Are tuition-free primary education policies associated with lower infant and neonatal mortality in low- and middle-income countries?

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ABSTRACT

Robust evidence from low- and middle-income countries (LMICs) suggests that maternal education is associated with better child health outcomes. However, whether or not policies aimed at increasing access to education, including tuition-free education policies, contribute to lower infant and neonatal mortality has not been empirically tested. We joined country-level data on national education policies for 37 LMICs to information on live births to young mothers aged 15–21 years, who were surveyed as part of the population-based Demographic and Health Surveys. We used propensity scores to match births to mothers who were exposed to a tuition-free primary education policy with births to mothers who were not, based on individual-level, household, and country-level characteristics, including GDP per capita, urbanization, and health expenditures per capita. Multilevel logistic regression models, fitted using generalized estimating equations, were used to estimate the effect of exposure to tuition-free primary education policies on the risk of infant and neonatal mortality. We also tested whether this effect was modified by household socioeconomic status. The propensity score matched samples for analyses of infant and neonatal mortality comprised 24,396 and 36,030 births, respectively, from 23 countries. Multilevel regression analyses showed that, on average, exposure to a tuition-free education policy was associated with 15 (95% CI = −32, 1) fewer infant and 5 (95% CI = −13, 4) fewer neonatal deaths per 1000 live births. We found no strong evidence of heterogeneity of this effect by socioeconomic level.

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1. Background

Reducing child mortality is a global health priority and one of the major health-related United Nations Millennium Development Goals. There are marked socioeconomic gradients in child health, with research consistently showing that children born into lower compared to higher SES households are more likely to experience neonatal (under 28 day), infant (under 1 year), and child (under 5 year) death (Bradley and Corwyn, 2002; Arntzen and Andersen, 2004; Finch, 2003; Hobcraft et al., 1984; Vapattanawong et al., 2007; Wang, 2003). Among socioeconomic indicators, maternal education may be particularly important for child health. Studies from high- and low-income countries show that maternal education is associated with increased birth weight, improved child nutrition, and increased likelihood of breastfeeding, which are in turn associated with lower child mortality and improved child health (Cochrane et al., 1982; Bicego and Ties Boerma, 1993; Caldwell and McDonald, 1982; Hobcraft, 1993; Boyle et al., 2006). A systematic examination of data from countries participating in the Demographic and Health Surveys (DHS) suggested that maternal education played a more important role in child survival than household earnings (Lutz and Samir, 2011). Recent work by Gakidou and colleagues estimated that over one-half of the 8.2 million fewer child deaths worldwide between 1970 and 2009 can be attributed to increases in maternal education (Gakidou et al., 2010).

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Several mechanisms might explain the relation between maternal education and improved child health in low- and middle-income countries (LMICs) (Cleland and Van Ginneken, 1988). First, maternal education predicts later age of marriage and first birth, increased use of modern contraception, greater birth spacing, and other reproductive health practices that are generally associated with child health and survival (Cleland and Van Ginneken, 1988; Ahmed et al., 2010; Raj et al., 2010). Second, maternal education is associated with increased utilization of healthcare, including preventative measures, such as antenatal care visits and vaccination, as well as curative services (Ahmed et al., 2010; Basu and Stephenson, 2005; Vissandjée et al., 1997; Ahmed et al., 2005). Third, better-educated mothers are more likely to engage in salutary behaviors associated with improved child nutrition and survival, such as breastfeeding (Basu and Stephenson, 2005). Finally, education and attendant socioeconomic advantages, including income, better housing, and access to clean water and sanitation, are another potential channel explaining improved child survival among mothers with greater educational attainment (Cleland and Van Ginneken, 1988; Frost et al., 2005).

A growing body of experimental research has examined the effects of programs for increasing education in LMICs. In general, studies supports the inference that reducing user fees makes schooling more financially feasible and increases enrollment (Kremer et al., 2013). For example, a program that provided financial support to poor mothers increased rates of secondary school enrollment, particularly for girls (Paul Schultz, 2004). However, whether programs that reduce out-of-pocket costs for schooling are also effective at improving birth outcomes among young mothers is unclear, in part because such research requires large sample sizes and longer periods of follow-up. Evaluating the effects of policies aimed at increasing schooling by making education more affordable, for example by abolishing tuition fees, can help to address this research gap. To the best of our knowledge, the association between tuition-free education policies and child health outcomes has not been empirically investigated in LMICs.

In this study we used cross-national data from the population-based DHS to answer two research questions. First, is the exposure of mothers to tuition-free education policies associated with a lower probability of infant and neonatal mortality? Second, does this association vary by household SES, thus suggesting differential policy impacts across population groups? Because policy data are limited for older cohorts, in these analyses we focus on the relation between tuition-free primary education policies and the risk of infant and neonatal death among young mothers aged 15–21 years. Further work should consider the effects of primary and secondary education policies among women in later childbearing years.

2. Materials and methods

2.1. Study design

This study was designed to estimate the effect of national-level tuition-free primary education policies on the risk of infant and neonatal death among live births to mothers residing in LMICs surveyed by the DHS between 2003 and 2011. We linked birth histories from mothers to information on whether public sector primary education was tuition-free when they would have been enrolled in primary school, based on the school structure in their country of residence. Because education policies are not randomly assigned to countries, births to mothers exposed to tuition-free primary education (exposed) and births to mothers exposed to tuition fees (unexposed) are unlikely to be comparable, introducing the potential for confounding of the effect of tuition-free policies on birth outcomes. We used propensity score matching methods to identify comparable groups, based on the distributions of measured characteristics hypothesized to confound the effect of tuition-free education policies on infant and neonatal mortality.

2.2. Participants

The DHS collect comparable information on demographic, socioeconomic, nutritional, behavioral, fertility and health characteristics from a nationally representative sample of households in LMICs using a two-stage cluster sampling design. Individuals are selected for interviews from the household roster; information is collected on women of reproductive age (15–49 years), men (usually aged 15–54 or 15–59), and children aged 0–59 months. Trained interviewers and standardized tools and measurement techniques are used to ensure comparability of surveys across countries and waves. Further details regarding sampling strategies and study procedures are available elsewhere (Rutstein and Rojas, 2006; Corsi et al., 2012).

Our target population included children born to mothers who were 15–21 years of age at the time of their interview between 2003 and 2011. We restricted our sample to live births among 15 to 21 year-old women because policy data was limited for older cohorts. In addition, including older cohorts of mothers in our sample might have increased error in the measurement of the exposure, as country-level data on education policies were less consistently reported in earlier years. After excluding those countries with missing information on tuition-free policies or for which policies were judged unclear or indeterminate, our sample consisted of 52,896 live births in 38 LMICs. We created separate samples for our analyses of infant and neonatal mortality, comprised of 34,740 and 52,048 live births that occurred at least one year and at least 28 days prior to the DHS interview date, respectively. From these samples we excluded observations with missing information on key covariates, resulting in a final sample of 33,735 births for analyses of infant mortality and 50,509 births for analyses of neonatal mortality in 37 countries. The Institutional Review Board of McGill University reviewed and approved this study.

2.3. Measures

The outcome variables, infant and neonatal mortality, were measured using the five-year birth histories provided by women interviewed in the DHS. We created binary indicators for infant and neonatal mortality to measure whether each child died before the age of 1 year or 28 days, respectively.

We assigned each live birth to the education policy that was in place when the child's mother, the respondent, would have been enrolled in primary school. We first characterized the school system in each country by collecting information on the legislated starting age and the durations of primary schooling in each country, available from the DHS. We then defined the interval during which the 15–21 year old respondents from each DHS country would have been exposed to the primary school system in each country, assuming respondents began school at the legislated starting age and completed school without repeating grades. Next, for each respondent we recorded whether primary education was tuition-free or not during this interval. Finally, for every individual we constructed a binary exposure variable indicating whether primary education was free or not during the interval when they would have been enrolled in primary school. Further details regarding the measurement of education policies are provided in eAppendix A.

We accounted for potential confounding by individual, household, and country-level covariates posited to influence exposure to tuition-free primary education and the risk of infant and neonatal death. Individual and household-level covariates included the