

Association of Maternal Risk Factors in Infancy with Reproductive Outcomes in Young Adult Years: A Multi-National Study Using Synthetic Cohorts

A Detailed Abstract

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Significance

Maternal age, birth interval length and parity are known to be correlated with adverse birth outcomes, i.e. low birth weight, poor intrauterine growth, and infant mortality (1-4). A meta-analysis of 67 articles regarding birth spacing and adverse birth outcomes concludes that birth intervals shorter than 18 months and longer than 59 months are significantly associated with increased risk of adverse birth outcomes (5).

An unexplored pathway as yet for developing countries is the influence of maternal factors in infancy on females' subsequent health and mortality, specifically the life-course impact of mothers' risk factors that may be conveyed to their daughters' experience with adverse pregnancy outcomes. Children born to relatively young or old mothers, following short or very long birth intervals, or at five or higher parity are more vulnerable to childhood malnutrition, infection and illnesses and have a lower probability of surviving to age five than those born to low-risk mothers (6, 7).

Children born in such high risk maternal environments may be disproportionately immunocompromised throughout childhood and into adolescence. Many lifestyle conditions associated with nutrition and development during the fetal and newborn stages and childhood years can carry lifetime impacts on females into their childbearing years. For example, females born shortly after an earlier sibling may be at higher risk of being low birth weight, a complicated birth, malnourished or vulnerable to communicable diseases, these conditions can compromise their own growth and reproductive development. In turn, as young females, their own maternal and newborns' health conditions may carry elevated risks, risks that are further aggravated by poverty.

Objective

The objective of this study is to assess the relationship between maternal factors of age, birth order and duration of the preceding birth interval for infants and children with birth outcomes subsequently experienced by young female mothers (between approximate ages 20- 25), using a synthetic cohort approach.

In this study we will investigate the hypothesis that female infants born to mothers with high risk factors related to poor infant survival and child development will, as mothers themselves, be more likely experience adverse outcomes with their own pregnancies and newborn health.

Data and Methods:

We use Demographic and Health Survey (DHS) data for 20 developing countries with 4 or more waves where the first and last are about 20 years apart. Twelve are in the Africa region, 4 Asian and 4 Latin American. We construct age-specific birth cohorts for ages i , where $i=0$ to 4 years from the earliest survey and then for ages $i+n$ years with the latest survey, where n is the number of years between earliest and latest rounds. For example, illustrated in this abstract are the experiences of five single-year cohorts of 0 to 4 year olds from the Dominican Republic DHS

in 1986 and 21 to 25 year olds in the 2007 DHS and the same for the Kenyan 0-4 cohorts in 1989 and 19 to 23 cohorts in 2008.

A synthetic cohort approach is adopted in this study because the Demographic and Health Surveys are not longitudinal. Being cross-sectional, DHSs do not follow the same individuals over time. However, they are representative samples of the same population aging at different points in time. Groups of individuals, who are members of the same birth cohort, can be matched over time in a way analogous to an individual cohort. Selection bias is introduced by migration in an out of the country and child mortality. The potential bias from the former is less concerning than the latter, where a “healthy survivor effect” may confound the analysis but in a conservative manner. These issues notwithstanding, DHS data can provide an appropriate estimation of the status of each single-year birth cohort at each available round. We can reconstruct therefore some of the key developmental experiences of the synthetic birth cohorts. One particular advantage of this approach is that unobservable time-invariant characteristics of groups can be addressed, just as individual fixed effects are with longitudinal data and therefore solve the problem of heterogeneity bias. Moreover, averaging over observations within each cohort can “average out” individual measurement error (8). With about 100 cohorts most of which have more than 400 female members, we can obtain consistent estimates without heterogeneity bias (9-11).

After constructing single-year birth cohorts for female children under age 5 using the earliest DHS survey round, we also construct the same for adult females interviewed in the latest DHS round who will be age $i+n$. In the case of the illustrative countries, Dominican Republic and Kenya, these are ages 21 to 25 and 19 to 23 respectively. Each early cohort is characterized by summary measures, such as the proportion of members whose mothers were under age 18 and over age 34 at birth, who were born less than 18 months after their previous sibling, and who are at parity 5 or higher. The older cohorts are characterized by such measures as the proportion with whose last birth was of very small or small size, the proportion ever having lost an infant and the proportion with undernourished children. Relationships with the first two outcomes are illustrated here.

Results

Figure 1 shows the Lexis diagram for synthetic birth cohorts that can be constructed for 0 to 4 year olds in the first 1989 DHS and traced forward over rounds, who are 14 to 18 year olds in 2003 and 21 to 25 year olds in 2008. The number of birth cohorts that can be analyzed across the 20 countries¹ is 96 as shown in Table 1; we can observe outcomes at age 15 for 5 cohorts, at age 16 for 7 cohorts, with experiences for the most number of cohort units observable between ages 18 and 23. While childbearing may be increasingly delayed to older ages, these countries have median ages at first birth that fall within the age ranges observable by the last DHS. Additionally, the sample sizes of the early surveys are sufficient to provide approximately 200 female members per birth cohort.

¹ Egypt (1988-2008), Morocco (1987-2004), Ghana (1988-2008), Kenya (1989-2009), Madagascar (1992-2009), Mali (1987-2006), Nigeria (1990-2008), Senegal (1986-2009), Tanzania (1991-2008), Uganda (1988-2006), Zambia (1992-2007), Zimbabwe (1988-2006), Bangladesh (1993-2007), Indonesia (1987-2007), Jordan (1990-2007), Philippines (1993-2008), Bolivia (1989-2008), Colombia (1986-2005), Dominican Republic (1986-2007), and Peru (1986-2008).

Figure 2a shows for Kenya the cohort-specific values of the summary measure, proportion of cohort born within 18 months of preceding birth; and Figure 2b, shows the proportion of young females in age cohorts 21 to 25 years who have experienced infant or child loss. Figure 2c shows the plot of the 5 pairs of cohort values, indicating that as the proportion of closely spaced births increases, the risk of child loss increases. Figure 2d shows the same relation with child loss except for cohort values related to young maternal age (mothers were under age 18 at the time of birth).

We can pool the cohort data and examine the significance of the trend lines, as shown for the ten pairs of Dominican Republic and Kenyan cohorts in Table 2. Here we examine the unadjusted OLS regression coefficients (with their p-values reported in brackets) between young female adult cohorts' pregnancy outcomes of birth size and infant/child loss with maternal risk factors at the time of their birth and infancy. The coefficients are sizeable, positive and frequently statistically different from 0. For example, for each percentage point of a female infant/child cohort born to very young mothers, an estimated 1% point is added to those females' subsequent delivery of low birth weight infants as young adults. We show the trend line for the Kenyan adult cohorts experience with ever loss of an infant and child, which suggests a 5% point increase with each percentage point increase in short birth spacing in infancy.

The results for two countries with very different fertility transitions suggest that the analysis of the full sample of cohorts can be promising. Preliminary review of the quality of age reporting is needed however; and additional characterization of cohorts, including early and later nutritional status and selected socio-economic and demographic characteristics, will be carried out. We will also investigate weighting the birth distributions in each country's sample.

Discussion

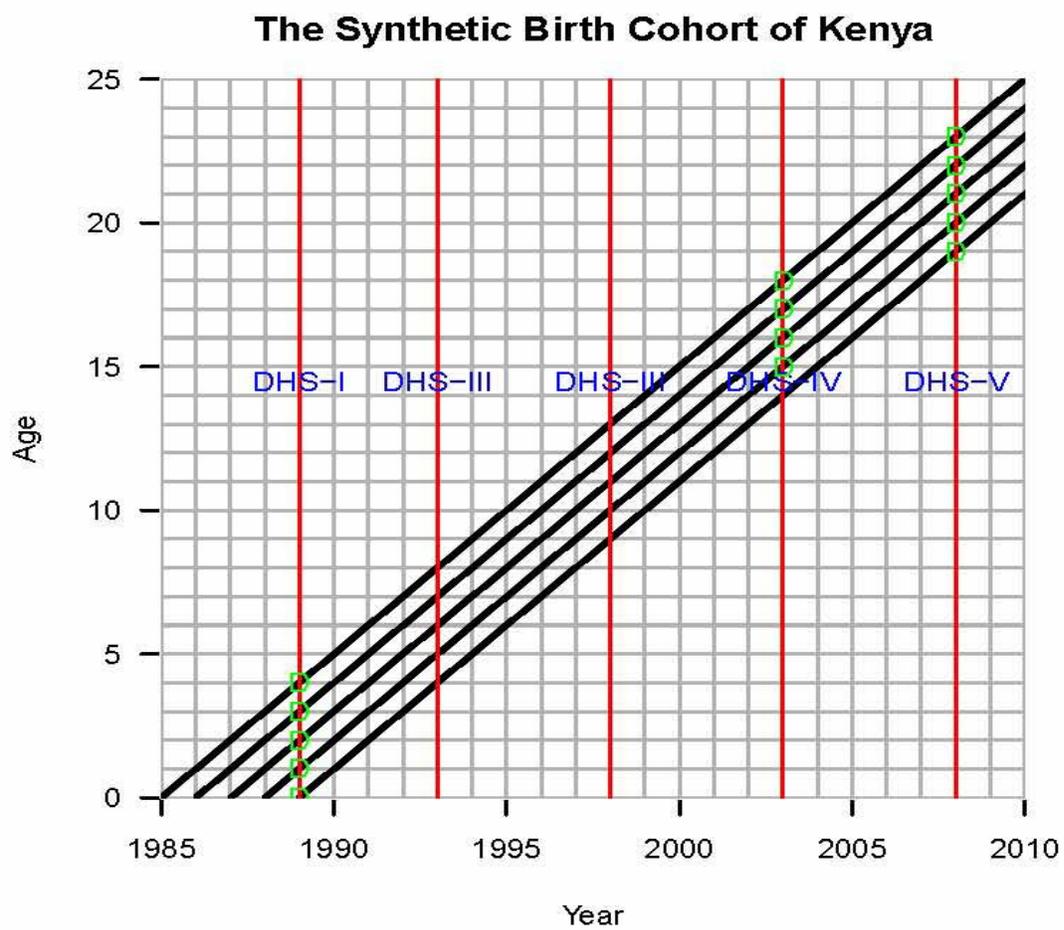
This synthetic birth cohort approach requires a disentangling of age, period, and cohort effects of underlying behaviors and subsequent birth outcomes. recently proposed correlated multivariate age-period-cohort models (12) will be employed to solve this issue. This approach explicitly takes into account the correlation of multiple outcomes while traditional age-period-cohort models usually assume independence of outcomes. Potential biases arising from migration and early age mortality in cohort composition will also be explored.

The availability of multiple rounds of national surveys across two decades in many developing countries recommends attempting to relate early-life with later adult health experiences. These findings from two very different countries warrant replication with the other available eighteen. While not as ideal as having national registries of vital events and longitudinal health and nutrition surveys, the relationships may be sufficiently robust and informative regarding young mothers' risks for infant and child mortality and adverse reproductive outcomes to withstand the biases of survivor effects and compositional change due to population migration.

References

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Figure 1



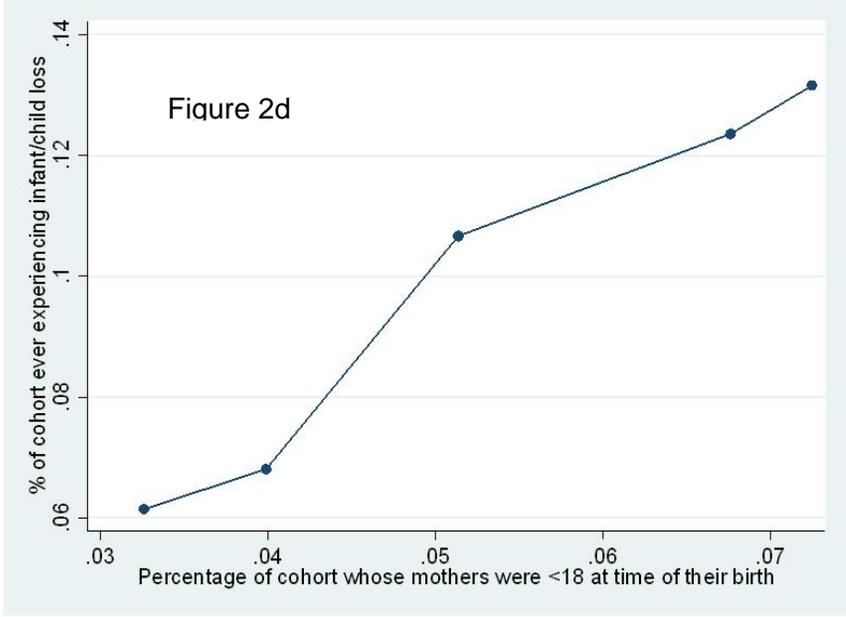
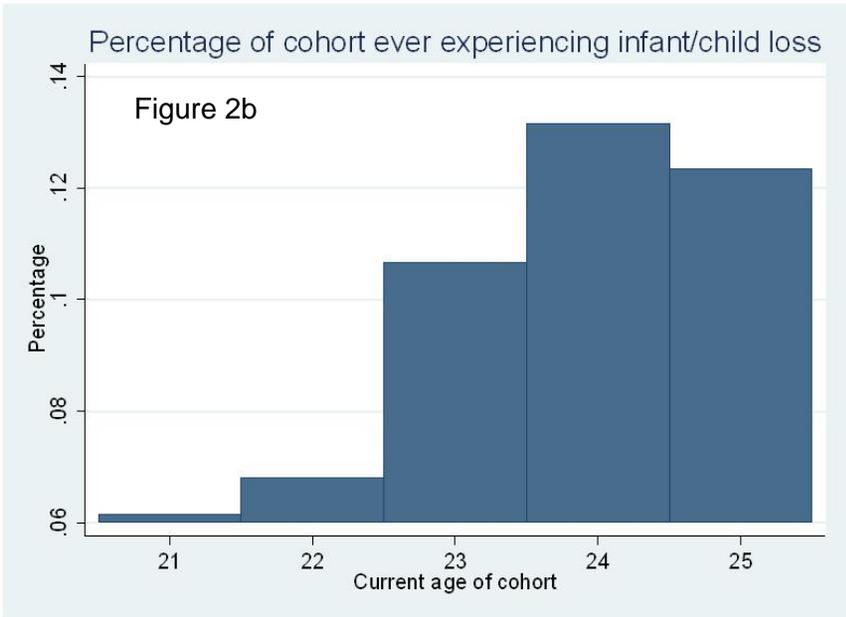
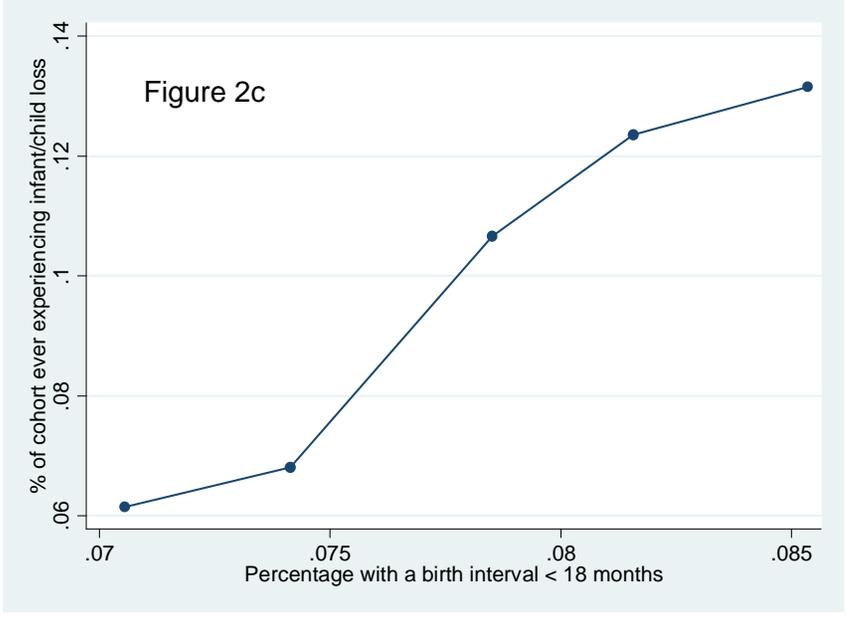
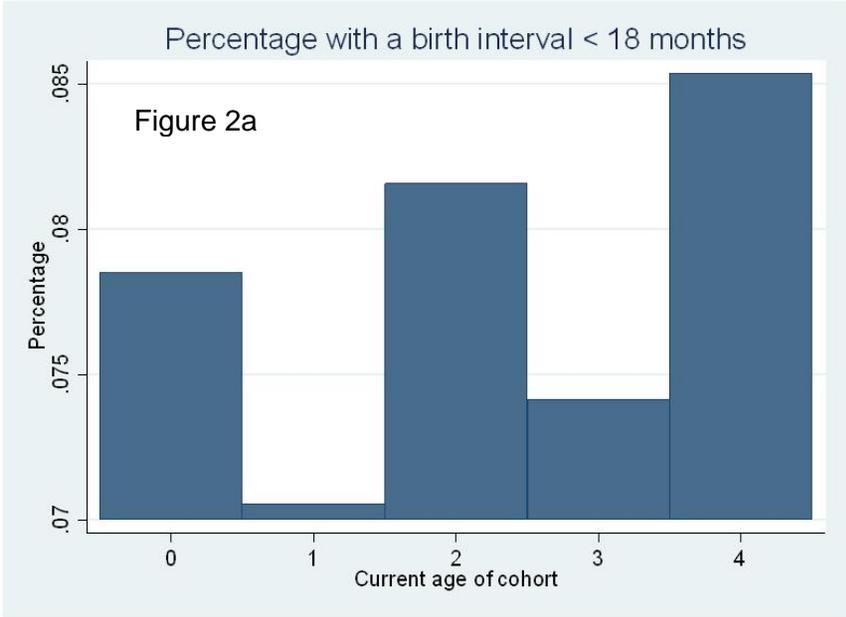


Table 1. Distribution of age-specific cohorts from 20 Demographic and Health Surveys

First age	Last observed age											Total
	15	16	17	18	19	20	21	22	23	24	25	
0	2	2	1	3	5	3	1	0	0	0	0	17
1	2	2	2	1	3	5	3	1	0	0	0	19
2	1	2	2	2	1	3	5	3	1	0	0	20
3	0	1	2	2	2	1	3	5	3	1	0	20
4	0	0	1	2	2	2	1	3	5	3	1	20
Total	5	7	8	10	13	14	13	12	9	4	1	96

96 birth cohorts from 20 countries, among which 41 cohorts have three DHS while 55 have two DHS.

Table 2

Illustrative Results of Simple OLS Regressions of Adult Female Outcomes and Risk Factors at Birth: Single-Year Cohorts Observed at Ages 0-4 and 20 Years Later in the Dominican Republic 1986 and 2007 and Kenya 1998 and 2008 DHSs

Variables	% mothers reporting last born birth size small or very small			% mothers reporting ever experiencing infant loss			
	Kenya and Dom Rep cohorts			Kenya and Dom Rep cohorts			Kenya cohorts only
% maternal age <18 years	1.013**			0.354			
	[0.042]			[0.709]			
% maternal age >34 years		0.434**			0.941***		
		[0.023]			[0.000]		
% born parity 5 or higher			0.120			0.362***	
			[0.157]			[0.001]	
% born within 18 months of preceding sibling							5.313***
							[0.005]
Constant	0.098***	0.107***	0.120***	0.05	-0.042*	-0.046*	-0.316**
	[0.005]	[0.001]	[0.002]	[0.399]	[0.053]	[0.094]	[0.011]
Cohort observations	10	10	10	10	10	10	5
R-squared	0.421	0.496	0.234	0.018	0.834	0.758	0.949

p value in brackets; *** p<0.01, ** p<0.05, * p<0.10