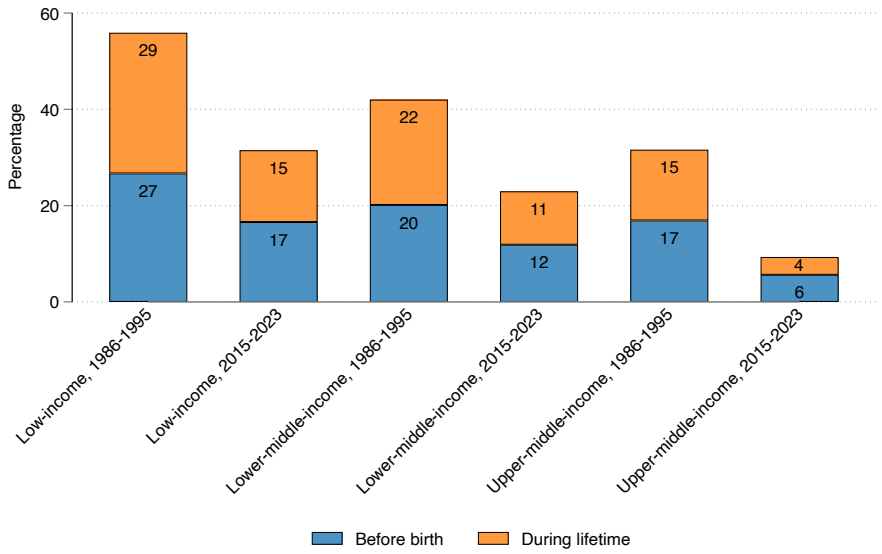
and adolescents. Specifically, we will analyze the number of children born after a sibling's death and calculate the mean number of siblings impacted by each mortality event. These analyses will be stratified by cohort, allowing us to examine how shifts in mortality and fertility are reshaping the dynamics of sibling mortality over time.

Preliminary Findings

In this extended abstract, we analyzed DHS data from 26 countries, collected between 1986 and 2023. Given the strong correlation between child mortality rates and World Bank income classifications, we categorized countries into three groups: low-income, lower-middle income, and upper-middle income. First, we calculated the prevalence of sibling death and the timing of these events (either before the focal child's birth or during childhood) among children who were alive at the time of the survey. This analysis was conducted for two periods: the earliest surveys (1986-1995) and the most recent surveys (2015-2023).

As shown in Figure 1, in the earliest surveys, the prevalence of sibling death was highest in low-income countries (56%), followed by lower-middle-income (42%), and upper-middle-income countries (32%). In both low- and lower-middle-income countries, slightly more than half of sibling deaths occurred before the focal child was born, whereas in upper-middle-income countries, most occurred during the focal child's lifetime. In the most recent surveys, the prevalence of sibling mortality has decreased by approximately half across all income groups. Furthermore, we observe a shift in the timing of sibling deaths, with slightly more than half now occurring before the focal child was born across all income groups.

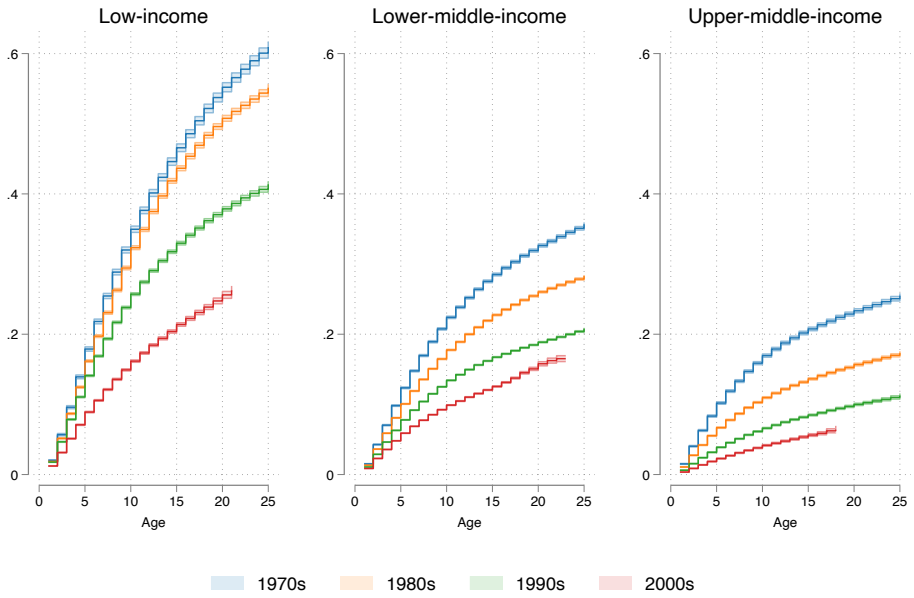
Figure 1. Prevalence and timing of sibling death by income group and survey year



Next, we applied hazard models to estimate the cumulative probability of experiencing sibling loss between birth and age 25. Our findings show that this probability is highest in low-income countries and lowest in upper-middle-income countries. For the 1970s birth cohort, children in low-income countries had a 60% probability of experiencing a sibling death by age 25, compared to 35% in lower-middle-income countries and 25% in upper-middle-income countries. These probabilities have declined across cohorts in all income groups. Among

children in the 2000s birth cohort, 25% in low-income countries, 15% in lower-middle-income countries, and fewer than 10% in upper-middle-income countries are expected to experience a sibling die by age 20.

Figure 2. Cumulative probability of experiencing sibling loss by birth cohort



Discussion and Next Steps

Our initial analyses indicate that sibling mortality remains a significant issue in LMICs, despite substantial declines over time. While the prevalence of sibling death has decreased substantially from the earliest to the most recent surveys, it remains particularly high in low-income countries, where approximately one-third of children and young adults (ages 0 to 24) alive at the time of the survey had at least one sibling who died. Importantly, we observe a shift in the timing of these deaths, with a growing proportion occurring before the focal child's birth rather than during their lifetime. In addition, we find that the cumulative probability of experiencing sibling loss has declined across birth cohorts. Nevertheless, sibling loss remains a prevalent event in low-income and lower-middle-income countries, where children still face a 15 to 25% probability of losing a sibling by age 20.

In the final version of our paper, we plan to expand the analysis by incorporating data from the MICS, allowing us to estimate sibling mortality across a broader range of countries. We will also generate estimates at the country level, as well as by region and income group. Additionally, as outlined in our methods section, we intend to create sociodemographic profiles of both bereaved and deceased siblings. This will allow us to explore shifting patterns in sibling mortality, such as whether losing a sibling during childhood, rather than before birth, is becoming more common across cohorts, and whether the number of siblings affected by each death is declining as fertility rates decrease. These findings will provide a deeper understanding of trends in sibling mortality, helping to inform the development of effective programs and policies aimed at supporting bereaved children and mitigating the adverse effects of sibling mortality on their well-being and future prospects.

References

Bolton, James M., Wendy Au, Dan Chateau, Randy Walld, William D. Leslie, Jessica Enns, Patricia J. Martens, Laurence Y. Katz, Sarvesh Logsetty, and Jitender Sareen. 2016. "Bereavement after Sibling Death: A Population-Based Longitudinal Case-Control Study." *World Psychiatry* 15(1):59–66. doi: 10.1002/wps.20293.

Fletcher, Jason, Marsha Mailick, Jieun Song, and Barbara Wolfe. 2013. "A Sibling Death in the Family: Common and Consequential." *Demography* 50(3):803–26. doi: 10.1007/s13524-012-0162-4.

Fletcher, Jason, Marian Vidal-Fernandez, and Barbara Wolfe. 2018. "Dynamic and Heterogeneous Effects of Sibling Death on Children's Outcomes." *Proceedings of the National Academy of Sciences* 115(1):115–20. doi: 10.1073/pnas.1709092115.

Rostila, Mikael, Lisa Berg, Jan Saarela, Ichiro Kawachi, and Anders Hjern. 2019. "Experience of Sibling Death in Childhood and Risk of Psychiatric Care in Adulthood: A National Cohort Study from Sweden." *European Child & Adolescent Psychiatry* 28(12):1581–88. doi: 10.1007/s00787-019-01324-6.

Sharrow, David, Lucia Hug, Danzhen You, Leontine Alkema, Robert Black, Simon Cousens, Trevor Croft, Victor Gaigbe-Togbe, Patrick Gerland, Michel Guillot, Kenneth Hill, Bruno Masquelier, Colin Mathers, Jon Pedersen, Kathleen L. Strong, Emi Suzuki, Jon Wakefield, and Neff Walker. 2022. "Global, Regional, and National Trends in under-5 Mortality between 1990 and 2019 with Scenario-Based Projections until 2030: A Systematic Analysis by the UN Inter-Agency Group for Child Mortality Estimation." *The Lancet Global Health* 10(2):e195–206. doi: 10.1016/S2214-109X(21)00515-5.

Smith-Greenaway, Emily, and Abigail Weitzman. 2020. "Sibling Mortality Burden in Low-Income Countries: A Descriptive Analysis of Sibling Death in Africa, Asia, and Latin America and the Caribbean." *PLOS ONE* 15(10):e0236498. doi: 10.1371/journal.pone.0236498.

UN Inter-agency Group for Child Mortality Estimation. 2023. "UN IGME | Child Mortality Estimates."

United Nations Inter-agency Group for Child Mortality Estimation. 2023. *Levels & Trends in Child Mortality, Report 2022*. New York: UNICEF.

World Bank. 2014. *Health for the World's Adolescents: A Second Chance in the Second Decade*. Geneva: World Bank.

Yu, Yongfu, Zeyan Liew, Sven Cnattingius, Jørn Olsen, Mogens Vestergaard, Bo Fu, Erik Thorlund Parner, Guoyou Qin, Naiqing Zhao, and Jiong Li. 2017. "Association of Mortality with the Death of a Sibling in Childhood." *JAMA Pediatrics* 171(6):538–45. doi: 10.1001/jamapediatrics.2017.0197.

Appendix 1. Countries and survey years, Demographic and Health Surveys and Multiple Indicator Cluster Surveys

Country	Income Group	Region	Survey Years
Bangladesh	Lower-middle	South Asia	1993, 1996, 1999, 2004, 2007, 2011, 2014, 2017
Burkina Faso	Low	Sub-Saharan Africa	1993, 1996, 1998, 2003, 2006, 2010, 2021
Burundi	Low	Sub-Saharan Africa	1987, 1996, 2000, 2005, 2010, 2016
Cameroon	Lower-middle	Sub-Saharan Africa	1991, 1998, 2000, 2004, 2006, 2011, 2014, 2018
Central African Republic	Low	Sub-Saharan Africa	1994, 1996, 2000, 2006, 2010, 2018
Colombia	Upper-middle	Latin America and the Caribbean	1986, 1990, 1995, 2000, 2005, 2010, 2015
Côte d'Ivoire	Lower-middle	Sub-Saharan Africa	1994, 1996, 1998, 2000, 2006, 2011, 2016, 2021
DR Congo	Low	Sub-Saharan Africa	1995, 2001, 2007, 2010, 2013, 2017
Dominican Republic	Upper-middle	Latin America and the Caribbean	1986, 1991, 1996, 1999, 2000, 2002, 2007, 2013, 2014, 2019
Eswatini	Lower-middle	Sub-Saharan Africa	1995, 2000, 2006, 2010, 2014, 2021
Ethiopia	Low	Sub-Saharan Africa	1995, 2000, 2005, 2011, 2016
Ghana	Lower-middle	Sub-Saharan Africa	1988, 1993, 1995, 1998, 2003, 2006, 2008, 2011, 2014, 2017, 2022
Haiti	Lower-middle	Latin America and the Caribbean	1994, 2000, 2005, 2012, 2016
India	Lower-middle	South Asia	1992, 1995, 1998, 2000, 2005, 2015, 2019
Indonesia	Upper-middle	East Asia and Pacific	1987, 1991, 1994, 1996, 1997, 2002, 2007, 2012, 2017
Jordan	Lower-middle	Middle East and North Africa	1990, 1997, 2002, 2007, 2012, 2017
Kazakhstan	Upper-middle	Europe and Central Asia	1995, 1999, 2006, 2010, 2015
Kenya	Lower-middle	Sub-Saharan Africa	1989, 1993, 1998, 2000, 2003, 2008, 2014, 2022
Kyrgz Republic	Lower-middle	Europe and Central Asia	1995, 1997, 2005, 2012, 2014, 2018
Liberia	Low	Sub-Saharan Africa	1986, 1995, 2007, 2013, 2019
Madagascar	Low	Sub-Saharan Africa	1992, 1995, 1997, 2000, 2003, 2008, 2018, 2021
Malawi	Low	Sub-Saharan Africa	1992, 1995, 2000, 2004, 2006, 2010, 2013, 2015, 2019
Maldives	Upper-middle	South Asia	1995, 2001, 2009, 2016
Mali	Low	Sub-Saharan Africa	1987, 1995, 1996, 2001, 2006, 2009, 2012, 2015, 2018
Mauritania	Lower-middle	Sub-Saharan Africa	1995, 2007, 2011, 2015, 2019
Mexico	Upper-middle	Latin America and the Caribbean	1987, 2015
Mozambique	Low	Sub-Saharan Africa	1995, 1997, 2003, 2008, 2011, 2022
Mynanmar	Lower-middle	East Asia and Pacific	1995, 2000, 2009, 2015
Nigeria	Lower-middle	Sub-Saharan Africa	1990, 1999, 2003, 2007, 2008, 2013, 2016, 2018, 2021
Pakistan	Lower-middle	South Asia	1990, 1995, 2006, 2012, 2017
Philippines	Lower-middle	East Asia and Pacific	1993, 1998, 1999, 2003, 2008, 2013, 2017, 2022
Rwanda	Low	Sub-Saharan Africa	1992, 2000, 2005, 2010, 2014, 2019
Senegal	Lower-middle	Sub-Saharan Africa	1986, 1992, 1996, 1997, 1999, 2000, 2005, 2010, 2012, 2014, 2015, 2016, 2017, 2018, 2019, 2023
Sierra Leone	Low	Sub-Saharan Africa	1995, 2005, 2008, 2010, 2013, 2017, 2019
Tanzania	Lower-middle	Sub-Saharan Africa	1991, 1996, 1999, 2004, 2010, 2015, 2022
Turkey	Upper-middle	Europe and Central Asia	1993, 1998, 2003, 2008, 2013, 2018
Uganda	Low	Sub-Saharan Africa	1988, 1995, 2000, 2006, 2011, 2016
Zambia	Lower-middle	Sub-Saharan Africa	1992, 1996, 2001, 2007, 2013, 2018
Zimbabwe	Lower-middle	Sub-Saharan Africa	1988, 1994, 1999, 2005, 2010, 2015