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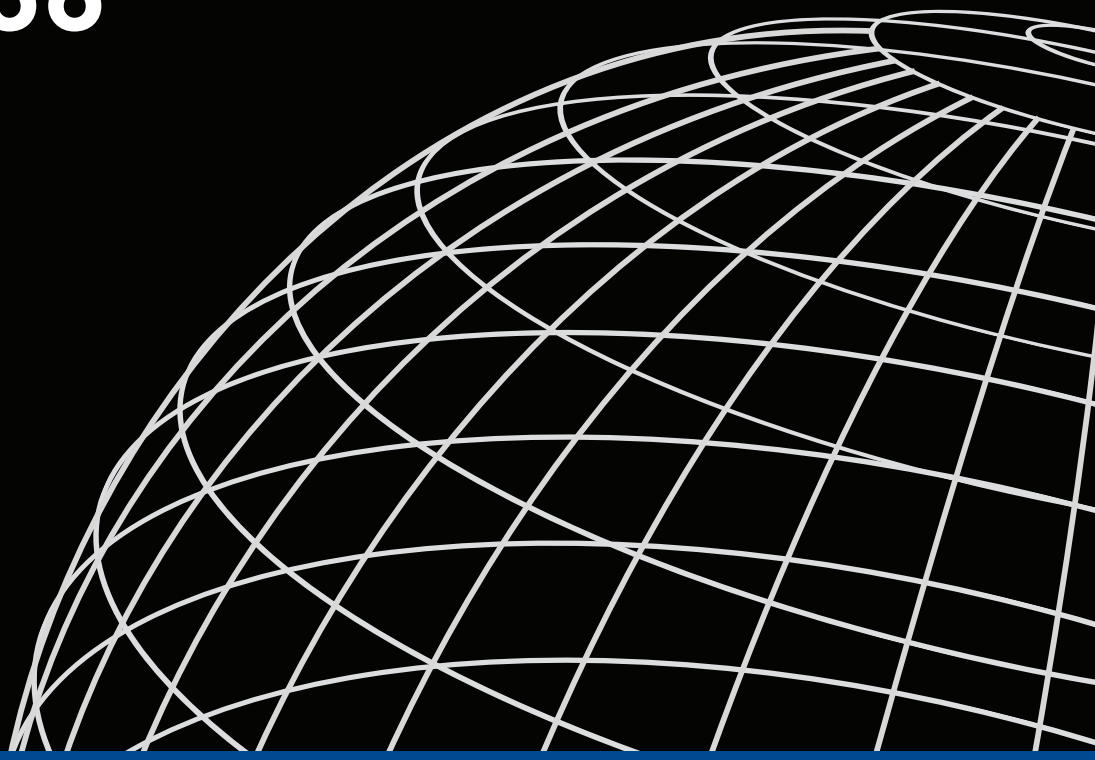
THE EFFECT OF FERTILITY BEHAVIOR ON CHILD SURVIVAL: EVIDENCE FROM THE DEMOGRAPHIC AND HEALTH SURVEYS, 2012–2022

DHS ANALYTICAL STUDIES 88



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The Effect of Fertility Behavior on Child Survival: Evidence from the Demographic and Health Surveys, 2012–2022

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EXECUTIVE SUMMARY

Reducing child mortality is a major public health concern. Its causes are widely debated. This is the fourth and largest study in a series of papers based on Demographic and Health Surveys that examine the relationship between birth spacing and infant and child mortality, which has been shown in numerous studies to be associated. The first DHS study included 17 surveys from 1990 to 1997, the second expanded to 52 surveys from 2000 to 2005, and the third included 45 surveys from 2006 to 2012. The current study includes 84 surveys from 56 countries, which were conducted from 2012 to 2022. There are no overlapping surveys between the third study and present study. All surveys in this report were publicly available as of July 2023. As in the third study, this report includes analysis of the association of maternal age and birth order on mortality.

Over 3.7 million births in the 179 months before the surveys are included in the estimates of mortality for under 5 and child (age 1–5) mortality. Almost 1.3 million of these births took place in the 59 months before the surveys and are included in the analysis of early neonatal mortality (within 6 days of birth), neonatal mortality (age 0–1 month), post-neonatal mortality (age 1–11 months), and infant mortality (age 0–11 months). The study presents summary statistics for individual surveys and pooled results for bivariate and multivariate Cox hazard regressions for mortality.

As found in previous studies, short birth intervals are associated with an increased risk of mortality for all age groups in this analysis. This is consistent for both the unadjusted and adjusted models. The shorter the birth interval, the greater the odds. First born children also experience greater odds of mortality than higher order children who were conceived three to four years after their next oldest sibling.

With maternal age, the pattern is also similar to the most recent study, with children born to young mothers (under age 18) having an increased risk of mortality for all six mortality measures, and children born to women over age 35 having an increased risk for mortality before age 1, but similar risks to the reference group (women age 18–24) for child and under-5 mortality.

The risk of mortality is highest for children with birth order 7 or greater. For birth orders 5 and 6, mortality risks are higher than the reference group (parity 1 and 2) after the neonatal period.

Combining information on spacing, maternal age, and birth order, a child with two risk factors faces over a 50% increased risk of dying in the early neonatal period, neonatal period, the post-neonatal period, and infant period compared to a child with no risk factors. The children's risk of dying under age 5 is 130% higher than a child with no risk. A child with all three risk factors has a risk of dying that is over 100% higher than a child with no risk in all mortality groups.

GLOSSARY OF TERMS

Birth order: A count of all live births the mother had before the index child.

Child mortality: Refers to deaths to children age one to four among children who survive to age one year.

Early neonatal mortality (ENN): Refers to deaths that occur 0 to 6 days after live birth.

Neonatal mortality (NN): Refers to deaths within the first 30 days among all children born alive.

Infant mortality: Refers to deaths to children age 0–11 months among all children born alive.

Odds: The ratio of the number of events that will produce an outcome to the number that do not.

Odds ratio (OR): Defined as the ratio of the odds of an event that occurs in one group relative to the odds of it occurring in another group.

Post-neonatal mortality (PNN): Refers to deaths at age 1–11 months after live birth.

Preceding birth-to-conception interval: Refers to the number of months between the date of the conception of the child under study (index child) and the date of the immediately preceding birth to the mother, if any.

Preceding birth-to-birth interval: Refers to the number of months between the date of birth of the child under study (index child) and the date of the immediately preceding birth to the mother, if any.

Risk ratio (RR): A measure of the risk of a certain event (such as infant mortality) happening in one group compared with the risk of the same event happening in another group.

Singleton birth: A birth that is not a twin or other multiple birth.

Under-5 mortality: Refers to deaths to children younger than age 5 among all children born alive.

1 INTRODUCTION AND RATIONALE

Reducing child mortality is a major public health concern. Its causes are widely debated. This study is the latest in a series that includes over 30 years of surveys on child mortality and birth spacing. The study provides an update to the most recent study that included risk factors for maternal age at birth and birth order.[1,2,3] The three risk factors are closely related and difficult to separate. The current report, which analyzes three times as many births as any of the previous reports, examines the association of each risk group on child mortality, while including a large set of control variables. This study hopes to extend the previous findings on the importance of healthy birth spacing and other risk factors on reducing child mortality.

1.1 Literature Review

Globally, the neonatal, infant and under-5 mortality rates have been declining steadily over the past three decades from 37 per 1,000 live births to 18 per 1,000 live births; 65 per 1,000 live births to 28 per 1,000 births; and 93 per 1,000 live births to 38 per 1,000 births, respectively.[4] Although much of this trend has been driven by declines in mortality rates in low-income countries, a wide gap between low and high-income countries persists. In 2021, the neonatal mortality rate, which the World Bank defined as mortality between 0 and 27 days, was nine times higher among low-income countries compared to the high-income countries (27 per 1,000 live births, compared to 3 per 1,000 live births).[5] Infant mortality, defined as the number of infants who die before one year of age, was nearly 12 times higher in low-income countries compared to the high-income countries (47 per 1,000 live births, compared to 4 per 1,000 live births), and the under-5 mortality rate was over 13 times higher in low-income countries compared to the high-income countries (67 per 1,000 births, compared to 5 per 1,000 live births).[6] The Sustainable Development Goal (SDG) target 3.2 aims to end preventable deaths of newborns and children under-5 by 2030.[7] Understanding the risk factors for newborn and under-5 mortality, as well as potential mechanisms for averting these risk factors, is key to achieving this goal.

Throughout the literature, many risk factors have been identified. This report focuses on three individual level risk factors for child mortality: preceding birth-to-pregnancy interval (too long or too short); maternal age (too young or too old); and parity at birth.

1.2 Preceding Birth-to-Pregnancy Interval

Both short birth-to-pregnancy intervals (less than 24 months) and long birth-to-pregnancy intervals (longer than 60 months) have been associated with an increased risk of infant death.[3] The relationship between short birth interval and mortality has been demonstrated in many different developmental, geographical, and temporal contexts. A 2018 study found that after controlling for unobserved maternal heterogeneity, a birth-to-pregnancy interval less than 24 months was associated with a substantial increase in the probability of infant death across all 77 countries in the analysis.[8] This finding was consistent with other studies that examined the impact of short birth interval on child survival in a variety of contexts.[9-15] A 2008 study that examined pooled birth data from 52 DHS surveys estimated that under-5 deaths would decline by 13% by extending the birth-to-pregnancy interval to 24 months, and 25% by extending the birth-to-pregnancy interval to 36 months.[2] Notably, Molitoris et al. showed that birth interval was associated with child survival

across developmental contexts, although it declined in importance at the more advanced levels of development.[8] Evidence of long birth intervals as a risk factor for infant mortality are inconsistent, with some studies finding an elevated risk of infant death associated with birth intervals over 60 months,[3,16-17] some finding a protective effect of increasing birth interval,[1] and others finding no evidence that birth intervals over 60 months are associated with a greater probability of mortality.[8] Based on the large body of literature that examined the association between birth interval and adverse infant and maternal outcomes, the World Health Organization (WHO) recommends that women space their births between 3 and 5 years apart to reduce the risks for mothers and children.[18]

Several potential mechanisms have been proposed to explain the relationship between birth interval (both long and short) and adverse outcomes. Mechanisms through which short birth-to-pregnancy intervals affect infant and child mortality include maternal nutritional depletion, the likelihood of care-seeking behavior, infection transmission, and sibling competition. Closely-spaced births may not allow women to fully recuperate from the previous pregnancy, which may lead to poorer nutrition, and particularly, folate depletion and physiological stress.[8,19] Women with shorter birth intervals may be burdened with the care for multiple dependent children and may be less likely to seek health care services that include prenatal care, post-natal care, and child vaccination.[19] Closely-spaced births may also put younger siblings at risk by exposing them to disease and illness from the older sibling, while having a less developed immune system and potentially being unvaccinated.[8,19] The theory of sibling competition states that closely-spaced children will be more likely to have to compete for limited resources such as food and parental time and investment.[8] Although the relationship between long birth intervals and poor child outcomes has not been firmly established, one suggested mechanism through which long birth-to-pregnancy intervals affect infant and child mortality is maternal regression. This theory suggests that the longer a woman lives without a subsequent pregnancy, the more her physiology resembles that of a first-time mother, including her risk of eclampsia and pre-eclampsia.[8]

There are many factors associated with short birth intervals, such as maternal age, age at reproductive initiation, parity, socioeconomic status, death of a previous child, postpartum abstinence, and duration of breastfeeding. A study in rural Bangladesh found that younger women, women who initiated childbearing later, and those with higher parity were less likely to experience short birth intervals.[20] Short birth intervals (<21 months) were more likely among women who were socioeconomically disadvantaged, and those who had a previous adverse outcome.[20] Younger women and women with higher parity may be less likely to experience shorter birth intervals because they may feel less pressure to tightly group their pregnancies in order to achieve their desired fertility.[20] Birth spacing is shortest among the most socioeconomically disadvantaged, which may be the result of the lack of physical or financial access to family planning services.[20] Previous adverse outcomes, such as prior infant or child death, may result in a replacement effect, in which women seek a more closely-spaced subsequent pregnancy.[20-21] Studies in Bangladesh and Ghana found that the birth after a deceased child tended to be shorter if the deceased child was a male.[21] Finally, interruption to breastfeeding is associated with a shorter birth-to-pregnancy interval, because it shortens the postpartum infecund period.[21]

1.3 Maternal Age

The association between maternal age and infant and child mortality has been extensively studied, but with inconsistent results. Studies have found adverse effects associated with both older and very young mothers,

although some researchers argue that much of the relationship being observed can be explained by confounding factors.[3,22-23] Two separate meta-analyses describe an increased risk for adverse perinatal outcomes with increasing age.[23,24] Higher rates of stillbirth and adverse perinatal outcomes among older women were documented in the literature, independent of parity and maternal comorbidities.[23,24] Some of the pathways that explain older maternal age as a risk factor include congenital anomalies and physiological changes to the reproductive system associated with aging.[23] Another potential mechanism that has not been extensively studied is advanced paternal age, which is often linked with advanced maternal age. Alio et al. found a 24% increase in the incidence of stillbirth with paternal age between 40 and 45, and a 50% increase in the rate of stillbirth with paternal age ≥45, while controlling for maternal age.[25]

The literature that examines young maternal age as a risk factor for infant and child mortality is extensive. After controlling for socioeconomics, demographics, and health service utilization, Neal, Channon and Chintsanya[26] found that a higher risk of neonatal mortality among adolescent mothers under age 16. Ganchimeg et al. found that even after controlling for country and facility-level effects, as well as individual demographic characteristics (including marital status, educational attainment and parity), the risks of adverse perinatal outcomes were higher with decreasing age.[27] Studies in Nigeria, Ethiopia, and Tanzania found that the risk of infant mortality was higher among younger mothers. In rural Ethiopia, infants of mothers age 15–19 were more than two times as likely to die than those of mothers age 25–29.[28] In studies from Tanzania and Nigeria, neonates and infants born to mothers under age 20 had a higher risk of death than those born to mothers age 30–39.[12,29]

Several pathways have been proposed to explain the higher rates of child mortality among young mothers. Younger women (< 20) are less likely to use health care services, have lower socioeconomic status, have completed less education, and to be experiencing their first pregnancy, all of which have been associated with higher rates of child mortality. [14,15,26,29] After controlling for these confounding socioeconomic factors, several studies have found more adverse outcomes among younger mothers compared to older mothers, which suggests that some biological factors may be involved. Adolescent mothers may be at greater risk of certain infections and diseases, including urinary tract infections, malaria, and hypertension in pregnancy, that can affect birth weight and length of gestation.[26] Very young mothers may also require additional energy for their own growth, which may lead to nutritional competition between the mother and fetus.[26] Biological immaturity, which can lead to infection, pre-term birth, low birthweight, and associated complications, has also been cited.[26-28,30] Some known risk factors for infant mortality may also vary by age. Schummers et al. found that the risk factors associated with short birth interval were highest among younger women.[14]

1.4 Birth Order

The evidence on birth order as a risk factor for child mortality is inconsistent.. The relationship between birth order and child mortality is often described as U-shaped with the first birth and higher-order births associated with greater mortality.[3] It is difficult to isolate the effects of birth order from other potential risk factors, including maternal age and parity, which is one explanation for the inconsistent results found in the literature. Younger women have typically had fewer births than older women, and there is often a relationship between higher parity and shorter birth-intervals, because some women may need to more closely space their births to achieve their aspirations of high parity.

Research suggests that first-births have an increased risk of dying compared to second or third order births.[3,31] Ogbo et al. found that firstborn children were at higher risk of both neonatal and under-5 mortality.[29] A study by Handa et al. found a protective effect of higher birth order, with a birth order higher than 3 associated with a reduction in relative risk of dying of 24 to 36%.[32] Since the authors controlled for maternal depletion in the model (through parity), this finding points to an experience effect, in which mothers with more children may be more experienced in keeping those children alive and healthy (Handa, Koch and Ng 2008). At the same time, evidence also points to a relationship between higher birth orders and greater risk of infant mortality. Even after adjusting for confounding factors, Neal and colleagues found that among adolescent mothers, the risk of child mortality was higher for a second or subsequent birth compared to first births in all regions studied, which included South and South-East Asia, sub-Saharan Africa, and Latin America and the Caribbean.[26] Udden et al. also found a positive association between child mortality and birth order in Bangladesh.[33] Rutstein and Winter, who analyzed data from 52 Demographic and Health Surveys (DHS), found that higher birth order does not have an effect on neonatal mortality, but does increase the risk of post-neonatal and under-5 mortality.[3] Some studies chose not to isolate the effects of birth order and birth-to-pregnancy interval. Studies in Tanzania and Nigeria found that children with a fourth or higher birth interval and a short interpregnancy interval ($\leq$ 2 years) were at a higher risk of neonatal, post-neonatal, and infant and under-5 mortality.[12,29] Maternal depletion, sibling competition, and poor health-seeking behavior have all been considered as explanations for the relationship between child mortality and higher birth order.

2 METHODS AND DATA

2.1 Methods

This study presents weighted summary statistics by survey for birth intervals, maternal age at birth, and birth order. All studies were then pooled (unweighted within or across surveys) to produce summary statistics, and bivariate and multivariate survival analysis. The benefit of pooling datasets is the creation of a large dataset that allows for better estimation of mortality risks and control of random sampling variation.

Birth recode files and individual recode (women's) files are used for this study. Analysis was preformed using R version 4.2.2. and RStudio version 2023.06.01. All code used in this study is available on the DHS Github: https://github.com/DHSProgram/DHS-Analysis-Code/tree/main/AS88_birthspacing. DHS data is available at https://dhsprogram.com/data/new-user-registration.cfm.

With this topic comes several challenges related to accurately measuring the impact of birth intervals, maternal age at birth, and birth order on mortality. One of the most common limitations is the inability to control for confounding factors. In many cases, this is unavoidable due to data limitations. For example, factors such as the mother's alcohol consumption, nutrition during pregnancy, smoking, BMI during pregnancy, and fetal anomalies are not available in many datasets. Studies that rely on retrospective data may be less accurate inreporting the dating of births, which may affect the estimates of birth intervals and maternal age at birth. Separating the effects of related aspects (maternal age at birth, birth interval, birth order, and breastfeeding) is another challenge. Most studies acknowledge these limitations and conduct analyses to best address these issues, when possible, by including pooledlarge datasets to better estimate effects, testing for multicollinearity, and building multivariate models that minimize the effects of the observed confounding variables, and performing sensitivity analyses that examine the potential role of unobserved or residual confounding.

2.2 Dependent Variables

This study includes 6 childhood mortality outcomes:

- ENN–Early neonatal mortality, death at 0–6 days after birth
- NN–Neonatal mortality, death at 0–30 days and <1 month after birth
- PNN–Post–neonatal mortality, death at 1–11 months after birth
- IMR–Infant mortality, death at 0–11 months after birth
- Child mortality, death at 12–59 months after birth
- Under–5 mortality, death at 0–59 months after birth

For the 4 measures that focus on the first year of life, births in the 59 months before a survey are included; for the remaining two measures, the timeline is extended to 179 months before the survey. The retrospective data are limited to 179 months, or 15 years, because only women who gave birth before the age of 35 15 years ago were eligible to be interviewed at the time of survey (which interviews women age 15–49). This potentially biases the sample and limits our observations of births at older ages. For the mortality risks

under 1 year, we limit births to the previous 5 years in order to create control variables from survey questions that are asked only about births in this window.

All measures use life-table probabilities of mortality based on survival status and age at death.

Birth recode files are used in this analysis. To learn more about the structure of DHS datasets and variable naming conventions, visit dhsprogram.com/Data/Guide-to-DHS-Statistics/index.cfm. In each household selected for a DHS interview, all women age 15–49 are interviewed (except in Afghanistan, Bangladesh, Egypt, Jordan, and Pakistan where only ever married are interviewed) and provide a complete birth history, with a listing of all births. In the birth recode file, each birth is an observation, which means that the same mother can be presented several times in the dataset. If a child has since died, information about age at death is recorded. For early neonatal and neonatal mortality, variable b6 is used, which records death in days up to the first month, then by month up until 2 years, then by year. For the other four outcome variables, variable b7 is used, which contains imputed age at death in months. Each outcome measure uses two variables: the time at death or censoring (in days for early neonatal and neonatal mortality and in months for all others), and an indicator for if a death occurred or the observation was censored. Post-neonatal mortality and child mortality both include left hand censoring for children who died before reaching the age range of these mortality rates (for example, children who died in the first month of life cannot die in months 1–11).

2.3 Key Independent Variables

Three key independent variables are included in this study: time from birth to next conception, mother's age at birth, and birth order.

The length of the preceding birth-to-conception interval includes the months from the birth of one child to the conception of the next child (the index child). This interval is only applicable to 2nd and higher order births. The date of birth is stored as a century month code (CMC) for each child. Date of conception is calculated by subtracting length of gestation from date of birth. If a survey contains a contraceptive/reproductive calendar, we directly calculate the length of gestation for the index child's pregnancy by totaling how many months the women reported being pregnant/giving birth in that calendar event. When a survey does not include a calendar or the conception occurred before the start of the calendar, gestation is assumed to be 9 months. By taking the date of conception for the index child and subtracting it from the date of birth of the child born before the index child, we calculate the length of the preceding birth-to-conception interval. The interval is categorized into the same 11 groups as the previous studies in this series: under 6 months, 6–11 months, 12–17 months, 18–23 months, 24–29 months, 30–35 months, 36–47 months, 48–59 months, 60–95 months, 95+ months, and first birth. For all non-first births, the weighted mean and median interval lengths are calculated.

Maternal age at birth is calculated as the difference between the CMC for mother's birth (v011) and child's birth (b3), and is then grouped into 5 categories: under age 18, 18–24, 25–34, 35–39, and 40+.

Birth order is based off variable bord. As in the most recent study, for summary statistics and bivariate statistics, birth order is grouped into first, second, third-fourth, fifth-six, and seven plus. For the multivariate analysis, the groups are condensed into first-second, third-fourth, fifth-six, and seven plus. Because most

DHS do not include a full pregnancy history, pregnancies that do not result in live births are not included in this measure. Birth order is child specific, and it is not the parity of mother at the time of interview.

We created two additional summary measures to examine potential interactions in the three key independent variables. First, we define which categories of each variable we treat as high risk:

- Birth to conception interval: under 24 months, 24–35 months
- Maternal age: under 18, over 40
- Birth order: (unavoidable) first birth, 4 plus

A birth could have none, one, two, or 3 risks. There are 21 combinations of risk groups, although the number of births in some categories are very small (such as double risk parity 4 plus and maternal age under 18). We look at summary statistics, bivariate, and multivariate analysis for the 21 categories of risk, as well as a simplified measure that includes no risk, unavoidable first birth, single, double, and triple risk (regardless of risk categories).

For the bivariate and multivariate analysis, the R package "survival" is used. Coefficients are exponentiated to give relative risk ratios, and 95% confidence intervals are available in exponentiated form using the summary option for the Cox proportional hazard model.

2.4 Control Variables in the Multivariate Analysis

Many variables could act as confounding variables between the key independent variables and mortality. One factor, multiplicity of births, is controlled for by excluding non-singleton births. Other factors serve as control variables in the multivariate analysis. Because we include two different time restrictions (births in the last 59 months when looking at mortality rates under the age of one, and 179 for older child mortality), some variables of interest are only available for more recent birth because of the structure of the DHS questionnaire. This study includes the same set of control variables as in Rutstein and Winter 2014,[3] which allowed us to compare results. The list of variables is listed below.

For all multivariate analysis (children born 0–59 and 0–179 months before the survey):

- Sex of index child
- Type of place of residence
- Mother's highest level of education
- Wealth index quintile
- Household has refrigerator
- Type of toilet/latrine
- Source of drinking water
- Length of gestation (months)
- Survival of preceding child

For multivariate analysis with only children born in the last 59 months:

- Outcome of preceding pregnancy
- Time wanted pregnancy
- Pregnancy was result of contraceptive failure
- Prenatal care provider
- Delivery care provider
- Number of tetanus shots during pregnancy
- Timing of first antenatal check

Several variables require no recoding: sex (b4), residence (v025), mother's education (v106), wealth quintile (v190), and time wanted pregnancy (m10). Another set of indicators use one DHS variable with grouped answers: household has refrigerator (v122), type of toilet/latrine (v116), source of drinking water (v133), and number of tetanus shots (m1). Timing of the first antenatal visit combines information on if there were any antenatal visits (m14) and the timing of the first visit (m13). Prenatal and delivery providers are created by combining m2a-m2n (for prenatal) and m3a-m3n (for delivery). All the above variables are available in the birth recode files.

Using the women's recode file, if a survey contains a contraceptive/reproductive calendar, we directly calculate the length of gestation. When a survey does not include a calendar or conception occurred before the start of the calendar, gestation is assumed to be 9 months.

Also using the contraceptive calendar, we determine if a pregnancy was the result of a contraceptive failure. We look at the month prior to conception to see if contraception was used (vcal_1), and if so, if the reason for discontinuation (vcal_2) was "contraceptive failure." A birth that was not a result of a contraceptive failure is categorized as "not result of contraceptive failure." When there is no calendar or the conception took place before the start of the calendar, it is categorized as "not asked." Using the caseid variable for the mother and the CMC of birth of the child, we merge this information into the birth recode.

Finally, using the contraceptive calendar, we can look at the pregnancy outcome of the pregnancy immediately preceding the pregnancy of the index child (coded as B for birth and T for termination) in vcal_1. For cases in which there is an end to a pregnancy before the pregnancy of the index child in the calendar, we can see if this was a birth or termination (which groups together miscarriages, still births, and abortions). If the preceding pregnancy was a birth or termination, the variable is recoded accordingly. If the index child was the first born (bord=1) and the mother reports never having a terminated pregnancy (v228=0), the outcome of the preceding pregnancy is recorded as "not available" because we do not recode as first birth due to collinearity. If the child is not the first born and a woman reports no terminations, we assume the preceding pregnancy ended in live birth. Finally, if we do not have information on the preceding pregnancy (it is not in the calendar or there is no calendar) and a women reported that she has had terminations in the past, we recode the variable as "not available" because we are unable to determine when the termination(s) occurred. Using the caseid variable for the mother and the CMC of birth of the child, we merge gestation length, contraceptive failure, and outcome of preceding pregnancy information into the birth recode.

To determine if the preceding child was alive at the conception of the index child, we use the birth recode file. If a child is dead at the time of the survey, we have their CMC of death. We then create a birth order variable (bord), which is the ID of the child born directly after the dead child. We relabel this edited dataset with a new name (new older child) and merge it into the birth recode file, so that the CMC of death of the closest older sibling is merged with the index child's information. We take the CMC of conception (discussed above) and determine if the preceding child died or did not die before conception of the index child. First born children are assigned "preceding child did not die." They cannot have a separate first born category because we already have first born as a separate category when looking at birth order and our grouped risk variables.

2.5 Analysis Methodology

Summary statistics are calculated for the key independent variables for all surveys (using survey weights) and for a pooled dataset of all surveys. Each summary statistics table shows the distribution of the variables, and when applicable, a mean and median.

Pooled data are used for all bivariate and multivariate analysis, by using the Cox proportional hazard models and the Survival package in R. For each mortality measure, a birth contains information on if the child died in the period or survived/observation was censored, as well as the age at death. Unadjusted models were run first, followed by multivariate models, using the control variables described above. Results are shown as exponentiated coefficients, and display adjusted risk ratios.

2.6 Data

Data for this study come from 84 national surveys from 56 countries collected by the DHS Program between 2012 and 2022. The DHS has collected nationally representative surveys since 1984 and is funded principally by USAID.

We do not include 2012 surveys which were included in the 2014 report on mortality and birth spacing. All surveys included in this report were publicly available in July 2023. Table 1 lists all countries and survey years included in this analysis.

Table 1 List of surveys, by country

Countries and survey years	
Afghanistan 2015	Liberia 2013, 2019–20
Albania 2017–18	Madagascar 2021
Angola 2015–16	Malawi 2015–16
Armenia 2015–16	Maldives 2016–17
Bangladesh 2014, 2017–18	Mali 2012–13, 2018
Benin 2017–18	Mauritania 2019–2021
Burundi 2016–17	Mozambique 2015
Cambodia 2014, 2021–2022	Myanmar 2015–16
Cameroon 2018	Namibia 2013
Chad 2014–15	Nepal 2016, 2022
Colombia 2015	Niger 2012
Comoros 2012	Nigeria 2013, 2018
Congo Democratic Republic 2013–14	Pakistan 2012–13, 2017–18
Dominican Republic 2013	Papua New Guinea 2016–2018
Egypt 2014	Philippines 2013, 2017, 2022
Ethiopia 2016, 2019	Rwanda 2014–15, 2019
Gabon 2012, 2019–21	Senegal 2012–13, 2014, 2015, 2016, 2017, 2018, 2019
Gambia 2013, 2019	Sierra Leone 2013, 2019
Ghana 2014	South Africa 2016
Guatemala 2014–15	Tajikistan 2012, 2017
Guinea 2012, 2018	Tanzania 2015–16
Haiti 2012, 2016–17	Timor-Leste 2016
India 2015–16, 2019–2021	Togo 2013–14
Indonesia 2012, 2017	Turkey 2013
Jordan 2012, 2017–18	Uganda 2016
Kenya 2014, 2022	Yemen 2013
Kyrgyz Republic 2012	Zambia 2013–14, 2018
Lesotho 2014	Zimbabwe 2015

2.7 Creation of the Pooled Data Set

For pooled survey data, each birth recode file (and calendar information if available) was loaded into R with selected variables, and combined into one large dataset, before creating the needed variables. Finally, two polled datasets were created, one with all births in 179 months before surveys with 3,735,351 births, and the other with births 59 months before surveys with 1,280,024 births.

3 RESULTS

3.1 Univariate Analysis

Univariate results are presented for the preceding birth to conception interval, maternal age at birth, birth order, a combination of all risk groups, and a simplified combination of all risk groups. All univariate results include birth in the 179 months before a survey interview. Weighted results are presented for each survey and unweighted results are shown for pooled surveys. With two surveys included (2015–2016 and 2019–2021), India contributes the largest number of births, over 1.5 million, to this analysis. The next largest is Nigeria (surveys in 2013 and 2018) with 170,000 births, and Senegal (surveys in 2012–13, 2014, 2015, 2016, 2017, 2018, and 2019) with 130,000 births. Albania (2017–18), Armenia (2015–16), Comoros (2012), Lesotho (2014), Maldives (2016–17), Mozambique (2015), and South Africa (2016) contributed less than 10,000 births in this analysis.

3.2 Preceding Birth to Conception Interval

Overall, 12.7% of births in the pooled sample occurred in the first year after birth, with 4.6% of all intervals in the first 6 months (Table 2). Yemen and Pakistan had the largest share of conceptions within 6 months of birth (13.2% in Yemen (2013) and 10.9% in Pakistan (2012–2013) and 10.3% in Pakistan (2017–2018). Afghanistan (2015) and Comoros (2012) had over 9% of births in this interval. These countries also all had over 20% of their births conceived within a year of delivery. Chad (2014–15) also had 20% of births conceived within a year of another birth, and Jordan was similar with 19.6% (2012 survey) and 18.5 (2017–2018). Chad had the highest share of conceptions within 2 years of a previous birth: 57.6%, followed by Afghanistan: 56.8%; Niger (2012): 56.8%; Pakistan: (2012–2013) 53.2%; Yemen: 51%; and Pakistan (2017–2018): 50.9%. In the pooled dataset, 24.9% of births were conceived 12–23 months after a previous birth, for a total of 37.6% within 2 years of birth.

The share of births that were first births ranged from 17.4% in Chad to 46.4% in Armenia (2015–2016). Five other countries had first births that represented over 40% of births: Albania (2017–2018), Colombia (2015), Maldives (2016–2017), Mozambique (2015), and South Africa (2016). In the pooled dataset, 29.6% of births were first births.

The mean birth to conception interval ranged from 20.2 months in Afghanistan to 53 months in South Africa, with 28.8 months on average in the pooled dataset.

Table 2 Distribution of births 0 to 179 months prior to survey by duration of preceding birth to conception interval, 84 DHS surveys, 2012 to 2022

		Preceding birth to conception interval in months (%)										First			
Country	Year	<6	6-11	12-17	18–23	24–29	30–35	36–47	48–59	60–95	96+	births	Mean	Median	N
Afghanistan	2015	9.9	11.6	22.3	13.0	8.5	5.1	5.7	2.6	2.1	0.5	18.7	20.2	17	90,584
Albania	2017–18	1.7	3.7	5.6	4.9	5.9	5.2	10.2	6.7	10.2	4.0	41.9	42.3	38	8,887
Angola	2015–16	6.0	8.2	15.9	13.4	9.7	6.3	7.3	3.8	4.2	1.5	23.6	26.5	21	32,088
Armenia	2015–16	3.7	7.8	7.1	4.9	5.0	4.3	6.1	4.2	6.7	3.8	46.4	36.7	27	5,009
Bangladesh	2017–18	2.5	4.1	6.9	5.6	6.1	4.7	9.2	7.5	12.3	4.9	36.2	44.3	38	26,788
Bangladesh	2014	2.9	4.7	8.1	6.8	6.8	5.3	9.3	6.5	10.4	4.0	35.2	41.1	33	25,517
Benin	2017–18	2.8	7.0	13.7	15.9	12.1	8.0	8.8	3.7	3.8	1.0	23.2	27.7	23	32,478
Burundi	2016–17	3.9	8.1	16.2	15.6	12.6	8.0	8.5	3.2	2.4	0.5	21.0	24.9	22	34,004
Cambodia	2021–2022	1.7	3.6	6.6	6.1	5.8	5.3	8.8	7.0	10.9	4.8	39.4	43.7	37	23,241
Cambodia	2014	2.7	5.3	10.0	8.4	8.2	6.1	8.8	6.0	7.9	2.6	33.9	36.3	28	20,961
Cameroon	2018	5.0	9.3	17.2	13.2	8.9	5.7	7.3	3.6	3.9	1.4	24.5	26.9	20	24,006
Chad	2014–15	7.3	12.7	22.4	15.2	8.8	5.9	5.5	2.2	2.0	0.5	17.4	20.8	17	50,878
Colombia	2015	2.5	5.7	6.8	5.8	4.8	3.8	6.7	4.8	10.0	7.2	41.8	44.8	35	35,975
Comoros	2012	9.6	10.5	16.1	10.7	8.0	5.6	7.0	3.9	4.4	1.1	23.2	24.7	18.5	8,004
Congo Democratic Republic	2013–14	5.4	9.9	17.1	14.7	10.6	6.5	7.0	3.0	3.1	1.0	21.7	24.6	20	43,982
Dominican Republic	2013	4.3	7.6	8.5	6.7	5.9	4.4	8.0	5.2	8.8	4.3	36.3	36.6	28	10,582
Egypt	2014	3.8	6.4	9.7	9.7	9.1	6.2	8.8	5.4	6.3	2.3	32.2	33.1	26	39,294
Ethiopia	2019	7.7	9.1	15.9	10.7	9.4	6.1	8.8	4.8	5.1	1.9	20.5	27.2	21	15,808
Ethiopia	2016	6.9	9.4	16.5	12.1	10.7	6.7	8.2	4.1	4.3	1.2	19.9	25.7	21	29,720
Gabon	2019–21	3.3	6.2	10.8	9.3	7.6	5.7	8.0	5.9	8.2	4.5	30.5	34.5	27	15,499
Gabon	2012	4.0	5.7	11.2	9.9	8.2	5.5	8.7	5.3	7.9	4.2	29.6	32.4	27	14,837
Gambia	2019	2.1	6.0	14.3	16.3	12.6	7.4	8.7	4.3	4.0	1.4	23.0	27.9	23	22,382
Gambia	2013	2.7	6.3	13.7	15.2	11.8	7.3	8.7	4.7	4.4	1.4	23.6	28.8	24	19,247
Ghana	2014	1.9	5.8	11.1	10.9	9.8	7.6	10.6	6.1	7.7	2.7	25.6	34.8	28	15,358
Guatemala	2014–15	2.9	7.9	13.5	11.0	7.8	5.4	7.9	5.0	6.8	2.6	29.1	32.2	24	34,893
Guinea	2018	2.4	4.8	16.0	11.1	14.5	7.3	8.9	4.5	5.0	1.6	23.9	30.2	25	20,476
Guinea	2012	1.2	5.2	14.4	13.4	14.9	9.0	9.8	4.3	4.2	1.3	22.2	29.7	25	18,918
Haiti	2016–17	3.5	6.8	11.4	10.4	7.4	5.9	8.0	5.1	7.5	3.3	30.6	33.8	25	17,942
Haiti	2012	3.5	7.8	12.9	10.3	8.5	5.8	7.8	4.7	5.9	2.9	30.0	31.2	24	19,214
India	2019–2021	4.2	8.3	12.5	9.3	7.2	4.9	6.6	3.8	4.2	1.2	37.8	27.8	21	731,751
India	2015–16	4.9	7.9	13.7	9.6	7.8	5.0	6.7	3.7	3.8	1.1	35.8	26.6	21	795,094
Indonesia	2017	1.7	3.2	4.6	4.3	4.5	3.8	7.9	7.3	15.7	10.0	37.1	51.0	50	53,309
Indonesia	2012	2.1	3.7	5.7	4.8	4.7	3.9	7.9	7.0	14.6	8.2	37.3	47.1	45	52,456
Jordan	2017–18	7.0	11.5	12.0	9.1	7.1	5.6	9.1	5.0	6.2	1.5	25.8	27.0	22	30,778
Jordan	2012	6.5	13.1	13.7	10.2	7.8	5.7	8.8	5.2	4.9	1.4	22.9	25.9	20	27,734
Kenya	2022	3.7	6.3	10.8	9.3	7.5	5.4	8.8	6.1	8.7	3.9	29.6	33.3	27	52,579
Kenya	2014	4.0	7.4	13.2	11.5	8.8	6.0	8.3	5.1	6.2	2.4	27.0	29.5	24	58,891
Kyrgyz Republic	2012	3.1	8.3	10.8	7.9	6.1	4.3	7.4	5.8	8.8	4.7	32.8	37.4	26	10,328
Lesotho	2014	1.4	3.2	6.9	7.9	8.4	6.3	9.5	6.1	8.6	4.1	37.6	40.5	33	8,028
Liberia	2019–20	3.6	6.8	11.1	11.2	9.0	6.1	9.1	5.8	7.6	3.4	26.3	32.0	26	16,201
Liberia	2013	3.9	7.1	13.1	11.9	9.9	6.7	8.5	5.1	6.3	2.7	24.7	30.2	24	20,458
Madagascar	2021	5.0	7.5	12.7	9.4	7.9	5.7	8.8	5.2	7.3	2.9	27.5	32.4	25	32,821
Malawi	2015–16	3.3	5.4	10.4	11.5	11.8	8.2	11.5	5.9	5.7	1.1	25.2	31.7	27	47,171
Maldives	2016–17	1.5	4.4	5.7	5.2	4.4	4.2	7.6	6.5	12.0	6.6	41.7	48.0	41	8,422
Mali	2018	4.8	9.5	18.0	15.2	10.2	6.6	7.4	3.6	3.4	0.8	20.6	25.0	20	24,987
Mali	2012–13	5.7	8.5	17.3	13.4	9.8	6.7	7.6	3.8	3.8	1.1	22.2	26.1	20	26,289
Mauritania	2019–2021	7.0	9.7	16.7	11.4	10.0	6.0	7.9	3.9	3.9	1.3	22.1	25.8	20	29,769

Continued…

Table 2—*Continued*

Country	Year	Preceding birth to conception interval in months (%)										First births	Mean	Median	N
		<6	6-11	12-17	18–23	24–29	30–35	36–47	48–59	60–95	96+				
Mozambique	2015	2.1	3.9	11.9	14.4	11.2	6.7	6.1	2.1	0.5	0.0	41.2	24.1	22	3,620
Myanmar	2015–16	2.9	5.0	8.5	7.3	6.7	6.0	9.2	7.2	10.2	4.4	32.6	37.6	33	14,711
Namibia	2013	2.2	4.1	8.5	8.9	6.9	5.4	9.2	6.8	9.6	4.7	33.6	41.1	32	12,505
Nepal	2022	2.7	6.0	9.7	7.5	6.6	5.0	8.1	5.6	6.9	2.8	39.3	34.1	27	16,135
Nepal	2016	3.5	7.5	11.6	9.6	8.0	5.9	8.0	4.7	5.2	1.5	34.5	29.9	24	15,709
Niger	2012	7.6	9.0	23.4	14.2	11.6	5.4	6.3	2.6	2.0	0.4	17.5	22.2	18	33,213
Nigeria	2018	4.1	10.1	20.0	14.4	10.0	6.3	6.9	3.2	3.1	1.0	20.9	24.9	19	87,879
Nigeria	2013	4.4	8.2	20.8	14.1	10.9	6.2	7.1	3.4	3.4	1.0	20.5	25.3	20	81,637
Pakistan	2017–18	10.3	13.2	16.5	10.9	7.7	4.4	6.2	3.0	3.1	0.6	24.1	22.6	17	35,303
Pakistan	2012–13	10.9	12.5	18.3	11.5	8.3	5.1	5.9	2.7	2.6	0.7	21.6	21.7	17	33,747
Papua New Guinea	2016–2018	4.9	8.6	13.3	11.7	9.0	6.2	8.3	4.6	5.4	2.0	26.0	29.9	23	24,919
Philippines	2022	4.3	7.9	9.2	7.6	6.5	4.5	7.4	5.5	9.6	5.1	32.5	37.6	28	28,776
Philippines	2017	5.0	9.5	10.4	8.4	6.4	4.8	7.3	4.9	7.2	3.6	32.5	33.1	24	31,279
Philippines	2013	5.2	10.3	11.7	9.0	6.6	4.7	7.1	4.6	6.9	3.2	30.6	31.7	22	20,831
Rwanda	2019	2.6	6.0	11.3	11.5	9.8	6.9	9.7	5.6	7.0	2.1	27.5	33.2	26	21,196
Rwanda	2014–15	3.3	7.3	13.7	13.0	10.7	7.1	8.4	4.5	4.7	1.2	26.1	28.8	23	21,728
Senegal	2019	2.3	7.0	14.8	14.9	10.7	7.1	8.4	4.9	4.1	1.4	24.4	27.9	23	16,029
Senegal	2018	2.6	6.9	15.0	14.6	11.4	7.1	8.8	4.2	4.3	1.0	24.0	27.3	23	17,483
Senegal	2017	3.2	7.3	15.5	14.6	11.5	6.6	8.1	4.0	4.2	1.4	23.6	27.3	22	31,444
Senegal	2016	2.5	6.7	14.9	14.7	12.1	7.2	8.4	4.2	4.0	1.2	24.2	27.2	23	16,840
Senegal	2015	2.1	6.5	15.3	15.5	12.1	7.6	8.1	4.3	3.7	1.3	23.4	27.3	23	17,212
Senegal	2014	2.7	6.8	16.1	14.9	11.3	6.8	8.4	3.7	3.8	1.3	24.2	27.0	22	16,440
Senegal	2012–13	2.8	7.3	16.0	14.9	11.5	6.7	8.4	4.0	3.8	1.2	23.5	26.9	22	16,418
Sierra Leone	2019	2.8	6.2	13.6	11.1	9.7	7.0	9.3	5.5	6.8	2.5	25.7	32.7	25	27,103
Sierra Leone	2013	3.5	7.3	16.0	13.4	9.8	7.0	8.4	4.7	5.2	2.0	22.7	29.6	23	32,640
South Africa	2016	2.0	3.4	5.0	5.1	4.6	4.5	7.9	7.1	11.8	8.6	40.1	53.0	43	9,372
Tajikistan	2017	5.4	12.0	13.1	9.0	6.8	4.5	6.3	3.8	5.2	2.0	31.9	29.0	20	14,860
Tajikistan	2012	5.0	10.8	13.8	10.6	8.1	5.2	7.4	4.2	5.1	1.7	27.9	29.1	21	12,736
Tanzania	2015–16	2.9	6.8	14.3	13.9	10.6	6.7	8.2	5.1	5.7	1.7	24.2	29.4	24	25,414
Timor-Leste	2016	5.8	11.1	17.2	12.6	9.3	5.4	7.3	3.6	3.8	1.1	22.8	25.1	19	20,728
Togo	2013–14	2.8	6.4	11.5	12.3	11.2	9.0	9.9	5.1	5.2	1.7	24.8	30.3	26	18,483
Turkey	2013	4.1	7.3	7.1	6.3	5.7	5.1	8.0	5.6	9.8	5.0	36.1	37.5	31	10,736
Uganda	2016	5.2	9.5	17.7	14.3	10.3	6.4	7.1	3.4	3.4	1.1	21.6	25.0	20	40,119
Yemen	2013	13.2	12.8	15.2	9.8	8.1	5.2	6.8	3.7	3.8	0.8	20.6	22.6	17	45,899
Zambia	2018	2.7	5.7	12.3	13.0	11.6	7.7	10.1	5.3	5.8	1.3	24.5	30.2	25	26,490
Zambia	2013–14	2.7	6.4	13.8	15.4	12.5	7.8	9.3	4.3	4.3	1.1	22.5	28.4	24	34,808
Zimbabwe	2015	1.9	3.5	7.2	8.6	8.7	7.6	12.2	7.3	9.5	3.3	30.3	40.8	33	14,756
Total		4.6	8.1	14.0	10.9	8.6	5.7	7.5	4.2	4.9	1.7	29.6	28.8	22	3,732,837

Note: Percent distributions are based on weighted cases for all individual countries. The total percent distribution, however, is based on unweighted cases because the application of standard individual country weights is not meaningful in the pooled sample and analyses using the pooled data that are unweighted.

3.3 Maternal Age at Birth

In the pooled dataset, 6.8% of births were to women younger than 18 (Table 3). This ranged from less than 1% in Maldives (2016–2017), Tajikistan (2017), and Kyrgyz Republic (2012) to over 17% in Bangladesh (17.1% in the 2017–2018 survey and 19.1 in the 2014 survey). In the pooled dataset and 25 surveys, over 50% of births are to women under age 25.

Only 1.6% of births in the pooled dataset were to women over 40, with the lowest at 0.3% in Armenia and the highest at 4.6% in Mozambique. The countries with the most births to women over 35 were in Rwanda (2019) at 15.6% and Mauritania (2019–2021) at 15.2%. The mean age at birth ranged from under age 24 in both Bangladesh surveys to over 28 in both Jordan surveys, Timor-Leste, Myanmar, and Rwanda (2019). The mean for the pooled dataset was 25.8.

Table 3 Distribution of births 0 to 179 months prior to survey by the mother's age at child's birth, 84 DHS surveys, 2012 to 2022

		Mother's age at child's birth in years (%)							
Country	Year	<18	18–24	25–34	35–39	40+	Mean	Median	N
Afghanistan	2015	8.1	40.4	41.0	8.3	2.2	26.1	25.2	90,584
Albania	2017–18	1.8	37.7	54.2	5.6	0.6	26.8	26.3	8,887
Angola	2015–16	12.1	37.8	38.3	9.2	2.6	25.7	25.0	32,088
Armenia	2015–16	1.4	52.1	43.0	3.2	0.3	25.2	24.5	5,009
Bangladesh	2017–18	17.1	47.5	31.8	3.2	0.4	23.5	22.5	26,788
Bangladesh	2014	19.1	47.1	29.9	3.4	0.4	23.3	22.2	25,517
Benin	2017–18	6.5	38.6	43.2	9.1	2.6	26.6	25.8	32,478
Burundi	2016–17	3.5	35.1	47.1	10.9	3.3	27.7	26.9	34,004
Cambodia	2021–2022	2.9	35.6	52.2	7.8	1.5	26.8	26.6	23,241
Cambodia	2014	3.2	40.8	45.9	8.1	1.9	26.7	25.8	20,961
Cameroon	2018	10.5	39.6	41.0	7.3	1.6	25.6	24.9	24,006
Chad	2014–15	13.4	39.2	37.8	7.6	2.0	25.3	24.5	50,878
Colombia	2015	11.3	42.9	37.9	6.8	1.1	25.1	24.2	35,975
Comoros	2012	7.6	34.4	46.3	9.4	2.2	26.6	26.3	8,004
Congo Democratic Republic	2013–14	8.2	38.2	41.9	9.2	2.5	26.4	25.6	43,982
Dominican Republic	2013	12.6	45.4	36.3	4.9	0.8	24.2	23.7	10,582
Egypt	2014	3.4	43.4	45.9	6.3	1.1	26.3	25.4	39,294
Ethiopia	2019	11.6	39.3	40.3	7.1	1.7	25.3	24.8	15,808
Ethiopia	2016	8.7	38.7	42.3	8.2	2.1	26.0	25.3	29,720
Gabon	2019–21	9.1	36.8	42.4	9.5	2.2	26.4	25.8	15,499
Gabon	2012	12.3	38.5	38.7	8.3	2.2	25.9	24.8	14,837
Gambia	2019	6.2	36.2	46.0	9.3	2.3	26.8	26.3	22,382
Gambia	2013	8.1	38.1	43.2	8.2	2.5	26.2	25.6	19,247
Ghana	2014	6.2	31.7	48.1	11.1	2.8	27.5	27.2	15,358
Guatemala	2014–15	9.3	41.7	39.8	7.7	1.6	25.7	24.8	34,893
Guinea	2018	12.0	35.6	40.4	9.1	2.9	26.2	25.3	20,476
Guinea	2012	13.4	36.1	39.6	8.5	2.5	25.8	25.0	18,918
Haiti	2016–17	6.3	35.1	44.5	11.0	3.1	27.3	26.7	17,942
Haiti	2012	6.7	36.3	42.9	10.8	3.2	27.2	26.3	19,214
India	2019–2021	5.5	53.9	37.4	2.8	0.4	24.8	23.8	731,751
India	2015–16	6.4	53.3	36.6	3.2	0.5	24.9	23.8	795,094
Indonesia	2017	2.9	32.1	52.2	10.6	2.1	27.8	27.5	53,309
Indonesia	2012	3.6	34.7	49.6	10.1	2.0	27.2	26.9	52,456
Jordan	2017–18	2.6	31.1	52.9	11.2	2.1	28.0	27.5	30,778
Jordan	2012	1.6	31.4	53.6	11.2	2.3	28.3	27.6	27,734

Continued…

Table 3—*Continued*

Country	Year	Mother's age at child's birth in years (%)					Mean	Median	N
		<18	18–24	25–34	35–39	40+			
Kenya	2022	7.5	40.4	42.6	7.8	1.8	26.2	25.3	52,579
Kenya	2014	9.0	41.7	40.2	7.4	1.7	25.8	24.8	58,891
Kyrgyz Republic	2012	0.9	45.2	44.6	7.7	1.6	26.6	25.5	10,328
Lesotho	2014	6.8	45.9	38.0	7.2	2.1	25.6	24.5	8,028
Liberia	2019–20	11.7	38.3	38.5	8.8	2.7	26.3	25.0	16,201
Liberia	2013	11.4	38.4	38.9	8.7	2.6	26.1	25.0	20,458
Madagascar	2021	13.6	38.5	37.3	8.3	2.3	25.5	24.5	32,821
Malawi	2015–16	10.3	43.3	37.2	7.2	2.0	25.3	24.3	47,171
Maldives	2016–17	0.4	35.5	54.5	8.4	1.3	27.3	26.8	8,422
Mali	2018	10.5	38.0	41.0	8.4	2.1	25.9	25.2	24,987
Mali	2012–13	12.8	38.6	39.2	7.4	2.0	25.4	24.7	26,289
Mauritania	2019–2021	8.8	32.6	43.4	11.4	3.8	27.2	26.6	29,769
Mozambique	2015	13.8	37.8	34.3	9.6	4.6	25.8	24.7	6,134
Myanmar	2015–16	2.7	31.6	51.0	11.9	2.8	28.2	27.7	14,711
Namibia	2013	7.2	38.3	42.4	9.6	2.6	26.5	25.8	12,505
Nepal	2022	8.2	52.3	36.1	3.0	0.4	24.3	23.5	16,135
Nepal	2016	8.5	52.0	35.3	3.5	0.6	24.3	23.5	15,709
Niger	2012	11.8	39.0	38.7	8.2	2.4	25.7	24.8	33,213
Nigeria	2018	8.3	35.8	43.9	9.4	2.6	26.7	26.0	87,879
Nigeria	2013	9.7	35.6	42.5	9.3	2.8	26.6	25.8	81,637
Pakistan	2017–18	4.1	38.3	49.1	7.1	1.5	26.7	26.1	35,303
Pakistan	2012–13	4.1	37.9	48.5	7.8	1.6	26.8	26.2	33,747
Papua New Guinea	2016–2018	6.1	37.1	44.7	9.2	2.9	26.9	26.1	24,919
Philippines	2022	3.9	34.7	47.8	11.1	2.5	27.6	27.1	28,776
Philippines	2017	4.0	36.7	46.4	10.4	2.5	27.3	26.6	31,279
Philippines	2013	3.7	35.0	47.4	10.9	3.0	27.6	27.0	20,831
Rwanda	2019	1.6	29.4	53.3	12.4	3.2	28.5	28.1	21,196
Rwanda	2014–15	2.1	33.2	51.0	10.9	2.9	27.9	27.2	21,728
Senegal	2019	5.9	35.0	45.4	10.6	3.2	26.8	26.7	16,029
Senegal	2018	5.8	34.0	46.4	10.8	2.9	27.0	26.8	17,483
Senegal	2017	6.4	34.6	45.4	10.6	3.0	26.8	26.6	31,444
Senegal	2016	6.4	36.2	44.3	9.7	3.2	26.6	26.2	16,840
Senegal	2015	6.5	36.5	44.7	9.8	2.6	26.7	26.2	17,212
Senegal	2014	7.1	35.3	44.0	10.4	3.2	26.6	26.2	16,440
Senegal	2012–13	6.8	36.8	43.4	10.0	3.1	26.7	26.2	16,418
Sierra Leone	2019	10.5	37.6	41.1	8.3	2.3	26.1	25.2	27,103
Sierra Leone	2013	11.6	37.1	39.9	8.6	2.7	26.0	25.2	32,640
South Africa	2016	7.9	39.2	42.5	8.4	2.0	26.2	25.6	9,372
Tajikistan	2017	0.4	51.3	42.5	5.1	0.6	26.0	24.8	14,860
Tajikistan	2012	1.1	45.3	45.2	7.1	1.3	26.5	25.5	12,736
Tanzania	2015–16	7.5	38.9	41.2	9.7	2.7	26.7	25.7	25,414
Timor-Leste	2016	2.6	33.0	49.9	11.4	3.1	28.0	27.5	20,728
Togo	2013–14	5.9	35.3	46.1	9.8	2.9	27.2	26.5	18,483
Turkey	2013	2.8	39.3	50.5	6.6	0.9	26.5	26.1	10,736
Uganda	2016	9.1	40.7	39.8	8.4	2.2	25.9	25.0	40,119
Yemen	2013	8.2	40.0	41.5	8.1	2.2	26.2	25.2	45,899
Zambia	2018	10.0	39.4	39.4	8.8	2.3	26.0	25.1	26,490
Zambia	2013–14	9.1	40.4	39.9	8.2	2.3	25.9	25.0	34,808
Zimbabwe	2015	7.8	42.8	41.0	7.1	1.3	25.6	24.8	14,756
Total		6.8	43.5	41.4	6.7	1.6	25.8	24.9	3,735,351

Note: Percent distributions are based on weighted cases for all individual countries. The total percent distribution, however, is based on unweighted cases, because the application of standard individual country weights is not meaningful in the pooled sample and analyses using the pooled data are unweighted.

3.4 Birth Order

With birth order, the pooled dataset had an average birth order of 2.9; 29.6% of births were first time births, 25% were second births, and 27.4% were 3rd and 4th births (Table 4). Only 6.5% of births were parity 7 or above. A total of 12 surveys had over 30% of their births at parity 5 or higher (Afghanistan (2015), Burundi (2016–2017), Chad (2014–2015), DRC 2013–2014), Ethiopia (2019), Mali (2018), Niger (2012), Nigeria (2013 and 2018), and Yemen (2013)). The median birth order in all countries was 2 or 3, except in Niger and Chad where it was 4.

Table 4 Distribution of births 0 to 179 months prior to survey by child's birth order, 84 DHS surveys, 2012 to 2022

		Birth order (%)							
Country	Year	1	2	3 to 4	5 to 6	7+	Mean	Median	N
Afghanistan	2015	18.7	17.2	28.5	19.9	15.7	3.9	3	90,584
Albania	2017–18	41.9	37.2	19.9	0.9	0.1	1.9	2	8,887
Angola	2015–16	23.6	19.8	28.9	16.7	10.9	3.3	3	32,088
Armenia	2015–16	46.4	37.4	15.2	0.8	0.1	1.8	2	5,009
Bangladesh	2017–18	36.2	29.3	26.1	6.6	1.7	2.3	2	26,788
Bangladesh	2014	35.2	27.8	26.5	8.2	2.4	2.4	2	25,517
Benin	2017–18	23.2	20.0	30.3	17.0	9.5	3.4	3	32,478
Burundi	2016–17	21.0	19.0	29.8	18.6	11.5	3.5	3	34,004
Cambodia	2021–2022	39.4	32.4	23.2	4.1	0.8	2.2	2	23,241
Cambodia	2014	33.9	26.4	26.2	9.7	3.8	2.6	2	20,961
Cameroon	2018	24.5	20.2	29.2	15.8	10.3	3.3	3	24,006
Chad	2014–15	17.4	16.4	27.9	20.2	18.1	4.0	4	50,878
Colombia	2015	41.8	30.5	20.8	4.8	2.1	2.3	2	35,975
Comoros	2012	23.2	19.1	29.3	17.0	11.5	3.5	3	8,004
Congo Democratic Republic	2013–14	21.7	18.5	28.5	18.0	13.4	3.7	3	43,982
Dominican Republic	2013	36.3	28.4	27.6	5.9	1.7	2.3	2	10,582
Egypt	2014	32.2	28.3	30.4	6.9	2.2	2.5	2	39,294
Ethiopia	2019	20.5	18.0	28.7	18.6	14.2	3.6	3	15,808
Ethiopia	2016	19.9	17.7	29.1	19.5	13.7	3.6	3	29,720
Gabon	2019–21	30.5	24.1	28.7	11.3	5.5	3.2	2	15,499
Gabon	2012	29.6	22.2	27.1	12.7	8.4	3.5	2	14,837
Gambia	2019	23.0	19.5	29.5	17.3	10.6	3.5	3	22,382
Gambia	2013	23.6	19.6	29.1	17.5	10.2	3.4	3	19,247
Ghana	2014	25.6	22.0	30.4	15.1	6.8	3.2	3	15,358
Guatemala	2014–15	29.1	22.7	26.5	12.4	9.3	3.1	2	34,893
Guinea	2018	23.9	21.0	30.9	16.0	8.2	3.3	3	20,476
Guinea	2012	22.2	19.0	29.5	18.3	10.9	3.5	3	18,918
Haiti	2016–17	30.6	22.2	25.8	12.9	8.5	3.1	2	17,942
Haiti	2012	30.0	21.0	25.7	13.9	9.3	3.2	2	19,214
India	2019–2021	37.8	31.9	23.5	5.4	1.4	2.2	2	731,751
India	2015–16	35.8	30.2	24.8	7.0	2.2	2.4	2	795,094
Indonesia	2017	37.1	32.1	24.5	4.8	1.5	2.4	2	53,309
Indonesia	2012	37.3	29.2	24.5	6.4	2.7	2.4	2	52,456
Jordan	2017–18	25.8	22.2	33.6	13.9	4.5	3.0	3	30,778
Jordan	2012	22.9	20.5	32.2	16.1	8.3	3.4	3	27,734
Kenya	2022	29.6	23.7	28.8	11.9	6.0	3.1	2	52,579
Kenya	2014	27.0	22.3	28.6	14.0	8.2	3.3	3	58,891
Kyrgyz Republic	2012	32.8	27.0	31.7	7.5	1.0	2.5	2	10,328
Lesotho	2014	37.6	26.3	24.7	8.4	3.0	2.5	2	8,028
Liberia	2019–20	26.3	21.2	28.6	15.2	8.7	3.5	3	16,201

Continued…

Table 4—*Continued*

Country	Year	Birth order (%)					Mean	Median	N
		1	2	3 to 4	5 to 6	7+			
Liberia	2013	24.7	19.9	27.9	16.2	11.2	3.6	3	20,458
Madagascar	2021	27.5	21.7	28.2	13.9	8.7	3.2	3	32,821
Malawi	2015–16	25.2	21.3	30.3	15.5	7.8	3.2	3	47,171
Maldives	2016–17	41.7	28.8	21.9	5.9	1.6	2.2	2	8,422
Mali	2018	20.6	18.3	29.0	18.4	13.7	3.6	3	24,987
Mali	2012–13	22.2	20.1	30.8	16.8	10.1	3.4	3	26,289
Mauritania	2019–2021	22.1	19.1	29.1	17.5	12.2	3.5	3	29,769
Mozambique	2015	24.3	18.8	27.2	17.3	12.4	3.4	3	6,134
Myanmar	2015–16	32.6	25.4	27.1	10.3	4.5	2.8	2	14,711
Namibia	2013	33.6	25.1	26.9	10.1	4.3	2.7	2	12,505
Nepal	2022	39.3	30.3	23.9	5.4	1.1	2.3	2	16,135
Nepal	2016	34.5	27.6	26.5	8.8	2.6	2.5	2	15,709
Niger	2012	17.5	16.5	27.8	19.8	18.4	4.0	4	33,213
Nigeria	2018	20.9	18.6	28.6	17.5	14.4	3.7	3	87,879
Nigeria	2013	20.5	18.1	28.9	17.9	14.6	3.8	3	81,637
Pakistan	2017–18	24.1	21.0	30.9	15.5	8.6	3.3	3	35,303
Pakistan	2012–13	21.6	19.5	29.5	17.2	12.2	3.6	3	33,747
Papua New Guinea	2016–2018	26.0	21.9	32.2	15.0	5.0	3.0	3	24,919
Philippines	2022	32.5	26.5	27.7	9.1	4.2	2.7	2	28,776
Philippines	2017	32.5	26.0	26.8	9.7	4.9	2.8	2	31,279
Philippines	2013	30.6	23.8	26.6	11.7	7.2	3.0	2	20,831
Rwanda	2019	27.5	22.7	29.5	14.1	6.2	3.0	2	21,196
Rwanda	2014–15	26.1	20.8	29.2	15.7	8.2	3.1	3	21,728
Senegal	2019	24.4	20.1	29.1	16.8	9.5	3.4	3	16,029
Senegal	2018	24.0	19.9	29.4	17.2	9.5	3.5	3	17,483
Senegal	2017	23.6	19.5	29.2	17.1	10.6	3.5	3	31,444
Senegal	2016	24.2	20.0	29.1	16.6	10.1	3.5	3	16,840
Senegal	2015	23.4	19.8	29.5	17.1	10.2	3.5	3	17,212
Senegal	2014	24.2	20.0	28.7	16.4	10.7	3.5	3	16,440
Senegal	2012–13	23.5	19.3	27.8	16.9	12.6	3.6	3	16,418
Sierra Leone	2019	25.7	21.3	30.3	15.4	7.3	3.2	3	27,103
Sierra Leone	2013	22.7	19.6	30.3	17.0	10.4	3.4	3	32,640
South Africa	2016	40.1	30.0	24.0	4.7	1.2	2.2	2	9,372
Tajikistan	2017	31.9	27.3	32.0	7.8	1.1	2.4	2	14,860
Tajikistan	2012	27.9	23.6	31.4	12.6	4.5	2.8	2	12,736
Tanzania	2015–16	24.2	19.7	28.0	16.5	11.6	3.6	3	25,414
Timor-Leste	2016	22.8	20.2	31.0	17.4	8.7	3.4	3	20,728
Togo	2013–14	24.8	20.6	29.9	16.0	8.7	3.4	3	18,483
Turkey	2013	36.1	30.9	23.2	6.2	3.6	2.5	2	10,736
Uganda	2016	21.6	18.1	27.1	17.7	15.4	3.8	3	40,119
Yemen	2013	20.6	18.1	27.8	17.9	15.7	3.8	3	45,899
Zambia	2018	24.5	19.7	28.9	16.6	10.4	3.5	3	26,490
Zambia	2013–14	22.5	19.3	28.7	17.3	12.3	3.5	3	34,808
Zimbabwe	2015	30.3	25.9	31.0	9.6	3.2	2.6	2	14,756
Total		29.6	25.0	27.4	11.6	6.5	2.9	2	3,735,351

Note: Percent distributions are based on weighted cases for all individual countries. The total percent distribution, however, is based on unweighted cases, because the application of standard individual country weights is not meaningful in the pooled sample and analyses using the pooled data are unweighted.

3.5 Combined Risk Groups, Full

Only 17.1% of births in the pooled dataset had no risk factors (Table 5). The country data ranges from 37.4% in Indonesia (2017) to just 6.6% in Afghanistan. For first births, most have only the risk of being unavoidable first births (24.1% of all births), but some have the additional risk of being first births to women under 18 (5.5%). Almost no births are first births to women over the age of 40.

The remaining single risk groups represent one-third of all births. The most common risks are birth spacing 24–35 months (12.5%), spacing under 24 months (10.6%), and then parity 4+ (10%). In most countries, the largest category of single risks is parity 4+.

A total of 24.8% of births have double risks. The largest double risk is spacing 24–35 months and parity 4+ (9.5%), followed by spacing under 24 months and parity 4+ (7.9%); 19.6% of births in Niger are spaced 24–35 months apart and parity 4+, which is the highest of all countries. In Chad, 19.3% of births are spaced under 24 months and parity 4+.

Less than 1% of births have 3 risk factors. The country with the most 3-way risk factors is Mauritania, with 1.9% (almost evenly split between over the age of 40, parity 4+, spacing under 24 months, and almost evenly split between over the age of 40, parity 4+, spacing between 24 and 35 months).

Table 5 Distribution of births 0 to 179 months prior to survey by maternal fertility related risk factors, 84 DHS surveys, 2012 to 2022

Country	Year	Extra risk due to fertility pattern (%)				Single risk age <18	Single risk age 40+	Single risk order 4+	Double risk spacing <24 mos, order 4+	Double risk spacing 24–35 mos, order 4+	Double risk first birth, age <18	Double risk first birth, age 40+	Double risk order 4+, age <18	Double risk order 4+, age 40+	Double Risk spacing <24 mos, age <18	Double risk spacing 24–35 mos, age <18	Double risk spacing <24 mos, age 40+	Double risk spacing 24–35 mos, age 40+	3-Way risk spacing <24 mos, order 4+, age <18	3-Way risk spacing <24 mos, order 4+, age 40+	3-Way risk spacing 24–35 mos, order 4+, age <18	3-Way risk spacing 24–35, order 4+, age 40+	N
		No extra risk	Unavoidable first birth risk	Single risk spacing <24 mos	Single risk spacing 24–35 mos																		
Afghanistan	2015	6.6	12.9	12.5	11.0	0.1	0.0	12.0	18.3	16.4	5.8	0.0	0	1.0	1.5	0.7	0	0	0.1	0.5	0	0.6	90,584
Albania	2017–18	35.7	40.2	7.8	9.4	0.0	0.3	3.1	0.6	0.8	1.5	0.1	0	0.1	0.1	0.1	0	0	0	0.0	0	0.0	8,887
Angola	2015–16	13.9	13.9	7.9	11.7	0.3	0.1	12.5	11.6	13.8	9.7	0.0	0	1.2	1.2	0.8	0	0	0	0.5	0	0.7	32,088
Armenia	2015–16	25.4	45.1	14.2	10.4	0.0	0.2	2.0	0.8	0.4	1.3	0.1	0	0.0	0.1	0.0	0	0	0	0.0	0	0.0	5,009
Bangladesh	2017–18	31.1	21.2	5.6	7.8	0.3	0.1	9.9	3.2	3.8	15.0	0.0	0	0.3	1.1	0.7	0	0	0	0.0	0	0.0	26,788
Bangladesh	2014	27.8	19.3	5.6	8.2	0.5	0.0	10.5	4.0	5.0	15.8	0.0	0	0.2	1.5	1.2	0	0	0	0.1	0	0.1	25,517
Benin	2017–18	14.3	17.9	7.0	14.2	0.1	0.1	15.0	7.9	14.5	5.3	0.0	0	1.5	0.6	0.5	0	0	0	0.3	0	0.7	32,478
Burundi	2016–17	12.1	17.9	9.0	13.9	0.0	0.1	14.5	9.9	15.9	3.1	0.0	0	1.8	0.2	0.1	0	0	0	0.4	0	1.0	34,004
Cambodia	2021–2022	31.8	36.6	6.5	10.1	0.0	0.4	6.7	1.7	2.3	2.7	0.1	0	0.7	0.1	0.0	0	0	0	0.1	0	0.1	23,241
Cambodia	2014	22.9	30.9	7.7	11.3	0.0	0.2	11.4	4.3	6.4	2.9	0.0	0	1.2	0.2	0.1	0	0	0	0.1	0	0.2	20,961
Cameroon	2018	13.0	16.5	9.0	12.3	0.2	0.1	12.0	11.5	13.7	8.1	0.0	0	0.8	1.4	0.8	0	0	0	0.4	0	0.4	24,006
Chad	2014–15	7.2	8.3	9.3	10.6	0.4	0.0	11.4	19.3	18.4	9.1	0.0	0	0.8	2.4	1.5	0	0	0.1	0.6	0	0.6	50,878
Colombia	2015	28.2	31.8	7.4	7.6	0.1	0.4	5.8	3.3	3.5	9.9	0.1	0	0.4	0.9	0.4	0	0	0	0.1	0	0.1	35,975
Comoros	2012	11.2	17.7	12.7	9.2	0.1	0.1	13.3	13.6	12.4	5.5	0.0	0	1.0	1.4	0.6	0.1	0	0	0.5	0	0.5	8,004
Congo Democratic Republic	2013–14	11.2	15.3	9.1	11.8	0.2	0.1	12.7	13.1	16.1	6.4	0.0	0	1.2	0.9	0.6	0	0	0	0.5	0	0.7	43,982
Dominican Republic	2013	25.8	25.8	10.0	9.3	0.2	0.5	6.8	4.9	4.1	10.5	0.0	0	0.1	1.3	0.6	0	0	0	0.0	0	0.1	10,582
Egypt	2014	21.5	29.3	11.0	15.0	0.1	0.1	11.0	3.4	4.4	2.8	0.0	0	0.7	0.3	0.2	0	0	0	0.0	0	0.1	39,294
Ethiopia	2019	13.6	13.2	7.5	8.1	0.7	0.1	16.1	14.4	13.8	7.2	0.0	0	0.8	2.0	1.4	0	0	0.2	0.4	0	0.4	15,808
Ethiopia	2016	13.0	13.3	8.3	10.0	0.1	0.0	15.2	14.2	15.2	6.6	0.0	0	1.2	1.3	0.7	0	0	0	0.4	0	0.5	29,720
Gabon	2019–21	22.3	22.6	7.9	9.6	0.2	0.2	12.1	6.4	7.8	7.8	0.1	0	1.1	0.5	0.6	0	0.1	0	0.3	0	0.4	15,499
Gabon	2012	19.8	19.1	6.7	9.6	0.1	0.0	14.2	6.6	9.4	10.4	0.0	0	1.6	1.0	0.7	0	0	0	0.3	0	0.3	14,837
Gambia	2019	14.2	17.9	6.8	13.9	0.1	0.1	15.9	6.9	15.9	5.1	0.0	0	1.4	0.5	0.5	0	0	0	0.2	0	0.7	22,382
Gambia	2013	14.6	17.3	6.6	12.8	0.4	0.1	15.2	7.9	15.2	6.3	0.0	0	1.5	0.6	0.7	0	0	0	0.3	0	0.7	19,247
Ghana	2014	21.1	20.2	6.5	10.8	0.1	0.1	16.3	5.7	10.4	5.4	0.0	0	1.6	0.4	0.3	0	0	0	0.3	0	0.7	15,358
Guatemala	2014–15	18.7	21.1	8.7	10.0	0.1	0.1	11.7	7.6	11.4	8.0	0.0	0	0.8	0.9	0.4	0	0	0	0.2	0	0.4	34,893
Guinea	2018	17.6	14.3	5.7	12.6	0.4	0.2	14.9	7.5	12.4	9.6	0.0	0	1.6	0.8	1.1	0	0.1	0	0.4	0	0.7	20,476
Guinea	2012	15.9	11.7	4.7	11.6	0.5	0.1	17.3	7.6	15.4	10.5	0.0	0	1.5	1.1	1.3	0	0	0	0.3	0	0.6	18,918
Haiti	2016–17	18.6	24.9	7.6	10.2	0.1	0.3	12.9	7.2	9.2	5.7	0.0	0	1.6	0.4	0.2	0	0.1	0	0.4	0	0.7	17,942
Haiti	2012	16.5	24.0	8.1	10.3	0.0	0.2	12.7	8.3	10.2	5.9	0.1	0	1.7	0.5	0.3	0	0	0	0.4	0	0.8	19,214
India	2019–2021	19.0	33.2	13.4	14.3	0.1	0.1	4.8	4.6	4.7	4.6	0.0	0	0.2	0.5	0.3	0	0	0	0.1	0	0.1	731,751

Continued…

Table 5—*Continued*

Country	Year	Extra risk due to fertility pattern (%)				Single risk age <18	Single risk age 40+	Single risk order 4+	Double risk spacing <24 mos, order 4+	Double risk spacing 24–35 mos, order 4+	Double risk first birth, age <18	Double risk first birth, age 40+	Double risk order 4+, age <18	Double risk order 4+, age 40+	Double Risk spacing <24 mos, age <18	Double risk spacing 24–35 mos, age <18	Double risk spacing <24 mos, age 40+	Double risk spacing 24–35 mos, age 40+	3-Way risk spacing <24 mos, order 4+, age <18	3-Way risk spacing <24 mos, order 4+, age 40+	3-Way risk spacing 24–35 mos, order 4+, age <18	3-Way risk spacing 24–35, order 4+, age 40+	N
		No extra risk	Unavoidable first birth risk	Single risk spacing <24 mos	Single risk spacing 24–35 mos																		
India	2015–16	17.6	30.7	13.1	14.5	0.2	0.1	5.9	5.5	5.9	5.1	0.0	0	0.2	0.7	0.4	0	0	0	0.1	0	0.1	795,094
Indonesia	2017	37.4	34.3	4.8	5.9	0.0	0.7	7.8	2.1	2.7	2.7	0.1	0	1.0	0.1	0.0	0	0	0	0.1	0	0.1	53,309
Indonesia	2012	33.4	33.9	5.3	6.1	0.0	0.4	9.2	2.8	3.6	3.3	0.1	0	1.1	0.2	0.1	0	0	0	0.1	0	0.2	52,456
Jordan	2017–18	13.6	23.4	16.2	10.9	0.0	0.1	15.9	7.8	7.4	2.2	0.2	0	1.2	0.3	0.1	0.1	0	0	0.2	0	0.2	30,778
Jordan	2012	10.5	21.4	16.9	10.6	0.0	0.1	17.4	9.7	9.7	1.4	0.1	0	1.4	0.1	0.0	0.1	0.1	0	0.2	0	0.3	27,734
Kenya	2022	22.9	23.4	7.4	9.4	0.2	0.2	12.3	6.8	8.6	6.2	0.0	0	1.0	0.6	0.4	0	0	0	0.2	0	0.3	52,579
Kenya	2014	18.2	19.7	7.9	11.1	0.2	0.1	12.7	8.4	11.3	7.2	0.0	0	0.9	0.9	0.6	0	0	0	0.2	0	0.4	58,891
Kyrgyz Republic	2012	21.1	31.8	13.3	12.1	0.0	0.3	11.1	3.6	4.5	0.9	0.1	0	1.0	0.0	0.0	0	0	0	0.1	0	0.1	10,328
Lesotho	2014	26.5	31.1	5.2	9.9	0.0	0.3	10.6	2.3	5.6	6.5	0.0	0	1.3	0.2	0.1	0	0	0	0.1	0	0.4	8,028
Liberia	2019–20	19.3	16.3	6.0	10.3	0.3	0.2	14.9	8.2	10.7	10.0	0.0	0	1.6	0.7	0.7	0	0	0	0.4	0	0.5	16,201
Liberia	2013	16.6	15.2	6.4	10.5	0.1	0.1	15.7	9.4	12.2	9.5	0.0	0	1.5	0.9	0.8	0	0	0	0.4	0	0.6	20,458
Madagascar	2021	18.7	17.0	7.4	9.0	0.4	0.1	13.1	9.4	9.7	10.6	0.0	0	1.2	1.5	1.0	0	0	0.1	0.4	0	0.5	32,821
Malawi	2015–16	19.2	16.4	6.0	11.7	0.2	0.0	17.6	6.4	10.4	8.8	0.0	0	1.3	0.7	0.6	0	0	0	0.3	0	0.4	47,171
Maldives	2016–17	29.4	41.3	6.7	7.1	0.0	0.4	8.8	2.3	2.6	0.4	0.1	0	0.7	0.0	0.0	0	0.1	0	0.0	0	0.0	8,422
Mali	2018	11.5	12.4	8.2	12.0	0.2	0.1	13.6	12.9	16.8	8.2	0.0	0	1.0	1.2	1.0	0	0	0	0.4	0	0.6	24,987
Mali	2012–13	13.4	12.9	8.2	12.1	0.4	0.1	12.9	11.6	14.1	9.3	0.0	0	1.0	1.6	1.4	0	0	0.1	0.3	0	0.5	26,289
Mauritania	2019–2021	12.7	15.8	9.6	10.1	0.4	0.2	13.1	13.0	13.1	6.3	0.1	0	1.5	1.2	0.8	0.1	0.1	0.1	0.8	0	1.0	29,769
Mozambique	2015	20.7	13.6	2.9	6.7	1.9	0.1	26.6	2.9	8.2	10.8	0.0	0	3.3	0.6	0.5	0	0	0	0.3	0	0.8	6,134
Myanmar	2015–16	26.2	30.2	6.5	8.7	0.0	0.4	11.8	5.0	6.1	2.3	0.1	0	1.7	0.2	0.1	0	0.1	0	0.2	0	0.3	14,711
Namibia	2013	25.9	27.0	5.6	9.2	0.1	0.4	11.4	4.2	6.9	6.6	0.0	0	1.5	0.3	0.2	0	0.1	0	0.2	0	0.4	12,505
Nepal	2022	24.5	32.0	9.4	11.5	0.0	0.1	6.3	3.5	4.2	7.3	0.0	0	0.3	0.6	0.3	0	0	0	0.0	0	0.0	16,135
Nepal	2016	20.5	27.1	10.0	12.6	0.0	0.0	8.2	5.9	6.6	7.4	0.0	0	0.4	0.8	0.2	0	0	0	0.1	0	0.1	15,709
Niger	2012	8.2	9.3	8.5	11.1	0.2	0.0	12.9	16.2	19.6	8.2	0.0	0	1.0	2.0	1.3	0	0	0.1	0.5	0	0.8	33,213
Nigeria	2018	10.9	14.5	9.1	12.3	0.2	0.1	12.9	12.9	16.4	6.3	0.0	0	1.3	1.1	0.7	0	0	0	0.4	0	0.7	87,879
Nigeria	2013	10.7	13.4	8.2	12.3	0.2	0.1	13.5	12.7	16.6	7.1	0.0	0	1.4	1.3	1.1	0	0	0	0.5	0	0.8	81,637
Pakistan	2017–18	9.7	21.0	16.2	11.5	0.0	0.1	10.4	14.5	11.1	3.0	0.0	0	0.6	0.8	0.2	0	0	0	0.3	0	0.4	35,303
Pakistan	2012–13	9.0	18.4	14.5	11.3	0.1	0.0	10.9	16.6	13.4	3.1	0.0	0	0.9	0.7	0.2	0	0	0	0.3	0	0.4	33,747
Papua New Guinea	2016–2018	16.6	21.2	10.4	11.6	0.2	0.2	12.1	8.7	10.4	4.7	0.0	0	1.4	0.8	0.4	0	0	0	0.4	0	0.8	24,919
Philippines	2022	23.6	28.8	10.3	9.1	0.0	0.6	9.6	5.9	6.2	3.5	0.1	0	1.3	0.3	0.1	0	0	0	0.2	0	0.2	28,776
Philippines	2017	19.7	28.9	12.6	9.6	0.0	0.4	9.5	6.3	6.8	3.5	0.1	0	1.2	0.4	0.1	0	0	0	0.3	0	0.5	31,279
Philippines	2013	16.8	27.3	12.7	9.4	0.0	0.4	10.8	8.0	8.2	3.2	0.1	0	1.6	0.4	0.1	0	0	0	0.3	0	0.5	20,831

Continued…

Table 5—*Continued*

Country	Year	Extra risk due to fertility pattern (%)				Single risk age <18	Single risk age 40+	Single risk order 4+	Double risk spacing <24 mos, order 4+	Double risk spacing 24–35 mos, order 4+	Double risk first birth, age <18	Double risk first birth, age 40+	Double risk order 4+, age <18	Double risk order 4+, age 40+	Double Risk spacing <24 mos, age <18	Double risk spacing 24–35 mos, age <18	Double risk spacing <24 mos, age 40+	Double risk spacing 24–35 mos, age 40+	3-Way risk spacing <24 mos, order 4+, age <18	3-Way risk spacing <24 mos, order 4+, age 40+	3-Way risk spacing 24–35 mos, order 4+, age <18	3-Way risk spacing 24–35, order 4+, age 40+	N
		No extra risk	Unavoidable first birth risk	Single risk spacing <24 mos	Single risk spacing 24–35 mos																		
Rwanda	2019	19.8	25.9	8.0	11.9	0.0	0.2	13.7	5.7	10.3	1.6	0.1	0	2.2	0.0	0.0	0	0	0	0.2	0	0.6	21,196
Rwanda	2014–15	15.3	24.1	9.4	12.4	0.0	0.1	13.7	7.3	12.9	1.9	0	0	1.9	0.1	0.0	0	0	0	0.2	0	0.7	21,728
Senegal	2019	14.7	19.5	7.4	13.0	0.1	0.2	13.9	7.7	14.9	4.9	0	0	1.7	0.4	0.4	0	0	0	0.4	0	0.8	16,029
Senegal	2018	14.6	19.1	7.4	13.0	0.1	0.2	14.1	8.0	14.9	4.8	0.1	0	1.5	0.5	0.5	0	0.1	0	0.3	0	0.7	17,483
Senegal	2017	14.2	18.3	7.5	12.7	0.1	0.1	13.5	8.9	15.4	5.2	0	0	1.6	0.6	0.4	0	0	0	0.3	0	0.9	31,444
Senegal	2016	14.9	18.6	7.3	13.3	0.1	0.2	13.3	7.6	15.3	5.5	0	0	1.8	0.5	0.3	0	0	0	0.3	0	0.9	16,840
Senegal	2015	14.8	17.9	7.1	13.3	0.1	0.1	14.2	7.7	15.9	5.5	0	0	1.5	0.5	0.4	0	0	0	0.2	0	0.7	17,212
Senegal	2014	14.1	18.2	7.8	12.8	0.1	0.2	13.3	8.0	15.4	6.0	0	0	1.6	0.5	0.5	0	0	0	0.3	0	1.0	16,440
Senegal	2012–13	13.7	17.8	7.4	12.6	0.1	0.1	13.6	8.7	16.4	5.6	0	0	1.6	0.6	0.4	0	0	0	0.5	0	0.8	16,418
Sierra Leone	2019	19.2	16.9	6.4	11.0	0.2	0.2	14.7	8.0	10.9	8.7	0	0	1.4	0.8	0.7	0	0	0	0.3	0	0.5	27,103
Sierra Leone	2013	15.0	13.9	7.0	11.4	0.4	0.1	14.6	10.1	13.7	8.7	0	0	1.4	1.3	1.1	0	0	0.1	0.5	0	0.7	32,640
South Africa	2016	33.5	32.4	5.1	6.9	0.0	0.6	7.0	2.4	2.8	7.6	0.1	0	1.0	0.2	0.1	0	0	0	0.1	0	0.2	9,372
Tajikistan	2017	14.0	31.5	19.2	14.2	0.0	0.2	10.2	4.8	5.1	0.4	0	0	0.4	0.0	0.0	0	0	0	0.0	0	0.1	14,860
Tajikistan	2012	13.6	26.9	15.5	13.0	0.0	0.1	13.0	6.7	8.9	1.0	0	0	0.9	0.1	0.0	0	0	0	0.1	0	0.2	12,736
Tanzania	2015–16	15.9	17.6	6.9	11.6	0.1	0.1	14.9	8.6	14.3	6.6	0	0	1.5	0.5	0.3	0	0	0	0.4	0	0.8	25,414
Timor-Leste	2016	11.2	20.5	13.3	12.1	0.0	0.2	12.5	11.2	13.6	2.2	0.1	0	1.6	0.3	0.1	0	0.1	0	0.5	0	0.6	20,728
Togo	2013–14	19.1	19.8	6.2	11.1	0.2	0.1	15.3	7.4	12.2	5.0	0	0	1.8	0.4	0.4	0	0	0	0.4	0	0.6	18,483
Turkey	2013	27.8	33.5	9.5	9.1	0.0	0.2	7.7	4.9	3.8	2.5	0	0	0.5	0.2	0.0	0	0	0	0.0	0	0.1	10,736
Uganda	2016	10.9	14.4	8.8	11.4	0.2	0.0	14.0	12.9	16.4	7.2	0	0	1.1	1.0	0.7	0	0	0	0.4	0	0.6	40,119
Yemen	2013	9.2	15.0	13.2	8.5	0.1	0.0	13.5	18.0	12.3	5.6	0	0	1.1	1.8	0.6	0	0	0.1	0.5	0	0.5	45,899
Zambia	2018	17.0	15.6	5.7	12.0	0.1	0.1	17.2	7.5	12.7	8.8	0	0	1.5	0.6	0.5	0	0	0	0.2	0	0.5	26,490
Zambia	2013–14	14.9	14.5	6.1	13.1	0.1	0.0	16.5	7.9	15.6	7.9	0	0	1.3	0.6	0.5	0	0	0	0.3	0	0.7	34,808
Zimbabwe	2015	29.0	23.1	4.8	10.7	0.1	0.1	13.9	3.3	6.2	7.2	0	0	1.0	0.3	0.2	0	0	0	0.1	0	0.2	14,756
Total		17.1	24.1	10.6	12.5	0.1	0.1	10.0	7.9	9.5	5.5	0	0	0.8	0.7	0.4	0	0	0	0.2	0	0.4	3,735,351

Note: Percent distributions are based on weighted cases for all individual countries. The total percent distribution, however, is based on unweighted cases, because the application of standard individual country weights is not meaningful in the pooled sample and analyses using the pooled data are unweighted.

3.6 Combined Risk Groups, Simplified

Table 6 shows a simplified version of Table 5, with the risk categories grouped together into no risk, unavoidable first risk (and no other risk), single risk, double risk, and triple risk. Overall, 58.9% of births have a single, double, or triple risk. Chad, Niger, and Afghanistan have over 80% of births with a risk (not including unavoidable first birth). In 62 countries, single risks are more common than double and triple risks, while in the remaining 22 countries, double risks are more common. In Chad, over 50% of births have 2 risks.

Table 6 Distribution of births 0 to 179 months prior to survey by maternal fertility related risk factors, simplified, 84 DHS surveys, 2012 to 2022

		Summary measure of extra risk (%)					
Country	Year	No extra risk	Unavoidable first birth risk	Any single risk	Any double risk	Any 3-way risk	N
Afghanistan	2015	6.6	12.9	35.7	43.6	1.2	90,584
Albania	2017–18	35.7	40.2	20.7	3.4	0.0	8,887
Angola	2015–16	13.9	13.9	32.6	38.4	1.2	32,088
Armenia	2015–16	25.4	45.1	26.7	2.8	0.0	5,009
Bangladesh	2017–18	31.1	21.2	23.6	24.1	0.0	26,788
Bangladesh	2014	27.8	19.3	24.9	27.9	0.1	25,517
Benin	2017–18	14.3	17.9	36.5	30.2	1.1	32,478
Burundi	2016–17	12.1	17.9	37.4	31.1	1.4	34,004
Cambodia	2021–2022	31.8	36.6	23.7	7.8	0.2	23,241
Cambodia	2014	22.9	30.9	30.6	15.2	0.4	20,961
Cameroon	2018	13.0	16.5	33.5	36.3	0.8	24,006
Chad	2014–15	7.2	8.3	31.7	51.5	1.3	50,878
Colombia	2015	28.2	31.8	21.3	18.5	0.2	35,975
Comoros	2012	11.2	17.7	35.5	34.6	1.0	8,004
Congo Democratic Republic	2013–14	11.2	15.3	33.9	38.4	1.2	43,982
Dominican Republic	2013	25.8	25.8	26.7	21.5	0.1	10,582
Egypt	2014	21.5	29.3	37.1	11.9	0.1	39,294
Ethiopia	2019	13.6	13.2	32.5	39.6	1.1	15,808
Ethiopia	2016	13.0	13.3	33.6	39.2	0.9	29,720
Gabon	2019–21	22.3	22.6	30.1	24.4	0.7	15,499
Gabon	2012	19.8	19.1	30.7	29.8	0.6	14,837
Gambia	2019	14.2	17.9	36.7	30.4	0.8	22,382
Gambia	2013	14.6	17.3	35.0	32.2	1.0	19,247
Ghana	2014	21.1	20.2	33.9	23.9	0.9	15,358
Guatemala	2014–15	18.7	21.1	30.6	29.1	0.6	34,893
Guinea	2018	17.6	14.3	33.9	33.2	1.0	20,476
Guinea	2012	15.9	11.7	34.1	37.4	0.9	18,918
Haiti	2016–17	18.6	24.9	31.0	24.4	1.1	17,942
Haiti	2012	16.5	24.0	31.3	26.9	1.2	19,214
India	2019–2021	19.0	33.2	32.7	14.9	0.1	731,751
India	2015–16	17.6	30.7	33.7	17.9	0.2	795,094
Indonesia	2017	37.4	34.3	19.3	8.8	0.2	53,309
Indonesia	2012	33.4	33.9	21.1	11.2	0.3	52,456
Jordan	2017–18	13.6	23.4	43.2	19.4	0.5	30,778
Jordan	2012	10.5	21.4	45.0	22.6	0.5	27,734
Kenya	2022	22.9	23.4	29.5	23.7	0.5	52,579
Kenya	2014	18.2	19.7	32.0	29.4	0.7	58,891
Kyrgyz Republic	2012	21.1	31.8	36.8	10.1	0.1	10,328
Lesotho	2014	26.5	31.1	26.0	16.0	0.5	8,028

Continued…

Table 6—*Continued*

Country	Year	Summary measure of extra risk (%)					N
		No extra risk	Unavoidable first birth risk	Any single risk	Any double risk	Any 3-way risk	
Liberia	2019–20	19.3	16.3	31.5	31.9	0.9	16,201
Liberia	2013	16.6	15.2	32.8	34.4	1.0	20,458
Madagascar	2021	18.7	17.0	29.9	33.4	1.0	32,821
Malawi	2015–16	19.2	16.4	35.5	28.2	0.7	47,171
Maldives	2016–17	29.4	41.3	23.1	6.1	0.1	8,422
Mali	2018	11.5	12.4	34.1	41.1	1.0	24,987
Mali	2012–13	13.4	12.9	33.7	39.0	0.9	26,289
Mauritania	2019–2021	12.7	15.8	33.3	36.2	2.0	29,769
Mozambique	2015	20.7	13.6	38.2	26.4	1.2	6,134
Myanmar	2015–16	26.2	30.2	27.5	15.7	0.5	14,711
Namibia	2013	25.9	27.0	26.7	19.9	0.5	12,505
Nepal	2022	24.5	32.0	27.3	16.2	0.0	16,135
Nepal	2016	20.5	27.1	30.9	21.4	0.2	15,709
Niger	2012	8.2	9.3	32.8	48.2	1.5	33,213
Nigeria	2018	10.9	14.5	34.5	38.9	1.1	87,879
Nigeria	2013	10.7	13.4	34.3	40.3	1.4	81,637
Pakistan	2017–18	9.7	21.0	38.2	30.3	0.7	35,303
Pakistan	2012–13	9.0	18.4	36.9	35.0	0.7	33,747
Papua New Guinea	2016–2018	16.6	21.2	34.5	26.4	1.2	24,919
Philippines	2022	23.6	28.8	29.6	17.5	0.4	28,776
Philippines	2017	19.7	28.9	32.2	18.5	0.7	31,279
Philippines	2013	16.8	27.3	33.4	21.6	0.9	20,831
Rwanda	2019	19.8	25.9	33.7	19.9	0.8	21,196
Rwanda	2014–15	15.3	24.1	35.5	24.2	0.9	21,728
Senegal	2019	14.7	19.5	34.6	30.1	1.2	16,029
Senegal	2018	14.6	19.1	34.8	30.3	1.1	17,483
Senegal	2017	14.2	18.3	34.0	32.1	1.3	31,444
Senegal	2016	14.9	18.6	34.2	31.0	1.2	16,840
Senegal	2015	14.8	17.9	34.8	31.6	0.9	17,212
Senegal	2014	14.1	18.2	34.2	32.1	1.3	16,440
Senegal	2012–13	13.7	17.8	33.8	33.4	1.3	16,418
Sierra Leone	2019	19.2	16.9	32.5	30.6	0.7	27,103
Sierra Leone	2013	15.0	13.9	33.5	36.4	1.2	32,640
South Africa	2016	33.5	32.4	19.6	14.2	0.3	9,372
Tajikistan	2017	14.0	31.5	43.8	10.7	0.1	14,860
Tajikistan	2012	13.6	26.9	41.6	17.7	0.3	12,736
Tanzania	2015–16	15.9	17.6	33.6	31.7	1.2	25,414
Timor-Leste	2016	11.2	20.5	38.1	29.1	1.1	20,728
Togo	2013–14	19.1	19.8	33.0	27.1	1.0	18,483
Turkey	2013	27.8	33.5	26.6	11.9	0.2	10,736
Uganda	2016	10.9	14.4	34.4	39.2	1.1	40,119
Yemen	2013	9.2	15.0	35.3	39.4	1.1	45,899
Zambia	2018	17.0	15.6	35.0	31.6	0.8	26,490
Zambia	2013–14	14.9	14.5	35.8	33.8	1.0	34,808
Zimbabwe	2015	29.0	23.1	29.6	18.1	0.2	14,756
Total		17.1	24.1	33.4	24.9	0.6	3,735,351

Note: Percent distributions are based on weighted cases for all individual countries. The total percent distribution, however, is based on unweighted cases, because the application of standard individual country weights is not meaningful in the pooled sample and analyses using the pooled data are unweighted.

3.7 Bivariate Results

The bivariate results presented below examine the relationship between each key independent variable (birth spacing, maternal age at birth, and birth order) and the combination of these groups with 6 measures of infant and child mortality: extreme neonatal mortality (deaths within the first week of life), neonatal mortality (deaths in the first month of life), post-neonatal mortality (deaths in months 1–11), infant mortality (deaths in the first year of life), child mortality (deaths in years 1–4), and under-5 mortality (deaths in the first year of life). Table 7 shows results for unadjusted risk ratios for the three key independent variables and the 6 mortality measures. All analysis use the unweighted pooled data. For the four younger age groups, births in the 0–59 months before the survey are included. For child and under-5 mortality, births 0–179 months are included.

Table 7 Unadjusted relative risk of mortality by duration of preceding birth to conception interval, mother's age at child's birth, and the birth order, children born 0 to 179 months prior to the survey, 84 DHS surveys, 2012 to 2022

	Early neonatal			Neonatal			Post-neonatal			Infant			Child			Under five		
	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+
Birth to conception interval (months)																		
Under 6	3.92	3.65	4.21	3.95	3.70	4.21	3.53	3.25	3.83	3.77	3.59	3.97	3.25	3.10	3.40	4.29	4.19	4.39
6 to 11	2.09	1.95	2.23	2.17	2.04	2.30	2.26	2.09	2.44	2.21	2.10	2.31	2.51	2.40	2.62	2.68	2.62	2.74
12 to 17	1.48	1.39	1.59	1.56	1.47	1.66	1.85	1.73	1.99	1.68	1.60	1.75	2.31	2.22	2.41	2.10	2.06	2.15
18 to 23	1.20	1.12	1.29	1.26	1.18	1.34	1.51	1.40	1.62	1.35	1.29	1.42	1.93	1.85	2.01	1.69	1.65	1.73
24 to 29	1.04	0.96	1.12	1.10	1.03	1.17	1.27	1.17	1.37	1.16	1.11	1.23	1.46	1.40	1.53	1.32	1.29	1.36
30 to 35	1.07	0.99	1.16	1.09	1.01	1.17	1.16	1.06	1.27	1.12	1.05	1.18	1.32	1.25	1.39	1.22	1.19	1.26
36 to 47 (ref)	1			1			1			1			1			1		
48 to 59	1.13	1.04	1.23	1.10	1.02	1.19	0.95	0.86	1.06	1.04	0.98	1.11	0.84	0.79	0.90	0.94	0.91	0.97
60 to 95	1.15	1.06	1.25	1.17	1.08	1.26	0.92	0.84	1.02	1.07	1.01	1.13	0.72	0.68	0.77	0.91	0.89	0.95
96 or More	1.62	1.46	1.79	1.57	1.43	1.72	1.02	0.89	1.17	1.36	1.26	1.46	0.71	0.65	0.79	1.11	1.06	1.16
First born	1.93	1.82	2.04	1.90	1.80	2.01	1.22	1.14	1.30	1.63	1.56	1.70	1.09	1.05	1.14	1.65	1.61	1.69
Total N		1,278,349			1,278,349			1,278,349			1,278,349			3,732,837			3,732,837	
Mother's age at child's birth																		
Under 18	1.51	1.43	1.58	1.53	1.47	1.60	1.68	1.58	1.78	1.58	1.53	1.64	1.79	1.74	1.84	1.71	1.69	1.74
18 to 24 (ref)	1			1			1			1			1			1		
25 to 34	0.82	0.80	0.85	0.83	0.81	0.85	0.98	0.95	1.02	0.88	0.87	0.90	1.06	1.04	1.08	0.94	0.93	0.95
35 to 39	1.04	0.99	1.09	1.04	1.00	1.09	1.24	1.17	1.31	1.11	1.08	1.15	1.30	1.26	1.34	1.17	1.15	1.19
40 or Older	1.37	1.29	1.47	1.36	1.28	1.45	1.58	1.46	1.70	1.44	1.37	1.51	1.42	1.34	1.51	1.36	1.32	1.40
Total N		1,28,0024			1,280,024			1,280,024			1,280,024			3,735,351			3,735,351	
Birth order																		
1	1.55	1.50	1.61	1.50	1.45	1.55	1.05	1.01	1.10	1.33	1.30	1.37	0.90	0.88	0.92	1.19	1.17	1.20
2 (ref)	1			1			1			1			1			1		
3 to 4	1.06	1.02	1.10	1.06	1.03	1.10	1.24	1.19	1.30	1.13	1.10	1.16	1.38	1.35	1.42	1.20	1.19	1.22
5 to 6	1.22	1.16	1.28	1.24	1.19	1.29	1.60	1.52	1.68	1.37	1.33	1.42	1.97	1.91	2.02	1.58	1.55	1.60
7 or More	1.73	1.65	1.82	1.74	1.66	1.82	2.12	2.01	2.24	1.89	1.82	1.95	2.61	2.53	2.69	2.13	2.10	2.17
Total N		1,280,024			1,280,024			1,280,024			1,280,024			3,735,351			3,735,351	

Note:

Age range of analysis:
ENN (early neonatal), NN (neonatal), PNN (postneonatal), and Infant Mortality: Births in 0 to 59 months prior to survey
Child and Under-5 Mortality: births in 0 to 179 months prior to survey

3.8 Unadjusted Risk Ratios: Preceding Birth to Conception Interval

For the unadjusted survival analysis, 36–47 months from birth to conception serves as the reference group. With the early neonatal mortality, 24–29 months and 30–35 months are not statistically different from the reference group. First births have significantly higher risks of mortality, and are 1.9 times more likely to die in their first week of life than children conceived 36–47 months after a sibling's birth. The highest relative risk are births conceived within 6 months of a previous birth when they are 3.9 times as likely to die. The risk ratios then decline toward one as the length of the preconception interval increases. Births spaced 48 months and longer also have an increased risk, especially those births after 96 months (who are 1.6 times more likely to die).

Looking at neonatal mortality, all groups have statistically significant higher risk ratios than the reference groups. The largest risk ratios are for short birth intervals (under 6 months and 6–11 months) and first births, who are 3.9, 2.2, and 1.9 times as likely to die in the first month of life than children in the reference group. With post-neonatal mortality, the shortest birth intervals have the highest relative risks, and those from months 48 to 96+ do not have statistically different risks than the reference group. Infant mortality also follows a relationship with first births having higher risks and the risks being highest at smallest intervals. The relative risk decreases as the length of time moves towards the reference group.

With child mortality, risks are highest at the youngest intervals and then decline as the interval widens. The intervals of 48–59 months, 60–95 months, and 96+ months have statistically lower risks of mortality than the reference group. For all under-5 mortality, first births have statistically higher risk ratios than the reference group, which means they are 1.6 times as likely to die. The smallest birth interval has the highest relative risk, and then declines as the birth interval increases. Months 48 to 95 have statistically lower risk ratios than the reference group.

3.9 Unadjusted Risk Ratios: Maternal Age at Birth

For all six measures of mortality, births to women under the age of 18 have higher relative risk than births to women age 18–24 (who serve as the reference group), with ranges from 1.5 times as high for early neonatal mortality to 1.8 times as high for child mortality. For women age 25 to 34 at birth, risks are statistically lower for early neonatal, neonatal, infant, and under-5 mortality compared to women age 18 to 24. Women age 35–39 have higher mortality for post-neonatal, infant, child, and under-5, but no statistically significant difference for early neonatal and neonatal. Women who gave birth over age 40 have higher risks in all 6 mortality measures.

3.10 Unadjusted Risk Ratios: Birth Order

When looking at birth order, first order births have higher risk of mortality for early neonatal, neonatal, post-neonatal, infant, and under-5 mortality, but lower risk in child mortality. This suggests that the risk is focused in the first year of life. After the 2nd births, risk increases with parity. For 7th or more order births, the risk of early neonatal and neonatal morality is 1.7 times as high as parity 2, and the highest is child-mortality, where it is 2.6 times as high as the reference group.

3.11 Unadjusted Risk Ratios: Multiple Fertility Extra Risk Factors

Combining all fertility risk variables, we can look at the interaction of variables in Table 8. Almost all groups have higher risk of mortality that children with no extra risk factors. For the unavoidable risk of first birth, risk of death is 1.8 times higher for both early neonatal and neonatal, compared to births with no extra risk. Unavoidable first birth does not have a statically higher risk for child mortality.

Looking at single risks, birth spacing under 24 months is statistically significant for all mortality measures, and higher than the risk for births 24–35 months, when compared to no extra risk. In Table 5, there were very few births born to women under age 18 (that are not their first births), and as shown in Table 8, the confidence intervals for most mortality measures are large and include 1. For all mortality rates except for child, single risk of births after age 40 are statistically higher than those with no extra risks.

Looking at double risks, the largest risk ratio is for short birth spacing and advanced maternal age for early neonatal, neonatal, and infant mortality. For neonatal, child, and under-5 mortality, short birth spacing and young maternal age have the highest risk ratio of the double extra risks.

With three-way extra risks, there are very few cases that involved high parity and young maternal age. For high parity and advanced maternal age, those with under 24 months birth spacing have some of the highest relative risks compared to the reference group. Those with 24–35 months spacing have high risks as well, but these were not as high as the shorted birth interval.

Table 8 Unadjusted relative risk of mortality by mother's fertility related risk, children born 0 to 179 months prior to the survey, 84 DHS surveys, 2012 to 2022

	Early neonatal			Neonatal			Post-neonatal			Infant			Child			Under 5		
	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+
No extra risk (ref)	1			1			1			1			1			1		
Unavoidable first-birth risk	1.82	1.74	1.90	1.78	1.71	1.85	1.18	1.11	1.24	1.55	1.51	1.60	1.01	0.97	1.04	1.53	1.51	1.56
Single risk spacing <24 months	1.86	1.77	1.96	1.90	1.81	1.99	1.91	1.80	2.03	1.90	1.83	1.98	2.13	2.06	2.21	2.39	2.35	2.44
Single risk spacing 24-35 months	1.07	1.01	1.13	1.10	1.04	1.16	1.40	1.32	1.49	1.21	1.16	1.26	1.76	1.70	1.83	1.50	1.48	1.53
Single risk age <18	0.62	0.32	1.20	0.62	0.34	1.12	1.34	0.79	2.27	0.89	0.60	1.31	2.11	1.72	2.58	1.51	1.33	1.71
Single risk age 40+	1.57	1.20	2.05	1.55	1.22	1.98	1.17	0.81	1.69	1.41	1.15	1.73	0.98	0.71	1.35	1.26	1.09	1.46
Single risk order 4+	1.13	1.07	1.20	1.14	1.08	1.20	1.31	1.23	1.40	1.21	1.16	1.26	1.60	1.54	1.67	1.36	1.33	1.39
Double risk spacing <24, order 4+	2.70	2.56	2.85	2.79	2.66	2.93	3.59	3.38	3.81	3.09	2.97	3.20	4.42	4.28	4.57	3.98	3.91	4.05
Double risk spacing 24-35, order 4+	1.28	1.21	1.36	1.37	1.30	1.44	2.07	1.95	2.20	1.63	1.57	1.69	2.99	2.89	3.10	2.27	2.22	2.31
Double risk first birth, age <18	2.43	2.29	2.58	2.46	2.33	2.60	2.41	2.24	2.59	2.44	2.34	2.55	2.71	2.61	2.82	2.96	2.90	3.02
Double risk first birth, age 40+	3.01	2.03	4.47	2.84	1.97	4.09	2.04	1.16	3.61	2.55	1.87	3.46	1.19	0.66	2.14	1.98	1.56	2.52
Double risk order 4+, age <18	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	2.10	0.68	6.50
Double risk order 4+, age 40+	1.71	1.55	1.90	1.67	1.52	1.84	1.89	1.68	2.12	1.75	1.63	1.88	1.67	1.51	1.84	1.76	1.67	1.85
Double risk spacing <24 and age <18	3.40	2.94	3.94	3.61	3.18	4.10	3.73	3.16	4.41	3.66	3.31	4.05	5.03	4.70	5.37	4.61	4.44	4.77
Double risk spacing 24-35 and age <18	1.55	1.21	1.99	1.67	1.35	2.08	2.55	2.03	3.21	1.97	1.68	2.31	4.30	3.94	4.69	2.89	2.74	3.05
Double risk spacing <24 and age 40+	5.63	3.39	9.36	5.19	3.22	8.36	1.60	0.52	4.98	3.86	2.49	5.98	1.04	0.39	2.78	2.66	1.94	3.66
Double risk spacing 24-35 and age 40+	1.52	0.73	3.20	1.94	1.08	3.51	1.84	0.82	4.09	2.02	1.27	3.21	0.67	0.25	1.79	1.41	0.99	2.01
3-way risk spacing 24-35, order 4+, age<18	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	5.29	2.64	10.58	3.99	2.65	6.00
3-way risk spacing <24, order 4+, age 40+	4.67	4.08	5.35	4.84	4.30	5.46	4.51	3.83	5.32	4.74	4.30	5.22	5.39	4.83	6.01	5.29	5.00	5.59
3-way risk spacing <24, order 4+, age<18	1.09	0.15	7.73	1.77	0.44	7.07	1.53	0.22	10.88	1.69	0.54	5.24	5.79	4.07	8.24	5.44	4.52	6.55
3-way risk, spacing 24-35, order 4+, age 40+	2.28	1.99	2.61	2.27	2.00	2.56	2.92	2.52	3.37	2.50	2.27	2.74	3.21	2.88	3.57	2.89	2.73	3.07
Total N	1,280,024			1,280,024			1,280,024			1,280,024			3,735,351			3,735,351		

Note:

Age range of analysis:
ENN (early neonatal), NN (neonatal), PNN (postneonatal), and Infant Mortality: Births in 0 to 59 months prior to survey
Child and Under-5 Mortality: Births in 0 to 179 months prior to survey

nc = no cases

3.12 Unadjusted Risk Ratios: Multiple Fertility Extra Risk Factors, Simplified

Combining individual extra risk groups by number of risks, Table 9 presents simplified results. All fertility related extra risk groups are higher and statistically significant in terms of mortality risks compared to children with no extra risks (except for unavoidable first births with child mortality). The risk ratio increases with each additional extra fertility related risk.

Table 9 Unadjusted relative risk of mortality by mother's fertility related risk, simplified, children born 0 to 179 months prior to the survey, 84 DHS surveys, 2012 to 2022

	Early neonatal			Neonatal			Post-neonatal			Infant			Child			Under five		
	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+	URR	CI-	CI+
No extra risk (ref)	1			1			1			1			1			1		
Unavoidable first-birth risk	1.82	1.74	1.90	1.78	1.71	1.85	1.18	1.11	1.24	1.55	1.51	1.60	1.01	0.97	1.04	1.53	1.51	1.56
Any single risk	1.32	1.26	1.38	1.34	1.29	1.40	1.51	1.44	1.59	1.41	1.36	1.45	1.83	1.77	1.88	1.74	1.71	1.77
Any double risk	1.98	1.89	2.07	2.05	1.97	2.13	2.57	2.45	2.70	2.24	2.17	2.31	3.40	3.30	3.50	3.01	2.96	3.06
Any 3-way risk	3.06	2.77	3.38	3.11	2.84	3.40	3.42	3.05	3.82	3.22	3.01	3.46	4.07	3.77	4.39	3.84	3.69	4.00
Total N	1,280,024			1,280,024			1,280,024			1,280,024			3,735,351			3,735,351		

Note:

Age range of analysis:
ENN (early neonatal), NN (neonatal), PNN (postneonatal), and Infant Mortality: Births in 0 to 59 months prior to survey
Child and Under-5 Mortality: Births in 0 to 179 months prior to survey

3.13 Multivariate Results

Multivariate results are presented for the six mortality measures and key independent variables shown in the bivariate results discussed above. As in the bivariate results, early neonatal, neonatal, post-neonatal, and infant mortality include births 0–59 months prior to a survey. Child and under-5 mortality include births 0–179 months prior to the study. Included in the multivariate results are the control variables discussed in the methods section of this report. Early neonatal, neonatal, post-neonatal, and infant mortality include a more extensive list of control variables than child and under-5 mortality. This is due to the structure of DHS questionnaires and the belief that information surrounding pregnancy and birth has less of an impact on mortality the farther away that the birth occurred. Annex 1 provides summary statistics for the control variables.

3.14 Adjusted Risk Ratios: Preceding Birth to Conception Interval

In Table 10, when controlling for possible confounding variables, the general pattern remains as it did for the unadjusted results, although in many cases it is attenuated. First births have a higher relative risk of mortality in all mortality measures than births with intervals of 36 to 47 months. Children born with intervals less than 6 months are 2.5 times more likely to die in the first week of life and 3.6 times as likely to die in the first 5 years as the reference group. Births intervals of 6–11 months and 12–17 months are also higher (and statistically significant) than the reference group. For early neonatal, neonatal, and infant mortality, birth intervals greater than 48 months have a higher relative risk of mortality than the reference group, and the risk is larger as intervals increase.

Table 10 Adjusted relative risk of mortality by duration of preceding birth to conception interval, mother's age at child's birth, and the birth order, children born 0 to 179 months prior to the survey, 84 DHS surveys, 2012 to 2022

	Early neonatal			Neonatal			Post-neonatal			Infant			Child			Under-5		
	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+
Birth to conception interval (months)																		
Under 6	2.51	2.33	2.70	2.57	2.41	2.75	2.55	2.35	2.78	2.57	2.44	2.70	2.96	2.83	3.10	3.63	3.54	3.72
6 to 11	1.66	1.55	1.78	1.73	1.62	1.84	1.85	1.71	2.00	1.78	1.69	1.87	2.43	2.32	2.53	2.49	2.43	2.55
12 to 17	1.24	1.16	1.32	1.29	1.22	1.37	1.49	1.38	1.60	1.37	1.31	1.44	2.08	2.00	2.17	1.92	1.88	1.97
18 to 23	1.06	0.98	1.13	1.10	1.04	1.18	1.27	1.18	1.37	1.17	1.11	1.23	1.75	1.67	1.82	1.57	1.54	1.61
24 to 29	0.94	0.87	1.02	0.99	0.93	1.06	1.10	1.02	1.20	1.04	0.99	1.09	1.34	1.28	1.40	1.25	1.21	1.28
30 to 35	1.01	0.93	1.10	1.02	0.95	1.10	1.07	0.98	1.17	1.05	0.99	1.11	1.26	1.19	1.32	1.18	1.15	1.22
36 to 47 (ref)	1			1			1			1			1			1		
48 to 59	1.20	1.10	1.31	1.17	1.08	1.27	1.05	0.94	1.16	1.12	1.05	1.20	0.90	0.84	0.96	0.98	0.94	1.01
60 to 95	1.28	1.17	1.39	1.30	1.20	1.40	1.09	0.98	1.20	1.21	1.14	1.29	0.83	0.78	0.88	1.00	0.96	1.03
96 or More	1.83	1.65	2.02	1.79	1.63	1.97	1.32	1.15	1.50	1.62	1.50	1.74	0.87	0.79	0.96	1.24	1.19	1.30
First born	1.78	1.66	1.92	1.76	1.65	1.88	1.20	1.11	1.30	1.54	1.47	1.62	1.47	1.41	1.54	2.04	2.00	2.09
Total N	1,252,692			1,252,692			1,252,692			1,252,692			3,657,557			3,657,557		
Mother's age at child's birth																		
Under 18	1.29	1.22	1.35	1.30	1.24	1.36	1.41	1.32	1.49	1.33	1.29	1.38	1.49	1.45	1.53	1.57	1.55	1.60
18 to 24 (ref)	1			1			1			1			1			1		
25 to 34	1.01	0.98	1.04	1.01	0.98	1.03	1.04	1.00	1.08	1.02	1.00	1.04	0.97	0.96	0.99	0.91	0.90	0.92
35 to 39	1.34	1.27	1.41	1.31	1.26	1.38	1.25	1.18	1.33	1.29	1.25	1.34	1.01	0.98	1.04	1.02	1.00	1.03
40 or Older	1.80	1.68	1.93	1.74	1.64	1.85	1.58	1.46	1.72	1.68	1.60	1.76	0.98	0.93	1.04	1.10	1.06	1.13
Total N	1,254,367			1,254,367			1,254,367			1,254,367			3,660,071			3,660,071		
Birth Order																		
1 to 2 (ref)	1			1			1			1			1			1		
3 to 4	0.91	0.88	0.94	0.91	0.88	0.94	1.07	1.03	1.12	0.97	0.95	1.00	1.09	1.07	1.12	0.89	0.89	0.90
5 to 6	1.01	0.96	1.06	1.01	0.97	1.05	1.19	1.14	1.26	1.08	1.05	1.12	1.27	1.24	1.30	1.04	1.02	1.05
7 or More	1.39	1.32	1.46	1.37	1.31	1.44	1.49	1.41	1.57	1.42	1.37	1.47	1.51	1.47	1.55	1.30	1.28	1.32
Total N	1,254,367			1,254,367			1,254,367			1,254,367			3,660,071			3,660,071		

Note:

In addition to the three key fertility risk behavior characteristics, adjusted models included the following variables ENN, NN, PNN, and Infant Mortality: Sex of index child, urban or rural area of residence, wantedness of child, mother's education, if conception was a result of contraceptive failure, outcome of preceding pregnancy (live birth or stillbirth), type of provider of prenatal care, type of provider of delivery assistance, number of prenatal tetanus injections, timing of first prenatal care visit, quintile of DHS wealth index, type of water supply, type of toilet facility, possession of refrigerator, duration of pregnancy, and if preceding child died before conception of index child.

Child and Under-5 Mortality: Sex of index child, urban or rural area of residence, mother's education, quintile of wealth Index, type of water supply, type of toilet facility, possession of refrigerator, duration of pregnancy, and if preceding child died before conception of index child

Age range of analysis:

ENN, NN, PNN, and Infant Mortality: 0 to 59 months

Child and Under-5 Mortality: 0 to 179 months

3.15 Adjusted Risk Ratios: Maternal Age at Birth

As with the unadjusted risk ratios, births to mothers under age18 have higher risk ratios than births to mothers age 18–24. The results are statistically significant. For births to mothers over age 40, mortality risks are higher in mortality groups except for child mortality, where they are not statistically different from the reference group. For women age 35–39 at birth, their children have an increased risk of early neonatal, neonatal, post-neonatal, and infant mortality compared to children born to mothers age 25–34.

3.16 Adjusted Risk Ratios: Birth Order

Unlike in the unadjusted results, the adjusted birth order regressions combine birth orders 1 and 2 to form the reference group. For early neonatal, neonatal, and under-5 mortality, parity 3 and 4 have lower relative risk of mortality than parity 1 and 2. Post-neonatal and child mortality have higher relative risks for birth order 3 and 4 than parity 1 and 2. While there is no significant difference between parity 5 and 6 and parity 1 and 2 for early neonatal and neonatal mortality, the relative risks are higher for post-neonatal, infant, child, and under-5 mortality. In all 6 mortality measures, children of birth order 7 or higher have statistically higher risks of death than children who are birth order 1 or 2.

3.17 Adjusted Risk Ratios: Multiple Fertility Extra Risk Factors

Table 11 shows the combination of the three key independent variables. First births have higher risks of death in all 6 mortality categories than children with no extra fertility risks (the reference group). Births to women under age 18 (that are not first births) have lower risk of mortality than children with no risks for early neonatal, neonatal, post-neonatal, and infant, although first births to mothers under 18 have higher (and statistically significant risks) then children with no extra fertility risk factors.

With birth spacing under 24 months, adjusted risk ratios are higher and significant in almost all cases compared to the reference group. The risk ratios are also larger than the adjusted risk ratios for births spaced 24–35 months. In most cases, the risks associated with giving birth over the age of 40 are higher than those of giving birth before the age of 18, relative to the reference group.

Table 11 Adjusted relative risk of mortality by the mother's fertility related risk, children born 0 to 179 months prior to the survey, 84 DHS surveys, 2012 to 2022

	Early neonatal			Neonatal			Post-neonatal			Infant			Child			Under five		
	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+
No extra risk (ref)	1			1			1			1			1			1		
Unavoidable first-birth risk	1.61	1.51	1.71	1.57	1.49	1.66	1.07	1.00	1.15	1.39	1.33	1.45	1.22	1.18	1.27	1.76	1.73	1.79
Single risk spacing <24 months	1.36	1.29	1.43	1.4	1.33	1.47	1.48	1.39	1.58	1.43	1.38	1.49	1.98	1.91	2.05	2.13	2.09	2.17
Single risk spacing 24-35 months	0.91	0.86	0.96	0.93	0.89	0.98	1.15	1.08	1.22	1.01	0.97	1.06	1.55	1.5	1.61	1.37	1.35	1.4
Single risk age <18	0.42	0.22	0.81	0.41	0.23	0.74	0.75	0.44	1.26	0.55	0.37	0.81	1.39	1.13	1.7	1.13	1.00	1.28
Single risk age 40+	1.78	1.36	2.33	1.77	1.39	2.26	1.41	0.97	2.04	1.65	1.34	2.02	1.06	0.77	1.46	1.31	1.13	1.52
Single risk order 4+	1.02	0.96	1.08	1.01	0.96	1.07	1.04	0.97	1.11	1.03	0.99	1.07	1.13	1.09	1.18	1.09	1.07	1.12
Double risk spacing <24, order 4+	1.85	1.75	1.96	1.89	1.8	1.99	2.18	2.05	2.32	2.01	1.93	2.09	2.92	2.82	3.02	2.92	2.87	2.97
Double risk spacing 24-35, order 4+	1.04	0.98	1.1	1.09	1.03	1.15	1.38	1.29	1.47	1.21	1.16	1.26	1.96	1.89	2.03	1.74	1.70	1.77
Double risk first birth, age <18	1.90	1.76	2.05	1.88	1.76	2.01	1.63	1.50	1.78	1.79	1.70	1.89	2.24	2.15	2.33	2.73	2.67	2.79
Double risk first birth, age 40+	3.39	2.26	5.08	3.19	2.20	4.64	2.65	1.50	4.69	2.99	2.19	4.09	1.71	0.95	3.10	2.48	1.95	3.15
Double risk order 4+, age <18	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	1.31	0.42	4.07
Double risk order 4+, age 40+	1.69	1.52	1.88	1.63	1.48	1.79	1.62	1.44	1.83	1.63	1.51	1.76	1.11	1.01	1.23	1.37	1.30	1.44
Double risk spacing <24 and age <18	1.78	1.54	2.07	1.90	1.66	2.16	1.95	1.65	2.31	1.93	1.74	2.14	3.33	3.11	3.56	3.18	3.07	3.30
Double risk spacing 24-35 and age <18	1.00	0.77	1.28	1.07	0.86	1.33	1.33	1.05	1.68	1.16	0.99	1.36	2.73	2.50	2.98	2.06	1.95	2.18
Double risk spacing <24 and age 40+	4.11	2.47	6.82	3.78	2.35	6.09	1.23	0.40	3.83	2.83	1.83	4.39	0.96	0.36	2.55	2.35	1.70	3.25
Double risk spacing 24-35 and age 40+	1.53	0.73	3.21	1.94	1.07	3.51	1.71	0.77	3.80	1.97	1.24	3.12	0.61	0.23	1.62	1.34	0.94	1.91
3-way risk spacing 24-35, order 4+, age<18	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	3.22	1.61	6.45	2.71	1.80	4.08
3-way risk spacing <24, order 4+, age 40+	3.34	2.90	3.83	3.42	3.03	3.87	2.95	2.49	3.49	3.28	2.97	3.62	3.19	2.85	3.56	3.61	3.41	3.82
3-way risk spacing <24, order 4+, age<18	0.67	0.09	4.74	1.06	0.26	4.24	0.74	0.10	5.23	0.93	0.30	2.89	3.23	2.25	4.62	3.48	2.89	4.20
3-way risk spacing 24-35, order 4+, age 40+	2.06	1.79	2.37	2.01	1.77	2.28	2.16	1.86	2.50	2.06	1.88	2.27	1.90	1.71	2.12	2.11	1.99	2.23
Total N	1,254,367			1,254,367			1,254,367			1,254,367			3,660,071			3,660,071		

Note:

Adjusted models included the following variables:

ENN, NN, PNN, and Infant Mortality: Sex of index child, urban or rural area of residence, wantedness of child, mother's education, whether conception was a result of contraceptive failure, outcome of preceding pregnancy (live birth or stillbirth), type of provider of prenatal care, type of provider of delivery assistance, number of prenatal tetanus injections, timing of first prenatal care visit, quintile of DHS wealth index, type of water supply, type of toilet facility, possession of refrigerator, duration of pregnancy, and if preceding child died before conception of index child.

Child and Under-5 Mortality: Sex of index child, urban or rural area of residence, mother's education, quintile of wealth index, type of water supply, type of toilet facility, possession of refrigerator, duration of pregnancy, and if preceding child died before conception of index child

Age range of analysis:

ENN, NN, PNN, and Infant Mortality: 0 to 59 months

Child and Under-5 Mortality: 0 to 179 months

nc = no cases

3.18 Adjusted Risk Ratios: Multiple Fertility Extra Risk Factors, Simplified

The final table (Table 12) shows the simplified version of Table 11, which combines all categories by number of fertility-related extra risk factors. Similar to the unadjusted relative risks, the adjusted relative risks are all higher than for births with no fertility-related extra risks factors. The risks are attenuated, but all remain statistically significant.

Table 12 Adjusted relative risk of mortality by the mother's fertility related risk, children born 0 to 179 months prior to the survey, simplified, 84 DHS surveys, 2012 to 2022

	Early neonatal			Neonatal			Post-neonatal			Infant			Child			Under five		
	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+	ARR	CI-	CI+
No extra risk (ref)	1			1			1			1			1			1		
Unavoidable first-birth risk	1.48	1.40	1.56	1.46	1.39	1.53	1.10	1.03	1.18	1.34	1.29	1.40	1.22	1.18	1.27	1.75	1.72	1.78
Any single risk	1.09	1.05	1.14	1.11	1.07	1.16	1.20	1.14	1.27	1.15	1.11	1.18	1.52	1.47	1.57	1.51	1.49	1.54
Any double risk	1.51	1.44	1.58	1.54	1.48	1.6	1.70	1.62	1.79	1.61	1.56	1.66	2.35	2.28	2.42	2.37	2.34	2.41
Any 3-way risk	2.57	2.32	2.85	2.57	2.35	2.82	2.44	2.17	2.73	2.52	2.35	2.71	2.42	2.24	2.61	2.74	2.63	2.86
Total N	1,254,367			1,254,367			1,254,367			1,254,367			3,660,071			3,660,071		

Note:

Adjusted models included the following variables:

ENN, NN, PNN, and Infant Mortality: Sex of index child, urban or rural area of residence, wantedness of child, mother's education, whether conception was a result of contraceptive failure, outcome of preceding pregnancy (live birth or stillbirth), type of provider of prenatal care, type of provider of delivery assistance, number of prenatal tetanus injections, timing of first prenatal care visit, quintile of DHS wealth index, type of water supply, type of toilet facility, possession of refrigerator, duration of pregnancy, and if preceding child died before conception of index child.

Child and Under Five Mortality: Sex of index child, urban or rural area of residence, mother's education, quintile of wealth Index, type of water supply, type of toilet facility, possession of refrigerator, duration of pregnancy, and if preceding child died before conception of index child.

Age range of analysis:

ENN, NN, PNN, and Infant Mortality: 0 to 59 months.

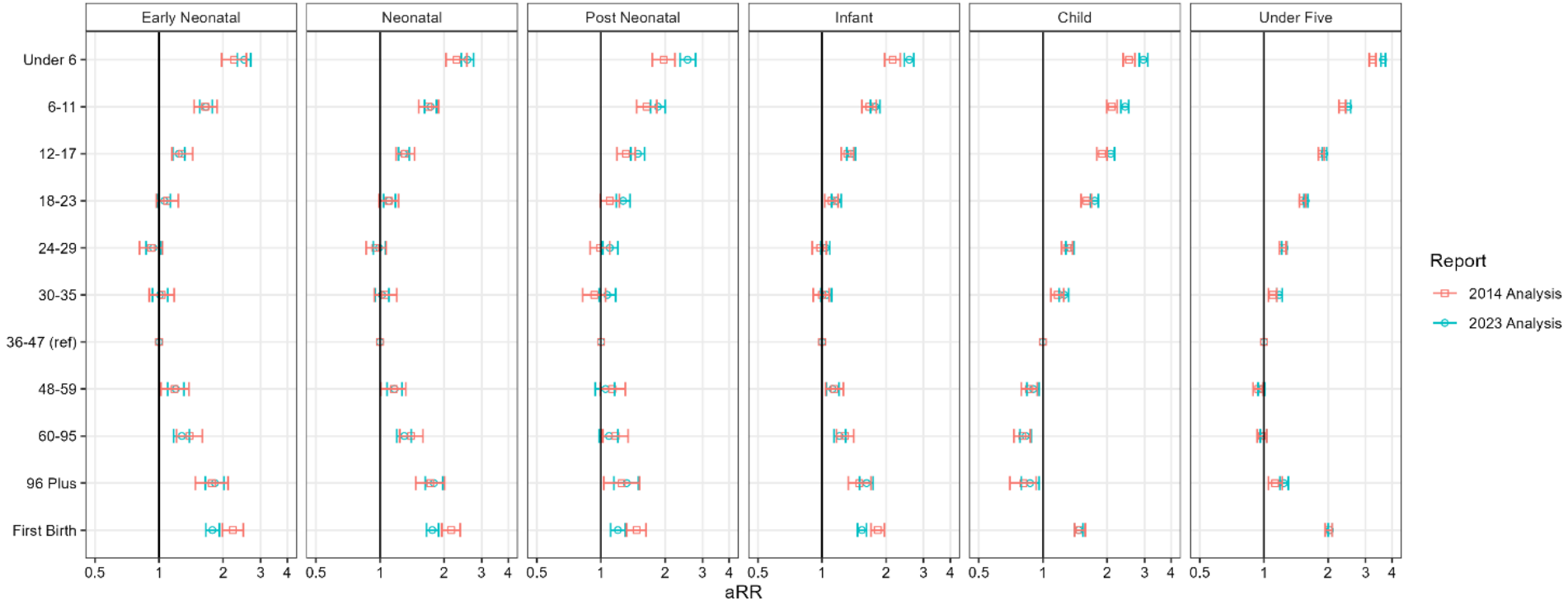
Child and Under Five Mortality: 0 to 179 months.

4 DISCUSSION

With over 3.7 million births from 84 surveys and 56 countries, this study is the largest to date in a series of DHS reports that studied the relationship between birth intervals and mortality. We follow the 2014 study by including maternal age at birth and birth order as key independent variables, and the same set of control variables for our multivariate models. For the first time, all code is written using free R software and is available online for anyone who seeks to replicate or extend results. Figures 1, 2, and 3 compare results from the adjusted risk ratios for the 2023 study compared to the 2014 report.

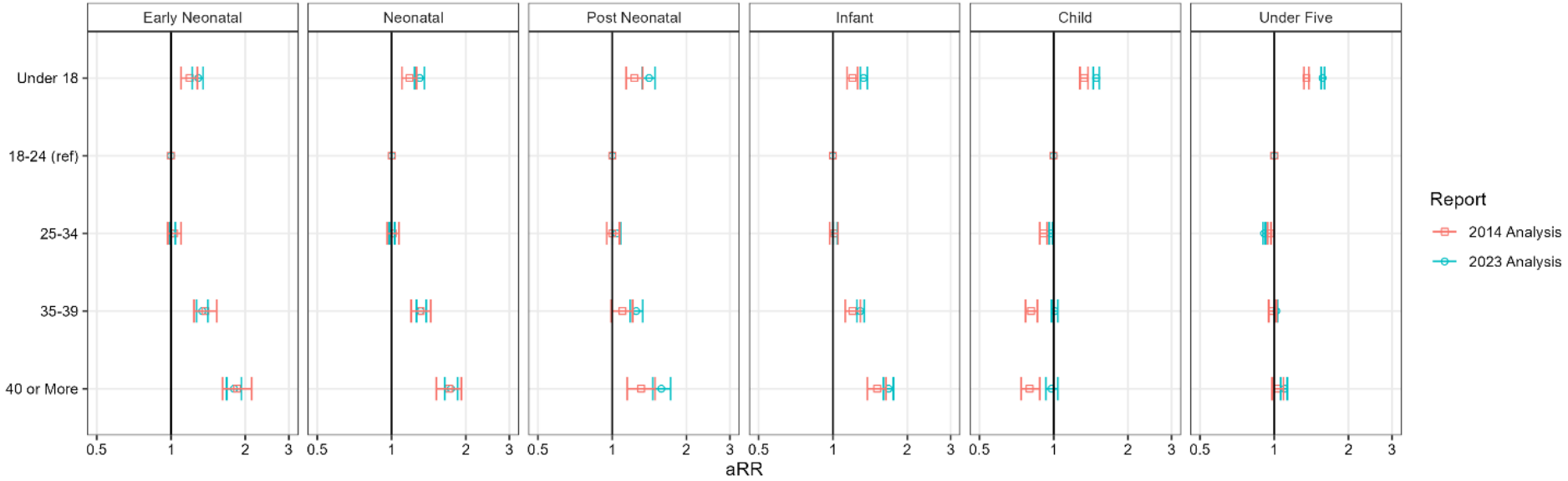
As with the 2014 study, first births have increased risks compared to the 36–47 month interval for all six mortality measures. Also in line with the previous study, we find that the adjusted relative risk ratios for most mortality measures indicate that the risk of dying is highest at the shortest birth interval, then declines to 23 months, and then rises again at 48 months and beyond. The exception is child mortality (births between age 1–4), where 48–59, 60–95, and 96+ months are lower than the reference group in both reports[3].

Figure 1 Comparing adjusted relative risk of mortality by duration of preceding birth to conception interval between the 2014 and 2023 DHS



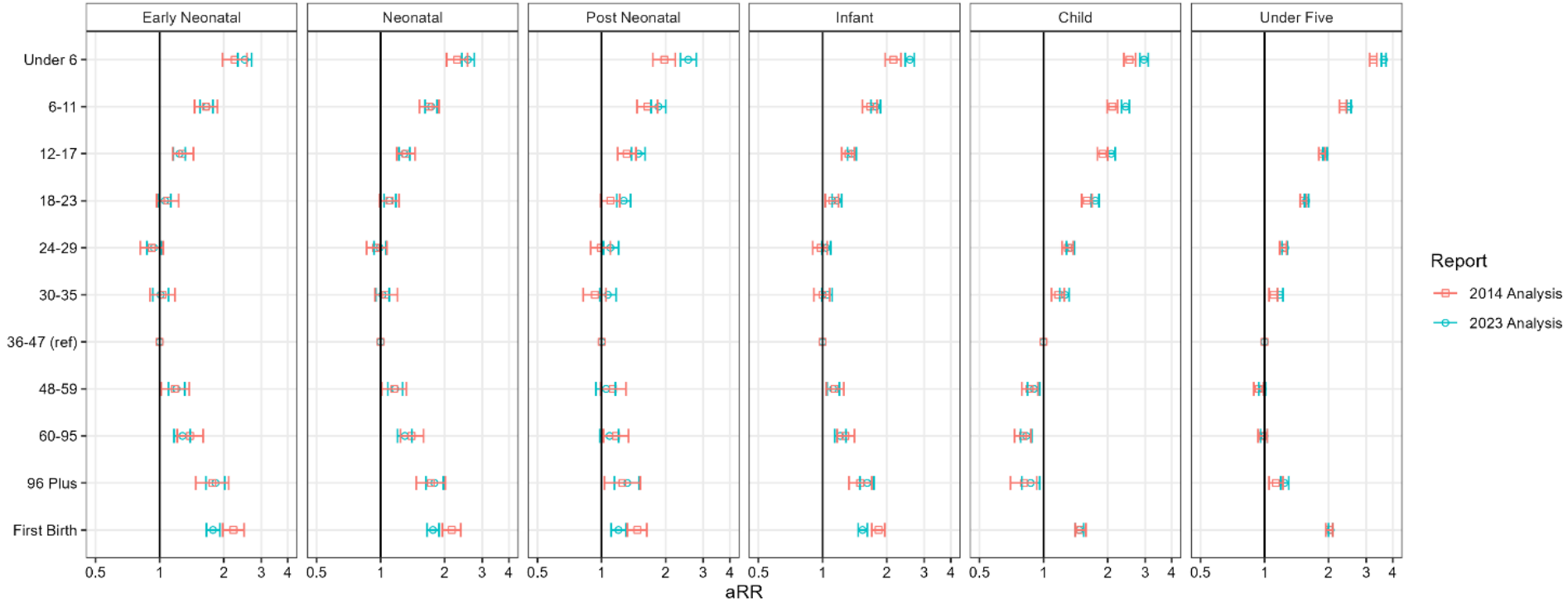
Also in agreement with the 2014 report, children born to women under 18 and over 40 have an increased risk of death. For births to women under 18, all six morality measure have odds ratios above 1 and are statistically significant. In both reports, mortality odds ratios are significant and above 1 for 40 year olds in all mortality categories except for child mortality, which suggests that the impact of advanced maternal age is greatest on the youngest children, compared to the reference group of children born to mothers age 18 to 24.

Figure 2 Comparing adjusted relative risk of mortality by mother's age at child's birth between the 2014 and 2023 DHS



For birth order, while the 2014 report showed no difference in birth order and risks of early neonatal and neonatal mortality, we find increase risks of dying for those parity 7 or more, compared to parity 1 and 2, when controlling for other variables. Post-neonatal and child mortality results mirror patterns in the 2014 report, with mortality risks increasing with parity. For under-5 mortality, our current study finds statistically significant lower risks associated with parities 3 and 4 compared to 1 and 2, which is the opposite of that found in 2014.

Figure 3 Comparing adjusted relative risk of mortality by birth order between the 2014 and 2023 DHS



This updated study continues to demonstrate the importance of birth spacing in reducing child mortality.

REFERENCES

1. Rutstein SO. Effects of preceding birth intervals on neonatal, infant and under–five years mortality and nutritional status in developing countries: Evidence from the Demographic and Health Surveys. *Int J Gynecol Obstet*. 2005;89: S7–S24. https://doi.org/10.1016/j.ijgo.2004.11.012

2. Rutstein SO. *Further evidence of the effects of preceding birth intervals on neonatal, infant, and under–five–years mortality and nutritional status in developing countries: Evidence from the Demographic and Health Surveys.* 2008. DHS Working Papers No. 41. Calverton, Maryland, USA: Demographic and Health Research Division, Macro International. https://dhsprogram.com/pubs/pdf/wp41/wp41.pdf

3. Rutstein S, Winter R. *The effects of fertility behavior on child survival and child nutritional status: Evidence from the Demographic and Health Surveys, 2006 to 2012.* 2014. DHS Analytical Studies No. 37. Rockville, Maryland, USA: ICF International. https://dhsprogram.com/publications/publication-as37-analytical-studies.cfm

4. World Bank. Mortality Rate, infant (per 1,000 live births). 2023. https://data.worldbank.org/indicator/SP.DYN.IMRT.IN.

5. World Bank. Mortality Rate, neonatal (per 1,000 live births). 2023. https://data.worldbank.org/indicator/SH.DYN.NMRT

6. World Bank. Mortality Rate, under-5 (per 1,000 live births). 2023. https://data.worldbank.org/indicator/SH.DYN.MORT

7. World Health Organization. SDG Target 3.2. World Health Organization; 2023. https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GHO/sdg-target-3.2-newborn-and-child-mortality.

8. Molitoris J, Barclay K, Kolk M. When and where birth spacing matters for child survival: An international comparison using the DHS. *Demography* 2019.56(4):1349–1370. https://doi.org/10.1007/s13524-019-00798-y

9. Akinyemi JO, Bamgboye AE, Ayeni O. Trends in neonatal mortality in Nigeria and effects of bio-demographic and maternal characteristics. *BMC Pediatr*. 2015;15:36. https://doi.org/10.1186/s12887-015-0349-0

10. Alam N. Birth spacing and infant and early childhood mortality in a high fertility area of Bangladesh: Age–dependent and interactive effects. *J Biosoc Sci.* 1995;27(4):393–393. https://doi.org/10.1017/S0021932000023002

11. Bhalotra S, Soest AV. Birth spacing and neonatal mortality in India: Dynamics, frailty and fecundity. 2006. Paper presented at the 2006 Annual Meeting - Population Association of America, Los Angeles, CA. https://dx.doi.org/10.2139/ssrn.670245

12. Ezeh OK, Agho KE, Dibley MJ, Hall JJ, Page AN. Risk factors for postnatal, infant, child and under-5 mortality in Nigeria: A pooled cross-sectional analysis. *BMJ Open* 2014;5(3):e00679. http://dx.doi.org/10.1136/bmjopen-2014-006779

13. Hosseinpoor AR, van Doorslaer E, Speybroeck N, et al. Decomposing socioeconomic inequality in infant mortality in Iran. *Int J Epidemiol* 2006; 35(5): 1211–1219. https://doi.org/10.1093/ije/dyl164

14. Schummers L, Hutcheon JA, Hernandez-Diaz S, et al. Association of short interpregnancy interval with pregnancy outcomes according to maternal age. *JAMA Int Med* 2018;178(12):1661–1670. https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2708196

15. Tesema GA, Worku MG. Individual and community-level determinants of neonatal mortality in the emerging regions of Ethiopia: A multilevel mixed-effect analysis." *BMC Pregnancy Childbirth* 2021; 21:12. https://doi.org/10.1186/s12884-020-03506-6

16. Conde-Agudelo A, Rosas-Bermudez A, Castaño F, Norton MH. Effects of birth spacing on maternal, perinatal, infant, and child health: A systematic review of causal mechanisms. *Stud Fam Plann.* 2012;43 (2):93–114. https://doi.org/10.1111/j.1728-4465.2012.00308.x

17. Skjaerven R, Wilcox,AJ, Lie RT. The interval between pregnancies and the risk of preeclampsia. *N Engl J Medicine.* 2002;346(1):33–8. https://www.nejm.org/doi/full/10.1056/NEJMoa011379

18. World Health Organization. *Birth spacing – report from a WHO technical consultation.* Policy Brief. World Health Organization; 2006. https://apps.who.int/iris/bitstream/handle/10665/73710/RHR_policybrief_birthspacing_eng.pdf.

19. Shifti DM, Chojenta C, Holliday E, Loxton D. Effects of short birth interval on neonatal, infant and under-five child mortality in Ethiopia: A nationally representative observational study using inverse probability of treatment weighting. *BMJ Open* 2021;11(8):e047892. http://dx.doi.org/10.1136/bmjopen-2020-047892

20. de Jonge HCC, Azad K, Seward N, et al. 2014. Determinants and consequences of short birth interval in rural Bangladesh: A cross-sectional study. *BMC Pregnancy Childbirth* 14:427. https://doi.org/10.1186/s12884-014-0427-6

21. van Soest A, Saha UR. Relationships between infant mortality, birth spacing and fertility in Matlab, Bangladesh. *PLoS ONE* 2018;13(4): e0195940. https://doi.org/10.1371/journal.pone.0195940.

22. Markovitz BP, Cook R, Flick,LH, Leet TL. Socioeconomic factors and adolescent pregnancy outcomes: Distinctions between neonatal and post-neonatal deaths? *BMC Public Health* 2005:5:79. https://doi.org/10.1186/1471-2458-5-79

23. Pinheiro RL, Areia AL, Mota Pinto A, Donato H. Advanced maternal age: Adverse outcomes of pregnancy, a meta-analysis. *Acta Médica Portuguesa* 2019; 32(3): 219–226. https://doi.org/10.20344/amp.11057

24. Lean SC, Derricott H, Jones RL, Heazell AEP. Advanced maternal age and adverse pregnancy outcomes: A systematic review and meta-analysis. *PLoS ONE* 2017. 12(10):e0186287. https://doi.org/10.1371/journal.pone.0186287

25. Alio AP, Salihu HM, McIntosh C, et al. The effect of paternal age on fetal birth outcomes. *Am J Mens Health* 2012;6(5):427–35. https://doi.org/10.1177/1557988312440718

26. Neal S, Channon AA, Chintsanya J. The impact of young maternal age at birth on neonatal mortality: Evidence from 45 low and middle income countries." *PLoS ONE* 2018;13(5): e0195731. https://doi.org/10.1371/journal.pone.0195731

27. Ganchimeg T, Ota E, Morisaki N, et al. Pregnancy and childbirth outcomes among adolescent mothers: a World Health Organization multicountry study. *BJOG* 2013:121(Suppl. 1):40–48. https://doi.org/10.1111/1471-0528.12630

28. Weldearegawi B. Melaku YA, Abera SF, et al. Infant mortality and causes of infant deaths in rural Ethiopia: A population-based cohort of 3684 births. *BMC Public Health* 2015; 15:770. https://doi.org/10.1186/s12889-015-2090-x

29. Ogbo FA, Ezeh OK, Awosemo AO, et al. Determinants of trends in neonatal, post-neonatal, infant, child and under-five mortalities in Tanzania from 2004 to 2016. *BMC Public Health* 2019; 19:1243. https://doi.org/10.1186/s12889-019-7547-x

30. Londero AP, Rossetti E, Pittini C, Cagnacci A, Driul L. Maternal age and the risk of adverse pregnancy outcomes: A retrospective cohort study. *BMC Pregnancy Childbirth* 2019; 19:261. https://doi.org/10.1186/s12884-019-2400-x

31. Mahy M. *Child mortality in the developing world: A review of evidence from the Demographic and Health Surveys.* 2003. DHS Comparative Reports No. 4. Calverton, Maryland, USA: ORC Macro. https://dhsprogram.com/publications/publication-cr4-comparative-reports.cfm

32. Handa S, Koch SF, and Ng SW. Child mortality in Eastern and Southern Africa. Department of Economics Working Paper 2008–35. 2008. Pretoria, South Africa: University of Pretoria. http://hdl.handle.net/2263/8978

33. Uddin J, Hossain Z. Ullah MO. Child mortality in a developing country: A statistical analysis. *JAQM*. 2009; 4(3):270–283. https://files.eric.ed.gov/fulltext/EJ862376.pdf

APPENDIX

Appendix Table A1 Distribution of births 0 to 179 months and 0 to 59 months prior to survey by control variables used in multivariate analyses, 84 DHS surveys, 2012 to 2022

	Births 0 to 179 months prior to the survey		Births 0 to 59 months prior to the survey	
	Percent	Frequency	Percent	Frequency
Sex of index child				
Male	51.5	1,924,914	51.4	657,878
Female	48.5	1,810,437	48.6	622,146
Type of place of residence				
Urban	29.4	1,098,357	29.6	379,325
Rural	70.6	2,636,994	70.4	900,699
Mother's highest educational level				
No education	37.6	1,388,430	31.9	403,451
Primary	23.8	879,012	23.1	291,516
Secondary	31.6	1,164,047	36.0	455,677
Higher	7.0	257,858	9.0	113,531
Wealth index quintiles				
Poorest	27.0	1,006,800	26.5	338,874
Poorer	22.8	850,404	22.6	289,579
Middle	19.7	735,861	19.7	252,561
Richer	16.9	630,955	17.1	219,216
Richest	13.7	511,331	14.0	179,794
Household has refrigerator				
Yes	24.4	913,050	24.1	308,366
No	73.4	2,743,071	72.5	928,481
Missing	2.1	79,230	3.4	43,177
Type of toilet/latrine				
Flush	38.6	1,442,712	36.8	470,476
Pit	29.8	1,111,490	31.0	397,203
None	25.3	945,242	24.8	317,822
Other, missing	6.3	235,907	7.4	94,523
Source of drinking water				
Piped	35.4	1,313,698	34.7	440,395
Open well	27.3	1,013,480	26.0	330,467
Protected well	14.5	537,151	14.9	188,893
Surface	12.5	462,488	12.9	163,875
Rain	1.2	44,088	1.2	15,165
Tanker truck	1.9	70,210	1.9	24,468
Bottled	4.1	153,146	4.2	52,787
Other, missing	3.0	111,814	4.3	54,166
Length of gestation (months)				
7	0.3	10,126	0.8	9,750
8	1.6	58,482	4.5	56,963
9	96.8	3,615,528	90.8	1,162,638
10	1.4	51,215	4.0	50,673
Survival of preceding child				
Did not die	95.6	3,570,568	95.9	1,227,764
Preceding died	4.4	164,783	4.1	52,260

Continued…

Appendix Table A1—*Continued*

Additional control variables included in models predicting early neonatal, neonatal, post-neonatal, and infant mortality	Births 0 to 59 months prior to the survey	
	Percent	**Frequency**
Outcome of preceding pregnancy		
Live birth	59.8	765,357
Not a live birth	3.7	47,796
Not available	36.5	466,871
Time wanted pregnancy		
Then	80.7	1,033,205
Later	10.6	136,128
No more	5.3	67,380
Missing	3.4	43,311
Pregnancy was result of contraceptive failure		
Yes	2.3	29,936
No	77.2	988,225
Not asked	20.5	261,863
Prenatal care provider		
Doctor	27.3	350,086
Nurse/midwife	30.8	394,639
Other medical	2.5	31,470
TBA	0.8	9,995
Other person	30.0	383,920
No one	8.6	109,914
Delivery care provider		
Doctor	31.9	408,714
Nurse/midwife	36.2	463,488
Other medical	2.6	33,586
TBA	13.1	167,416
Other person	13.9	178,127
No one	2.2	28,693
Prenatal tetanus injections		
None	12.6	161,224
One	12.8	163,795
2+	42.5	543,553
Missing, don't know	32.1	411,452
Timing of first antenatal check		
No antenatal	37.2	476,142
< 3 months	17.4	222,230
3–4 months	30.9	395,479
5–6 months	10.7	137,094
7–8 months	2.8	35,397
9 months	0.8	9,705
Missing, don't know	0.3	3,977

Note: Distributions and percentages are based on unweighted cases, since the application of standard individual country weights is not meaningful in the merged sample.