

# Eliminating Reproductive Risk Factors and Reaping Female Education and Work Benefits: A Constructed Cohort Analysis of 50 Developing Countries

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# Significance

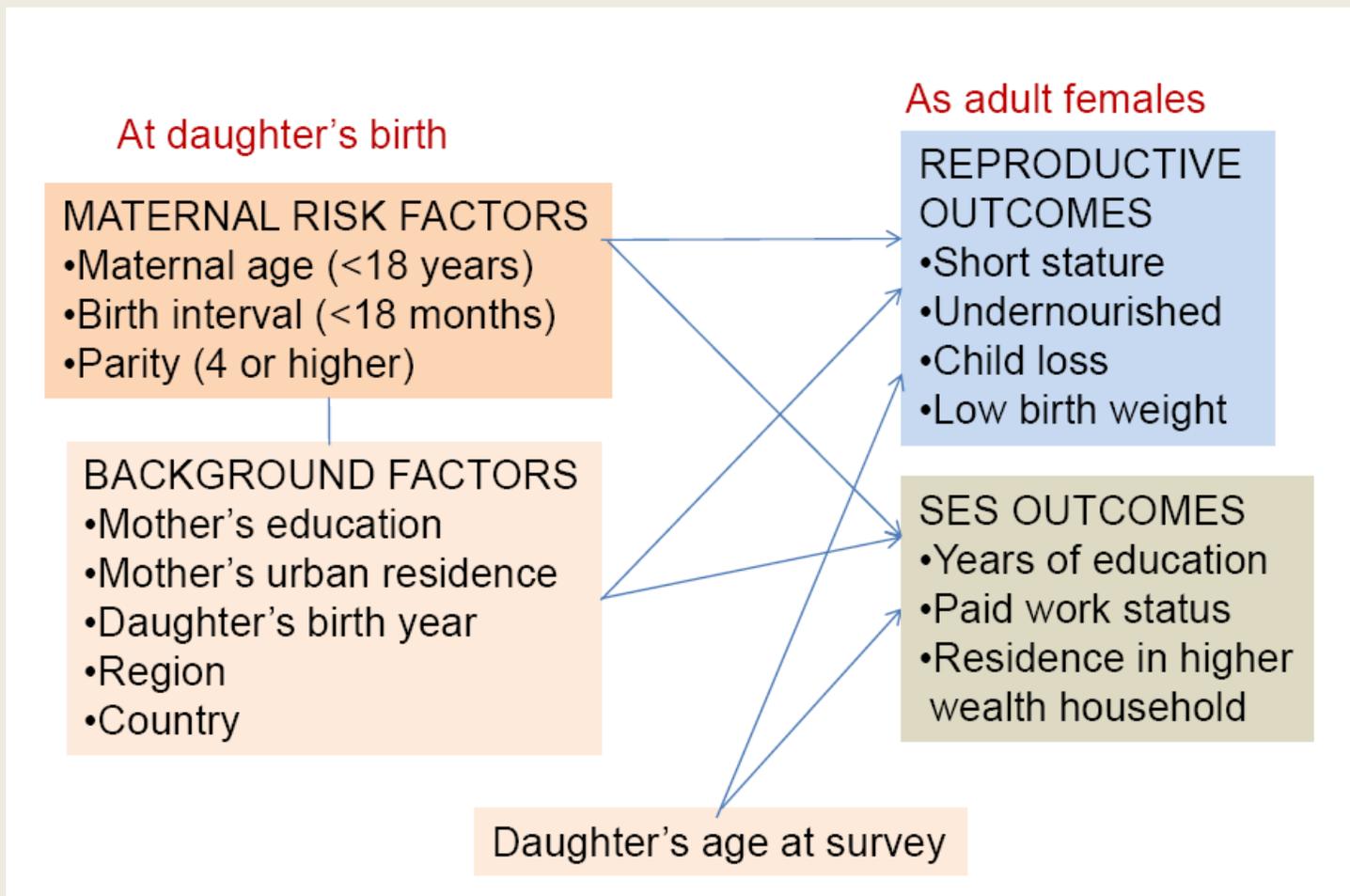
- Demographic Dividend (DD): Opportunities for accelerated economic growth
- Proponents of the DD framework recommend investing in human-capital quality, including schooling, nutrition, health care and job skills training, to boost economic growth and productivity
- The gendered perspective advocates prioritizing investments in the female population to capture their potential contributions to the DD
  - Compensate population aging

# Study objectives

- Our analysis assesses the impacts of reproductive risk factors prevailing at the time of daughters' births on their subsequent health, reproductive and socioeconomic outcomes, particularly with respect to years of schooling or paid work in adulthood
- Simulate for adult female cohorts the expected mean years of schooling and mean proportion with paid work with the elimination of reproductive risks
- Hypotheses tested at cohort level

# Analytic framework

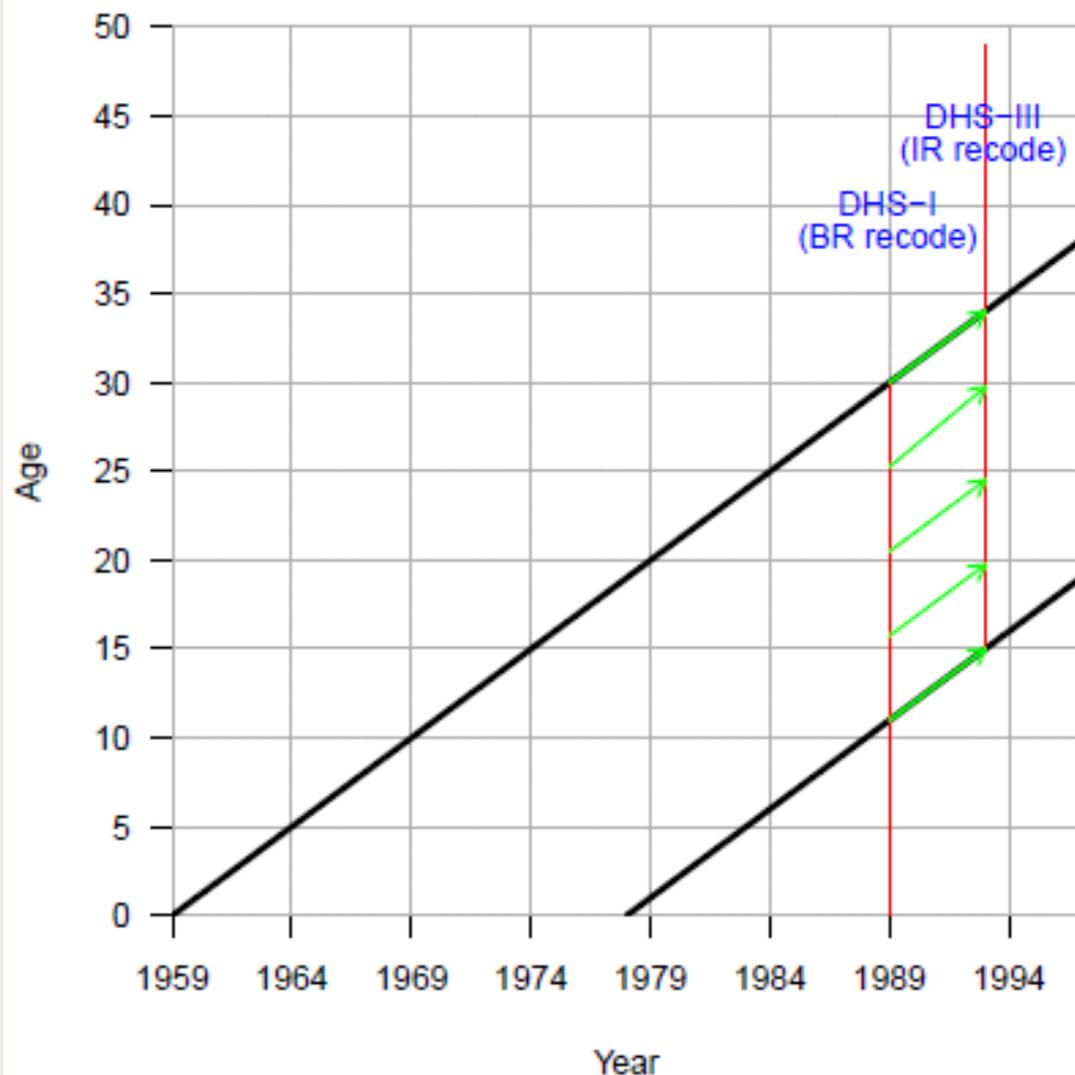
## Birth cohorts as units of analysis



# Data and Methods

- Capturing temporal change with repeated cross-sectional survey data in multiple countries
- Pseudo-panel approach
  - Deaton (1985), used in other fields (labor economics)
  - A similar idea use for HIV incidence with 2 sequential DHSs in a given country (Hallett et al., 2010)
  - Extracts dynamics of life course change from DHS database of country-level surveys some 20 years apart
  - Constructs single-year birth cohorts with DHS data
  - Data from DHS surveys conducted in 50 countries between 1986 and 2012

## A Pseudo-Cohort in Kenya

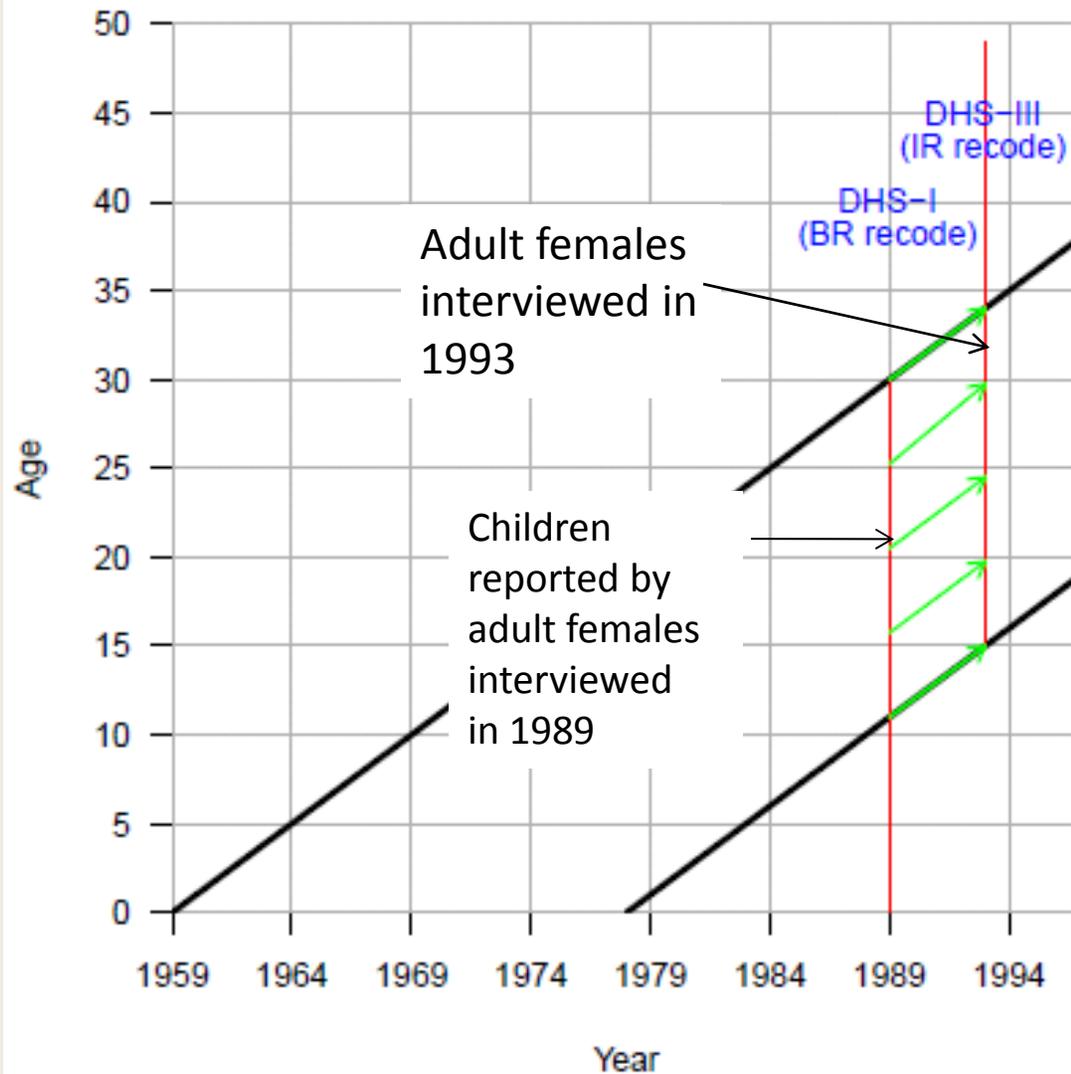


- Paired sequential DHSs
- Constructed single-year birth cohorts
- Used data on all children to respondents in the 1<sup>st</sup> DHS to obtain maternal risk factors
- Used data on individual respondents in the 2<sup>nd</sup> DHS for reproductive outcomes
- Linked the two by birth cohort year (pseudo-panel)

### Example for Kenya

1993 DHS reproductive outcomes for a woman age 17 is linked to her cohort counterpart in 1989 DHS (aged 13), using her child birth information and that of her mother (as a survey respondent)

### A Pseudo-Cohort in Kenya

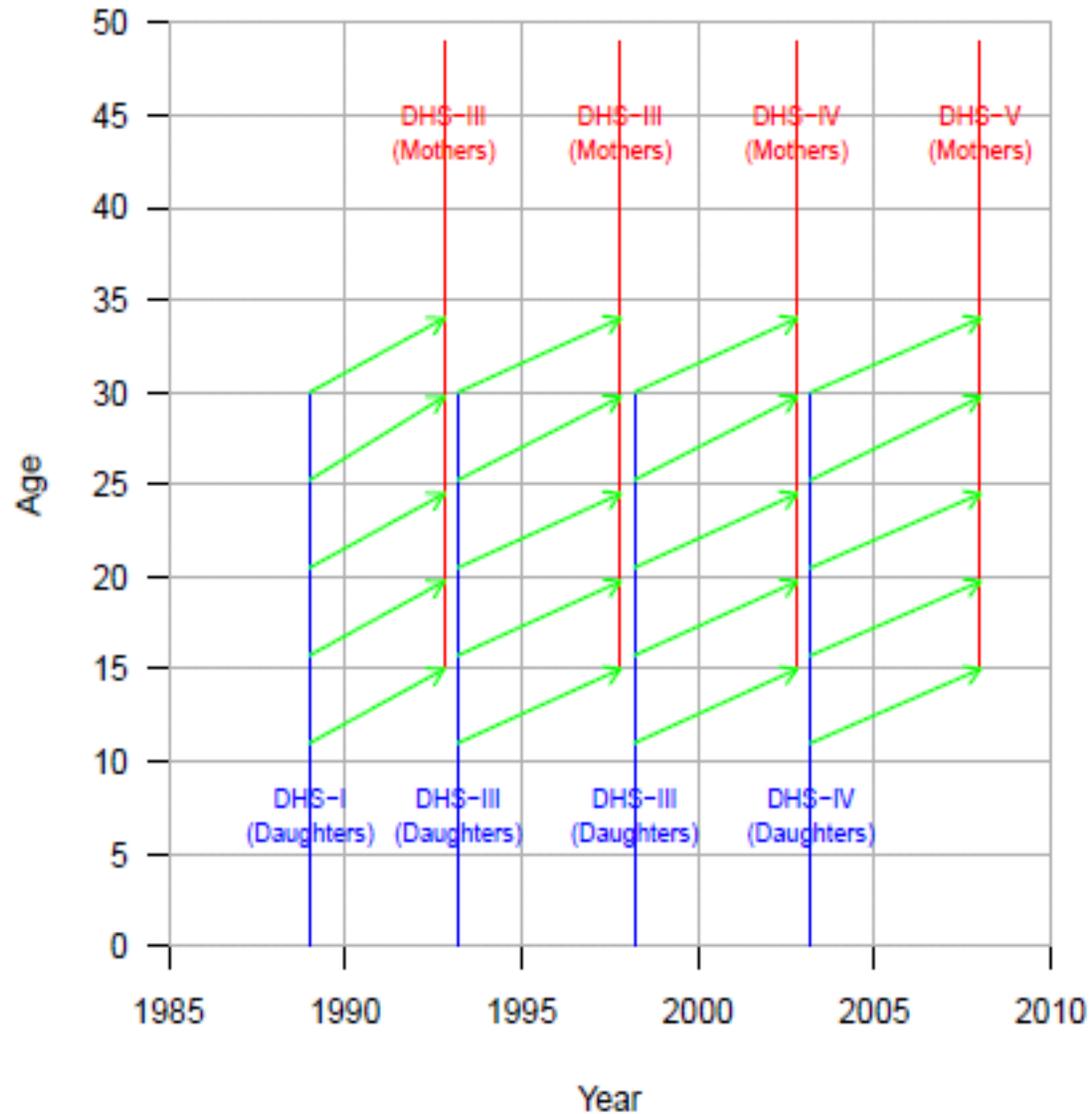


- Paired sequential DHSs
- Constructed single year birth cohorts
- Used data on all children to respondents in the 1<sup>st</sup> DHS to obtain maternal risk factors
- Used data on individual respondents in the 2<sup>nd</sup> DHS for reproductive outcomes
- Linked the two by birth cohort year (pseudo-panel)

#### Example for Kenya

1993 DHS reproductive outcomes for a woman age 25 is linked to her cohort counterpart in 1989 DHS (aged 21), using her child birth information and that of her mother (as a survey respondent)

## An Example of Data Construction: Kenya



In this example, pseudo-cohorts are constructed with four pairs of surveys

Cohort sample for each country is formed and grouped with other similarly constructed cohorts for other countries (total of 50 across 4 regional groupings)

# Data Preparation

- Constructed 2,542 single-year birth cohorts
  - Minimum of 100 women to increase the accuracy of the cohort-level measurements (M Verbeek et al., 1992)
  - 1,386 from 27 Sub-Saharan African (SSA) countries
- Constructed covariates for maternal factors at birth by cohort
- Attached cohort-specific maternal factor covariates to daughters-as-mothers cohorts

# Statistical Model

- Generalized linear regression models (GLM) for each of the 6 reproductive and 2 socioeconomic outcomes
- Includes regions as dummy variables with robust variance estimation to adjust for correlated observations within regions
- Estimates the models for the full and SSA samples of cohorts

## Results of Generalized Linear Model Estimation of Cohort Proportions for Reproductive and Socioeconomic Outcomes in 50 Developing Countries Regressed on Maternal Risk Factors, Maternal Attributes and Region

All regions								
Covariate	Proportion of children died before age 5	Proportion of mothers who report ever losing a child before age 5	Proportion of births reported born small	Proportion of mothers reporting ever having a small baby	Proportion of adult daughters with BMI < 18.5	Proportion of adult daughters with height < 145cm	Proportion of adult daughters currently with paid work	Average years of education for adult daughters
Maternal education	-0.698*** (0.249)	-0.819*** (0.301)	-0.578*** (0.191)	-0.546*** (0.197)	-0.822** (0.347)	0.549 (0.604)	0.242 (0.384)	7.426*** (0.677)
Maternal age<18	2.022*** (0.707)	3.215*** (0.792)	-1.416** (0.642)	2.110** (0.919)	2.303* (1.239)	2.108 (1.280)	-4.315*** (1.216)	-2.194 (2.596)
Born in parity>=4	0.938* (0.486)	1.212** (0.538)	0.928** (0.458)	1.959*** (0.554)	0.145 (0.883)	0.188 (1.685)	-0.983 (0.985)	1.585 (1.777)
Birth Interval<18m	0.697 (0.714)	1.365 (0.836)	1.026* (0.583)	2.055*** (0.650)	0.646 (1.291)	0.411 (2.032)	1.014 (1.358)	-3.630 (2.649)
Maternal residence in urban area	-0.037 (0.330)	-0.053 (0.401)	0.316 (0.302)	0.322 (0.334)	-0.091 (0.556)	-2.290 (1.459)	0.322 (0.524)	-0.337 (1.174)
Birth year of the cohort	-0.026*** (0.005)	-0.023*** (0.006)	0.001 (0.006)	0.001 (0.006)	0.013 (0.010)	-0.041* (0.024)	0.010 (0.025)	0.044* (0.026)
Age of cohort at outcome survey	-0.021*** (0.005)	0.055*** (0.007)	-0.119*** (0.006)	0.029*** (0.007)	-0.059*** (0.011)	-0.054*** (0.017)	0.113*** (0.015)	0.085*** (0.026)
Region (Latin America and Caribbean=Ref)								
North Africa/West Asia/Europe	-0.377** (0.175)	-0.499** (0.193)	-0.429** (0.168)	-0.265* (0.139)	-0.969* (0.541)	-2.192*** (0.379)	-1.986*** (0.167)	1.070* (0.565)
Central Asia/South & Southeast Asia	0.258 (0.175)	0.086 (0.183)	-0.149 (0.141)	-0.053 (0.143)	1.313*** (0.431)	-0.029 (0.841)	-0.412** (0.170)	-0.214 (0.469)
Sub-Saharan Africa	0.552*** (0.179)	0.625*** (0.195)	-0.325** (0.137)	-0.078 (0.129)	0.543 (0.385)	-1.701** (0.658)	0.368** (0.170)	-1.459*** (0.443)
Constant	48.833*** (10.043)	41.731*** (11.821)	-1.728 (12.351)	-5.720 (11.988)	-26.502 (20.441)	80.174 (48.203)	-23.587 (50.696)	-86.436 (51.859)
Cohort observations	2,542	2,542	1,052	1,052	1,985	1,985	1,054	2546

Regression coefficients shown with standard errors in parentheses  
 \*p<0.10 \*\*p<0.05 \*\*\*p<0.001

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Maternal residence in urban area							0.322 (0.524)	-0.337 (1.174)
Birth year of the cohort							0.010 (0.025)	0.044* (0.026)
Age of cohort at outcome survey							0.113*** (0.015)	0.085*** (0.026)
Region (Latin America and Caribbean)								
North Africa/West Asia/Europe							-1.986*** (0.167)	1.070* (0.565)
Central Asia/South & Southeast Asia	0.258 (0.175)	0.086 (0.183)	-0.149 (0.141)	-0.053 (0.143)	1.313*** (0.431)	-0.029 (0.841)	-0.412** (0.170)	-0.214 (0.469)
Sub-Saharan Africa	0.552*** (0.179)	0.625*** (0.195)	-0.325** (0.137)	-0.078 (0.129)	0.543 (0.385)	-1.701** (0.658)	0.368** (0.170)	-1.459*** (0.443)
Constant	48.833*** (10.043)	41.731*** (11.821)	-1.728 (12.351)	-5.720 (11.988)	-26.502 (20.441)	80.174 (48.203)	-23.587 (50.696)	-86.436 (51.859)
Cohort observations	2,542	2,542	1,052	1,052	1,985	1,985	1,054	2546

The effects are sizeable, mostly in the expected direction, and often statistically significant

## Results of Generalized Linear Model Estimation of Cohort Proportions for Reproductive and Socioeconomic Outcomes in 27 Sub-Saharan African Countries Regressed on Maternal Risk Factors and Attributes

Covariate	Proportion of children died before age 5	Proportion of mothers who report ever losing a child before age 5	Proportion of births reported born small	Proportion of mothers reporting ever having a small baby	Proportion of adult daughters with BMI < 18.5	Proportion of adult daughters with height < 145cm	Proportion of adult daughters currently with paid work	Average years of education for adult daughters
Maternal education	-0.480 (0.292)	-0.517 (0.348)	-0.548** (0.258)	-0.497** (0.219)	-0.859** (0.379)	0.955 (0.669)	0.287 (0.541)	7.401*** (0.767)
Maternal age<18	2.760*** (0.787)	3.842*** (1.089)	-0.297 (0.952)	3.445** (1.439)	0.581 (2.109)	-1.752 (2.405)	-4.475 (3.061)	-0.167 (4.286)
Born in parity>=4	1.233** (0.512)	1.904*** (0.681)	0.699 (0.499)	2.653*** (0.612)	0.813 (0.834)	0.138 (0.989)	-1.740 (2.003)	-2.184 (1.731)
Birth Interval<18m	1.509 (0.914)	2.202* (1.100)	0.849 (0.841)	1.937** (0.726)	1.570 (1.796)	4.569 (3.261)	2.225 (1.481)	-7.436* (4.010)
Maternal residence in urban area	0.393 (0.285)	0.483 (0.402)	0.013 (0.373)	0.030 (0.403)	-0.127 (0.628)	-0.894 (1.051)	0.654 (0.627)	-2.109 (1.295)
Birth year of the cohort	-0.027*** (0.006)	-0.023*** (0.007)	0.001 (0.007)	0.006 (0.008)	0.008 (0.010)	0.009 (0.017)	0.000 (0.035)	-0.026 (0.020)
Age of cohort at outcome survey	-0.017** (0.007)	0.068*** (0.008)	-0.118*** (0.006)	0.043*** (0.006)	-0.054*** (0.013)	-0.052*** (0.019)	0.097*** (0.021)	-0.009 (0.019)
Constant	51.763*** (11.408)	41.544*** (14.039)	-1.517 (14.831)	-15.344 (15.414)	-17.291 (20.079)	-20.999 (33.527)	-2.314 (70.431)	55.083 (-40.041)
Cohort observations	1,386	607	607	1,153	1,153	484	484	1386

Regression coefficients shown with standard errors in parentheses  
 \*p<0.10 \*\*p<0.05 \*\*\*p<0.001

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Constant							0.097*** (0.021)	-0.009 (0.019)
							-2.314 (70.431)	55.083 -40.041
Cohort observations	1,386	607	607	1,153	1,153	484	484	1386

**Stronger effects in Sub-Saharan Africa, mostly in the expected direction**

Regression coefficients shown with standard errors in parentheses  
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## Observed Cohort Proportions and Simulated Proportions with Maternal Risk Factor Eliminated: All Regions and Sub-Saharan Africa Only

RH outcome

Outcome	Expected proportion with elimination of risk factors	All regions		SSA	
		Mean	SD	Mean	SD
Proportion of children who died before age 5	Observed	0.084	0.037	0.109	0.032
	Maternal age<18	0.084	0.037	0.074	0.016
	Born in parity>=4	0.062	0.023	0.075	0.031
	Birth Interval<18m	0.064	0.032	0.090	0.024
	All three risk factors	0.075	0.034	0.040	0.008
Proportion of mothers who report ever losing a child before age 5	Observed	0.187	0.133	0.231	0.136
	Maternal age<18	0.187	0.133	0.142	0.074
	Born in parity>=4	0.120	0.070	0.148	0.123
	Birth Interval<18m	0.144	0.126	0.181	0.110
	All three risk factors	0.154	0.116	0.061	0.041
Proportion of children reported born small	Observed	0.116	0.084	0.117	0.077
	Maternal age<18	0.116	0.084	0.121	0.078
	Born in parity>=4	0.133	0.090	0.092	0.059
	Birth Interval<18m	0.087	0.061	0.107	0.072
	All three risk factors	0.100	0.076	0.086	0.055
Proportion of mothers reporting ever having a small baby	Observed	0.156	0.056	0.152	0.052
	Maternal age<18	0.156	0.056	0.095	0.027
	Born in parity>=4	0.118	0.032	0.070	0.044
	Birth Interval<18m	0.094	0.056	0.119	0.038
	All three risk factors	0.110	0.034	0.030	0.010
Proportion of adult daughters with BMI < 18.5	Observed	0.103	0.070	0.103	0.040
	Maternal age<18	0.103	0.070	0.096	0.039
	Born in parity>=4	0.076	0.053	0.078	0.027
	Birth Interval<18m	0.099	0.068	0.085	0.035
	All three risk factors	0.094	0.066	0.059	0.023
Proportion of adult daughters with height < 145cm	Observed	0.052	0.051	0.018	0.010
	Maternal age<18	0.052	0.051	0.022	0.011
	Born in parity>=4	0.038	0.033	0.017	0.009
	Birth Interval<18m	0.049	0.049	0.010	0.006
	All three risk factors	0.048	0.047	0.011	0.006
Proportion of adult daughters with paid work	Observed	0.335	0.163	0.384	0.146
	Maternal age<18	0.335	0.163	0.380	0.144
	Born in parity>=4	0.413	0.189	0.341	0.149
	Birth Interval<18m	0.330	0.163	0.356	0.139
	All three risk factors	0.316	0.158	0.310	0.138
Adult daughter's average years of education	Observed	6.072	2.244	5.168	1.852
	Maternal age<18	6.394	2.168	5.193	1.849
	Born in parity>=4	5.558	2.247	5.949	1.871
	Birth Interval<18m	6.773	2.343	6.225	1.794
	All three risk factors	6.579	2.303	7.031	1.789

Elimination of maternal risk factors individually and then collectively

## Observed Cohort Proportions and Simulated Proportions with Maternal Risk Factor Eliminated: All Regions and Sub-Saharan Africa Only

Outcome	Expected proportion with elimination of risk factors	All regions		SSA	
		Mean	SD	Mean	SD
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Proportion of adult daughters with BMI < 18.5	Observed	0.103	0.070	0.103	0.040
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	Maternal age<18	0.335	0.163	0.380	0.144
	Born in parity>=4	0.413	0.189	0.341	0.149
	Birth Interval<18m	0.330	0.163	0.356	0.139
	All three risk factors	0.316	0.158	0.310	0.138
Adult daughter's average years of education	Observed	6.072	2.244	5.168	1.852
	Maternal age<18	6.394	2.168	5.193	1.849
	Born in parity>=4	5.558	2.247	5.949	1.871
	Birth Interval<18m	6.773	2.343	6.225	1.794
	All three risk factors	6.579	2.303	7.031	1.789

Elimination of maternal risk factors individually and then collectively

Developmental outcome

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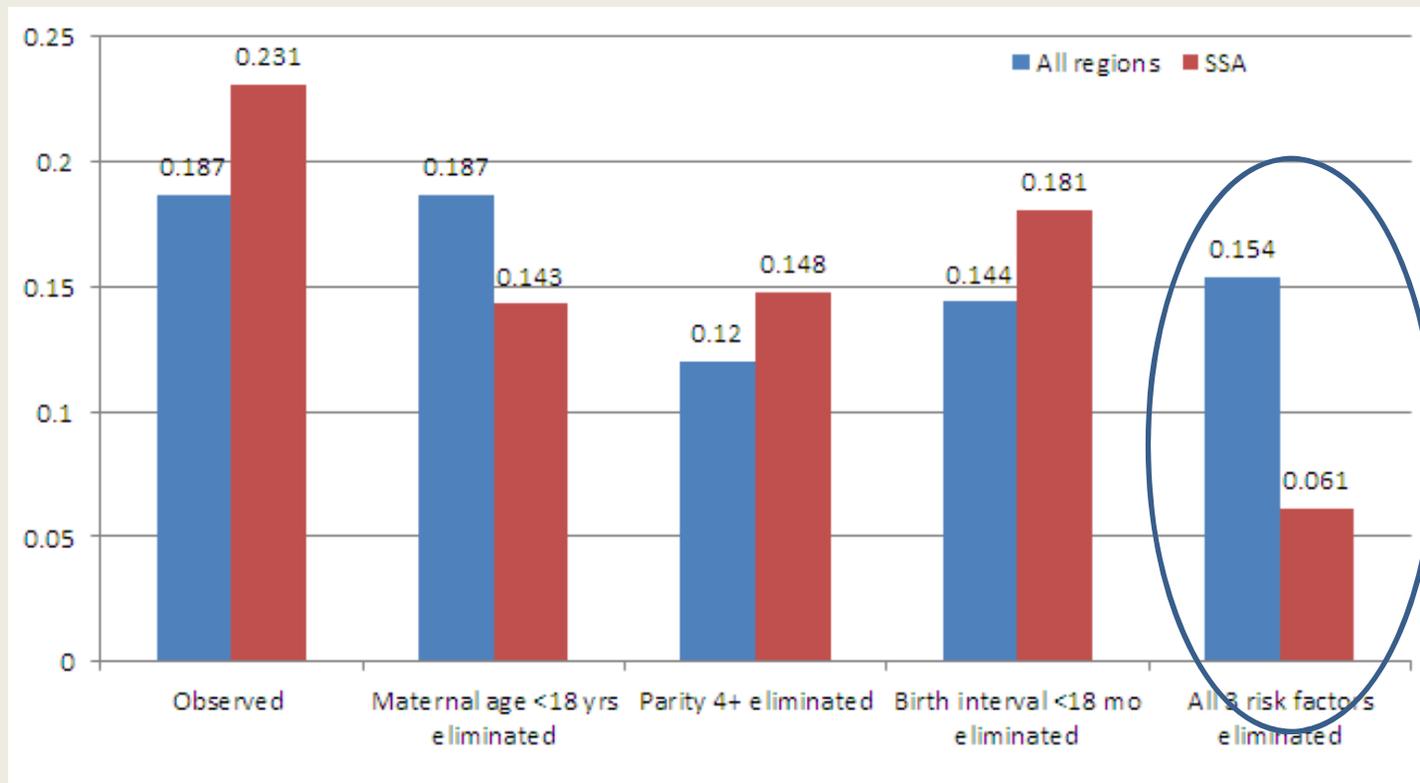
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	Born in parity>=4	0.413	0.189	0.341	0.149
	Birth Interval<18m	0.330	0.163	0.356	0.139
	All three risk factors	0.316	0.158	0.310	0.138
Adult daughter's average years of education	Observed	6.072	2.244	5.168	1.852
	Maternal age<18	6.394	2.168	5.193	1.849
	Born in parity>=4	5.558	2.247	5.949	1.871
	Birth Interval<18m	6.773	2.343	6.225	1.794
	All three risk factors	6.579	2.303	7.031	1.789

Elimination of maternal risk factors individually and then collectively

SES outcome

# Results

Observed and Predicted Cohort Proportions of Mothers Experiencing Child Loss before Age 5 by Type of Maternal Risk Factor Eliminated and Region



Observed and Predicted Cohort Average Years of Education for Adult Daughters by Type of Maternal Risk Factor Eliminated and Region

<b>Simulation scenario</b>	<b>All regions</b>	<b>SSA</b>
Observed	6.07	5.17
Maternal age <18 yrs eliminated	6.39	5.19
Parity 4+ eliminated	5.56	5.95
Birth interval <18 mo eliminated	6.77	6.23
All 3 risk factors eliminated	6.58	7.03

- Across the three reproductive risks, eliminating early childbearing shows the highest gain in the mean proportion having paid work—from 0.286 to 0.326
- The individual elimination of the other two risk conditions does not increase the mean cohort proportion with paid employment
- However, the elimination of all three does raise it from 0.286 to 0.305

# Findings

- Eliminating 3 maternal risk factors in overall and SSA samples
  - Lowers the observed level of adverse reproductive health outcomes
  - Increases average years of schooling for adult daughters
    - Appears to increase proportion in highest wealth households
- Analysis supports hypothesized linkages between maternal childbearing indicators, adult health measures and socioeconomic wellbeing
  - One of the first applications of pseudo-panel approach to public health outcomes
- Because maternal risks are preventable, findings show potential to prevent adverse birth outcomes over long run and in an enduring manner

# Conclusions

The findings suggest further research to capture the complexities of female employment, while contributing to the understanding of how investments in reproductive, maternal and child health can produce healthy childbearing patterns that translate into improved quality of human capital and the Demographic Dividend.

Thank You  
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