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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 gender of the infant, gender of the household head, education of the household head (if s/he completed primary school or not), urban/rural residence, and household SES. Household SES, split into quintiles for analysis, was measured using a wealth index provided by the DHS, which is based on ownership of specific assets (e.g., bicycle, radio and television), environmental conditions, and housing characteristics (e.g., type of water source, sanitation facilities, materials used for housing construction), and constructed using the method proposed by Filmer and Pritchett (Filmer and Pritchett, 2001, 1999). Country-level covariates included levels of economic development (measured by GDP per capita), percentage of the national population living in urban centres, and health expenditures per capita, available from the World Bank's World Development Indicators database. To ensure temporality, country-level information was measured for the year when each respondent was expected to enroll in primary school.

2.4. Statistical analyses

We used propensity scores methods to (i) achieve balance in the distributions of measured covariates between the exposed (births to mothers exposed to a tuition-free primary education policy) and unexposed and (ii) limit inference to regions of "common support", thereby avoiding extrapolation (King and Zeng, 2006; Stuart, 2010; Rosenbaum and Rubin, 1983). A propensity score for each live birth, representing the predicted probability of exposure as a function of the measured individual, household, and country-level covariates described above, including a quadratic term for GDP per capita to account for any nonlinear effects, was estimated using logistic regression models (separately for the infant and neonatal mortality samples). To ensure they were conditionally exchangeable, we used the estimated propensity scores to match exposed observations to their nearest unexposed neighbor, also known as 'nearest neighbor matching' (Rubin, 1973). We assessed several techniques, including matching with or without replacement, matching each exposed observation to one or greater than one control, and matching with or without a caliper, and selected the method—specifically 1:1 matching without replacement using a 33 percent caliper—that provided the best balance of measured covariates based on the standardized mean difference. Further information regarding the construction of the matched sample is provided in eAppendix B and eTable 1. We estimated the effect of the exposure on the risk of infant and neonatal mortality in the matched samples by regressing each outcome on the exposure using logistic models fitted with generalized estimating equations (GEE) to account for the clustering of observations within countries (Zeger and Liang, 1986). Results are presented on the absolute scale as risk differences. To examine whether the association between tuition-free primary education policies and the risk of infant and neonatal death varied by SES, we included cross-products between quintiles of SES and the exposure and calculated marginal effects for each SES group. A test of homogeneity was used to assess whether marginal effects varied across SES groups. Propensity score methods were conducted using the psmatch2 command in Stata. All statistical analyses were conducted using Stata version 12.1.

Table 1
Sample characteristics for the full sample and stratified by exposure to primary education policies; 37 LMICs included in the Demographic and Health Surveys (DHS), 2003–2011.

	Total		Primary education			
			Not free		Free	
Infant mortality sample	33,735		12,443 (36.9%)		21,292 (63.1%)	
Variables	Mean[a]	SD[b]	Mean	SD	Mean	SD
Death before age of 1 year (Yes = 1)	0.08	0.27	0.09	0.29	0.07	0.25
Gender of child (female = 1)	0.49	0.50	0.49	0.50	0.49	0.50
Urban residence (Yes = 1)	0.26	0.44	0.23	0.42	0.28	0.45
SES1: 1st (lowest) wealth quintile (Yes = 1)	0.26	0.44	0.26	0.44	0.26	0.44
SES2: 2nd wealth quintile (Yes = 1)	0.25	0.43	0.24	0.43	0.25	0.44
SES3: 3rd wealth quintile (Yes = 1)	0.22	0.41	0.21	0.41	0.22	0.42
SES4: 4th wealth quintile (Yes = 1)	0.17	0.37	0.18	0.38	0.16	0.37
SES5: 5th (highest) wealth quintile (Yes = 1)	0.10	0.30	0.11	0.31	0.10	0.30
Household head has completed primary education (Yes = 1)	0.27	0.45	0.20	0.40	0.31	0.46
Female household head (Yes = 1)	0.16	0.37	0.14	0.35	0.17	0.38
GDP per capita (PPP, constant 2005 USD)[c]	1.62	1.31	1.10	0.54	1.91	1.50
Percentage of population in urban centers[d]	3.12	1.52	2.73	0.91	3.33	1.72
Health expenditure per capita (PPP, constant 2005 USD)[e]	0.61	0.54	0.38	0.15	0.74	0.63
Neonatal mortality sample	50,509		18,493 (36.6%)		32,016 (63.4%)	
Variables	Mean	SD	Mean	SD	Mean	SD
Death before age of 1 month (Yes = 1)	0.04	0.20	0.05	0.21	0.04	0.19
Gender of child (female = 1)	0.49	0.50	0.49	0.50	0.49	0.50
Urban residence (Yes = 1)	0.27	0.44	0.24	0.43	0.28	0.45
SES1: 1st (lowest) wealth quintile (Yes = 1)	0.25	0.44	0.25	0.43	0.26	0.44
SES2: 2nd wealth quintile (Yes = 1)	0.25	0.43	0.24	0.43	0.25	0.43
SES3: 3rd wealth quintile (Yes = 1)	0.22	0.41	0.21	0.41	0.22	0.42
SES4: 4th wealth quintile (Yes = 1)	0.17	0.38	0.18	0.39	0.17	0.37
SES5: 5th (highest) wealth quintile (Yes = 1)	0.11	0.31	0.11	0.32	0.10	0.30
Household head has completed primary education (Yes = 1)	0.28	0.45	0.21	0.40	0.32	0.47
Female household head (Yes = 1)	0.16	0.37	0.15	0.35	0.17	0.38
GDP per capita (PPP, constant 2005 USD)[c]	1.63	1.32	1.10	0.55	1.92	1.51
Percentage of population in urban centers[d]	3.12	1.52	2.72	0.92	3.33	1.73
Health expenditure per capita (PPP, constant 2005 USD)[e]	0.62	0.54	0.38	0.15	0.75	0.63

[a] All means weighted by probability of selection weights.
[b] Standard deviation.
[c] GDP per capita is given in thousands.
[d] Percentages of population in urban centers are divided by 10.
[e] Health expenditures per capita are divided by 100.

2.5. Sensitivity analyses

We conducted several sensitivity analyses to tests the robustness of our main findings. First, we assessed whether additionally controlling for covariates in regression analyses using the matched sample influenced associations between exposure to tuition-free primary education policies and infant and neonatal mortality. Second, we compared measures of association in the propensity score matched sample ($N = 23$ countries) to those in the full unmatched sample ($N = 37$ countries). Third, we assessed whether controlling for a policy that made primary school compulsory when respondents would have started primary school influenced the association between tuition-free primary education policies and mortality.

3. Results

3.1. Descriptive statistics

Descriptive statistics for the full, unmatched infant and neonatal mortality samples are shown in Table 1. Approximately 63% of live births were to respondents exposed to a tuition-free education policy and the risks of infant and neonatal death were 8% and 4%, respectively. On average, infant and neonatal mortality were less common among respondents in countries with tuition-free policies compared to without (7% vs. 9% for infant mortality and 4% vs. 5% for neonatal mortality). There were, however, important differences in the balance of potentially confounding characteristics between exposure groups, particularly country-level covariates. Respondents exposed to tuition-free policies, relative to those unexposed to such policies, occurred in countries with higher levels of GDP per capita (about $1900 among the exposed compared to $1100 among the unexposed), urbanization (33% among the exposed compared to 27% among the unexposed), and health expenditures per capita (about $75 among the exposed compared to $38 among the unexposed).

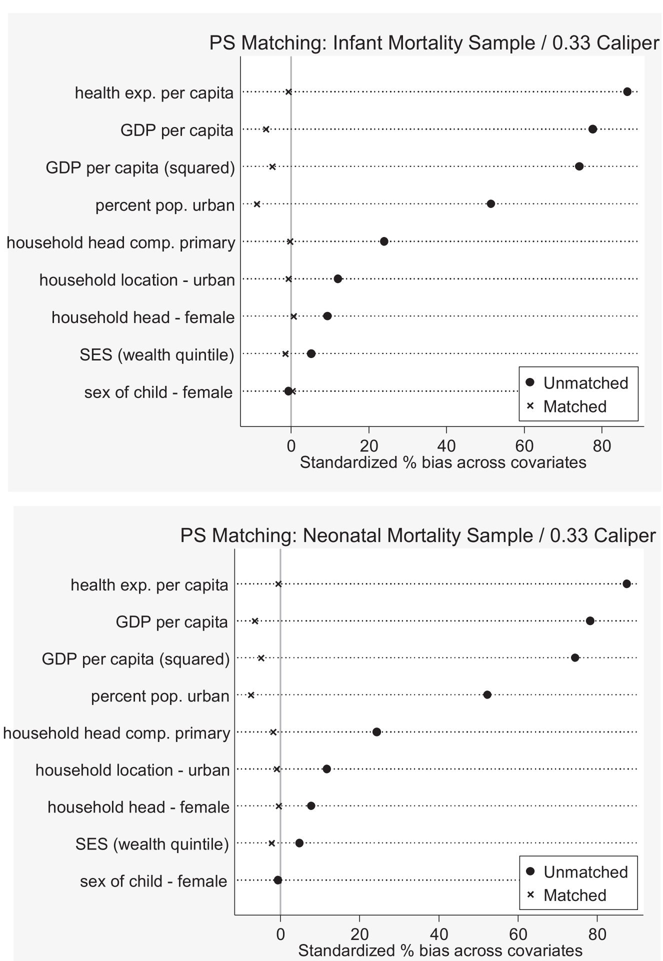

Fig. 1. Diagrams showing the standardized mean differences for each covariate before (solid circles) and after (cross-hatches) matching (1:1 nearest neighbor matching using a caliper of 0.33) in the infant mortality and neonatal mortality samples.

3.2. Matching

After matching on the propensity score, the infant and neonatal mortality samples were reduced to 24,396 and 36,030 births, respectively, from 23 countries (eTable 2). A comparison of the standardized mean differences before and after matching shows that matching on the propensity score substantially reduced imbalances in the distributions of measured confounders in the infant and neonatal mortality samples (Fig. 1). After matching, the distributions of propensity scores for the exposed and unexposed groups were similar, suggesting inference was being restricted to regions of common support (Fig. 2).

3.3. Main effect estimates

Exposure to a tuition-free primary education policy was associated with 15 [95% confidence interval (CI) = −32, 1] fewer infant and 5 (95% CI = −13, 4) fewer neonatal deaths per 1000 live births, in models adjusting for household SES (Table 2). There were pronounced socioeconomic inequalities in infant and neonatal mortality. Compared to the highest quintile of household SES, the lowest quintile was associated with 35 (95% CI = 24, 46) additional infant deaths and 14 (95% CI = 7, 21) additional neonatal deaths per 1000 live births.

3.4. Assessing effect modification by household SES

Tests of homogeneity indicated that the associations between exposure to tuition-free primary education policies and infant and neonatal mortality did not vary across SES groups (Table 3). However, there was a curvilinear trend and the associations were largest in magnitude for births in the middle of the socioeconomic gradient. For those in the third quintile of household SES, exposure to a tuition-free policy was associated with 23 (95% CI = −45, −1) fewer infant and 12 (95% CI = −25, 1) fewer neonatal deaths per 1000 live births.

3.5. Sensitivity analyses

First, additionally controlling for covariates in the matched sample using a variety of techniques did not appreciably alter our main effects estimates (eAppendix C and eTable 3). Second estimates of the effects of tuition-free education policy in the matched sample were comparable to those from the regression-adjusted unmatched sample (eTable 4). Third, as shown by Model 4 of eTable 4, additionally controlling for compulsory primary education policies attenuated estimates of the effect of tuition-free education policies; the exposure was associated with 7 (95% CI = −19, 6) fewer infant deaths and 2 (95% CI = −10, 5) fewer neonatal deaths per 1000 live births.

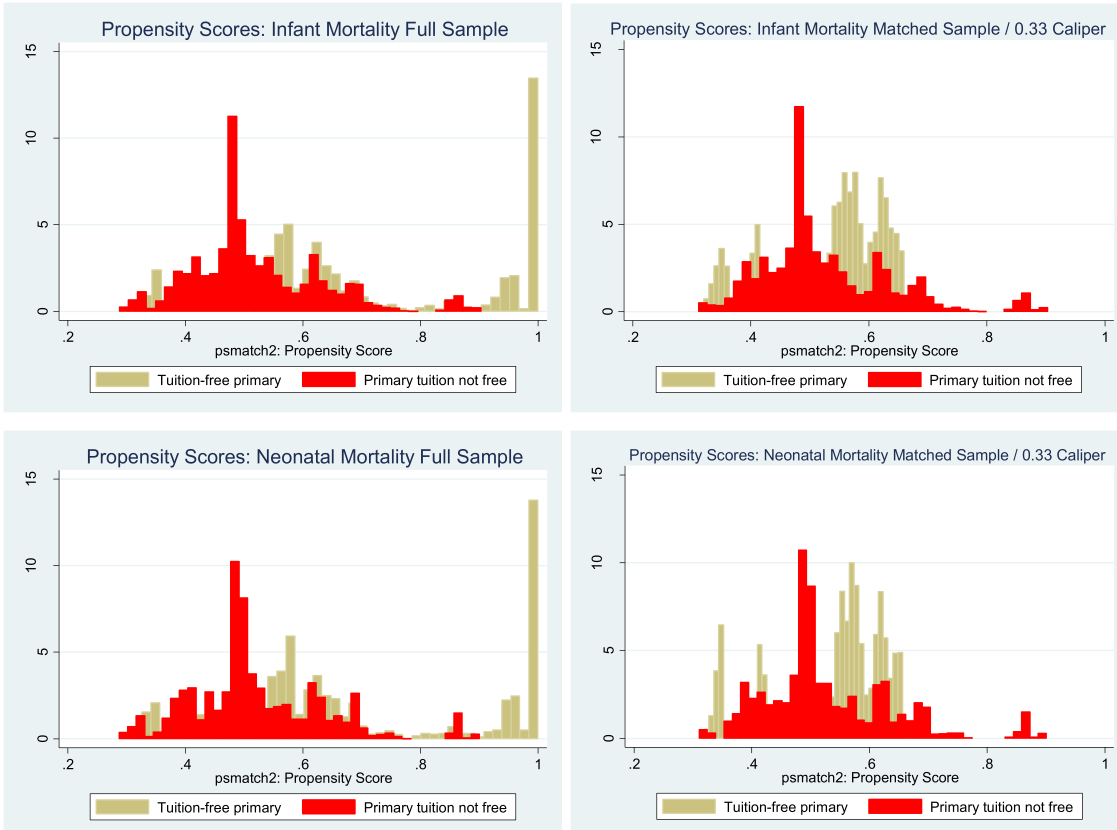

Fig. 2. Histograms showing the distributions of the estimated propensity scores for the infant (top) and neonatal (bottom) mortality samples for exposed and unexposed respondents before (left) and after (right) matching.

4. Discussion

In this multilevel study we linked birth histories from mothers surveyed as part of the DHS to information on whether public sector primary education was tuition-free when they would have been enrolled in primary school and estimated the effect of living in a country with a tuition-free education policy on the risk of infant and neonatal death. Overall, exposure to a tuition-free policy was associated 15 (95% CI = −32, 1) fewer infant and 5 (95% CI = −13, 4) fewer neonatal deaths per 1000 live births, reductions of approximately 19% and 13% relative to the sample means, respectively. Associations were strongest in magnitude for births to households in the middle of the socioeconomic gradient.

Since the seminal work by Caldwell (1979) showed that maternal education predicted child survival in Nigeria even after accounting for other socioeconomic indicators including characteristics of the father, (Caldwell, 1979) subsequent work from LMICs has consistently documented an association between maternal education and child health, including infant and neonatal mortality, and nutritional outcomes (Cochrane et al., 1982; Bicego and Ties Boerma, 1993; Caldwell and McDonald, 1982; Hobcraft, 1993; Boyle et al., 2006; Cleland and Van Ginneken, 1988; Frost et al., 2005). Whether these associations represent causal effects is unclear (Desai and Alva, 1998). Further research is needed to assess whether associations between maternal education and child health in LMICs are explained by common causes of maternal education and child health, including contextual factors.

If the relation between maternal education and child health is indeed causal, how can this inequality be redressed? From a public policy perspective, one approach would be to intervene on the mechanisms connecting maternal education to health. For example, if educational attainment induces women to access health services that improve child survival, then efforts to improve access to health services, such as antenatal care visits, among less educated women might reduce inequalities in infant mortality. Consistent with the Millennium Development Goals of achieving universal primary education and eliminating gender disparities in educational attainment, a complementary approach would be to shift the distribution of maternal education. For example, education policies aimed at increasing school enrollment and retention, including those that make education more affordable, could improve child survival by improving maternal education. However, in comparison to the burgeoning literature on the relation between maternal educational attainment and infant mortality, research concerning the health returns to education policies is scarce.

Our findings suggest that tuition-free primary education policies were associated with about 15 fewer infant deaths per 1000 live births, even after controlling for overall levels of economic development and other covariates using propensity score matching. Furthermore, we found that the association between tuition-free policies and infant mortality was strongest for births to mothers in the middle of the socioeconomic gradient. Although differences across socioeconomic strata were not statistically significant, we posit that the absence of an association between tuition-free policies and infant mortality among those in the poorest socioeconomic quintile may be explained by the pervasive poverty and attendant obstacles to school attendance faced by individuals in this group, including barriers due to uniform and textbook costs and expectations that girls perform household work and care for younger siblings (Glick and Sahn, 2000). Conversely,

Table 2
Estimates of the average marginal effects of exposure to tuition-free primary education policies and household SES on the risk of infant and neonatal mortality in the propensity score matched sample[a]; 23 LMICs included in the Demographic and Health Surveys (DHS), 2003–2011.

	Infant mortality		Neonatal mortality	
	RD[b]	95% CI	RD	95% CI
Tuition-free primary education policy	−0.015*	(-0.032, 0.001)	−0.005	(−0.013, 0.004)
SES4[c]	0.013**	(0.002, 0.024)	0.004	(-0.003, 0.011)
SES3	0.028***	(0.017, 0.040)	0.014***	(0.007, 0.021)
SES2	0.035***	(0.024, 0.046)	0.014***	(0.008, 0.021)
SES1 (lowest)	0.035***	(0.024, 0.046)	0.014***	(0.007, 0.021)
Number of live births	24,396		36,030	
Number of countries	23		23	

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
[a] Propensity score matched sample formed by matching exposed and unexposed respondents on individual, household, and national-level characteristics (i.e., gender of the infant, gender of the household head, education of the household head, urban/rural residence, household SES, GDP per capita, quadratic term for GDP per capita, percent of population per country living in urban centers, health expenditure per capita) using 1:1 nearest neighbor matching; further details in eAppendix B.
[b] Average marginal effects interpreted as risk differences, RD (e.g., risk of infant deaths among live births to mothers exposed to a tuition-free education policy vs. not).
[c] Quintiles of household SES compared to the highest quintile.

the nearly null association between tuition-free policies and infant mortality observed among those in the highest quintile of SES may be explained by the lower opportunity cost to education among relatively wealthier individuals, as well as the increased means to pay for education in countries where primary education was not tuition-free.

Given the lack of comparable studies, we highlight several areas for further research concerning education policies and child health. First, data constraints required us to examine the effects of primary education policies among young mothers; therefore, this study may have underestimated the effect of education policies. Several of the mechanisms posited by previous work are likely to be more observable when mothers of all ages are examined, including the benefits of delayed childbirth (not fully observable in young mothers) and the benefits of birth spacing (observable only in multiparous women who are, on average, older). Moreover, tuition-free secondary education may be more likely to lead to delays in marriage and child bearing, increased use of contraception, greater birth spacing, and other reproductive health practices associated with child health and survival. We recommend future studies include the effects of tuition-free secondary education policies and examine women of all reproductive ages. Second, there is ongoing debate about whether increasing the quantity of schooling alone without targeting specific learning objectives is an effective means for imparting the skills and competencies necessary for facilitating the transition into adulthood (Barrett, 2011). Evidence from LMICs suggests that a substantial proportion of children who complete primary school have not received an adequate education in terms of learning objectives (Pritchett, 2013). Evaluating the effects of programs and policies aimed at improving the quality of education on child health is a potentially fruitful area of further research. Third, we suggest that future work should leverage changes in education policies over time to estimate causal effects on child health outcomes. Lastly, further work is needed to elucidate the causal mechanisms connecting maternal education to child health outcomes.

There were a few limitations to our study. First, our analyses were unable to account for other monetary costs to education, such as the costs of school materials, uniforms and the existence of matriculation fees that may impose important barriers to educational access even in the presence of a tuition-free policy. Second, our empirical strategy does not account for potential unmeasured confounding and the estimates reported should be interpreted as associations and not causal effects. This caveat considered, we attempted to measure important individual, household, and country-level confounders and account for them in our analyses using propensity score methods. Third, our results are only generalizable to children of 15–21 year-old mothers sampled in the 23 low and middle-income countries included in our analyses.

In summary, our findings provide preliminary evidence that education policies represent a potential mechanism for reducing infant mortality in LMICs. However, other strategies might be needed to prevent infant and neonatal deaths among the poorest of households in LMICs.

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Table 3
Association of exposure to primary education policies and risk of infant and neonatal mortality by quintiles of household SES in the propensity score matched sample[a]; 23 LMICs included in the Demographic and Health Surveys (DHS), 2003–2011.

	Not free	Free	Free vs. Not free	
Risk of infant death	Risk (95% CI)	Risk (95% CI)	Difference (95% CI)	Test of homogeneity[b]
SES1 (lowest)	0.094 (0.079, 0.108)	0.081 (0.064, 0.097)	−0.013 (−0.035, 0.009)	$p = 0.63$
SES2	0.094 (0.079, 0.109)	0.079 (0.063, 0.095)	−0.015 (−0.037, 0.007)	
SES3	0.092 (0.076, 0.108)	0.069 (0.053, 0.084)	−0.023 (−0.045, −0.001)	
SES4	0.072 (0.058, 0.086)	0.058 (0.043, 0.073)	−0.014 (−0.035, 0.007)	
SES5 (highest)	0.054 (0.040, 0.069)	0.049 (0.034, 0.065)	−0.005 (−0.026, 0.016)	
Risk of neonatal death	Risk (95% CI)	Risk (95% CI)		
SES1 (lowest)	0.043 (0.035, 0.051)	0.045 (0.036, 0.055)	0.002 (−0.010, 0.014)	$p = 0.21$
SES2	0.046 (0.038, 0.055)	0.042 (0.033, 0.051)	−0.004 (−0.016, 0.008)	
SES3	0.050 (0.041, 0.059)	0.038 (0.029, 0.047)	−0.012 (−0.025, 0.001)	
SES4	0.039 (0.031, 0.047)	0.029 (0.021, 0.037)	−0.010 (−0.021, 0.001)	
SES5 (highest)	0.033 (0.025, 0.042)	0.026 (0.018, 0.035)	−0.007 (−0.019, 0.005)	

[a] Propensity score matched sample formed by matching exposed and unexposed respondents on individual, household, and national-level characteristics (i.e., gender of the infant, gender of the household head, education of the household head, urban/rural residence, household SES, GDP per capita, quadratic for GDP per capita, percent of population per country living in urban centers, health expenditure per capita) using 1:1 nearest neighbor matching; further details in eAppendix B.
[b] Test for interaction assessing whether the average marginal effects of exposure to tuition-free primary education policies differed across quintiles of household SES.

had no involvement in the design of the study or the analysis and interpretation of the data.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2014.09.016.

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