Published in final edited form as:
Soc Sci Med. 2009 May ; 68(9): 1625–1632. doi:10.1016/j.socscimed.2009.02.018.

Age at First Birth, Parity, and Post-Reproductive Mortality among White and Black Women in the US, 1982–2002

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Abstract

We investigate the relationship between the timing of first birth, parity, and women's risk of post-reproductive mortality over twenty-one years (1982–2001), among representative samples of black and white women in the United States. Data are taken from the National Longitudinal Survey of Mature Women. We find early childbearing to be associated with higher mortality among whites, while later childbearing is associated with higher mortality among blacks. The effect of age at first birth on white women's mortality is explained by background and mediating social, economic, and health related factors, but this effect remains robust for black women. In addition, childless white women have a higher risk of post-reproductive mortality than those with 2–3 children. High parity (6+ children) has a significant protective effect for blacks, though the effect is reduced with age. A similar protective effect of high parity becomes apparent among whites only after controlling for background and mediating characteristics. Findings are interpreted in light of the "weathering hypothesis" and from a life course framework that views women's fertility as adaptive to particular social and historical contexts.

Keywords

USA; age at first birth; parity; mortality; life course; weathering; ethnicity; fertility

Introduction

Fertility is a central element of the life course for women. The timing of pregnancy and childbirth as well as the number of births are central in shaping women's opportunities, attitudes, decisions, and behaviors. Recent trends toward later childbearing and increased

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Author Comments: An earlier version of this paper was presented at the IUSSP Seminar on Longevity: Early-life Conditions, Social Mobility, and Other Factors that Influence Survival to Old Age, Lund (Molle), Sweden, June 2006. This seminar was organized by the IUSSP Scientific Committee on Historical Demography in collaboration with the Research Group in Economic Demography, Lund University. We would like to thank seminar participants for helpful comments. Support for this research was provided by the Center for Demography and Population Health at Florida State University. Data and technical consultation were provided through the Center for Human Resource Research at the Ohio State University.

childlessness have prompted concern over whether and how there might be long-term consequences for women's later life health and survival.

One possibility is that fertility adds uniquely to "chains of risk" and the accumulation of (dis) advantage across women's lives. Fertility may have both indirect and direct effects on health and mortality through many pathways (Kuh & Ben-Shlomo, 2004). Another possibility is that the relationship between fertility and post-reproductive mortality is spurious. The age pattern and level of fertility may reflect background or early life disadvantages (e.g., childhood poverty and disease exposure or underlying health status), which may also influence mortality. It is particularly important to consider social causation and selection in interpreting observed relationships. Background factors and other characteristics may vary widely across social groups within the same society, e.g., for blacks and whites in the US.

Together, a life course perspective and the weathering hypothesis comprise an ideal framework for studying group differences in the long-term mortality consequences of childbearing in the US. A life course framework views early life experiences and exposures to be related to health in later life (Elder, Johnson, & Crosnoe, 2004; Kuh & Ben-Shlomo, 2004). Principles of historical and social contingency are key (Elder, Johnson, & Crosnoe, 2004), such that patterns and relationships should vary across time, place, and group. The 'weathering hypothesis' posits race differences in the health and mortality consequences of childbearing by age (Geronimus, 1994, 2003).

We examine the relationships between age at first birth, completed fertility, and post reproductive mortality for black and white women in the US, including a wide range of social, economic, and health characteristics across the life course to address issues of selection and causation. Much research on the relationship between fertility and longevity is based on European and historical populations (e.g., Doblhammer & Oeppen 2003; Smith, Mineau, & Bean, 2002). Less is known about contemporary cohorts and among women in the US. Further, the available research is limited in the examination of factors that may serve to mediate the fertility-adult mortality relationship (e.g., Doblhammer, 2000). Finally, studies on women in the US lack racial and ethnic comparisons (e.g., Henretta, 2007), despite strong theoretical reasons to believe that such differences exist given the historically based and persistent social and economic disadvantages associated with minority status in the United States.

Background

Age at birth

Research on historical cohorts of women and age at first birth is inconsistent on the relationship of fertility and longevity. For example, some research finds decreased longevity associated with earlier age at first birth (Westendorp & Kirkwood, 1998) or higher longevity among women having a first birth later in life (Perls, Alpert, & Fretts, 1997). Others, employing more rigorous statistical methods and a wider range of controls, find that women with later first births do not live longer (Mueller, 2004; Smith, Mineau, & Bean, 2002).

Studies of more recent cohorts are more consistent. Early childbearing is associated with higher mortality risks, while later initiation of childbearing is linked to longer life. Mirowsky (2005) finds the highest mortality among adult women in the United States who had their first birth at younger ages and lower mortality associated with delay to about age 22. Other research finds higher death rates among women who had first births before age 20 compared to those who began childbearing at older ages (Doblhammer, 2000; Henretta 2007).

Evidence for a beneficial effect of later births is also found cross-culturally. The lowest mortality risk among American women is found among those who had their first birth after 30

(Mirowsky, 2005). Doblhammer (2000) finds lower mortality associated with a birth after age 40 among women in Austria and England and Wales. Lower mortality was found among married Norwegian women with late first and last births (Lund, Arnesen, & Borgan, 1990). Finally, elderly Chinese women with at least 2 or more births after the ages of 35 and 40 have been found to have lower mortality than those who do not (Yi & Vaupel, 2004).

The seemingly conclusive pattern of early first births as detrimental and later first births as beneficial may not apply to diverse populations. Some evidence suggests that the long-term effects of childbearing may differ for black and white women. A recent study on African American women over the age of 55 in Chicago suggests that later first births may be detrimental (Astone, Ensminger, & Juon, 2002). Controlling for social and economic circumstances of young adulthood, women aged 25 and older at the time of their first birth had higher mortality than those who had their first child before age 25. It is not clear whether this reflects underlying health differences that might also be implicated in varying ages at first birth. Among black but not white women, high parity appears to be associated with poor self-rated health (Sudha, Mutran, Williams, & Suchindran, 2006), a strong predictor of mortality (Benjamins, Hummer, Eberstein, & Nam, 2004; Idler & Benyamini, 1997).

Racial differences in the relationship between age at first birth and mortality warrant additional investigation in light of the ‘weathering hypothesis’ (Geronimus, 1994, 2003). This framework emphasizes that health insults cumulate with age at a faster rate for black than white women, due to their experience with racism and the consequences of disproportionate low socioeconomic status. From this process, it is expected that African American women beginning childbearing at older ages will be in worse health relative to younger black women than is the case among whites (Geronimus, 1996). Relatively poorer health may contribute to later age at first birth and higher mortality, and it may also be that giving birth while in poor health reduces life expectancy. In either case, the weathering hypothesis suggests younger optimal ages at childbearing among blacks and higher mortality among black women beginning childbearing later in life.

Parity

Inquiries into the relationship between parity and mortality produce rather consistent results. Kitagawa and Hauser (1973) demonstrated a clear J-shaped pattern in mortality ratios by parity. They found that women with no children had above average mortality and women with five or more children exhibited higher mortality risks than those with 2–4 children, even after including controls for socioeconomic status. Much research since then supports the idea that parents are better off than nonparents, but having a large number of children (about 5 or more) can be detrimental (Doblhammer & Oeppen, 2003; Grundy & Tomassini, 2005; Smith et al., 2002). However, Henretta (2007) finds no significant net effects of parity once background characteristics are controlled. Thus, further research is needed to determine the robustness of such findings in the face of controls for social and economic factors across the life course.

Potential mechanisms

Numerous social and economic factors across the life course may be important for the relationship between fertility and post-reproductive mortality. These include social and economic characteristics of the family of origin, educational attainment, employment, income and assets, and marital status. It is important to note that many of these have reciprocal relationships with fertility. Also, each of these characteristics may influence fertility and longevity through a variety of different pathways. Issues of causation and selection are paramount.

A growing body of life course research strongly suggests that childhood conditions matter for adult health and mortality (e.g., Hayward & Gorman, 2004; Hertzman, Power, Matthews, & Manor, 2001; Preston, Hill, & Drevenstedt, 1998) and contribute to race differences (Warner & Hayward, 2006). Factors such as family structure and socioeconomic status may shape health over the long-term, although precise mechanisms are in some dispute. As an example, rather than a direct causal effect of childhood socioeconomic status, Preston and colleagues (1998) posit that "correlated environments" (i.e., individuals growing up privileged are likely to maintain this relative social position throughout life) may link early life social conditions to later life health. However, early life social conditions have been shown to influence fertility, so indirect effects may be important (Henretta, 2007).

In addition to characteristics of the family of origin, education may affect fertility as it competes for women's time and attention (Barber, 2001). Because of the difficulties often associated with attending school and having children, one may be delayed or forgone for the other. In addition to the causal or selective role that education may play in age at birth, education is an oft cited independent and relatively strong predictor of mortality (Rogers, Hummer, & Nam, 2000).

Like education, labor force participation may affect fertility and mortality independently. Employed women may delay childbearing to establish careers, resulting in later age at first birth and ultimately lower parity. In addition, women with early and/or more children may be penalized for their absence from the labor force (Budig & England, 2001). Paid employment may have beneficial effects on health through greater material resources, more positive psychosocial resources, and greater social integration (Moen, Dempster-McClain, & Williams, 1992; Sorensen & Verbrugge, 1987; Thoits, 1986), but negative effects are also evident from combining paid and domestic labor (Blane, Berney, & Montgomery, 2001).

Marriage is another important predictor of both fertility and mortality. Although changed sexual behavior along with modern contraception and cohabitation have created variability in this relationship, marriage is important for exposure to the risk of pregnancy, particularly among older cohorts of women where non-marital fertility was rare (Ventura and Bachrach 2000). Marriage and marital stability can positively impact health and mortality, even controlling the positive health selection of those who marry (e.g., Waite, 1995).

Changing norms may be important in other ways. Individuals whose timing of first birth or completed fertility is out of sync with prevailing patterns may experience negative later life health and mortality through the social mechanisms identified above. Historical and social contexts of the transition to motherhood likely shape women's childbearing strategies (Elder et al, 2004). Because weathering implies a younger optimal age at childbearing for black than white women, it may be that these strategies will vary by race.

In addition to social factors that may be important in linking fertility to later life mortality, positive or negative health selection may play a role. For example, unhealthy women may have difficulties conceiving and carrying a baby to term, and the fact that they are less healthy to begin with means that they are more likely to die younger. Having many children, on the other hand, may be associated with physically good health or robustness; thus healthy women may be positively selected into high parity (Doblhammer & Oeppen, 2003).

Overall, the present study is an important test of the existence and form of the relationship between age at first birth and parity and mortality risks during the post-reproductive period of life. Nationally representative longitudinal data are used to follow women born in the US during the 1920s and 1930s over a 21-year interval following the completion of their reproductive period. A particular strength of the study is a consideration of whether and how the fertility – mortality relationship might vary for blacks and whites. Another is the inclusion of a large number of social, economic, and health characteristics across the life course that may serve as mechanisms.

Data and Sample

We use data from the National Longitudinal Survey of Mature Women (NLS-MW). Multistage probability sampling was used to draw a representative sample of 5,393 civilian, non-institutionalized women aged 30–44 years in 1967, with an oversample of black women (see Center for Human Resource Research 2001 for more detailed information). Ninety-four percent participated in the baseline (1967) interview (n=5,083), including 3,606 whites and 1,390 blacks. There are too few respondents of other race/ethnic groups for analysis (87 of the 5,083 original respondents were coded as “Other”). We use survey data through 2001 and death data through 2002. At the end of the entire 35 year period, 45.6 percent of original respondents were still alive and part of the study (47.6 percent of whites and 40.9 percent of blacks).

Our analyses follow women for 21 years beginning in 1982, when the sample was approximately 45–59 years old. By these ages, estimates of fertility – mortality relationships are not biased by the inclusion of women whose fertility may not be complete or by maternal mortality. Multiple imputation procedures (using the *ice* command in STATA; Royston, 2005) were used to handle missing values. The analysis sample consists of 1,001 black and 2,768 white women. There were 355 deaths for blacks and 641 for whites.

Measures

Post-reproductive mortality is the dependent variable of interest, coded 1 when the respondent died, 0 otherwise. Month and year of death were obtained from Social Security Administration (SSA) state death reports. Approximately 22 percent of deaths are unverified by SSA. This proportion is the same for blacks and whites. To assess the sensitivity of our findings, we imputed an age at death as the midpoint between the last alive interview and the subsequent interview where the respondent is noted to be deceased, and we alternately included and dropped these deaths in the analysis. Including these deaths yields no substantive changes in conclusions for black or white mothers, although the observed empirical relationships are a bit weaker among whites when we examine only SSA verified deaths. We report findings for all deaths combined.

Reproductive Patterns are measured with a series of time-invariant covariates. Women were asked about up to 16 children ever born. As noted above, age norms about the optimum timing of childbearing may differ across social groups. We measure these norms using z-score based categorical indicators of early (− 1 standard deviation) or late (+ 1 standard deviation) childbearing relative to average age at first birth within each race group. *Early first births* correspond to those at ages 16 or younger for blacks and 18 or younger for whites, while *late first births* are those at ages 25 or older for blacks and 27 or older for whites.

Although we expected cohort to be important for norms about birth timing, preliminary analysis within race indicated no significant differences in age at first birth across five year cohorts of either black or white women. Although other factors like region of residence could contribute to fertility preferences and decisions, data limitations preclude additional exploration of these patterns. To illustrate, we do not know the region of residence at the time of first birth for births occurring before the baseline interview.

Parity is measured using a series of categorical indicators. Women with no children, 1 child, 4–5 children, and 6 or more children are compared to a reference group with 2–3 children. Marital status at first birth is used to indicate *premarital childbearing* (Henretta 2007). *Age at last birth* is coded 1 for mothers who completed childbearing at age 35 or older and 0 otherwise.

Early life influences are broadly classified as environmental influences, family influences, and adolescent social and economic circumstances. *Region of birth* (measured as South vs. Non-south) is used as a fixed covariate reflecting broad differences in life circumstances. Regional differences in the 1920s and 1930s were important in the extent of urban and industrial development, poverty, education and disease (cf. Odum, 1936). In addition, Southern birth in this era for blacks marks exposure to the experience of *de jure* racial segregation, an apartheid system that only began to be dissolved in the 1950s (Woodward, 2002). Infant mortality rates around the time of birth are generally considered a good indicator of the disease and nutritional environment and have been shown to relate with old age mortality (Bengtsson and Lindstrom, 2000, 2003). We consider the median *infant mortality rate* of the region of birth (South v. Non-south) during the year of birth. In addition, we consider national *maternal mortality rates* in the year of birth, which reflect both the disease environment and the level of maternal/infant health care. Earlier analyses included indicators of 5-year birth cohorts in various comparisons. However, these measures did not uniquely contribute to the analysis and are excluded from the models presented here.

Family influences are tapped by examining *mother's education* (8^{th} grade or less versus 9+) as an indicator of early life socioeconomic status and as a proxy for access to nutrition and prenatal care. Adolescent social and economic characteristics come from retrospective data collected in the baseline interview on the respondent's family of origin when she was 15 years of age. We use data on *family structure* (two-parent versus other), *type of residence* (rural versus other), and *mother's employment* (employed versus not).

Educational attainment is a time-invariant covariate measured at baseline in 1967, after which very few women experienced additional schooling. *Educational attainment* is measured as a series of dummy variables for 1) less than high school, 2) some high school but did not graduate, and 3) high school graduate, compared to women with college education or more.

Adult social, economic, and health characteristics include respondent's *family income* (in logged 1983 dollars), *employment status* (working for pay=1, not=0), *housing tenure* (respondent owns home=1, does not own home=0), and *marital status* (never married, widowed, and divorced or separated, with married as the reference category). We also include a dichotomous indicator of *region of residence* (South=1, non-South=0). Each of these characteristics is measured at baseline in 1967 (ages 30–44) to reflect circumstances during prime adulthood and also as a time-varying covariate during the post-reproductive period drawing on data collected between 1982 and 2001.

Health during prime adulthood and the post-reproductive years is controlled in these analyses by the inclusion of a dummy variable for *self-rated health* at each life course stage. Women were asked "Would you rate your health, compared with other women about your age, as excellent, good, fair, or poor?" Responses were dichotomized into excellent/good and fair/poor with the latter as the reference group. This question was fielded in 1967 and then not again until 1986. Therefore, we include an indicator for "data not available" to account for the gap in data collection during the post-reproductive period.

Methods

We use a series of race-specific discrete time hazards regression models to estimate the risk of mortality over the 21-year follow-up period from 1982–2002. Discrete-time models are used rather than continuous time methods such as Cox proportional hazard models, because: 1) these methods are more appropriate in a formal sense when deaths are measured at discrete time points, e.g., in years, and data contain many "ties" (i.e., multiple respondents experiencing the event at the exact same time), 2) they easily accommodate a large number of time-varying covariates, and 3) they are more flexible with regard to the proportionality assumption, allowing for the exploration of the age dependence of the parameters (Allison, 1984; Allison, 1995; Singer and Willett, 2003; Yamaguchi, 1991). Finally, these models generate results in log odds, which may be converted to odds ratios for ease of interpretation (OR=exp(b)).

The basic model is:

$$\ln[P_{it}(1-P_{it})]=\alpha_t+\beta_1\mathbf{X}_{it1}+\beta_2\mathbf{X}_{it2}(t),$$

where $\ln[P_{it}(1-P_{it})]$ is the log odds of dying at a specific time point (t), given that the individual *(i)* has survived to that point.; α_t is a function of time equal to the respondent's baseline age that increases linearly by one year until the respondent is censored; and $\beta_1 X_{it\,1} + \beta_1 X_{it\,2}\,(t)$ represents the effects of time-invariant and time-varying covariates, respectively. Since the mortality follow-up period begins in 1982 when respondents are different ages, we specify time as a linear function of age and enter respondents into the analysis at their baseline age. We test for non-proportionality across the primary predictor variables to see if the effects of age at first birth and parity vary across age. We find that parity significantly interacts with age among black women but not whites. This is discussed more fully below.

A person-years file is constructed for the analysis in which each individual contributes one record for each year she is alive and participating in the survey. Respondents are censored because of death or survey attrition. A person-years analysis file allows the data to be modeled using standard logistic regression techniques, accounting for risk over time. Analyses are adjusted for clustering within individuals, producing robust standard errors.

Preliminary analyses were conducted both adjusted for baseline sampling weights and unweighted. Both weighted and unweighted models indicated a significant interaction of age at first birth and race in predicting mortality (p<.05). More systematic race differences in patterns of relationships for the models as a whole were corroborated through a Chow test (likelihood ratio=66.39, df=27, p<.001). For these and theoretical reasons (i.e., the weathering hypothesis), we conduct separate analyses for black and white women. Race-specific analyses use only unweighted data, because the original baseline survey weights were constructed to adjust the entire sample primarily for the systematic oversampling of blacks, and it is thus inappropriate to use these weights for within-group analysis (Center for Human Resource Research 2001). Baseline sample weights also adjust for region and urban/rural residence. We tested different specifications of the race-specific models including and excluding these factors, with no change in substantive conclusions. Therefore, all analyses reported in the tables are based on unweighted data.

Results

Table 1 shows means for continuous variables and proportions for categorical variables from the person-years data file, separately by race. These statistics show significant race differences for all comparable variables (as noted previously, we defined early and late childbearing at different ages for black and white mothers). Importantly, we find race differences in parity, with 24 and 46 percent of black and white women having two or three children, respectively. Black women are more highly represented among those with six or more children (35 percent compared to 10 percent among whites).

Tables 2 and 3 show logistic regression coefficients (log odds) and robust standard errors, adjusted for clustering within individuals, for race specific models ordered left-to-right to combine successive life course stages. Table 2 displays the analyses for all white women, and Table 3 presents parallel findings for black women. For ease of presentation, full models are

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not displayed (but are available upon request). Rather, we indicate the control variables for each equation at the bottom of the table. Table 2 shows higher mortality among white women with no children relative to their counterparts with 2–3 children. This effect of childlessness is robust. Otherwise, mortality differences by parity are not significant among whites.

In contrast, we find that parity significantly interacts with age for black women. Findings in Table 3 suggest that having 4 or more children has a protective effect for survival (negative coefficients in predicting mortality) but the benefit wears off with age (positive coefficient on interaction terms). This pattern holds net of all control variables in the models.

The relationships of timing of childbearing and parity with mortality are shown for mothers only in Tables 4 and 5. Late first births are associated with higher mortality risks among blacks (Table 5 and Figure 1). In contrast, whites who begin childbearing early face higher odds of post-reproductive mortality controlling for age and characteristics of early life (models 1–2 in Table 4, and Figure 2).

Considering white women in greater detail, findings suggest that the baseline positive relationship between early age at first birth and post-reproductive mortality (Model 1 in Table 4) is mediated by other characteristics. Table 4 strongly suggests the important selective effects of early life characteristics, in particular educational attainment (Model 2); with these factors controlled, the relationship between age at first birth and post-reproductive mortality becomes insignificant. Interestingly, controls for later life characteristics do not seem particularly important when educational attainment is held constant. In addition, high parity may be a protective factor for white mothers, though the effect is only significant when controls are introduced for adult social, economic, and health status. One interpretation is positive health selectivity of women who were able to have 6 or more children that becomes visible empirically only controlling the other factors.

A very different pattern of relationships is suggested among black mothers. As in Table 3 for all women (including the childless), we see in Table 5 a similar protective effect of 4 or more births that seems to wear off with age. In addition, timing of first births is important. Late first birth (ages 25 or older) is associated with a sixty-nine percent higher odds of death during the post-reproductive period (OR=exp(.525)=1.69), compared to having a first child between ages 17–24. This relationship is robust, even with controls for all the variables in the analysis. Although there may be important selection processes, these data suggest that the fertility – mortality relationship among blacks is not spurious with regard to late births. Rather, there seem to be real implications of black women's patterns of childbearing for their mortality risks in later life, even after adjusting for early life circumstances and downstream social, economic, and health characteristics. The implications of these findings are discussed below.

Discussion

We have examined the relationship between two important aspects of women's fertility, age at first birth and completed parity, and their mortality risks over a 21-year follow-up during the post-reproductive period of life. Findings indicate that these relationships exist in the US, although the precise nature of the effect varies across racial groups. Specifically, early childbearing is associated with higher mortality among whites, but late age at first birth is associated with higher mortality among blacks. In addition, childlessness is significantly related to post-reproductive mortality among whites, and higher parity also appears marginally protective after the timing of childbearing and adult social, economic, and health characteristics are controlled. High parity similarly appears to be protective for black women, though the positive effect decreases with age, but childlessness is not significant. These data contradict past research that finds very high parities to be detrimental for women's well-being (Grundy

& Tomassini, 2005; Kitagawa & Hauser, 1973). The protective effect of high parity for may be attributed to the initially better health of women that allowed them to have a large family size, and the detrimental effect of childlessness for white mothers may be a marker of initially poor health that prevented them from having a family. A recent review concludes that the effect of parity on post-reproductive mortality depends on the population studied (Hurt, Ronsmans, & Thomas, 2006). Further efforts are required to understand the source of these inconsistencies.

Controls for characteristics of early life/adolescence reduce the effect of age at first birth on post-reproductive mortality among whites, and educational attainment appears to account for that relationship, suggesting the importance of selection processes among this group. Alternatively, level of education may have been at least partly determined by the timing of childbearing, making education a mediator of the relationship between early first births and mortality. Systematic comparisons of the implications of sequential controls for adult characteristics across various life course stages point to a high degree of correspondence in the life course for whites, such that there is an important correlation between the selective processes generating both young age at first birth and higher mortality during the post-reproductive period and the social, economic, and health characteristics of adulthood considered to be mechanisms of the fertility-mortality relationship.

Among blacks, controls for early life/adolescence as well as for adult social, economic, and health characteristics do not erase the significant relationships between late age at first birth and post-reproductive mortality. We cannot say the extent to which this reflects a more complex life course among blacks (although comparisons of pseudo R-squared statistics demonstrate less variation explained by these models for black mothers) or the operation of more immediate causal processes reflected in the direct effect of these aspects of women's reproduction on later life mortality. Late childbearing may be a signal of initially poor health, which may also be a determinant of post-reproductive mortality.

The positive association between late age at first birth and higher mortality among black women lends support for the weathering hypothesis. Although this hypothesis was developed from and has been tested primarily in the context of infant outcomes (e.g., neonatal mortality), we find that the same process applies when looking at the post-reproductive mortality of black women. That is, weathering has intergenerational consequences (i.e., a poor start for the surviving offspring of late child bearers), as well as adverse long-term health and mortality consequences for the mother. The weathering hypothesis has been the subject of some controversy (e.g., Furstenberg, 1992), in part because of the suggestion that early childbearing may be beneficial for black women. Our results do not support that notion, at least insofar as the life chances of mothers over the long-run are concerned.

Finally, a life course theoretical perspective highlights the dynamic interplay between personal biographies and the social and historical contexts in which people are born and live (Elder et al., 2004). Future research should examine later cohorts of American women to provide greater insight into the influence of the nutrition and health environment during childhood and the generalizeability of our findings to the experiences of other cohorts. The women of the NLS-MW did not delay childbearing at the same rates that we see in more recent cohorts. Moreover, these women were either children of the Great Depression or coming of age during that time, and thus they were unique in many ways compared to other cohorts, particularly in comparison to their children who were born and raised during the post-war boom of the 1950s. Moreover, future research on other countries might focus on majority/minority group differences, as our results may have implications for research in other countries. The extent to which such differences across cohorts and countries do not present will support more biological or evolutionary theories of the links between reproduction and longevity.

Like many studies in this area, we were unable to test evolutionary explanations for the link between fertility and mortality. Referencing research on other species (mainly the fruitfly Drosophila melanogaster), some researchers suggest that there are physical costs associated with reproduction that result in the shortened life span of women having early and many births (see, for example, Smith et al., 2002; Westendorp & Kirkwood, 1998). This posited trade-off may exist only at very high parities (Mueller, 2004), though a recent review concludes that no clear relationship exists between number of children and longevity among those surviving to the post-reproductive period (Le Bourg, 2007). While genetic or evolutionary mechanisms do not seem particularly germane for the explanation of inter-group *differences* in the nature of the fertility - mortality relationship, as found in the present research, it is nonetheless the case that contraceptive use should most likely mask underlying biological mechanisms in this study.

We believe that the research presented here provides a relatively comprehensive assessment of the relationship between reproductive patterns and post-reproductive mortality by examining theoretically important predictors of mortality at various stages of the life course. However, there is a notable absence of direct measures of the health impacts of pregnancy (e.g., weight gain), disease exposure and health throughout life (e.g., diabetes), health risk factors (e.g., smoking), and other social and economic correlates of mortality (e.g., religion). Moreover, it is beyond the scope of this paper to examine the characteristics of the children that might influence the mother's health (e.g., sex composition). It would also be interesting to know about other family members that may ease or exacerbate the stress associated with parenting. For example, women who have children early may receive assistance from their mothers while those having children late may have frail mothers or fathers who also need care. Future research should seek to explore such factors.

Finally, the NLS-MW data set was not originally developed to examine health and mortality. One consequence is that our analysis includes some deaths where official verification is lacking. Importantly, re-analysis without these cases indicates no substantive differences in our focal findings. Still, our analyses are based on a relatively small number of deaths and should be reconsidered as this cohort continues to age.

Although the present study makes a significant contribution to social scientific understanding of how women's reproductive patterns matter for their later well-being, substantial additional research with new, more inclusive data is required. In view of the importance of fertility to women's lives, this question should become a priority for research from diverse points of view. As current fertility trends continue, they can be expected to progressively spark interest, even outside of scientific communities. Indeed, late childbearing and low fertility have gained media attention. Media coverage coupled with the practical application to women's lives in contemporary developed countries position this burgeoning field of demographic research uniquely in its ability to reach and inform the public about the ways in which their late life health and longevity are influenced by earlier conditions and what may be done to overcome disadvantages in health.

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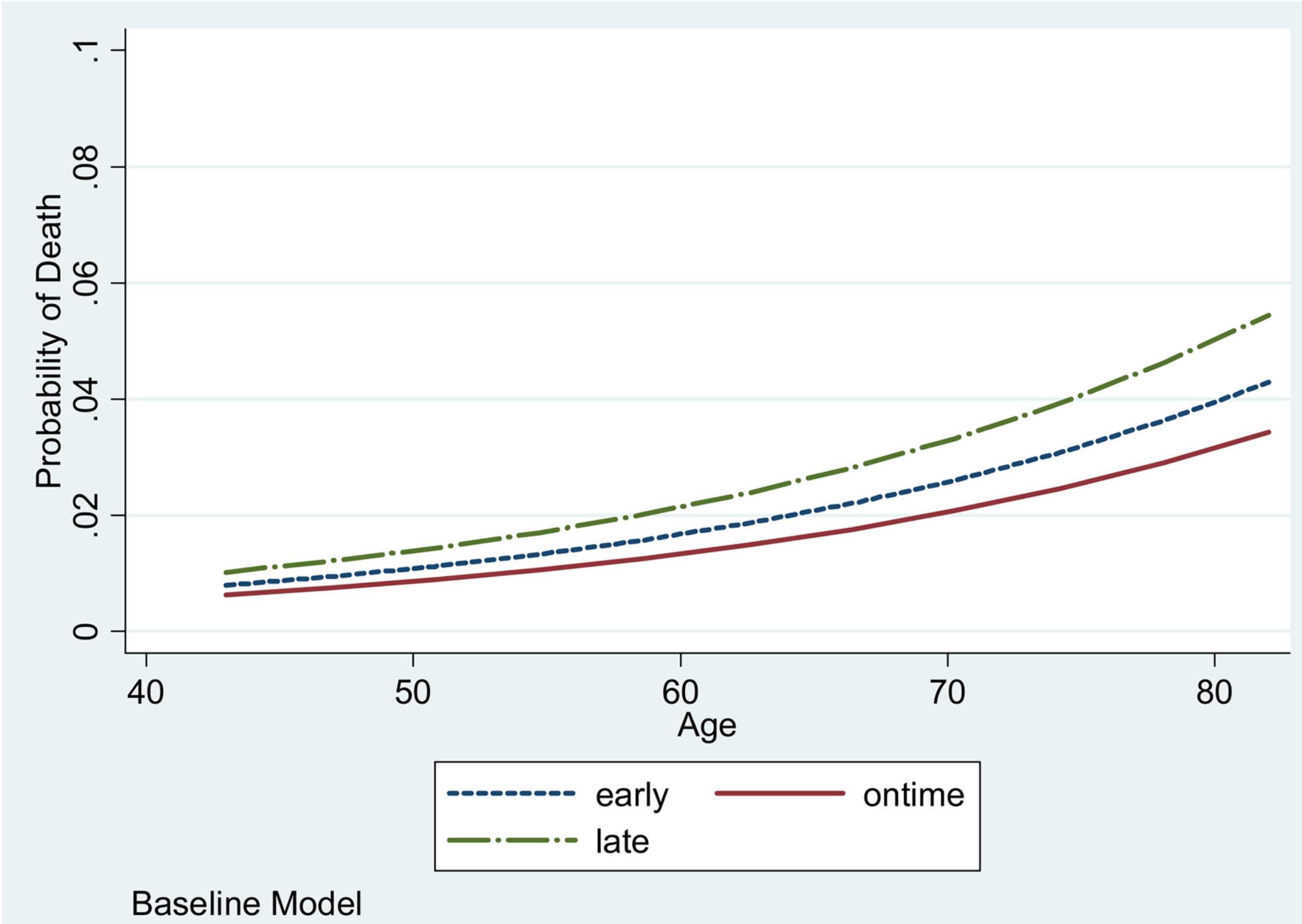

Figure 1.
Age-Specific Probability of Death by Timing of First Birth: Black Mothers

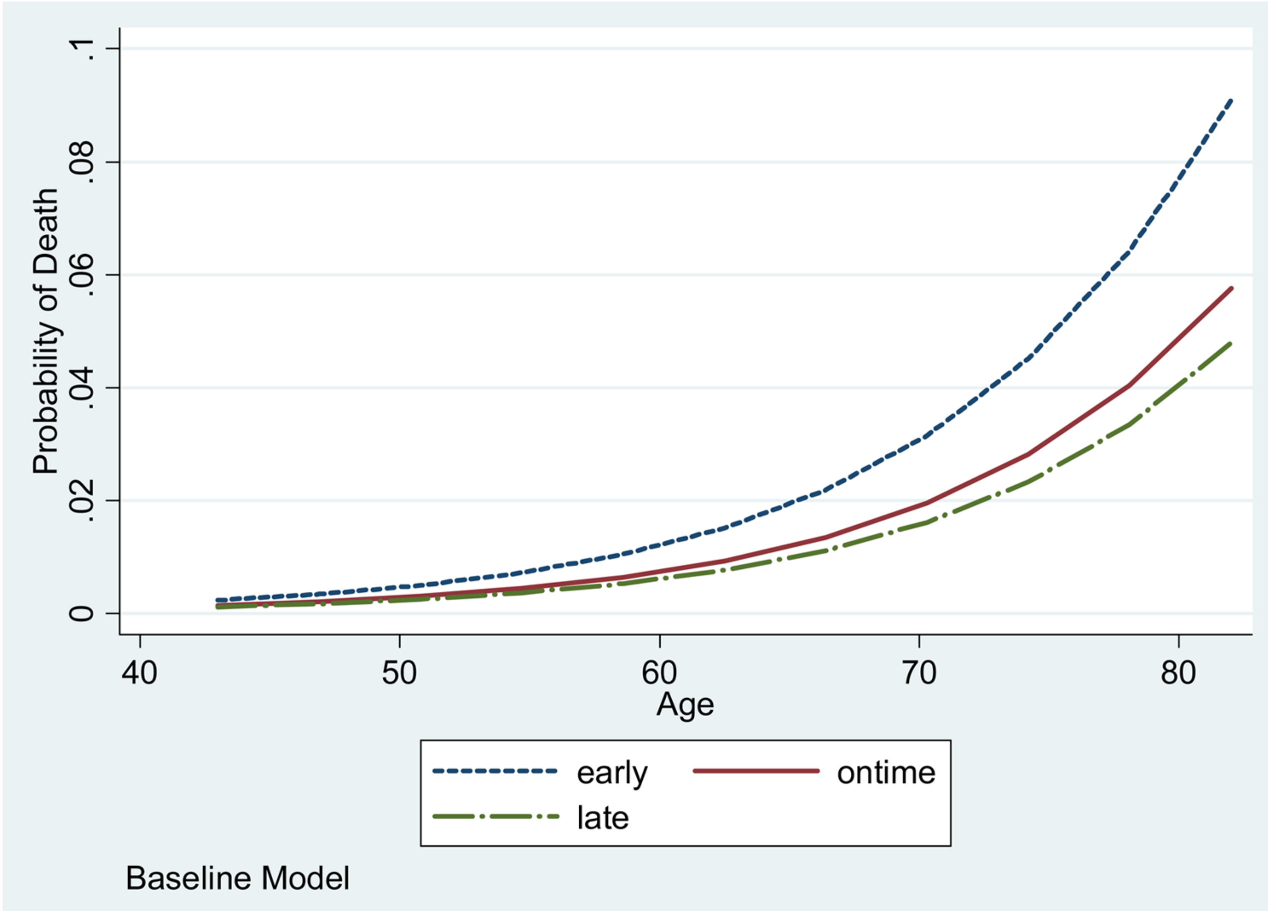

Figure 2.
Age-Specific Probability of Death by Timing of First Birth: White Mothers

Table 1

Means or proportions of all study variables by race

	White Women	Black Women
Died	0.009	0.015*
Age (in years)	61.941	61.778*
Reproductive Patterns		
Early First Birth[ab]	0.137	0.185
On-time First Birth[ab]	0.709	0.653
Late First Birth[ab]	0.154	0.162
Childless	0.100	0.092*
1 Child	0.088	0.106*
2–3 Children	0.464	0.242*
4–5 Children	0.246	0.208*
6 or more Children	0.102	0.352*
Non-Marital 1st Birth[b]	0.107	0.368*
Last Birth at Age 35+[b]	0.222	0.310*
Early Life Influences		
Regional IMR in Yr of Birth (per 1,000 live births)	65.062	72.864*
Maternal Mortality in Yr of Birth (per 1,000 live births)	6.421	6.442*
Born in the South	0.304	0.876*
Mother's Education—Less than 8th Grade	0.215	0.538*
Two-Parent Family at Age 15	0.783	0.553*
Rural Residence at Age 15	0.295	0.450*
Mother Employed at Age 15	0.317	0.588*
Educational Attainment		
Less than High School	0.128	0.345*
Some High School	0.195	0.335*
High School Graduate	0.480	0.230*
More than High School	0.197	0.090*
Social, Economic, Health Circumstances—Prime Adulthood		
Marital Status, 1967—Married	0.880	0.656*
Marital Status, 1967—Never Married	0.045	0.083*
Marital Status, 1967—Divorced/Separated	0.059	0.206*
Marital Status, 1967—Widowed	0.016	0.055*
ln(Net Family Income) in 1983 $, 1967	10.015	9.259*
Employed, 1967	0.413	0.563*
Home Owner, 1967	0.756	0.425*
Lived in South, 1967	0.296	0.666*
Self Rated Excellent/Good Health, 1967	0.867	0.772*
Social, Economic, Health Circumstances—Post-Reproductive[c]		
Marital Status—Married	0.683	0.388*

	White Women	Black Women
Marital Status—Never Married	0.033	0.066*
Marital Status—Divorced/Separated	0.107	0.242*
Marital Status—Widowed	0.176	0.304*
ln(Net Family Income) in 1983 $	9.714	9.005*
Employed	0.412	0.400*
Home Owner	0.834	0.628*
Lived in South	0.316	0.660*
Self Rated Excellent/Good Health	0.574	0.382*
Self Rated Health—Data Not Collected[d]	0.203	0.211*
N of Individuals	2,769	1,001
Person-Years	53,675	18,170
N of deaths	641	355

* Indicates significant difference from white women at p<.05

[a] These are race-specific measures. Early=16 and younger for black women and 18 and younger for white women. Late= 25+ and 27+ for black and white women, respectively.

[b] Mothers only

[c] These are time-varying measures based on from the period of 1982–2001.

[d] Data were not collected for the first years of the post-reproductive mortality follow-up period.

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Table 2

Log odds coefficients of parity on post-reproductive mortality, controlling for different stages of the life course: White Women (N=2,768, Person-Years=53,675).[a]

	(1)	(2)	(3)	(4)	(5)
Childless	0.378** (0.126)	0.386** (0.127)	0.392** (0.127)	0.414** (0.150)	0.515** (0.145)
1 Child (2–3=ref)	0.165 (0.137)	0.163 (0.138)	0.164 (0.137)	0.169 (0.140)	0.094 (0.141)
4 to 5 Children	0.038 (0.100)	0.036 (0.100)	0.012 (0.100)	0.021 (0.101)	0.002 (0.100)
6 or more Children	−0.136 (0.150)	−0.162 (0.150)	−0.241 (0.151)	−0.217 (0.152)	−0.233 (0.153)
Log Likelihood	−3329.30	−3314.57	−3305.03	−3281.00	−3112.95
Pseudo R^2	0.04	0.05	0.05	0.06	0.10

Robust standard errors in parentheses.

** $p<.01$

* $p<.05$

[a] Models control for the following:

1. Age (Baseline Model)
2. Age, early life influences
3. Age, early life influences, education
4. Age, early life influences, education, and prime adult social, economic, and health circumstances
5. All Covariates (Full Model)

Table 3

Log odds coefficients of parity on post-reproductive mortality, controlling for different stages of the life course: Black women (N=1,001, Person-Years=18,170)[a]

	(1)	(2)	(3)	(4)	(5)
Age	0.043** (0.016)	0.044** (0.016)	0.046** (0.017)	0.047** (0.017)	0.044* (0.017)
Childless	−3.280 (2.030)	−3.090 (2.046)	−3.073 (2.085)	−3.249 (2.103)	−2.998 (1.984)
1 Child	−1.963 (1.851)	−1.920 (1.842)	−1.487 (1.850)	−1.334 (1.871)	−1.406 (1.787)
4–5 Children	−4.149** (1.562)	−3.978* (1.547)	−3.854* (1.544)	−3.818* (1.553)	−3.909** (1.491)
6+ Children	−2.676* (1.280)	−2.587* (1.266)	−2.545* (1.270)	−2.653* (1.287)	−3.011* (1.220)
Age* Childless	0.052 (0.030)	0.048 (0.030)	0.048 (0.031)	0.051 (0.031)	0.048 (0.029)
Age*1 Child	0.034 (0.028)	0.033 (0.028)	0.026 (0.028)	0.025 (0.029)	0.025 (0.027)
Age*4–5 Children	0.062** (0.024)	0.059* (0.024)	0.057* (0.024)	0.056* (0.024)	0.057* (0.023)
Age*6+ Children	0.043* (0.020)	0.042* (0.020)	0.039* (0.020)	0.041* (0.020)	0.046* (0.019)
Log Likelihood	−1686.61	−1679.46	−1672.51	−1667.58	−1632.00
Pseudo R-squared	0.04	0.04	0.04	0.05	0.07

Robust standard errors in parentheses.

** p<.01

* p<.05

[a] Models control for the following:

1. Age (Baseline Model)
2. Age, early life influences
3. Age, early life influences, education
4. Age, early life influences, education, and prime adult social, economic, and health circumstances
5. All Covariates (Full Model)

Table 4

Log odds coefficients of reproductive patterns on post-reproductive mortality by race, controlling for different stages of the life course, White Mothers (N=2,491, Person-Years=48,502).[a]

	(1)	(2)	(3)	(4)	(5)
Early First Birth[b]	0.489** (0.144)	0.367* (0.150)	0.258 (0.154)	0.293 (0.152)	0.209 (0.150)
Late First Birth[b]	−0.195 (0.141)	−0.176 (0.143)	−0.132 (0.143)	−0.130 (0.146)	−0.142 (0.148)
1 Child (2–3=ref)	0.210 (0.140)	0.196 (0.141)	0.178 (0.141)	0.204 (0.144)	0.138 (0.145)
4 to 5 Children	0.004 (0.104)	−0.005 (0.104)	−0.015 (0.104)	−0.020 (0.104)	−0.033 (0.103)
6 or more Children	−0.239 (0.162)	−0.264 (0.163)	−0.305 (0.163)	−0.332* (0.163)	−0.323* (0.161)
Non-Marital 1st Birth	0.226 (0.127)	0.215 (0.128)	0.180 (0.129)	0.161 (0.130)	0.074 (0.130)
Last Birth at Age 35+	−0.011 (0.120)	0.001 (0.121)	−0.009 (0.121)	0.050 (0.123)	0.040 (0.123)
Log Likelihood	−2892.30	−2878.56	−2872.39	−2850.08	−2717.28
Pseudo R^2	0.05	0.05	0.05	0.06	0.10

Robust standard errors in parentheses

* p<.05

** p<.01

[a] Models consider timing of births and parity together and control for the following:

1. Age (Baseline Model)
2. Age, early life influences
3. Age, early life influences, education
4. Age, early life influences, education, and prime adult social, economic, and health circumstances
5. All Covariates (Full Model)

[b] These are race-specific measures. Early=18 and younger, Late= 27and older.

Table 5

Log odds coefficients of reproductive patterns on post-reproductive mortality by race, controlling for different stages of the life course, Black Mothers (N=910, Person-Years=16,559).[a]

	(1)	(2)	(3)	(4)	(5)
Age	0.044** (0.016)	0.048** (0.017)	0.050** (0.017)	0.051** (0.017)	0.047** (0.018)
Early First Birth[b]	0.230 (0.149)	0.223 (0.151)	0.170 (0.156)	0.184 (0.159)	0.162 (0.156)
Late First Birth[b]	0.482** (0.168)	0.472** (0.172)	0.564** (0.175)	0.558** (0.176)	0.525** (0.177)
1 Child (2–3=ref)	−1.893 (1.875)	−1.881 (1.861)	−1.412 (1.867)	−1.342 (1.892)	−1.376 (1.802)
4 to 5 Children	−3.839* (1.575)	−3.696* (1.554)	−3.567* (1.557)	−3.526* (1.563)	−3.638* (1.494)
6 or more Children	−2.570* (1.308)	−2.509 (1.292)	−2.464 (1.298)	−2.613* (1.313)	−2.989* (1.247)
Age*1 Child	0.032 (0.029)	0.031 (0.028)	0.025 (0.029)	0.024 (0.029)	0.024 (0.028)
Age*4–5 Children	0.059* (0.024)	0.056* (0.024)	0.053* (0.024)	0.052* (0.024)	0.054* (0.023)
Age*6+ Children	0.044* (0.020)	0.042* (0.020)	0.041* (0.020)	0.043* (0.020)	0.048* (0.019)
Non-Marital 1st Birth	0.056 (0.124)	0.070 (0.126)	0.042 (0.128)	0.038 (0.132)	−0.017 (0.131)
Last Birth at Age 35+	−0.076 (0.135)	−0.082 (0.137)	−0.090 (0.139)	−0.097 (0.141)	−0.125 (0.141)
Log Likelihood	−1496.43	−1488.75	−1482.67	−1479.22	−1450.10
Pseudo R^2	0.04	0.04	0.05	0.05	0.07

Robust standard errors in parentheses

* $p<.05$

** $p<.01$

[a] Models consider timing of births and parity together and control for the following:

1. Age (Baseline Model)
2. Age, early life influences
3. Age, early life influences, education

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4. Age, early life influences, education, and prime adult social, economic, and health circumstances
5. All Covariates (Full Model)

[b]These are race-specific measures. Early=16 or younger, Late= 25 and older.