

The Impact of Maternal Education on Late Childhood and Early Adolescent Mortality in 56 Countries: A Pooled Survival Analysis of Demographic and Health Survey Data from 2003 to 2016

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Background

Health during late childhood through early adolescence (here defined as ages 5-14) is an often-neglected topic in discussions on global health. This is despite the existence of large between-country variation in cause-specific mortality for this age group and the soaring population size of adolescents in most LMIC countries. Though this period is objectively the healthiest of our lives with a lower global rate of DALYs than all other age groups (Gore et al., 2011), large disparities remain as the rate of DALYs for 5-14 year olds in 2016 varies from 4,851.03 DALYs/100,000 in Singapore to 23,332.89 DALYs/100,000 in Central African Republic (GBD Compare Data Visualization).

Health during late childhood and early adolescence is critical to the accumulation of the human capital necessary to be a contributing citizen to nations' economies (Lim et al., in press; Lucas, 1988). Case et al. (2002) have found that income and health status in adulthood are predicated on socioeconomic factors experienced during childhood. Therefore, it is clear that intergenerational effects of socioeconomic status are mediated, to some extent, by health during schooling years. In order to break the educational equivalent to the cycle of poverty, understanding how parental socioeconomic factors affect health during this time is paramount.

Maternal education and other socioeconomic indicators are well-documented drivers of under-5 mortality (5q0) and infant mortality (1q0), and indeed the link between maternal education and 5q0 in particular has been replicated across a variety of settings and with many sources of data (Jamison et al., 1993). While numerous causal pathways have been proposed (outlined in Levine et al., 2012), there is still no consensus on the causal mechanism in question.

In contrast, there has been little to no research on the drivers of health during late childhood and early adolescence. Maternal education is more strongly correlated with mortality between ages 1 and 5 (4q1) than in 1q0, but it is unknown if this trend of increasing impact of maternal education continues past the age of 5. This study seeks to determine the association between maternal education and other parental and community socioeconomic characteristics and 5-14 mortality (10q5). Effect sizes will be compared with those for 1q0 and 4q1 to determine how the association between maternal education and mortality evolves with the age of the child. As one of the first inquiries of its type, this study seeks to confirm levels of association without implying causality, though we will speculate on potential mediators in our discussion.

Methods

The Demographic and Health Surveys (DHS) are nationally representative household surveys designed to measure a variety of population indicators. Included in most iterations of the surveys are complete birth history modules where surveyed mothers give an exhaustive history of all live births. While reliability of recall varies by country, the survey, due to its standardized survey process, remains a vital tool for making cross-country comparisons in areas with undeveloped vital registration systems.

This study used pooled complete birth histories data from 103 DHS for 56 countries conducted between 2003 and 2016 (table 1). This constitutes all available DHS surveys during this period that include the anthropometric data of the mothers and the DHS wealth indicator.

We operationalized maternal and paternal education as continuous variables bounded at 0 and 18 years of education. In an attempt to partially control for intergenerational effects of wealth, maternal height was used as a covariate under the assumption that a mother who was stunted came from a less-privileged background. It was operationalized as “ ≥ 160 cm,” “155-159.9 cm,” “150-154.9 cm,” “145-149.9 cm,” and “ < 145 cm” based off the precedent set in Finlay et al. (2011). Average community-level maternal education was the average education of all mothers surveyed in the primary sampling unit.

Using mixed effects Cox proportional hazards models, we analyzed the impact of community and household factors on under-1, 1-4, and 5-14 survival. Covariates included maternal education, paternal education, household wealth, urbanicity, average community-level maternal education, maternal height, birth year, and various interaction terms.

Relative risks for maternal education were formulated by sampling from the distributions of all beta coefficients for covariates and interaction terms related to maternal education. Paternal education estimates used were taken from the Global Burden of Disease and reflect the age-standardized average education of all men aged 15-99 (Gakidou et al., 2010). Baseline risk, which only affects interpretation, was set at 8 years of maternal education as it is a relatively achievable goal indicating almost 100% completion of primary and lower secondary education.

Findings [With tentative estimates]

Out of 1,942,408 live births who were still alive at age 5, 19,385 died before the age of 15. Maternal education persists as the most salient predictor of 10q5. In 1990, the RR of dying was 0.956 (0.932, 0.979) per year of maternal education. This is to say that the child of a mother with 2 years of education as compared to a mother with 8 years of education has an RR of dying of 1.298. while the child of a father with 2 years of education as compared to a father with 8 years of education has an RR of dying of 1.192. The effect of maternal education attenuates slightly through time such that a child born in 2000 has an RR of 1.286.

Average community maternal education was also highly associated with 10q5 as there was a 0.964 RR of dying per year of education. Both paternal and maternal education were slightly more protective in rural settings with an RR of 0.952 and 0.970 per 6 years of maternal and paternal education, respectively, for those children living in urban areas.

[in progress]

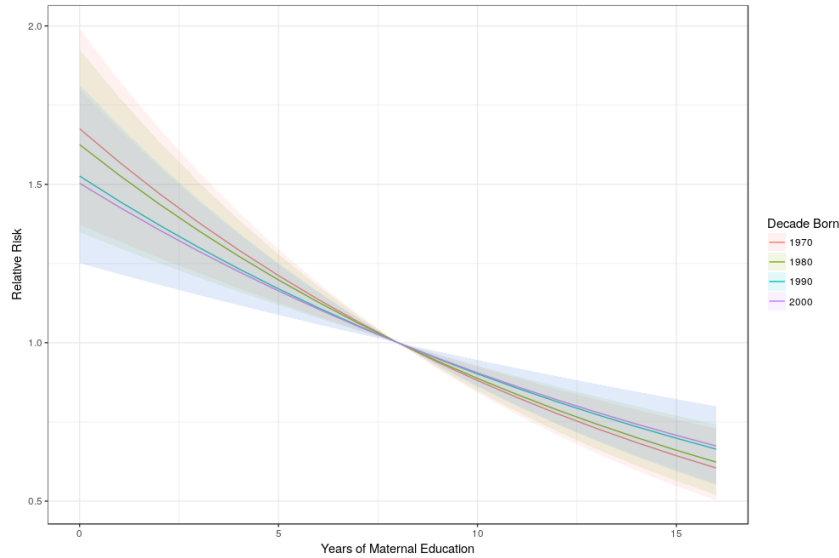


Figure 1. Relative Risk of Mortality for Ages 5-14 Based on Maternal Education, Disaggregated by Birth Year

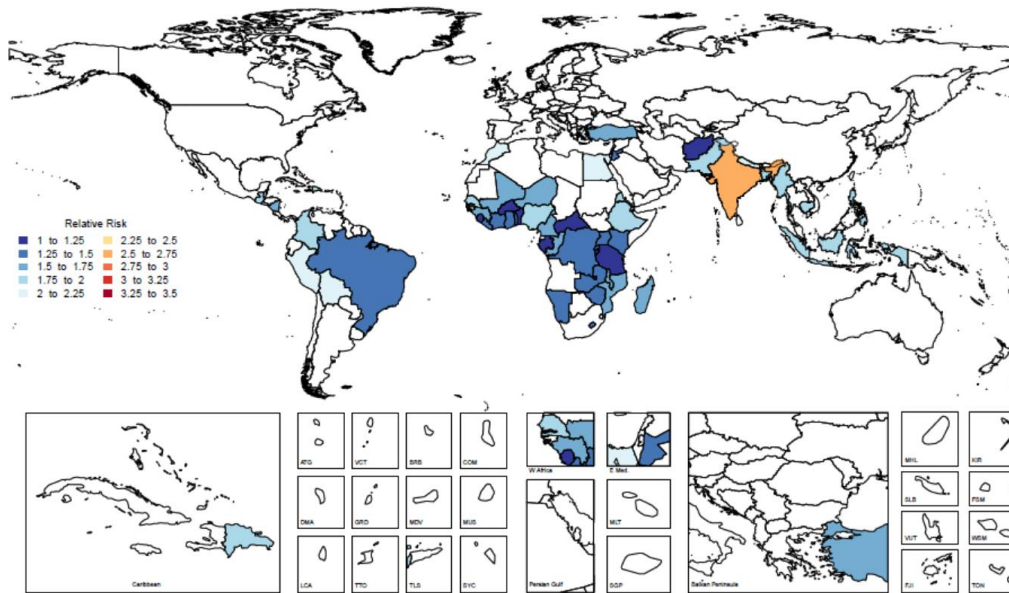


Figure 2. Relative Risks of 5-14 Mortality: 95th Percentile of Maternal Education per Country Compared to 0 Years of Maternal Education, 1990

Future Analyses

The completed version of this manuscript will include separate analyses for 1q0, 4q1, 5q5, 5q10, and 10q5. Preliminary results indicate that the effect of maternal education increases from 1q0 to 4q1 and to 5q10, but we would like to further break this down for 5-9 and 10-14 mortality. Additionally, it is possible to extract children's education from the DHS child health modules, but this has yet to be done. Final analyses will also control for children's relative amount of education as 5-15 year olds are accumulating their own capital during this time. We are excited

to explore the transition of parental social determinants to the child's own social determinants and the possible implications this carries for intergenerational inheritance of SES (i.e. how much is a child's education yoked to the parents' education?).

Interpretation

Despite the increase in independence that occurs throughout childhood and adolescence, adolescent health outcomes are still influenced by parental characteristics, with maternal education remaining the most important predictor. Community-level education, even when controlling for maternal and paternal education, is also significantly associated with survival to the age of 15. Which is consistent with Kravdal et al.'s 2004 study of the effects of community characteristics on child mortality, which supports the concept that decision-making and physical autonomy are linked to community level indicators.

Levine et al. (2012) posit that increased literacy could have led to increased uptake of public health interventions and utilization of health facilities. The most common causes of death in this age group in 2016 include malaria, intestinal infections, road injuries, and HIV/AIDS; and the most commonly attributed risks for deaths in this age group are unsafe water, sanitation, and handwashing, air pollution, and unsafe sex (GBD Compare Data Visualization). All these causes and risks are amenable to behavioral changes and have been the targets of many public health interventions to date whose uptake could have been influenced by maternal literacy and education.

The attenuation of the effect of maternal education across time is a promising indicator of reduction of health inequities, though this could be also symptomatic of the changing disease profiles of the countries in question. We suspect that as interventions have been implemented over the past three decades, the importance of maternal education has waned in the face of interventions being able to reach even those with the least education.

These findings should be interpreted with knowledge of the limitations of our analysis. Like all studies of DHS complete birth histories, the sample is limited to children of mothers who are still alive at the time of the interview, ergo those who did not die during or after childbirth. Further, these data are self-reported and are therefore subject to self-report bias. Education quality is also not captured in these estimates. Given some studies' reliance on literacy as a mediator for the effect of maternal education on childhood and adolescent mortality, future studies should incorporate some aspect of education quality in their analyses.

If adolescent mortality follows the precedent set by childhood mortality, the etiologies of the above phenomena will prove tremendously difficult to study with any rigor. Despite that, knowledge of socioeconomic precursors to 10q5 is crucial to pushing along research in the field and for providing actionable policy recommendations in the interim.

[In progress: Similar interpretations of 1q0, 4q1, 5q10, 5q5 to come, interpretations of impact of child's education to come]

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