Childbearing History, Health, and Mortality After Age 50 in the USA

John C. Henretta

University of Florida

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Abstract

This paper examines the effect of a woman's childbearing history, particularly her age at first birth and number of children ever born, on her later health and mortality. Data are drawn from the first five waves (1992 to 2000) of the Health and Retirement Study birth cohort of 1931-41. Results indicate that, conditional on survival to 1992, early childbearing before age 20 is associated with a higher hazard of dying over the period. There is not a similar effect for men. Having an early birth is also associated with a higher probability of reporting heart disease, lung disease, or cancer in 1992. Parity has inconsistent effects on both mortality and presence of health conditions.

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Recent years have seen a growing appreciation of the influence of early life course health events and socioeconomic status on mid-life health and mortality, thus extending the standard sociological life course analysis of the effects of early events to include the complex long-term relationship between social and biological processes. The research reported here extends that focus by examining the role of childbearing history as an intervening factor between early socioeconomic status and later midlife health and mortality. Reproduction is a biological process that in modern populations is subject to very strong social influences producing large socioeconomic and cohort differences in childbearing patterns. The dual biological and social character of reproduction suggests the complexity of the linkages that might produce associations among fertility patterns, early and later socioeconomic status, and mid-life health and mortality.

Socioeconomic Status, Childbearing History, and Health

Early socioeconomic status is associated with childbearing patterns. For the 1931-35 US birth cohort, part of the cohort examined here, Retherford & Luther (1996) show marked differences in fertility by socioeconomic status such that women with fewer than 12 years of schooling have an average of approximately one more child than women with 13 or more years of schooling. Their data indicate that socioeconomic differences in number of children are even greater in the 1941-45 birth cohort. In addition, higher socioeconomic status is related to later childbearing, though the results differ by cohort. Koo, Suchindran, and Griffith (1987) show that there is less education difference in the age at last birth in the 1931-35 US birth cohort (many of whom gave birth during the high fertility period of the 1950s) than in earlier cohorts.

There is also a well-established inverse relationship between both early and later socioeconomic status and health and mortality. While the effects of socioeconomic status of the family of origin are partly mediated by the individual's own later attainments, the effects of other early events associated with socioeconomic status, such as poor nutrition *in utero*, in infancy, or in childhood may have independent effects (Elo and Preston 1992; Blackwell, Hayward, and Crimmins, 2001; Hayward and Gorman 2004; Crimmins and Seeman 2004). Mid-life socioeconomic status also has a well-established association with mortality (Davey Smith & Egger, 1992; Keil, Sutherland, Knapp, & Tyroler, 1992; Lantz, House, Lepkowski, Williams, Mero, & Chen, 1998; Sorlie, Backlund, & Keller, 1995). Socioeconomic differences in mortality are increasing for men but have remained stable for women. Higher status men have benefited more from mortality decline, particularly cardiovascular mortality decline, than low status men. There is no socioeconomic difference in women's rate of mortality decline (Feldman, Makuc, Kleinman, & Cornoni-Huntley 1989).

Previous research has also found an association between childbearing patterns, health, and mortality. High parity has generally been associated with higher mortality (Doblhammer 2002; Friedlander 1996; Grundy and Tomassini 2004; Westendorp and Kirkwood 1998; Kvåle, Heuch, and Nilssen 1994) across a range of periods and nations, with some exceptions (Muller, Chiou, Carey, Wang 2002). This finding is supported by other research that finds death from specific diseases is associated with higher parity, including diabetes (Green, Beral and Moser 1988; Beral 1985) and heart disease (Kvale, Heuch, and Nilssen 1994; Beral 1985; Ness, Harris, Cobb, Flegal, Kelsey, Balanger, Stunkard and D'Agostino 1993). Effects of parity on cancer are more complex, with increases in some types and decreases in others (Beral 1985; Kvåle et al. 1994; Madigan, Ziegler, Benichou, Byrne, and Hoover 1995). Null parity has also been associated with higher mortality (Green, Beral, and Moser 1988; Doblhammer 2002) in some studies, though Friedlander (1996) found nulliparous women had higher levels of survivorship.

Associations between timing of births and health and mortality have also been found. Early childbearing has been associated with higher mortality in a number of studies (Grundy and Tomassini 2004; Doblhammer 2002; Westendorp and Kirkwood 1991) as well as more reported health problems (Waldron, Weiss, and Hughes 1998) and higher levels of functional limitations (Kington, Lillard, and Rogowski 1997). Late childbearing has been associated with later survival (Doblhammer 2002; Westendorp and Kirkwood 1991; Muller et al. 2002; Perls, Albert and Fretts 1997) in some studies but earlier mortality in others (Cooper, Baird, and Weinberg 2000).

The continual intertwining of health, socioeconomic status, and social relationships over the life course makes it very difficult to differentiate between biological and social explanations of the effects of parenthood. Evolutionary biology provides one route for understanding the physiological effects of timing and levels of childbearing through genetic mechanisms that produce a trade-off between early reproduction and later survival. Childbearing may have a direct physiological effect that becomes apparent only at later ages when the force of natural selection is less (Partridge and Harvey 1985; Kirkwood and Rose 1991; Westendorp and Kirkwood 1998).

There are also competing social and physiological explanations of the relationship. Because childbearing patterns play a role in life course socioeconomic attainments including education and income (Hofferth, Reid, and Mott 2001; Olausson, Haglund, Weitoft, and Cnattingius 2001; Taniguchi 1999), the effects of childbearing may be confounded with socioeconomic attainments. Educational attainment and childbearing are endogenous, and both may affect later attainments. Socioeconomic attainments may affect health through social pathways. For example, education may produce more effective health behaviors or both education and health behaviors may reflect the individual's time horizon (Smith 2004). Alternatively, low socioeconomic status may be associated with greater stress with physiological effects on health (e.g., Steptoe and Marmot 2004).

Moreover, childbearing patterns may also produce later-life health and mortality through the social relationships resulting from reproduction (Grundy and Tomassini 2004). Parenthood is an integrative mechanism and may be related to later marital status, social support from children, and stress levels. While there is an extensive literature on the importance of social support for health showing that supportive relationships reduce stress (e.g., Umberson, Chen, House, Hopkins, and Slaten 1996), there is also evidence for negative effects of parenthood on well-being (McLanahan and Adams 1987). Social support may have both social and physiological effects. For example, those with higher levels of social support may receive encouragement for appropriate health behaviors. Alternatively, social support may lower stress and have beneficial physiological effects (e.g., Crimmins and Seeman 2004).

Overall, the dual potential physiological and social effects of childbearing make the interpretation of results difficult. For example, Waldron, Weiss, and Hughes (1998) find that over a twenty-year period, women who bore children earlier reported more health problems. However, it is not clear from this finding whether the proper explanation is the direct physiological effects of early childbearing or the stress of the parent role hypothesis favored by the authors.

Goal of This Research

This paper extends existing research on fertility pattern and health in several ways. The data set used, the Health and Retirement Study for the US birth cohort of 1931-41 allows examination of the effects of childbearing in a cohort which, compared to other twentiethcentury cohorts, experienced early and high fertility. Some analysts have argued that low fertility in modern populations may mask the relation between fertility and survival (Westendorp and Kirkwood 1998), making this cohort a particularly important one to examine. In addition, the data source allows use of better measures of early and later socioeconomic status than are available in some existing research in order to address the correlation of socioeconomic status and childbearing. The HRS also allows a more comprehensive analysis than the data used in some existing research because it includes measures of mid-life disease presence as well as childbearing history. Finally the data allow a comparison with men as one indicator of whether the fertility history effects result from shared unmeasured aspects of socioeconomic status or the social effects of parenthood. Few existing studies provide a comparison with men (for exceptions, see Friedlander (1996) and Christensen *et al* (1998)). Parallel patterns for men and women would imply that shared unmeasured social characteristics produce the effects of parenthood. A null finding for men, however, does not necessarily imply that the association between childbearing patterns and mortality reflects the direct physiological effects of childbearing. The social aspects of parenthood might also have differential stress and other effects for men and women as a result of the gender-based division of child care responsibilities. Hence, a null finding for men is necessary but not sufficient evidence for a physiological explanation.

Data

Data are drawn from the first five waves of the Health and Retirement Study collected between 1992 and 2000. HRS is a panel study of the U.S. population that tracks individual change in the domains of health and physical functioning, employment, income and wealth, and family structure (Juster and Suzman 1995). The sample used here consists of the original HRS cohort born 1931-41. Two characteristics of the HRS are particularly important for this research. Data are linked to the National Death Index up to 2000, providing date of death for deceased respondents. In addition, the study conducts a proxy interview after a respondent's death and collects date of death.

The sample is limited to 9435 male and female age-eligible respondents born between 1931 and 1941 who are first interviewed in 1992, excluding respondents who are not interviewed either alive or in a proxy interview after death after the 1992 interview. Members of the HRS "overlap" sample, those who were interviewed in 1992 but subsequently transferred to another study, are also excluded. Models for mortality are estimated using Cox regression, with events measured by the month.

Month and year of death are derived from a combination of the NDI and the survey data. Respondents are observed until death or are censored at the last interview in which they participated. Using survey data, HRS categorizes respondents as known alive (N=7985), presumed alive (N=168), known dead (N=846), or unknown status (N=436) in 2000. Of those known to be dead, date of death from the NDI was available for 97 percent of respondents. The survey provided dates for an additional 21 respondents. Fourteen of these dates come from the proxy interview, and seven are estimated as the midpoint between the 1992 living interview and 1994 proxy interview because actual date of death is not known. The remaining seven known deceased respondents did not have date of death and there was no reasonable way to estimate it. They were deleted from the analysis. (In addition, there are eight respondents who are known to be dead who were not included in the sample as described above because they were not observed after 1992. There is no way to estimate their date of death.) Among respondents with a survey status of “unknown” NDI date of death was available for 17 and the remaining 419 observations were censored at their last interview.

Variables

Variables included in the analysis are:

Race and ethnicity, a three category variable differentiating white, black, and Hispanic respondents. Hispanic respondents may be of any race.

Respondent’s *gender* and *age.* Respondent’s age is calculated as completed years, based on the difference between the date of the interview and the date of birth. Respondents’ month and year of birth are available, and a mid-month birth day was assumed.

Father's education was collected in years and is here coded into three groups: 0-11 years, 12 or more years, and missing. Slightly over 10 percent of respondents answered 'don't know' to this question and there were a handful of respondents who refused to answer. It is likely that the missing responses would have fallen in the lower part of the education distribution.

Education coded as number of years of schooling.

Log net worth equals the log of the 1992 value of household assets (including housing assets) minus debts.

Marital status, measured in 1992, categorizes respondents as married, living with a partner, separated, divorced, widowed, and never married. There is also a time-varying covariate for *becoming a widow* in the period after 1992.

Children ever born was first measured in 1996. In earlier waves, HRS collected only number of living children. Use of children ever born in the analysis necessitated deletion of those who were not interviewed in 1996 (either in the living interview or the deceased proxy) or did not respond to the question. This number included 421 women (8.5 percent of women) and 500 men (11.3 percent). One-quarter of the women and 30 percent of the men who were missing on children ever born had died. In an Appendix, we discuss models estimated using number of living own children (excluding adopted and step children) as reported in 1992 in order to gauge the implications of this sample loss.

Three additional variables describe the fertility history of the respondent. *Births before age 20, births after age 39* and *shortest birth interval between 0-23 month*s are dummy indicators. These variables are based on living children reported in 1992. The HRS includes child's age only for living children; child's age is measured in completed years, thereby dictating the width of the birth interval measure. Children ever born was reported by each respondent individually. Number of living children in 1992 and age of children were reported by one respondent in a household; in married households, this was almost always the female member of the household.

Health conditions are a series of binary variables based on respondent responses in 1992 to the following questions, each including the phrase "Has a doctor ever told you…": *heart disease*: "… that you had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems?" *stroke*: "… that you had a stroke?" *high blood pressure*: "… that you have high blood pressure or hypertension?" *diabetes*: "… that you have diabetes or high blood sugar?" *cancer*: "… that you have cancer or a malignant tumor of any kind, except skin cancer?" *lung*: "Not including asthma, … that you have chronic lung disease such as chronic bronchitis or emphysema?"

Missing data on variables other than date of death and children ever born -- primarily assets, results in deletion of an additional 78 observations. In total, the final sample of 4524 women and 3907 men equals 89 percent of the starting sample. Results are weighted using 1992 individual weights.

Results

Table One presents means and distributions of the variables used in the analysis. By 2000, 5.1 percent of the female respondents had died and 8.4% of the males. As expected, more women than men are currently unmarried, and women are more likely to have been widowed since 1992. Women are more likely to have experienced parenthood before age 20 and less likely to have experienced it after age 39 than men, a finding that likely results from the difference in ages of spouses. Among health conditions, women have higher cancer prevalence and men have higher heart disease prevalence.

Table One About Here

Nearly one-quarter (23.2%) of women report a birth before age 20. The 1931-41 birth cohort reached age 20 between 1951 and 1961, a time of early and high fertility. To examine the reasonableness of the HRS estimate, we used Heuser's estimates of cumulative cohort birth rates (Office of Population Research 2005) to calculate the number of women in this cohort with a birth before exact age 20. The unweighted mean of the single-year birth cohort estimates from Heuser's data for the birth cohorts 1931-1941 is 31.0 percent. The HRS data collection method for children's age data may be one reason for the lower HRS estimate compared to Heuser. Unlike respondents for whom month and year of birth were queried, HRS collected children's current age in completed years. Hence, the respondent's age at child's birth able is calculated as the difference between the child's current age in completed years and the respondent's age in completed years. Depending on the date of the interview relative to the timing of the respondent's and the child's births, the calculation used may underestimate the proportion of respondents having a birth before exact age 20. That is, a birth when the respondent was age 19 would be calculated as having occurred at age 20 if the interview occurs after the respondent's birthday and before the child's birthday because the child will not have yet attained the next completed year of age. The effect may be magnified by the rapid increase in the cumulative proportion with at least one birth in the cohort; between exact ages 19 and 21, Heuser's estimates indicate that the unweighted proportion having had a birth increased from 20.7 to 41.9 percent.

Table Two presents Cox regression models. The primary focus is on models for women, and models for men are introduced for the purpose of highlighting the unique findings in women's models. The number of episodes shown in the table include extra observations created by the breaking up into two parts of observations on respondents who experienced widowhood.

Table Two About Here

Equation one presents a preliminary model, including only age and measures of fertility history in order to evaluate their simple association with mortality. Respondents with a birth before age 20 have a hazard of dying that is twice as high as those who did not. In a bivariate tabular analysis, 8.2% of female respondents with a birth before age 20 had died by the 2000 interview compared to 4.1% of those without early births. The average age at death was nearly equal between the two groups, with decedents in the early birth group surviving 22 days longer on average. The other measured aspects of fertility history are not statistically significant. In a model that included only parity and age but excluded the timing variables, high parity (five or more) was statistically significant and indicated that women at the highest parity level experienced a mortality hazard 1.6 times that of women with two children. However, high parity was no longer significant when father's education was added to the model.

Equation two begins examination of the interrelation of fertility and socioeconomic status, and includes age, race and ethnicity, and father's education. Equation three adds two variables, respondent's education and early birth timing, to the model. These two variables are added together because their time ordering is uncertain: early births may affect educational attainment and *vice versa*. The addition of these two respondent measures reduces the effect of being black though it remains significant. Father's education becomes non-significant when education and early birth are included. Equation four adds children ever born and the other timing variables. Race and birth before age 20 remain significant. Equation five adds 1992 net worth and marital status. Within levels of net worth, the contrast between black and white is no longer significant. Equation five-B presents the same model as equation five but limited to parous women. Results are essentially identical, indicating that the effect of having a birth before age 20 is not due to inclusion of women with zero parity.

Equation six adds health conditions (whether the respondent ever had heart, lung, cancer, stroke, diabetes, and high blood pressure disorders). The coefficients for the disorders are not shown to simplify the table. The goal in adding these variables to the equation is to examine whether the effects of early birth can be traced to specific disorders. The three significant effects from equation five, age, net worth, and having had a birth before age 20, change very little suggesting that the effects of early birth are not easily attributable to particular diseases.

For comparison, equations seven and eight present results for men that are parallel to equations five and six. Models for men differ somewhat from those of women. Equation six shows a hazard of dying for Hispanic men equal to .35 that of whites. When only age and race and ethnicity are in the equation, Hispanic men have a hazard of dying that is lower than whites but is not significant. The difference between whites and Hispanic males emerges when socioeconomic measures are added to the equation. Thus the finding indicates that Hispanic men have lower mortality than would be expected given their low socioeconomic status. Other studies have found lower mortality among both male and female Hispanics (Elo, Turra, Kestenbaum, and Ferguson 2004). Increasing years of schooling is also significantly associated with a lower hazard of dying among men. Two marital status contrasts, being separated or divorced (vs. being married) are associated with a higher hazard of dying. The effect of new widowhood after 1992 is large but insignificant. Less than one percent of men experienced widowhood. Most important, none of the parenthood characteristics is significant. Equation seven does not change these conclusions.

We also examined the difference between using number of living children in 1992 instead of children ever born collected in 1996 in the women's equations, and these results are reported in detail in an Appendix. The primary conclusion is that the size of coefficients changes little in most equations when living children instead of children ever born is used, but in some cases statistical significance does change. We compared model five in Table Two with three models estimated using living children: children living in 1992 among just those respondents who responded to the 1996 children ever born question; living children in 1992 using all available 1992 respondents; and living children as reported in 1996. Zero parity and short birth interval are significant in some of the equations using living children, but the difference in results does not appear to be due to children who have died. In sum, the measures do give slightly different results when the focus is on statistical significance but not when the focus is on relative size of coefficients.

Table Three About Here

Table Three presents logistic regression models for respondent-reported disease prevalence among women in 1992. The effects for race and ethnicity indicate that blacks and Hispanics have lower levels of heart and lung disease, blacks have lower levels of cancer, and blacks have higher levels of diabetes and high blood pressure. In order to understand these effects better, we conducted supplementary analyses by estimating a model including only age and ethnicity and a second model including age, ethnicity, education, and net worth. Results for the model including only age and ethnicity are quite different from the results shown in Table Three. In the simpler model, blacks have higher rates of heart disease, and there are no other race or ethnic differences for heart, lung, or cancer disorders. The negative effects in Table Three emerge when education and net worth are included in the equation, indicating that the prevalence of these diseases among blacks and Hispanics is less than one would expect given their levels of education and net worth. In the case of diabetes and high blood pressure, Hispanics are more likely than whites to report these diseases in the simple model, but these differences are accounted for by education and net worth. Null parity is positively associated with the presence of lung disease and low parity is associated with cancer. Women with four or more children report higher prevalance of diabetes. Having a birth before age 20 is associated with cardiovascular disease, lung disease, and cancer.

Discussion

Our central finding is that having an early birth is associated with a higher hazard of dying after ages 51-61. While this effect is partly due to the association of early birth with education, it remains substantial and significant net of education and even after introduction of controls for other aspects of childbearing history, current marital status, and mid-life economic status. We found no effect for parity, null parity, or late childbearing even though these measures have been associated with different mortality patterns in other studies. There is some suggestion in the HRS data of an effect for null parity, both in the size of the coefficient for children ever born and the effect of the number of living children.

Socioeconomic differences, measured by father's education, own education, and mid-life net worth do not account for the effect of early births before age 20. It is particularly interesting that the effect of an early birth is reduced very little by introduction of controls for presence of major diseases at the beginning of the observation period. Having an early birth is associated with presence of diseases of the heart and lung as well as cancer. However they account for only a small part of the effect of early birth.

We found no effect of an early birth for men. Men were substantially less likely to father a child at an early age, no doubt a result of the average age difference between marital partners. The lack of an effect for men, however, suggests that unmeasured shared socioeconomic or other social differences are not responsible for the effect of early birth. Given gender differences in child-rearing responsibilities, the lack of effect does not rule out the possibility that early births produce increased stress among women and these higher levels of stress are responsible for higher mortality. Alternatively, there are other physiological process that might account for higher death rates if there is a trade-off between reproduction and later survival (Partridge and

Harvey 1985; Kirkwood and Rose 1991; Westendorp and Kirkwood 1998) because physiological resources are used in reproduction that otherwise could be used for maintenance. The possibility of a physiological link between early birth and later survival is enhanced by the range of populations in which such a relationship has been found. These include married members of the British aristocracy born before 1876 (Westendorp and Kirkwood 1991) as well as contemporary populations in England and Wales (Doblhammer 2002; Grundy and Tomassini 2004) and Austria (Doblhammer 2002).`

The finding of a substantial effect for early birth on mortality in this study adds significantly to the research literature because early births were very common in this cohort in the United States. The high prevalence of teenage births in this cohort militates against the possibility that some unusual and rare unmeasured characteristic produced both early births and higher mid-life mortality. Moreover, most teenage mothers in the 1950's were married (National Center for Health Statistics 2001), suggesting that early marriage and birth was a common characteristic of the 1950s life course.

References

Blackwell, Debra L., Hayward, Mark D., and Crimmins, Eileen M. 2001. Does childhood health affect chronic morbidity in later life? *Social Science and Medicine*. 52: 1269-1284.

Beral, Valerie. 1985. Long term effects of childbearing on health. *Journal of Epidemiology and Community Health*. 39: 343-346.

Christensen, Kaare, Gaist, David, Jeune, Bernard, and Vaupel, James W. 1998. A tooth per child? *The Lancet*. 352: 204.

Cooper, Glinda S., Baird, Donna D. and Weinberg, Clarice R. 2000. Age at menopause and childbearing patterns in relation to mortality. *American Journal of Epidemiology.* 151: 620-623.

Crimmins, Eileen M. and Seeman, Teresa E. 2004. Integrating biology into the study of health disparities. *Population and Development Review*. 30(Supplement): 89-107.

Doblhammer, Gabriele. 2000. Reproductive history and mortality late in life: A comparative study of England and Wales and Austria. *Population Studies*. 54: 169-176.

Elo, Irma. T., & Preston, Samuel H. 1992. Effects of early life conditions on adult mortality: A review. *Population Index. 58:* 186-212.

Elo, Irma T., Turra, Cassio M., Kestenbaum, Bert, and Ferguson, B. Renee. 2004. Mortality among elderly Hispanics in the United States: Past evidence and new results. *Demography*. 41: 109-128.

Feldman, J. J., Makuc, D. M., Kleinman, J. C., & Cornoni-Huntley, J. (1989). National trends in educational differentials in mortality. *American Journal of Epidemiology, 129,* 919-33.

Friedlander, Nancylee J. 1996. The relation of lifetime reproduction to survivorship in women and men: A prospective study. *American Journal of Human Biology*. 8: 771-783.

Davey Smith, G., & Egger, M. (1992). Socioeconomic differences in morality in Britain and the United States. *American Journal of Public Health*, *82*, 1079-1081.

Hayward, Mark D. and Gorman, Bridget K. 2004. Early-life social conditions and men's mortality. *Demography*. 41: 87-108.

Green, Adèle, Beral, Valerie, and Moser, Kath. 1988. Mortality in women in relation to their childbearing history. *British Medical Journal*. 297: 391-394.

Grundy, Emily & Tomassini, Cecilia. 2004. Fertility history and health in later life: Associations between childbearing history, health and mortality among women in England and Wales, results from a record linkage study. Centre for Population Studies, London School of Hygiene and Tropical Medicine. unpublished.

Hofferth, Sandra L., Reid, Lori, and Mott, Frank L. 2001. The effects of early childbearing on schooling over time. *Family Planning Perspectives*. 33: 259-267.

Juster, F. T. and R. Suzman. 1995. An overview of the Health and Retirement Study. *Journal of Human Resources*. 30(Supplement): S1-S30.

Keil, J. E., Sutherland, S. E., Knapp, R., & Tyroler, H. A. 992. Does equal socioeconomic status in black and white men mean equal risk of mortality? *American Journal of Public Health*, *82*, 1133-1136.

Kington, Raynard, Lillard, Lee, and Rogowski, Jeannette. 1997. Reproductive history, socioeconomic status, and self-reported health status of women aged 50 and older. *American Journal of Public Health*. 87: 33-37.

Kirkwood, T.B. L. and Rose, M.R. 1991. Evolution of senescence: late survival sacrificed for reproduction. *Philosophical Transactions of the Royal Society B*. 322: 15-24.

Koo, H. P., Suchindran, C. M., & Griffith, J.D. 1987. The completion of childbearing: Change & variation in timing. *Journal of Marriage and the Family, 49*, 281-93.

Kvåle, Gunnar, Heuch, Ivar, and Nilssen Steinar. 1994. Parity in relation to mortality and cancer incidence: A prospective study of Norwegian women. *International Journal of Epidemiology*. 23: 691-699.

Lantz, P. M., House, J. S., Lepkowski, J. M., Williams, D. R., Mero, R. P., & Chen, J. 1998. Socioeconomic factors, health behaviors, and mortality: Results from a nationally representative prospective study of U.S. adults. *Journal of the American Medical Association, 279,* 1703-1708. .

Madigan, M. Patricia, Ziegler, Regina G. Benichou, Jacques, Byrne, Celia, and Hoover,Robert N. 1995. Proportion of breast cancer cases in the United States explained by well-established risk factors. *Journal of the National Cancer Institute*. 87: 1681-1685.

McLanahan, Sara and Adams, Julia. 1987. Parenthood and psychological well-being. *Annual Review of Sociology*. 13: 237-257.

Muller, H.G., Chiou, J.M., Carey, J.R., and Wang, J.L. 2002. Fertility and life span: Late children enhance female longevity. *Journals of Gerontology Series A: Biological Sciences and Medical Sciences*. 57: B202-B206.

National Center for Health Statistics. 2001. Births to teenagers in the United States, 1940-2000. National Vital Statistics Reports. 49:10.

Ness, Roberta B., Harris, Tamara, Cobb, Janet, Flegal, Katherine M., Kelsey, Jennifer L., Balanger, Albert, Stunkard, Albert J., D'Agostino, Ralph B. 1993. Number of Pregnancies and the Subsequent Risk of Cardiovascular Disease. *N England Journal of Medicine*. 328:

1528-1533.

Office of Population Research. 2005. U.S. Cohort and Period Fertility Tables, 1917-1980. Princeton: Office of Population Research http://opr.princeton.edu/archive/cpft/ (downloaded July 13, 2005).

Olausson, Petra O.., Haglund, Bengt, Weitoft, Gunilla R., and Cnattingius, Sven. 2001. Teenage childbearing and long-term socioeconomic consequences: A case study in Sweden. *Family Planning Perspectives*. 33: 70-74.

Partridge, Linda and Harvey, Paul H. 1985. Costs of reproduction. *Nature*. 316:20.

Perls, Thomas T., Alpert, Laura, and Fretts, Ruth C. 1997. Middle aged mothers live longer. *Nature*. 389: 133.

Retherford, R. D., & Luther, N. Y. (1996). Are fertility differentials by education converging in the United States? *Genus, 52*, 13-37.

Smith, James P. 2004. Unraveling the SES-Health Connection. *Population and Development Review*. 30(Supplement): 108-132.

Sorlie, P. D., Backlund, E., & Keller, J. B. (1995). U.S. mortality by economic, demographic, and social characteristics: The National Longitudinal Mortality Study. *American Journal of Public Health*, *85*, 949-956.

Steptoe, Andrew and Marmot, Michael. 2004. Socioeconomic status and coronary heart disease: A Psychobiological Perspective *Population and Development Review*. 30(Supplement): 133-152.

Taniguchi, Hiromi. 1999. The timing of childbearing and women's wages. *Journal of Marriage and Family*. 61:1008-1019.

Umberson, Debra, Chen, Meichu D., House, James S., Hopkins, Kristine, and Slaten, Ellen.

1996. The effect of social relationships on psychological well-being: Are men and women really so different? *American Sociological Review*. 61: 837-857.

Waldron, Ingrid, Weiss, Christopher C. and Hughes, Mary Elizabeth. 1998. Interacting effects of multiple roles on women's health. Journal of Health and Social Behavior. 39: 216-236.

Westendorp, Rudi G. J. and Kirkwood, Thomas B. L. 1998. Human longevity at the cost of reproductive success. *Nature*. 396: 743-746.

Appendix

Children Ever Born vs. Living Children

We examined the difference between using number of living children instead of children ever born collected in 1996, and these results are reported in Table A-1. The Health and Retirement Study collected number of living children in 1992 and children ever born in 1996. As outlined in the text, some respondents did not provide 1996 data. Using living children, therefore, would allow use of a larger number of observations but ignores the possible correlation between a respondent's mortality that of her children. The Appendix tables use the same basic model as that presented in equation five of Table Two.

Table A-1 About Here

Equation one utilizes number of children living in 1996. The 1996 living children measure is a follow-up to the children ever born question, asking how many are still living. Ninety-two percent of female respondents have the same value on living own children in 1992 and living children in 1996. The results in equation one are very close to those presented in the Table Two for children ever born. To investigate the matter further, we estimated a model without children ever born, children living, and the timing variables and instead included a measure of the difference between children ever born in 1996 and children living in 1996. The difference should indicate the number of children who have died. Neither of the dummy contrasts, coded as zero difference and a difference of two or more (coded as contrasts with difference of one) was significant in the equation for hazard of dying. Both equation one and these additional results suggest that children's deaths do not affect the relationship between parity and mortality.

In order to use the maximum number of observations available over the entire 1992-2000 time period, we also estimated a model, equation two, that uses number of living children in 1992. Children living in 1992 was collected through a family roster of living children which collected the relationship of the child to the respondent. Equation two uses the full number of observations available for number living children in 1992, increasing the number of episodes to 5092. Age, log net worth, and birth before age 20 remain significant. In this equation, women widowed in 1992 have a higher hazard of dying. In addition, women with a short birth interval of 0-23 months have a hazard of dying 1.38 times that of women without a short interval, a finding significant at the .05 level. Women with no living children in 1992 have a hazard of dying 1.68 times that of women with two living children; this finding is marginally significant (p=.050). While short birth interval and null parity are significant using 1992 children ever born, the coefficient estimates change by no more than 10 percent compared to equation five of Table Two.

Finally, in equation three, we used 1992 living children and restricted the sample to those respondents who responded to the children ever born question in 1996. Using the categorical measures of children, 87 percent of female respondents have equal values of ever born and number of living children living in 1992. Results for age, log net worth, and birth before age 20 remain significant. In addition, those with no living children have a hazard of dying twice that of women with two living children. It is unclear why the coefficient for null parity is larger in this equation, particularly given the results just discussed for equations one and two. Further analysis did not produce a simple explanation for the difference in results. It appears to result from the combination of using children living in 1992 but making the analysis conditional on providing children ever born data in 1996. On the general principle that it is better to use all the data available, equation two is superior to equation three for judging the implications of using children living in 1992 compared to children ever born.

The primary conclusion is that using children living does not lead to substantially different results from using children ever born. Results in appendix equation one are very similar to Table Two results. Equation two results are also similar when the focus is on size of coefficients, though statistical significance of some variables changes. Equation three results are also similar, though the effect of null parity is large and significant.

The primary purpose of this exercise has been to determine whether results would have been different had we used children living in 1992 instead of parity collected in 1996 in order to use the maximum amount of data. Results in this Appendix indicate that there would not be substantial differences.

Table One
Health and Retirement Study 1992-2000
Means and Percentages

	Women	Men
Died 1992-2000	5.1%	8.4%
Age	55.8	55.8
Education (years)	12.2	12.6
Log net worth	10.7	11.0
Race/ethnicity		
white, non-Hispanic	80.8%	83.2%
black	10.6%	8.8%
Hispanic	6.0%	5.7%
other	2.1%	2.1%
Father's education		
0-11 years	55.9%	54.2%
12 or more years	32.2%	35.3%
missing	11.9%	10.5%
Marital status		
married	70.2%	80.8%
live with partner	1.5%	2.7%
separated	2.6%	2.1%
divorced	12.9%	9.0%
widowed	9.6%	1.8%
never married	3.2%	3.6%
Children ever born		
none	8.3%	9.8%
one	8.8%	9.5%
two	24.6%	28.1%
three	23.7%	23.6%
four	15.7%	14.6%
five or more	18.9%	14.4%
New widow (time-varying)	2.9%	0.8%
Birth before age 20	23.2%	4.5%
Birth after age 39	3.6%	10.9%
Birth interval 0-23 months	33.0%	27.7%
Health conditions		
heart	10.3%	15.0%
lung	8.6%	7.7%
cancer	7.5%	2.7%
stroke	2.1%	2.8%
diabetes	9.0%	10.1%
high blood pressure	36.3%	38.7%
N	4524	3907

Table Two
Cox Regression for Hazard of Dying
Health and Retirement Study 1992-2000

	All women						Parous women	All men	
	1	2	3	4	5	6#	5b	7	8#
Age	1.08 **	1.07 **	1.07 **	1.07 **	1.07 **	1.06 *	1.07 **	1.09 **	1.07 **
Race (vs. white)									
black		1.71 **	1.49 *	1.49 *	1.16	1.05	1.04	0.94	1.07
Hispanic		1.22	1.07	1.07	1.00	1.05	1.01	0.37 **	0.44 **
other		1.37	1.45	1.45	1.34	1.28	1.32	1.70	1.48
Father's education (vs. 12 or more)									
0 - 11 years		1.50 *	1.35	1.34	1.35	1.33	1.34	1.16	1.11
missing		1.78 *	1.49	1.47	1.37	1.27	1.39	1.17	1.11
Education (years)			0.97	0.97	1.00	1.02	1.02	0.95 *	0.96 *
Birth before age 20	2.04 **		1.79 **	1.80 **	1.78 **	1.75 **	1.84 **	1.00	0.95
Children ever born (vs. 2)									
none	1.53			1.46	1.56	1.53		1.46	1.41
one	1.05			0.98	0.94	0.90	0.96	1.30	1.28
three	1.23			1.20	1.22	1.17	1.21	0.84	0.84
four	1.04			1.01	1.00	0.95	1.00	0.77	0.76
five or more	1.09			0.96	0.90	0.80	0.93	1.30	1.19
Birth after age 39	0.80			0.73	0.73	0.86	0.74	1.03	0.99
Birth interval 0-23 months	1.32			1.32	1.28	1.27	1.29	1.14	1.06
Log net worth					0.93 **	0.95 **	0.93 **	0.95 **	0.97
Marital status (vs. married)									
live with partner					1.19	1.16	1.35	0.84	0.99
separated					1.27	1.14	1.26	2.13 *	2.27 **
divorced					0.92	0.84	0.85	1.51 *	1.41
widowed					1.34	1.39	1.35	1.16	0.94
never married					0.56	0.61	0.64	0.63	0.66
New widow (time-varying)					1.07	1.02	1.15	1.65	1.95
episodes						4656	4267		3945

Notes:
Equations 6 and 8 are net of health conditions (heart, lung, cancer, stroke, diabetes, high blood pressure)

** p <= .01
* p <= .05

Table Three
Logistic Regression for Presence of Disease in 1992
Health and Retirement Study 1992-2000

	All women					
	1	2	3	4	5	6
	Heart	Lung	Cancer	Stroke	Diabetes	High BP
Age	0.08 **	0.06 **	0.05 **	0.04	0.05 **	0.06 **
Race (vs. white)						
black	-0.13	-0.70 **	-0.52 *	0.31	0.74 **	0.89 **
Hispanic	-0.63 *	-0.84 **	-0.29	-0.18	0.23	0.01
other	-0.17	-0.50	-0.33		0.67 *	0.06
Father's education (vs. 12 or more)						
0-11	0.25 *	0.16	-0.01	0.11	0.31 *	-0.09
missing	0.56 **	0.03	0.40 *	0.18	0.21	0.01
Education (years)	-0.03	-0.08 **	0.01	-0.07	-0.08 **	-0.03
Birth before age 20	0.58 **	0.45 **	0.33 *	0.02	-0.14	-0.09
Children ever born (vs. 2)						
none	-0.05	0.57 *	0.27	-0.54	0.03	-0.01
one	-0.16	0.41	0.56 **	-0.14	0.08	0.14
three	0.16	0.26	0.09	-0.24	-0.03	0.20 *
four	0.04	0.05	0.23	0.23	0.39 *	0.15
five or more	0.06	0.10	0.02	0.46	0.46 *	0.17
Birth after age 39	-0.43	0.29	-0.80	-0.62	-0.42	-0.03
Birth interval 0-23 months	-0.17	0.03	0.20	-0.46	0.01	0.01
Log net worth	-0.08 **	-0.08 **	-0.01	-0.07 *	-0.07 **	-0.07 **
Marital status (vs. married)						
live with partner	0.03	0.32	0.08	0.80	-0.53	0.12
separated	0.13	0.67 *	-0.14	0.57	-0.08	0.31
divorced	-0.01	0.33 *	0.20	-0.04	0.05	0.07
widowed	-0.04	0.27	-0.39	-0.21	-0.01	0.12
never married	-0.15	-0.67	0.23	-0.70	-0.52	0.06
Intercept	-5.90	-4.12	-5.53	-4.35	-4.17	-3.15

Notes:

** p <= .01
* p <= .05

Appendix Table A-1
Cox Regression for Hazard of Dying
Health and Retirement Study 1992-2000
Models using living children in 1992

	1	2	3
Age	1.07 **	1.08 **	1.08 **
Race (vs. white)			
black	1.14	1.04	1.13
Hispanic	0.99	0.74	0.97
other	1.33	1.06	1.28
Father's education (vs. 12 or more)			
0-11	0.74	0.74	0.74
missing	1.02	1.16	1.01
Education (years)	1.00	0.99	1.00
Birth before age 20	1.75 **	1.53 **	1.82 **
N. living children (vs. 2)			
none	1.50	1.68 *	2.07 **
one	1.17	1.46	1.18
three	1.21	1.08	1.09
four	1.02	1.03	0.98
five or more	0.97	1.03	0.95
Birth after age 39	0.69	0.70	0.72
Birth interval 0-23 months	1.27	1.38 *	1.33
Log net worth	0.93 **	0.92 **	0.93 **
Marital status (vs. married)			
live with partner	1.21	1.47	1.16
separated	1.27	1.35	1.26
divorced	0.90	0.94	0.88
widowed	1.33	1.49 *	1.32
never married	0.59	0.59	0.48
New widow (time-varying)	1.05	1.06	1.02
episodes	4656	5091	4656

Notes:

Equation 1 is estimated using number of living children in 1996.

Equation 2 is estimated using all observations available with data on living children in 1992.

Equation 3 is estimated using only those respondents with data for children ever born collected in 1996.

** $p <= .01$

* $p <= .05$