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Gender, the Marital Life Course, and Cardiovascular Disease in Late Midlife

Drawing on 5 waves of the Health and Retirement Study, we examine the influence of the marital life course on the prevalence and incidence of cardiovascular disease among 9,434 middle-aged individuals. Results show that compared to continuously married persons, both men and women with a marital loss have significantly higher prevalence of cardiovascular disease at baseline. Men and women, however, differ in the effects of marital loss on the incidence of cardiovascular disease over the course of the study. Women with a marital loss have a higher risk of cardiovascular disease in late midlife compared to continuously married women, whereas marital loss is not associated with men's risk of cardiovascular disease. Emotional distress and socioeconomic status account for the higher risk of cardiovascular disease among divorced women.

Marriage is an important social institution stratifying population health. In the United States, for example, mortality rates among unmarried women were 50% higher than those for married women, and the gap was worse for men: Unmarried men's mortality rates were approximately 250% higher than those for married men (Ross, Mirowsky, & Goldsteen, 1990). Whether the observed health advantages of marriage grow or subside in the future is clouded by trends showing a retreat from formal marriage in the American population as well as the changing social norms involving marriage, divorce, cohabitation, and remarriage. Family forms have become more diverse, the boundaries between marital statuses have blurred, and the permanence of marriage is uncertain (Bianchi & Casper, 2000).

Despite the changing nature of the marital life course, most studies have focused on the effects of *current* marital status, with mortality and mental health as the primary health outcomes. The effects of current marital status, however, may well encompass differential exposure to marriage, divorce, and widowhood up to the time at which a person's marital status is observed. This blurs the interpretation of marital status associations with health outcomes. People's increasingly complex marital experiences inherently call for research that examines the health consequences of the marital life course: how and when marriages begin and end, the duration of marriages/divorce/widowhood, and current marital status.

In this study, we investigate how the marital life course is associated with cardiovascular disease. We draw on the Health and Retirement Study (HRS), 1992 – 2000, to evaluate cardiovascular disease incidence for a nationally representative sample of middle-aged men and women aged 51 – 61 at baseline. The HRS allows us to track cardiovascular disease experience as individuals enter prime retirement ages. We focus

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Key Words: event history analysis, health, life course, marital status, midlife.

on cardiovascular disease because it is the number one killer in the United States in this age group, and it is one of the main causes of disability. Health care expenditures for heart disease and stroke were projected to be $209 billion in 2003 (National Center for Health Statistics, 2004). In addition, cardiovascular disease is closely associated with how people think, feel, and deal with daily stress in their lives (Burg, 1992). Because divorce and widowhood top the list of stressful life events, the marital career may be a good indicator of the chronic stress a person has experienced (Booth & Amato, 1991; Tucker, Friedman, Wingard, & Schwartz, 1996) and thus a risk factor for cardiovascular disease.

Our article contributes to the current discussion about the effects of marriage on health in several ways. First, we add specificity to the association between marriage and health by focusing on a specific and important health condition rather than on overall mortality or self-reported health. Second, our conceptualization of marriage incorporates marital experience in two ways. We differentiate between continuously married persons and remarried persons who have been divorced or widowed. This allows us to assess whether the cardiovascular health of middle-aged remarried people is more like that of continuously married persons or whether prior marital loss has a lasting effect on cardiovascular health, akin to our expectations about the cardiovascular health of middle-aged divorced or widowed persons. We also examine the effects of marital exposure, the idea being that long-term marital investments will result in advantaged cardiovascular health. Finally, we examine gender differences in the effects of the marital life course on cardiovascular morbidity. We expect that gender is an important moderator of the relationship between marriage and cardiovascular disease, as men and women accrue different costs and benefits from marriage.

BACKGROUND

Marital Status and Health

Previous research is clear on two points. First, married persons live longer than the divorced, the widowed, and the never married across different societies and time periods (Hu & Goldman, 1990; Lillard & Panis, 1996; Lillard & Waite, 1995). Second, married persons have lower rates of depression, anxiety, and other mental conditions than persons who are never married, widowed, or divorced. Both cross-sectional and longitudinal studies confirm the overall health benefits of marriage (Barrett, 2000; Cotten, 1999).

Previous research is less clear on the specific relationship between marital status and cardiovascular health in part because of the lack of attention to specific health conditions. There is some evidence from a Canadian study that cardiovascular disease death rates are lowest among married persons (Trovato & Lauris, 1989). Kawachi, Colditz, Ascherio, Rimm, and Giovannucci (1996) reported that socially isolated *men* (not married, few friends, no membership in church or community groups) were at higher risk of stroke but not of coronary heart disease. Pienta, Hayward, and Jenkins (2000) reported that self-reported cardiovascular problems were more prevalent among divorced men and women, with modest evidence that the marital status gradient may be stronger among women. In a study of risk factors for coronary heart disease in the Whitehall II study, Stansfeld, Fuhrer, Shipley, and Marmot (2002) reported that widowed women—though not widowed men—had a higher rate of heart disease than married persons. Similar to Pienta et al. (2000), the Whitehall II study suggests a stronger marital status gradient among women, although the evidence is not overwhelming. Why women might evidence a stronger marital status gradient in cardiovascular disease is not clear, and we take up this question later in the discussion.

Very few studies have also moved beyond examining the simple effect of current marital status. What available evidence there is suggests that remarried persons have higher mortality than continuously married persons (Hemstrom, 1996; Tucker et al., 1996). Other research examining the influence of temporal dimensions of the marital life course has yielded inconsistent findings. For example, divorce has short-term effects on psychological well-being, but it is less clear that there are long-term negative effects (Booth & Amato, 1991). Lund, Holstein, and Osler (2004) found that the duration of divorce was positively associated with the risk of mortality among Danish men. Research on the effects of widowhood duration is fairly consistent: Widowhood has strong short-term effects on both mortality and psychological well-being (Brockmann & Klein, 2004; Mastekaasa, 1994). No study of which we are aware has examined whether

duration in a particular marital status affects cardiovascular health.

What are the theoretical ways that marriage might be associated with cardiovascular health? Debate about the general association between marriage and health revolves around three major complementary arguments: selection, marital protection, and stress. Marriage may be associated with better health because those suffering from health problems are less likely to marry or stay married than those who are healthy (Fu & Goldman, 1996; Joung, Van De Mheen, Stronks, Van Poppel, & Mackenbach, 1997). Some research suggests that early life psychosocial and personality characteristics are sorting mechanisms for stable marriages (Tucker et al., 1996). To the extent that these characteristics are also protective against cardiovascular disease, we might expect that marriage is associated with a lower rate of cardiovascular disease. We note, though, that support for the selection hypothesis is fragmentary, and the evidence is inconsistent whether selection is strongly associated with the health advantages of married persons (Johnson & Wu, 2002; Waite & Gallagher, 2000).

Marriage may also enhance cardiovascular health via greater socioeconomic resources, economies of scale, social support, and better lifestyles (Murray, 2000; Ross et al., 1990). Results from prospective data strongly support the marriage protection hypothesis for mortality and mental health outcomes. Because socioeconomic status (SES), social support, and healthy lifestyles are inversely related to cardiovascular morbidity (Krause, 2005), we expect that married persons will have lower cardiovascular disease rates compared to all the unmarried groups.

The strains of marital loss may also undermine health and thereby contribute to the observed advantages of married persons (Tucker et al., 1996). Divorce and the death of the spouse are two of the most stressful events a person can experience (Booth & Amato, 1991), with acute and/or chronic stress coming from a deterioration in living standards, changes in residence, disruption in social networks, loss of social support, and sometimes single parenting (Booth & Amato; Kitson, 1990; Marks & Lambert, 1998). Although little empirical research has documented the links between marital loss, stress, and cardiovascular disease, research on stress and cardiovascular disease points to stress as a possible pathway stemming from marital loss. For example, stressful conditions increase the risk of cardiovascular disease by provoking the release of pituitary and adrenal hormones that can alter cardiovascular function (Kiecolt-Glaser & Newton, 2001) by increasing "… arrhythmias, certain clotting factors, and the heart's demand for oxygen while simultaneously narrowing arteries that would normally dilate to provide more oxygenated blood to the heart" (Fremont & Bird, 1999, p. 126). If cardiovascular reactivity to stress is exaggerated and prolonged such as may be the case with marital loss, the condition may lead to the development of cardiovascular disease (Morgan, 1980). A recent study by Kiecolt-Glaser et al. (2003) showed that chronic stress can induce overproduction of interleukin-6 (IL-6), a proinflammatory cytokine that is associated with a variety of age-related illnesses including cardiovascular disease. Moreover, the rate of increase in IL-6 was persistent several years after the original source of chronic stress is gone. Second, stress can also lead to unhealthy behaviors such as smoking, physical inactivity, and overeating, which are known to increase the risk of cardiovascular disease (Krause, 2005). Recent findings that cardiovascular disease mortality is elevated among divorced and widowed persons compared to married persons for *both* White men and White women lend support to the idea that marital loss is harmful to cardiovascular health (Johnson, Backlund, Sorlie, & Loveless, 2000).

Gender, Marital Status, and Health

The gendering of men and women's roles in marriage points to possible differences in how the marital life course is related to cardiovascular disease. Women tend to value themselves more in terms of family relationships than occupational achievement, whereas men are socialized to value themselves primarily in terms of their occupation. This suggests that entry into and from marriage may entail different benefits and costs for men and women, thereby affecting their health differently (Burman & Margolin, 1992; Gove, 1973; Umberson, 1992). The literature on gender differences in the association between marital status and physical health is sparse, and no consistent patterns are reported. For example, Pienta et al. (2000) reported that divorce seems to be more detrimental to women than men in terms of higher rates of chronic conditions, whereas widowhood has a more negative impact on men than on women. Williams and Umberson (2004) reported that marital dissolution is associated with worse

self-assessed health among men compared to women.

Conceptually, there are two major reasons that divorce may be more harmful to women's cardiovascular health than men's. First, divorce often incurs greater economic loss for women (Peterson, 1996; Williams & Umberson, 2000). Perceived and objective economic disadvantage can increase stress and lower women's sense of control, which adversely affects their health (Williams & Umberson). Second, recent findings from research on gender differences in marital conflict and physiological functioning suggest that divorce is more damaging to women (Kiecolt-Glaser & Newton, 2001). For instance, women spent more time ruminating about marital relations than men, and they felt more depressed after arguments with their spouses. Wives also had more vivid and detailed memories of marital conflict than did their husbands. As divorce may be a long and stressful process filled with bitter marital conflicts, "women's stronger and more enduring memories of marital disagreement are likely to sustain maladaptive physiological changes such as heightened cardiovascular responses and elevated stress hormones" (Kiecolt-Glaser & Newton, p. 494). In contrast, men's relative insensitivity to marital distress may insulate them from the negative impact of marital conflict on their health.

Control Variables

Control variables in this study include age, race, nativity, and parental survival status. The risk of cardiovascular disease increases with age (Black, 1992). Blacks are more likely than Whites to have hypertension and stroke, and the foreign born are less likely than their native-born counterparts to have cardiovascular disease (Hayward, Crimmins, Miles, & Yang, 2000; Jasso, Massey, Rosenzweig, & Smith, 2004). Previous research suggested that early-life conditions are associated with the risk of cardiovascular disease in later life (Lynch & Smith, 2005), and therefore parental survival status is included as a partial control for familial and genetic influences stemming from early life.

METHOD

Data

We draw on five waves (1992 – 2000) of the HRS to examine the association between the marital life course and cardiovascular health. The HRS is a nationally representative sample of persons aged 51 – 61 years in 1992, who have been reinterviewed approximately every 2 years after. Spouses or partners of these respondents were also interviewed regardless of age. The panel survey design allows us to examine cardiovascular disease onset for a period of the life course in which cardiovascular problems drastically increase. Cardiovascular disease is determined by respondents' responses to whether a doctor ever told them that they had heart disease or stroke. We supplement cardiovascular disease self-reports with information on cause of death to identify cardiovascular disease among decedents who did not report having cardiovascular disease in the survey. This partially resolves the problem of underreporting because cardiovascular disease reports are contingent on physician diagnosis. We anticipate that those persons with the least severe symptoms are underrepresented among persons classified as having cardiovascular disease.

The panel nature of the HRS also allows us to make use of prospective information on marital status changes over the 8-year observation period. Retrospective information is available that allows us to also document prior marital loss and duration of current marital status. The HRS also provides an array of information about lifetime socioeconomic experience and health behaviors, potentially important mechanisms explaining the link between the marital life course and the cardiovascular health.

The baseline survey of HRS contained 12,654 respondents in 7,705 households, for a response rate of 81.7%. There were 9,760 age-eligible respondents who were born between 1931 and 1941. The prevalence of cardiovascular disease at baseline is estimated on the basis of 9,434 (96.7%) respondents because of the elimination of 245 (2.5%) cohabitors and an additional 81 (0.8%) persons with missing data on key variables such as marital history and self-reported cardiovascular disease. We examine the association between marital experiences and cardiovascular disease prevalence at baseline to assess whether marriage has already left its stamp on cardiovascular health of the surviving middle-aged population. We assess cardiovascular disease incidence to determine whether marital experiences by middle age influence subsequent cardiovascular health. The analysis of the onset of cardiovascular disease is restricted to 8,247 (84.5%) respondents

who did not report having heart disease or stroke at baseline. Of these, 1,030 (12.5%) respondents reported having cardiovascular disease or died of cardiovascular disease ($n = 92$) in the following 8 years, 1,802 (21.9%) respondents dropped out of the study (alive when they dropped out), and 320 (3.9%) died of causes other than cardiovascular disease. We obtained some of the covariate information (e.g., household income, household wealth) from the RAND HRS DATA FILES, a cleaned and streamlined version of the HRS developed by RAND. One of the advantages of the RAND HRS DATA FILES is that it imputes asset wealth and income, using all available information and a consistent imputation method across waves.

MEASURES

Dependent Variables

HRS respondents were asked at each wave whether a doctor ever told them that (a) they had heart disease (i.e., heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems) and (b) they had a stroke. Respondents who reported having either problem were regarded as having cardiovascular disease. Incidence of cardiovascular disease is measured on the basis of the respondents' answer to the same questions in the follow-up surveys among those who reported no cardiovascular disease in previous waves. Starting with the third HRS wave (1996), diagnosed respondents were allowed to dispute prior reports. According to the HRS documentation report (Fisher, Faul, Weir, & Wallace, 2005), some respondents indicated that their condition was misdiagnosed. We thus assume in our study that disputes indicated errors, and we recoded these respondents as not having cardiovascular disease in previous waves.

Self-reports of health problems in surveys such as the HRS correspond reasonably well with clinical diagnosis. Accuracy varies with the type of disease with high accuracy (90% – 95%) for diseases such as cancer and diabetes and slightly less accuracy for cardiovascular disease (Hayward, 2002). Nonetheless, self-reports depend on an individual's health care use, which has implications for the underreporting of the condition. Those who do not have regular checkups or who are in the early stages of a disease may not know that they have had the disease, leading to underreporting (Hayward; Murray & Chen, 1992). An important issue with regard to underreporting is whether disparities in health care use across marital statuses groups leads to biases in self-reported cardiovascular disease. Prior research suggests that "married people are more likely to see the doctor for checkups, screening, and other early detection than single persons with the same symptoms, functioning, and general level of health" (Ross et al., 1990, p. 1064). This pattern indicates that our estimates of health advantages of marriage should be conservative.

As noted above, we take advantage of cause of death information to partially fill in information about cardiovascular problems between observation waves for persons not reporting cardiovascular disease, one source of underreporting. For example, some individuals reported no cardiovascular disease but later died because of a heart attack or other cardiovascular causes. Without the National Death Index cause of death information, the onset of cardiovascular morbidity leading to death would be unobserved. For those who did not report having cardiovascular disease but who died of cardiovascular problems, we assume that cardiovascular disease occurred in the 2-year observation interval before death. Symptoms not leading to physician diagnosis or death remain unobserved.

Independent Variables

We create several variables to describe the marital life course. Marital history identifies persons who are *continuously married*, *remarried*, *divorced/separated* (divorced thereafter), *widowed*, or *never married* at the time of observation. All marital measures are *time varying* (updated at each wave) and constructed on the basis of retrospective information at baseline about marriages and marital losses as well as new marital transitions during the 2-year observation period. Continuously married persons are still in their first marriage at the time of observation. We also created measures of marital status duration reflecting the number of years in a current marital status. Marital status duration is important, given the emphasis in the literature on exposure (e.g., marital investment) as a factor influencing health outcomes.

Four major mechanisms potentially link the marital life course and cardiovascular health: mental distress, socioeconomic circumstances, health behaviors, and comorbidity. Marital losses are often associated with mental distress. For

those who have been through a divorce, mental distress may start well before the divorce because of marital conflict. Research suggests that depressed women and men are more likely to develop heart problems than their nondepressed counterparts (Burg, 1992). In our study, we include two indicators of mental distress: depressive symptoms and emotional problems. The HRS includes a modified short version of the Center for Epidemiological Studies Depression scale, which can be used to measure depressive symptoms. In all, except the 1992 wave, respondents were asked to answer *yes* or *no* to eight statements about their feelings they experienced last week before the interview. The items included questions such as whether the respondent felt depressed, felt everything was an effort, felt sad, felt lonely, had restless sleep, could not get it going, enjoyed life, and felt happy much of the time. For the 1992 wave, there were four categories. To make consistent measures across waves, *all* and *most of the time* were coded as *yes*; *some* and *none of the time* were coded as *no*. High scores indicate greater levels of depressive symptoms. We measure emotional problems on the basis of self-reports to the following question: Has a doctor ever told you that you had emotional, nervous, or psychiatric problems? Thus, depressive symptoms reflect current mental distress, whereas emotional problems (controlling for depressive symptoms) capture distal mental distress although an explicit time dimension is clearly lacking.

We assess SES′s role as a pathway linking the marital life course with cardiovascular disease on the basis of four indicators: education, household income, net household wealth, and health insurance coverage. Education is measured as the number of years of schooling the respondent has completed at baseline. It is a continuous variable ranging from 0 to 17 years of schooling. Household income, a time-varying variable, measures the total household income in the previous year of each wave of the interview. Net household wealth is also measured as a time-varying variable representing the market value of respondents' assets minus any debts they might owe. Both household income and net household wealth are adjusted, respectively, by adding constants to all households to eliminate zero income and negative wealth and then the values are logged. We also include health insurance coverage to partially control for marital group differences in the access to health care. Respondents are considered uninsured when they are covered neither by federal government health insurance programs nor by private insurance programs. Another dummy variable is used to include those who have missing values in health insurance coverage.

Health behaviors may serve as another important mechanism linking marital history and health. Although it is often suggested that unmarried people have unhealthy behaviors, it is less clear to what extent marital status differences in chronic health problems result from health behaviors (Umberson, 1992). Four types of health behaviors are examined: smoking status, alcohol consumption, exercise, and obesity (as a proxy for diet). Three of four are time varying in the study but because of changes in question format across waves for alcohol consumption, it is impossible to create a time-varying variable. Therefore, only baseline information is used to create a variable describing the patterns of a respondent's alcohol consumption. Alcohol assumption is measured as a categorical variable including moderate drinkers (one to two drinks per day) and heavy drinkers (three or more drinks per day) with teetotalers as the reference group. Smoking status is measured as a categorical variable including current smokers and past smokers with people who have never smoked as the reference group. Exercise is measured as a dummy variable, with one representing *regular exercise*. Body mass index (BMI)—weight divided by the square of height—can indirectly reflect dietary behavior as well as genetic constitution. We created a categorical variable to measure body mass including obese ($BMI \geq 30$), overweight ($25.0 \leq BMI \leq 29.9$), and underweight ($BMI < 18.5$), with normal weight ($18.5 \leq BMI \leq 24.9$) as the reference category. The categories are based on U.S. federal guidelines for the identification of overweight and obesity in adults.

The last mechanism is comorbidity. Previous research showed that divorced and widowed persons have higher prevalence of high blood pressure, high cholesterol, and diabetes than the married, all of which are significant risk factors for cardiovascular disease. Having hypertension or diabetes rests on respondents' answer to the question whether a doctor has ever told them that they had a particular disease. Both variables are time varying. Having high cholesterol rests on the respondents' self-reports at baseline. (This question was asked only in 1992.)

Control variables: Age is measured as a continuous variable and is time varying across the observation waves. Gender (*women* = 1) and nativity (*foreign born* = 1) are dummy variables. Race is measured as a categorical variable identifying Blacks and Whites and others (reference category). Parental survival is measured as no parents alive, one parent alive, and both parents alive (reference category). A dummy variable is used to include those who have missing values on parental survival status.

Table 1 shows demographic factors, mental distress, socioeconomic conditions, health behaviors, and comorbidity across marital history groups by gender among those who are cardiovascular disease free at baseline. These persons are the *at-risk* population in our incidence analysis. Women who are continuously married have significantly higher household income, household wealth, and health insurance coverage than remarried, divorced, and widowed women. Divorced women have the lowest household income and wealth of all the marital statuses, and widows have the highest prevalence of no health insurance. Although never-married women are also economically disadvantaged, their education and health insurance coverage are similar to those of continuously married women. Smoking is the lowest among continuously married and never-married women, and obesity is less likely among both groups of married women. Continuously married women again fare best in terms of mental distress and comorbidity, with the lowest prevalence of emotional problems and hypertension. As is evident, the marital history group least at risk of cardiovascular disease is continuously married women.

Like married women, married men enjoy advantages in terms of SES and emotional well-being. Continuously married men are also less likely to smoke and drink heavily than other marital history groups. Continuously married men, however, are more likely to be overweight and obese than other men. Continuously married men also tend to have a lower prevalence of comorbid risk factors with the possible exception of high cholesterol. Thus, similar to continuously married women, continuously married men generally exhibit a lower risk factor profile than other marital history groups. The major exception is BMI that may put continuously married men at a higher risk of cardiovascular disease compared to unmarried men.

Analytic Strategy

We begin by looking at marital history differences in cardiovascular disease prevalence at baseline. This shows differences in cardiovascular disease experience by marital history among persons who survived to midlife. Then, we analyze the effects of the marital life course on the incidence of cardiovascular disease between 1992 and 2000. Cardiovascular disease incidence models identify whether the gap in cardiovascular disease will continue to grow or subside. A discrete-time event history modeling approach is used to examine the onset of cardiovascular disease. Specifically, person-interval (i.e., 2-year interval) record files are created from 1992 to 2000, and a logistic regression model is used for the discrete-time event history analysis. A respondent contributes an observation for each wave up to the onset of the disease or censoring. Preliminary analysis showed significant gender differences in the effects of the marital history on cardiovascular disease onset. Thus, separate analyses are carried out for men and women.

We first estimate a model that includes marital history and basic controls. Then, mental distress, SES, health behaviors, and comorbid conditions are added sequentially to estimate the extent to which these factors mediate the association between marital history and cardiovascular disease onset. Finally, we estimate the effects of duration in current marital status on the incidence of cardiovascular disease. We estimate all models using Stata, which adjusts standard errors for complex sampling design. All models are based on weighted data using baseline sampling weights.

RESULTS

Does Marital History Matter for Cardiovascular Disease?

Are differences in self-reported cardiovascular disease evident across marital history groups in middle age? Estimates of the prevalence of cardiovascular disease at baseline shown in Table 2 indicate that people who have experienced a marital loss have significantly higher prevalence compared to continuously married men and women. For example, approximately 10.7% of remarried women, 11.6% of divorced women, and 10.8% of widows report having cardiovascular disease compared to 8.7% of continuously

Table 1. *Sample Characteristics for Respondents Aged 51 – 61 Years Who Did Not Report Having Cardiovascular Disease by Gender and Marital History, the Health and Retirement Study, 1992 (Ms and %s)*

	Women ($n = 4,502$)				
	Continuously Married[a]	Remarried	Divorced	Widowed	Never Married
Age	55.6	55.0**	55.1**	56.4**	55.1
Black	6.2	7.3	20.0**	19.2**	25.8**
Foreign born	10.8	7.0**	9.1	8.6	11.0
Parental survival status					
No parent alive	50.3	47.3	46.3	53.3**	50.5
One parent alive	38.9	38.4	41.2	35.7†	35.8
Both alive	9.9	12.4	9.9	9.2	12.2
Missing	0.9	1.9	2.6*	1.8	1.5
Education[b]	12.4	12.1**	12.4	11.6**	12.6
Household income ($1,000)	56.5	47.5**	22.1**	22.3**	28.2**
Household wealth ($1,000)	309.1	223.3**	88.8**	125.2**	88.9**
No insurance	17.5	23.7**	25.8**	30.5**	17.6
Body mass index					
Underweight	1.9	1.7	2.0	2.9	0.8*
Overweight	34.2	37.4	31.2	27.8*	37.2
Obese	21.6	19.1	24.7*	34.8**	27.2*
Normal weight	42.3	41.8	42.1	34.5**	34.8*
Smoking status					
Current smoker	18.7	31.1**	35.6**	35.7**	17.6
Past smoker	27.2	30.9†	30.6*	24.0	26.4
Never smoked	54.1	38.0**	33.8**	40.3**	56.0
Alcohol consumption					
None	42.5	36.8**	37.4*	51.7**	43.3
Moderate (1 – 2 drinks/day)	56.1	59.6†	60.6*	46.3**	54.9
Heavy (3 or more drinks/day	1.4	3.6**	2.0	2.0	1.8
Exercise (1 = *yes*)	20.0	21.7	19.3	15.9	23.0
Depression[c]	0.6	0.8**	1.1**	1.2**	0.9*
Emotional problems (1 = *yes*)	7.7	12.3**	14.2**	13.4**	11.1†
High blood pressure (1 = *yes*)	31.2	33.2	37.3**	42.2**	40.1**
Diabetes (1 = *yes*)	7.9	6.0	10.0†	11.9**	6.3
High cholesterol (1 = *yes*)	25.0	28.5	25.8	22.4	29.9
Unweighted *n*	2,421	718	732	461	170
	Men ($n = 3,745$)				
	Continuously Married[a]	Remarried	Divorced	Widowed	Never Married
Age	55.7	55.2**	55.0**	56.9*	55.3
Black	6.6	8.0†	17.6**	24.0**	16.4**
Foreign born	10.8	5.6**	5.8**	11.2	9.3
Parental survival status					
No parent alive	46.2	41.8	46.2	58.9*	51.7
One parent alive	39.7	39.0	38.4	31.6	38.9
Both alive	10.0	13.8*	12.0	7.3	8.6
Missing	4.1	5.7†	3.4	2.2	0.8**
Education[b]	12.7	12.5	12.4	11.6*	12.4
Household income ($1,000)	63.7	60.3	36.9**	28.9**	28.5**
Household wealth ($1,000)	303.4	223.4**	140.5**	144.9**	199.7

Table 1. *Continued*

	Men ($n = 3,745$)				
	Continuously Married[a]	Remarried	Divorced	Widowed	Never Married
No insurance	16.8	17.8	25.8*	36.0**	25.6†
Body mass index					
Underweight	0.2	0.3	1.5*	0.9	0.9
Overweight	52.1	49.1†	42.9**	47.2	35.6**
Obese	19.6	21.5	15.4†	23.5	19.7
Normal weight	28.1	29.1	40.2**	28.4	43.8**
Smoking status					
Current smoker	22.4	31.7**	44.1**	40.4*	31.3*
Past smoker	47.9	47.6	35.3**	45.8	33.1**
Never smoked	29.7	20.7**	20.6**	14.1**	35.6
Alcohol consumption					
None	29.5	28.3	24.0*	29.3	34.0
Moderate (1 – 2 drinks/day)	63.8	60.0†	62.6	54.8	57.5
Heavy (3 or more drinks/day)	6.7	11.7**	13.4**	15.9†	8.5
Exercise (1 = *yes*)	20.0	18.7	26.3**	19.3	23.8
Depression[c]	0.5	0.5*	1.0**	1.4**	0.9**
Emotional problems (1 = *yes*)	3.8	6.0*	12.0**	14.2	10.9**
High blood pressure (1 = *yes*)	36.3	33.4	37.3	45.3	35.6
Diabetes (1 = *yes*)	8.2	7.3	8.0	18.6*	12.9
High cholesterol (1 = *yes*)	25.0	21.1	12.8**	23.3	17.8
Unweighted *n*	2,267	883	388	62	145

Note: All values are weighted. $N = 8,247$.

[a]Each marital group is compared with the continuously married. [b]Education ranges from 0 to 17 (low to high). [c]Depression ranges from 0 to 8.

†$p < .10$. *$p < .05$. **$p < .01$ (t tests).

married women. For men, the prevalence of cardiovascular disease is significantly higher. About 16.4% of remarried men, 17.7% of divorced men, and 16.5% of widowers report having cardiovascular disease compared to 13.5% of continuously married men. There is no statistically significant difference between the never married and the continuously married.

Models of cardiovascular disease incidence over the course of the study are shown in Tables 3 and 4 for women and men, respectively. We report both unstandardized logistic coefficients and odds ratios. An odds ratio with a value above 1 indicates that the independent variable increases the odds of cardiovascular disease, and an odds ratio below 1 indicates a decrease of the odds. Subtracting 1 from the odds ratio and multiplying by 100 gives the percent change in the odds of cardiovascular disease. Model 1 in Table 3 shows that the odds of having cardiovascular disease among remarried, divorced, and widowed women are higher by 58%, 60%, and 34%, respectively, than continuously married women, controlling for age, race, nativity, and parental survival status. Never-married women do not have a significantly greater risk of cardiovascular disease compared to continuously married women. The similarity of the remarried and the divorced women in terms of their high risk for cardiovascular disease supports the stress hypothesis that a marital loss, divorce in particular, may have lasting negative effects.

The results shown in Model 2 suggest that part of the higher risk of cardiovascular disease among women with a marital loss results from mental distress. The risk of cardiovascular disease among remarried and divorced women declines, although it remains statistically significant. When the socioeconomic measures are introduced in Model 3, the odds of cardiovascular disease of remarried women decline slightly but remain statistically significant. In contrast,

Table 2. *Prevalence of Cardiovascular Disease at Baseline by Gender and Marital History Groups, the Health and Retirement Study, 1992*

	Cardiovascular Disease	
	Women[a]	Men
Continuously married[b]	8.7	13.5
Remarried	10.7*	16.4*
Divorced	11.6*	17.7*
Widowed	10.8*	16.5*
Never married	8.4	13.0

Note: All values are weighted. $N = 9{,}434$.The prevalence figures are estimates derived from logistic regression model by regressing the log odds of cardiovascular disease on marital history and gender. Interactions between marital history and gender (i.e., Remarried × Gender, Divorced × Gender, Widowed × Gender, Never married × Gender) were tested, but none was statistically significant. Parameter estimates are used to calculate predicted rates.

[a]The main effect of gender on the prevalence of cardiovascular disease is statistically significant at $p < .01$. [b]Each marital history group is compared with the continuously married.

*$p < .05$.

divorced women's higher odds of cardiovascular disease are significantly reduced and no longer statistically different from those of continuously married women. This pattern suggests that mental distress and disadvantaged socioeconomic conditions in particular are the main mechanisms for divorced women's higher risk of cardiovascular disease compared to continuously married women. For remarried women, SES and emotional distress partially account for their higher risk of cardiovascular disease. When we introduced the health behavior measures in Model 4, we observe almost no change in the relative risk of cardiovascular disease for remarried and divorced women, suggesting that health behaviors are not the major factors linking marital loss and cardiovascular disease once SES is controlled. Finally, when hypertension, diabetes, and high cholesterol are introduced in Model 5, we observe almost no change in marital history effects.

Overall, these results reveal that a marital loss, divorce in particular, puts women at high risk for developing cardiovascular disease in late midlife, regardless of whether they are remarried. The results for the incidence of cardiovascular disease among never-married women parallel the prevalence findings. The never-married women are similar to the continuously married women, with and without control variables.

In contrast to women, the results shown in Table 4 indicate that marital loss has very different consequences for men. Remarried middle-aged men appear to be somewhat *less* likely to experience cardiovascular disease onset compared to continuously married men. Even in the full model (Model 5), remarried men are 19% less likely to experience cardiovascular disease than continuously married men. In addition, never-married men show a distinct advantage over continuously married men. After controlling for demographic, emotional distress, socioeconomic conditions, health behaviors, and comorbid conditions, the risk of cardiovascular disease for never-married men remains about 60% less than that for continuously married men. Finally, the risk of cardiovascular disease among divorced and widowed men is not significantly different from that of continuously married men.

Summarizing our results for men and women, we find that continuous marriage offers women protection against the onset of cardiovascular disease in middle age, but it does not offer similar benefits for men. It is clear that continuously married women have a lower risk of cardiovascular disease because of the financial and emotional well-being they derive from intact marriages. Our model is unable to fully explain why remarried women face such a high risk of cardiovascular disease compared to continuously married women. Never-married men and women in midlife are not significantly different from their continuously married counterparts.

Our prevalence model showed that disparity in cardiovascular health already exists across marital history groups by middle age. Our incidence model suggests that the gap across marital history groups widens among women in old age but narrows among men. Table 5 shows the hypothetical cardiovascular disease experiences during the prime retirement period (between 51 and 65 years of age) of men and women in different marital history groups. Assuming that the observed incidence rates do not change over time, we estimate the cumulative probability of having cardiovascular disease from age 51 to 65.

The estimates are broken down by gender and marital history groups to illustrate how these characteristics combine with aging to influence cardiovascular disease experience. For women, the significantly higher rates of cardiovascular disease among those with marital loss compared to the continuously married translate into increasingly greater differentials in the prevalence of

Table 3. *Discrete-Time Logistic Regression Model for the Association Between Marital History and the Onset of Cardiovascular Disease Among Women, the Health and Retirement Study, 1992 – 2000* (n = *4,502*)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Explanatory Variables	*B*	e^B	*B*	e^B	*B*	e^B	*B*	e^B	*B*	e^B
Marital history										
Remarried[a]	0.46**	1.58	0.42**	1.52	0.40**	1.49	0.39**	1.48	0.40**	1.50
Divorced	0.47**	1.60	0.41**	1.51	0.28	1.32	0.26	1.30	0.25	1.29
Widowed	0.29	1.34	0.23	1.25	0.11	1.12	0.05	1.05	0.06	1.06
Never married	0.18	1.20	0.17	1.19	0.05	1.05	0.05	1.06	0.13	1.13
Age	0.05**	1.05	0.05**	1.05	0.05**	1.05	0.06**	1.06	0.05**	1.05
Black	0.39**	1.47	0.38**	1.47	0.28**	1.33	0.20*	1.22	0.07	1.07
Foreign born	−0.09	0.91	−0.15	0.86	−0.20	0.82	−0.10	0.91	−0.14	0.87
Parental survival status										
No parents alive[b]	0.62**	1.87	0.63*	1.87	0.60**	1.81	0.54*	1.71	0.47*	1.60
One parent alive	0.41†	1.50	0.41†	1.51	0.40†	1.49	0.36	1.43	0.37	1.45
Parental survival status unknown	0.11	1.12	0.07	1.08	0.02	1.02	−0.05	0.95	−0.15	0.86
Depression[c]			0.04†	1.04	0.02	1.02	0.01	1.01	0.00	1.09
Emotional problem (1 = *yes*)			0.45**	1.56	0.41**	1.50	0.36**	1.43	0.28†	1.29
Education[d]					−0.03	0.97	−0.01	0.99	−0.00	1.00
Household income					−0.06*	0.94	−0.05†	0.95	−0.03	0.97
Household wealth					−0.38†	0.69	−0.34**	0.71	−0.31*	0.73
No insurance[e]					−0.27†	0.76	−0.27†	0.76	−0.23	0.79
Smoking status										
Current smoker[f]							0.42**	1.53	0.46**	1.57
Past smoker							0.15	1.16	0.09	1.09
Alcohol consumption										
Heavy drinker[g]							−0.57	0.56	−0.55	0.58
Moderate drinker							−0.27**	0.76	−0.17†	0.84
Body mass index										
Underweight[h]							0.15	1.16	0.15	1.16
Overweight							0.15	1.16	0.00	1.00
Obese							0.50**	1.65	0.20	1.22
Exercise (1 = *yes*)							−0.18	0.84	−0.14	0.87
High blood pressure (1 = *yes*)									0.50**	1.65
Diabetes (1 = *yes*)									0.98**	2.67
High cholesterol (1 = *yes*)									0.23*	1.26

Note: Number of person-intervals = 15,221.

[a]Continuously married is the reference category for the marital history variables. [b]Both parents alive is the reference category for the parental survival status variables. [c]Depression ranges from 0 to 8. [d]Education ranges from 0 to 17 (low to high). [e]Having insurance is the reference category. [f]Nonsmoker is the reference category. [g]People who do not drink is the reference category. [h]Normal weight is the reference category.

†$p < .10$. *$p < .05$. **$p < .01$.

cardiovascular disease from age 51 to 65. For example, at age 51, 9.8% of remarried women, 10.9% of divorced women, and 9.9% of widows reported having cardiovascular disease, whereas 7.3% of continuously married women have cardiovascular disease. By age 60, approximately 31% of remarried women, 33% of divorced women, and 30% of widows are expected to have cardiovascular disease, assuming no mortality, compared to 22% of continuously married women. Among men, the remarried and the divorced have relatively higher rates of cardiovascular disease at age 51 than the continuously married men. By age 60, the prevalence is slightly lower for remarried men than for continuously married men; divorced men still have the highest prevalence rate of cardiovascular disease. The never married and the widowers have much lower

Table 4. *Discrete-Time Logistic Regression Model for the Association Between Marital History and the Onset of Cardiovascular Disease Among Men, the Health and Retirement Study, 1992 – 2000 (*n = *3,745)*

	Model 1		Model 2		Model 3		Model 4		Model 5	
Explanatory Variables	*B*	e^B	*B*	e^B	*B*	e^B	*B*	e^B	*B*	e^B
Marital history										
Remarried[a]	−0.18	0.83	−0.21†	0.81	−0.21†	0.81	−0.23*	0.79	−0.21†	0.81
Divorced	0.08	1.08	−0.04	0.96	−0.09	0.91	−0.15	0.86	−0.14	0.87
Widowed	−0.40	0.67	−0.56†	0.57	−0.58†	0.56	−0.62†	0.54	−0.64†	0.53
Never married	−0.68†	0.51	−0.78*	0.46	−0.87*	0.42	−0.86*	0.42	−0.91*	0.40
Age	0.05**	1.06	0.05**	1.05	0.05**	1.05	0.06**	1.06	0.05**	1.05
Black	0.02	1.02	0.02	1.02	−0.06	0.94	−0.06	0.94	−0.15	0.86
Foreign born	−0.38†	0.69	−0.43*	0.65	−0.43†	0.65	−0.38†	0.68	−0.38	0.68
Parental survival status										
No parents alive[b]	0.38	1.46	0.37	1.45	0.36	1.43	0.35	1.42	0.32	1.38
One parent alive	0.15	1.16	0.15	1.16	0.15	1.16	0.16	1.18	0.14	1.15
Parental survival status unknown	0.66*	1.93	0.66*	1.94	0.64*	1.90	0.63*	1.87	0.62*	1.86
Depression[c]			0.10**	1.11	0.09**	1.10	0.09**	1.10	0.08*	1.08
Emotional problem (1 = *yes*)			0.22	1.24	0.20	1.22	0.16	1.18	0.09	1.10
Education[d]					0.00	1.00	0.01	1.01	0.01	1.01
Household income					−0.08*	0.92	−0.08*	0.93	−0.07*	0.93
Household wealth					−0.19*	0.83	−0.16†	0.86	−0.15	0.86
No insurance[e]					−0.45**	0.64	−0.47**	0.63	−0.44**	0.65
Smoking status										
Current smoker[f]							0.61**	1.83	0.65**	1.91
Past smoker							0.13	1.14	0.13	1.13
Alcohol consumption										
Heavy drinker[g]							−0.23	0.79	−0.25	0.78
Moderate drinker							−0.03	0.97	0.00	1.00
Body mass index										
Underweight[h]							0.25	1.29	0.34	1.41
Overweight							0.14	1.15	0.07	1.07
Obese							0.29*	1.34	0.12	1.13
Exercise (1 = *yes*)							−0.06	0.94	−0.04	0.96
High blood pressure (1 = *yes*)									0.40**	1.49
Diabetes (1 = *yes*)									0.38**	1.47
High cholesterol (1 = *yes*)									0.13	1.14

Note: Number of person-intervals = 11,354.

[a]Continuously married is the reference category for the marital history variables. [b]Both parents alive is the reference category for the parental survival status variables. [c]Depression ranges from 0 to 8. [d]Education ranges from 0 to 17 (low to high). [e]Having insurance is the reference category. [f]Nonsmoker is the reference category. [g]People who do not drink is the reference category. [h]Normal weight is the reference category.

†$p < .10$. *$p < .05$. **$p < .01$.

rates of cardiovascular disease compared to all other groups. A caveat here is that we have a very small sample of widowers in the HRS, and thus the results should be interpreted cautiously. The key point is that the health gap in terms of cardiovascular disease increases substantially between those with a marital loss and the continuously married as women advance into old age. Among men, the continuously married do not have much advantage compared to other marital groups (except divorced men) as they advance into old age.

Does Duration in Current Marital Status Matter for Cardiovascular Disease?

Next, we examined the effects of marital status duration on the onset of cardiovascular disease. The results (see Table 6) show that each year in

Table 5. *Cumulative Probability of Experiencing Cardiovascular Disease by Gender and Marital History from Age 51 to 65, the Health and Retirement Study, 1992 – 2000*

Age (Years)	Continuously Married	Remarried	Divorced	Widowed	Never Married
Women					
51	7.3	9.8	10.9	9.9	8.3
52	8.6	11.9	13.1	11.8	10.0
53	10.0	14.0	15.3	13.7	11.8
54	11.5	16.3	17.6	15.8	13.6
55	13.0	18.6	20.0	17.9	15.5
56	14.5	21.0	22.5	20.0	17.5
57	16.2	23.4	25.0	22.3	19.6
58	17.9	26.0	27.6	24.6	21.7
59	19.7	28.6	30.3	27.0	23.9
60	21.5	31.2	33.0	29.5	26.2
61	23.5	33.9	35.8	32.0	28.5
62	25.4	36.7	38.6	34.6	30.9
63	27.5	39.5	41.5	37.2	33.4
64	29.6	42.4	44.4	39.9	35.9
65	31.8	45.3	47.4	42.6	38.5
Men					
51	10.5	12.9	13.5	8.0	9.5
52	12.6	14.5	15.7	9.4	10.5
53	14.7	16.3	17.9	10.8	11.6
54	16.9	18.0	20.3	12.3	12.8
55	19.2	19.9	22.7	13.9	14.0
56	21.6	21.8	25.2	15.5	15.2
57	24.0	23.8	27.7	17.3	16.5
58	26.5	25.9	30.3	19.0	17.9
59	29.1	28.0	33.0	20.9	19.3
60	31.7	30.2	35.7	22.8	20.8
61	34.4	32.5	38.5	24.8	22.4
62	37.2	34.8	41.3	26.8	24.0
63	40.0	37.2	44.2	29.0	25.7
64	42.8	39.6	47.1	31.2	27.4
65	45.7	42.1	50.0	33.4	29.2

Note: $N = 8{,}247$. The probability of having cardiovascular disease at age 51 is calculated from the parameter estimates of logistic regression models that regresses the log odds of having cardiovascular disease on age and marital history separately for men and women in the baseline Health and Retirement Study. The cumulative probabilities after age 51 are calculated from the parameter estimates of hazard models by regressing the log of the risk of cardiovascular disease onset on age and marital history, separately for men and women.

marriage *increased* rather than decreased the risk of cardiovascular disease by 2% for both men and women, controlling for the number of marriages, age, race, nativity, and parental survival status. When mental distress, SES, health behaviors, and comorbid conditions are added to the model, the effect of marriage duration on cardiovascular disease reduces in half and becomes statistically insignificant. In additional analyses, we found that it was the health behaviors and comorbid conditions that largely explained the effect of marriage duration on cardiovascular disease for both men and women. Longer marriages were associated with less healthy behaviors and an accumulation of morbid conditions, such as hypertension, diabetes, and high cholesterol, all else being equal. We also tested whether effects of marriage duration are the same for the continuously married and the remarried by adding interaction terms of

Table 6. *Effect of Current Marriage Duration on the Risk of Cardiovascular Disease Among Men and Women, the Health and Retirement Study, 1992 – 2000*

	Women				Men			
	Model 1		Model 2		Model 3		Model 4	
Explanatory Variables	*B*	e^B	*B*	e^B	*B*	e^B	*B*	e^B
Marital history								
Marriage duration	0.02*	1.02	0.01	1.01	0.02*	1.02	0.01	1.01
Remarried[a]	0.83**	2.28	0.68**	1.97	0.13	1.14	0.04	1.04
Age	0.05*	1.05	0.05*	1.05	0.04*	1.04	0.05**	1.05
Black	0.17	1.18	−0.21	0.81	0.19	1.21	0.01	1.01
Foreign born	−0.06	0.94	−0.06	0.94	−0.38	0.69	−0.36	0.69
Parental survival status								
No parents alive[b]	0.58†	1.79	0.48	1.61	0.28	1.32	0.20	1.22
One parent alive	0.39	1.47	0.39	1.48	0.02	1.02	−0.01	0.99
Parental survival status unknown	0.25	1.28	−0.02	0.98	0.46	1.58	0.39	1.47
Depression[c]			0.00	1.00			0.05	1.05
Emotional problem (1 = *yes*)			0.08	1.08			−0.02	0.98
Education[d]			0.01	1.01			0.01	1.01
Household income			0.09	1.09			−0.11**	0.90
Household wealth			−0.60*	0.55			−0.19	0.83
No insurance[e]			−0.24	0.78			−0.44**	0.64
Smoking status								
Current smoker[f]			0.48**	1.61			0.67**	1.96
Past smoker			0.09	1.09			0.09	1.09
Alcohol consumption								
Heavy drinker[g]			−1.18	0.31			−0.19	0.83
Moderate drinker			−0.22	0.80			−0.02	0.98
Body mass index								
Underweight[h]			0.04	1.05			−0.77	0.46
Overweight			−0.15	0.86			0.04	1.05
Obese			0.22	1.25			0.24	1.27
Exercise (1 = *yes*)			−0.12	0.89			−0.02	0.98
High blood pressure (1 = *yes*)			0.43**	1.54			0.67**	1.45
Diabetes (1 = *yes*)			1.23**	3.44			0.37	1.26
High cholesterol (1 = *yes*)			0.24*	1.28			0.18	1.20
Number of person-intervals	10,297				9,419			

[a]Continuously married is the reference category for the marital history variables. [b]Both parents alive is the reference category for the parental survival status variables. [c]Depression ranges from 0 to 8. [d]Education ranges from 0 to 17 (low to high). [e]Having insurance is the reference category. [f]Nonsmoker is the reference category. [g]People who do not drink is the reference category. [h]Normal weight is the reference category.

†$p < .10$. *$p < .05$. **$p < .01$.

Marriage Duration × Remarried into Models 1 and 3 for women and men, respectively. None of the interaction terms were statistically significant. We then tested the effects of divorce and widowhood duration on the risk of cardiovascular disease, along with basic controls, but duration in these marital conditions was not statistically significant (results not shown). This held for both women and men.

The results shown in Table 6 also indicate that relative risk of cardiovascular disease for remarried women increases compared to continuously married women when marriage duration is controlled. With all the control variables in Model 2 of Table 6, remarried women are 97% more likely to experience cardiovascular disease than the continuously married. We tested whether low marital quality may explain the high risk of

cardiovascular disease among remarried women by including a global measure of marital quality at baseline into Model 2 (only baseline HRS asked questions about marital quality). Marital quality was measured by asking respondents whether they were satisfied with their marriage on a 5-point scale. Including this simple measure resulted in a slight decline in the odds of cardiovascular disease among remarried women from 1.97 to 1.88, but the effect of remarriage remained statistically significant (results not shown). Although the test is imperfect, the results suggest that marital quality plays a modest role in explaining the high risk of cardiovascular disease among remarried women.

In the end, in order to better interpret the results from the incidence models, we examined the issue of sample attrition and discussed the consequences of attrition on model estimates. A key question with regard to sample attrition is whether certain marital groups are more likely to drop out of the sample. Differential drop out rates can potentially lead to biased model estimates if attrition is related to the health outcomes of interest. Discrete-time hazard models of the risk of dropping out over a 2-year observation interval were estimated. Predictor variables included marital history, demographic controls, SES, health behaviors, and comorbidities. Results (available on request) showed that only divorced men and women were significantly more likely to drop out of the study than continuously married persons. Fortunately, considering previous results showing that the divorced are more likely to be unhealthy than the continuously married, the estimates for the attrition model suggest that the effects of divorce on cardiovascular disease are likely to be conservative.

Discussion

In this article, we asked whether the marital life course affects cardiovascular disease in late midlife and whether the effect differs by gender. Our results showed that marital loss is significantly associated with the prevalence of cardiovascular disease: Those who have been through a marital loss have significantly higher rates of cardiovascular disease compared to persons who are continuously married. Never-married persons are similar to the continuously married in the prevalence rates of cardiovascular disease. Our results are consistent with the hypothesis developed by Hughes, Waite, Cacioppo, and Hawkley (2004) that marital history is related to health dimensions that develop slowly, such as chronic disease. The effect of marital loss on the prevalence of cardiovascular disease does not differ by gender.

Middle-aged men and women, however, differed significantly in the effects of marital loss on the incidence of cardiovascular disease. Marital loss increased the risk of cardiovascular disease for women but not for men. This finding implies that women's marital group differences in cardiovascular disease widen as they advance to old age. For men, marital loss was not associated with a higher risk of cardiovascular disease. Instead, remarried men had a relatively lower risk of cardiovascular disease than continuously married men. Our research provides some evidence for the stress hypothesis in that marital loss rather than the marriage per se affects the onset of cardiovascular disease. Never-married men and women have comparable or even better cardiovascular health than their continuously married counterpart in late midlife. It appears that the stress hypothesis mainly operates among women in terms of the onset of cardiovascular disease in midlife.

What factors account for the observed gender differences in how marital history is linked to the onset of cardiovascular disease in late midlife? One factor is assortative mating, especially among the remarried population (although we cannot directly test for this explanation). White (1979) found that remarriage was selective of wealthier thus happier and healthier men. In contrast, remarriage was selective of poorer and less educated women.

Another factor is selection. For example, because never-married men are more likely to die (Waite, 1995), those who survived to middle age and managed to be cardiovascular disease free in midlife tend to be robust and do not exhibit risky behaviors typical of young and never-married men. This pattern is reflected in the descriptive statistics. We found that never-married men are more likely to have normal weight and not smoke compared to continuously married men.

The third factor is differential mortality selection during the observation period. Remarried, divorced, widowed, and never-married men may be more likely to die of causes other than cardiovascular disease in the follow-up period than continuously married men, with those surviving being healthier than or similar to continuously

married men. Such mortality patterns by marital history may not hold for women. We tested this possibility by examining cardiovascular disease mortality and mortality from other causes among men and women who survived to midlife without reporting cardiovascular problems. We found some support for our hypothesis. For example, remarried, divorced, and widowed men are significantly *more* likely to die of other causes than continuously married men, controlling for age, race, and nativity (results not shown). There is no evidence that remarried, divorced, widowed, and the never-married men are more likely to die from cardiovascular disease than continuously married men. In contrast, divorced and widowed women are significantly more likely to die of cardiovascular disease as well as of other causes compared to continuously married women, controlling for age, race, and nativity. Remarried women and single women do not have a higher risk of death from cardiovascular disease or other causes.

The fourth factor is related to gender differences in the onset of cardiovascular disease. Women develop cardiovascular disease about 10 years later than men. Their risk increases sharply after menopausal transition and begins to catch up to men by age 60. Whereas women have extremely low risk of heart attacks before middle age, men's risk of heart attack tends to peak earlier. In the 45 – 54 years age group, the number of men having heart attacks is six times that of women (Rosenfeld, 1992). Therefore, more men than women may have died of heart attack before middle age. Although cardiovascular disease mortality is very low before middle age and unlikely to seriously bias our results, we should not lose sight of the gender differences in cardiovascular morbidity and mortality before middle age.

We also examined the influence of a temporal dimension of the marital life course, that is, duration in current marital status, on the incidence of cardiovascular disease. The prevailing hypothesis concerning the positive effect of marriage duration on health is *not* supported by the data. Instead, each year in marriage is positively related to the risk of cardiovascular disease, with basic controls, for both men and women. This positive effect of marital duration on cardiovascular disease is largely explained by health behaviors and comorbidity. Our results show that divorce or widowhood duration has a negligible association with incidence of cardiovascular disease for both men and women. A caveat here is that we have a small sample of divorced and widowed men in our study, and the results for them should be interpreted cautiously.

Our results also point to the mechanisms linking the marital life course and cardiovascular disease. First, continuously married men and women are significantly less likely to have had any emotional problems than their counterparts in other marital statutes. The emotional well-being of continuously married women partly explained their lower risk of cardiovascular disease. Second, SES differs greatly across different marital history groups, and poor socioeconomic conditions largely explain the health disadvantages of women who are currently divorced. Health behaviors and comorbidity do not explain additional variance once SES is controlled. The health inequalities between remarried and continuously married women remain after all the control variables including marriage duration and marital quality, suggesting that other mechanisms are at work.

We also acknowledge the limitations of this study. First, because of data limitations, we were not able to directly test the selection hypothesis. We do not have information about early-life personality characteristics and/or health before marriage. Nonetheless, the lack of differences between the never married and the continuously married provides an indirect test of the selection hypothesis. If the selection hypothesis holds, healthier persons should be more likely to marry, and, as a consequence, the continuously married should show health advantages over the never married. The results for men and women, however, do not show that continuously married persons have better cardiovascular health in both the prevalence and the incidence models. This finding suggests that selection may play a negligible role in the association between marriage and cardiovascular disease, at least in late midlife. In addition, the longitudinal data set used here helps establish the temporal ordering between marital experiences and cardiovascular disease.

Still, selection effects cannot be completely ruled out because of various sample selection issues. Previous research showed that unmarried individuals, men in particular, are less likely than married individuals to survive to middle age. Unmarried adults are more likely to die from causes that have a large behavioral component, such as lung cancer and cirrhosis (Waite & Gallagher, 2000). In addition, our own research

showed that a significant percentage of middle-aged people across marital history groups have already experienced cardiovascular disease and thus are excluded from the analysis of cardiovascular disease incidence. To the extent that marital status effects play out earlier in the life course, the HRS design limits our ability to detect them. Nonetheless, in this article, by looking at both prevalence and incidence of cardiovascular disease, we present a more accurate picture of how marital history is associated with the risk of cardiovascular disease in late midlife. Prevalence differences not only reflect the burden of cardiovascular disease born by people with different marital experiences during middle age, but they also embody prior experience with cardiovascular disease at earlier ages.

Second, our analysis comparing remarried and continuously married persons is constrained by the fact that remarriage effects may reflect either the lingering trauma of a divorce, the incomplete institution of remarriage itself, or the differences in marital quality. Remarriage often involves greater conflict and stress than first marriages, especially when stepchildren are involved. Unfortunately, because of data limitations, we are unable to introduce measures of stress, conflict, perceived social support, detailed dimensions of marital quality, and personality characteristics in this study to examine whether these theoretically important characteristics account for the cardiovascular disease disadvantages of the remarried women. It is also essential to investigate gender differences in selection processes involved in remarriage.

Nonetheless, our research makes important contributions to the debate of health consequences of marriage by (a) incorporating remarriage as well as temporal dimensions of the marital life course into the study, (b) focusing on cardiovascular disease prevalence and incidence, (c) examining alternative mechanisms linking marital history and health, and (d) taking advantage of a recent, longitudinal, and nationally representative data set. This research is the first study that systematically examines the associations between the marital life course and the cardiovascular disease for both men and women. These results demonstrate that the marital life course affects cardiovascular disease in midlife for both men and women but in different ways. Given survival to midlife without cardiovascular disease, marital loss puts women at higher risk of cardiovascular disease. In contrast, marital loss has negligible effect on men's cardiovascular disease onset but increases their risk of death from causes other than cardiovascular disease. These surprising findings underscore the importance of continued research on the gendered health effects of the marital life course.

NOTE

An earlier version of this paper was presented at the 2004 Annual Scientific Meeting of the Gerontological Society of America, Washington, DC, November 19 – 23. Our thanks go to Susan Brown, three anonymous reviewers, and the editor for their helpful comments. This research was partially supported by Grants from the National Institute on Aging (R01 AG11758 and R55 AG09311). Infrastructural support was provided by National Child Health and Human Development population center grants to Penn State University (1 R24 HD41025) and Bowling Green State University (R21 HD042831-01).

REFERENCES

Barrett, A. E. (2000). Marital trajectories and mental health. *Journal of Health and Social Behavior*, *41*, 451 – 464.

Bianchi, S. M., & Casper, L. M. (2000). American families. *Population Bulletin*, *55*(3).

Black, H. (1992). Cardiovascular risk factors. In B. L. Zaret, L. S. Cohen, & M. Moser (Eds.), *The Yale University school of medicine heart book* (pp. 23 – 35). New York: Hearst Books.

Booth, A., & Amato, P. (1991). Divorce and psychological stress. *Journal of Health and Social Behavior*, *32*, 396 – 407.

Brockmann, H., & Klein, T. (2004). Love and death in Germany: The marital biography and its effect on mortality. *Journal of Marriage and Family*, *66*, 567 – 581.

Burg, M. M. (1992). Stress, behavior, and heart Disease. In B. L. Zaret, L. S. Cohen, & M. Moser (Eds.), *The Yale University school of medicine heart book* (pp. 94 – 104). New York: Hearst Books.

Burman, B., & Margolin, G. (1992). Analysis of the association between marital relationships and health problems: An interactional perspective. *Psychological Bulletin*, *112*, 39 – 63.

Cherlin, A. J., & Furstenberg, F. F. (1994). Stepfamilies in the United States: A reconsideration. *Annual Review of Sociology*, *20*, 359 – 381.

Cotten, S. R. (1999). Marital status and mental health revisited: Examining the importance of risk factors and resources. *Family Relations*, *48*, 225 – 233.

Fisher, G. G., Faul, J. D., Weir, D. R., & Wallace, R. B. (2005). *Documentation of chronic disease*

measures in the Health and Retirement Study (HRS/AHEAD) (No. HRS Documentation Report DR-009). Ann Arbor: University of Michigan.

Fremont, A. M., & Bird, C. E. (1999). Integrating sociological and biological models. *Journal of Health and Social Behavior*, *40*, 126 – 129.

Fu, H., & Goldman, N. (1996). Incorporating health into models of marriage choice: Demographic and sociological perspective. *Journal of Marriage and the Family*, *58*, 740 – 758.

Gove, W. R. (1973). Sex, marital status, and mortality. *American Journal of Sociology*, *79*, 45 – 67.

Hayward, M. D. (2002). *Using the Health and Retirement Survey to investigate health disparities*. Unpublished manuscript.

Hayward, M. D., Crimmins, E. M., Miles, T. P., & Yang, Y. (2000). The significance of socioeconomic status in explaining the racial gap in chronic health conditions. *American Sociological Review*, *65*, 910 – 930.

Hemstrom, O. (1996). Is marriage dissolution linked to differences in mortality risks for men and women? *Journal of Marriage and the Family*, *58*, 366 – 378.

Hu, Y., & Goldman, N. (1990). Mortality differentials by marital status: An international comparison. *Demography*, *27*, 233 – 250.

Hughes, M. E., Waite, L. J., Cacioppo, J. T., & Hawkley, L. (2004, August). *Marital biography and health at mid life*. Paper presented at the 99th annual meeting of the American Sociological Association, San Francisco, CA.

Jasso, G., Massey, D., Rosenzweig, M., & Smith, J. (2004). Immigration health: Selectivity and acculturation. In N. B. Anderson, R. A. Bulatao, & B. Cohen (Eds.), *Critical perspectives on racial and ethnic differences in health in late life*. Washington, DC: National Academies Press.

Johnson, D. R., & Wu, J. (2002). An empirical test of crisis, social selection, and role explanations of the relationship between marital disruption and psychological distress: A pooled time-series analysis of four-wave panel data. *Journal of Marriage and Family*, *64*, 211 – 224.

Johnson, N. J., Backlund, E., Sorlie, P. D., & Loveless, C. A. (2000). Marital status and mortality: The National Longitudinal Mortality Study. *Annals of Epidemiology*, *10*, 224 – 238.

Joung, I. M. A., Van De Mheen, H. D., Stronks, K., Van Poppel, F. W. A., & Mackenbach, J. P. (1997). A longitudinal study of health selection in marital transitions. *Social Science and Medicine*, *46*, 425 – 435

Kawachi, I., Colditz, G. A., Ascherio, A., Rimm, E. B., & Giovannucci, E. (1996). A prospective study of social networks in relation to total mortality and cardiovascular disease incidence in men. *Journal of Epidemiology and Community Health*, *50*, 245 – 251.

Kiecolt-Glaser, J. K., & Newton, T. L. (2001). Marriage and health: His and hers. *Psychological Bulletin*, *127*, 472 – 503.

Kiecolt-Glaser, J. K., Preacher, K. J., MacCallum, R. C., Atkinson, C., Malarkey, W. B., & Glaser, R. (2003). Chronic stress and age-related increases in the proinflammatory cytokine IL-6. *Proceedings of the National Academy of Sciences of the United States of America*, *100*, 9090 – 9095.

Kitson, G. C. (1990). The multiple consequences of divorce: A decade review. *Journal of Marriage and the Family*, *52*, 150 – 182.

Krause, N. (2005). Negative interaction and heart disease in late life: Exploring variations by socioeconomic status. *Journal of Aging and Health*, *17*, 28 – 55.

Lillard, L. A., & Panis, C. W. A. (1996). Marital status and mortality: The role of health. *Demography*, *33*, 313 – 327.

Lillard, L. A., & Waite, L. J. (1995). Til death do us part: Marital disruption and mortality. *American Journal of Sociology*, *100*, 1131 – 1156.

Lund, R., Holstein, B. E., & Osler, M. (2004). Marital history from age 15 to 40 years and subsequent 10-year mortality: A longitudinal study of Danish males born in 1953. *International Journal of Epidemiology*, *33*, 389 – 397.

Lynch, J., & Smith, G. D. (2005). A life course approach to chronic disease epidemiology. *Annual Review of Public Health*, *26*, 1 – 35.

Marks, N., & Lambert, J. (1998). Marital status continuity and change among young and midlife adults: Longitudinal effects on psychological well-being. *Journal of Family Issues*, *19*, 652 – 687.

Mastekaasa, A. (1994). The subjective well-being of the previously married: The importance of unmarried cohabitation and time since widowhood or divorce. *Social Forces*, *73*, 665 – 692.

Morgan, M. (1980). Marital status, health, illness and service use. *Social Science & Medicine*, *14A*, 633 – 643.

Murray, C., & Chen, L. D. (1992). Understanding morbidity change. *Population and Development Review*, *18*, 481 – 503.

Murray, J. E. (2000). Marital protection and marital selection: Evidence from a historical-prospective sample of American men. *Demography*, *37*, 511 – 521.

National Center for Health Statistics. (2004). *Preventing heart disease and stroke*. Retrieved October 1, 2004, fromhttp://www.cdc.gov/nccdphp/bb_heartdisease/index.htm

Peterson, R. R. (1996). A re-evaluation of the economic consequences of divorce. *American Sociological Review*, *61*, 528 – 536.

Pienta, A., Hayward, M. D., & Jenkins, K. R. (2000). Health consequences of marriage for the retirement years. *Journal of Family Issues*, *21*, 559 – 586.

Rosenfeld, L. E. (1992). Women and heart disease. In B. L. Zaret, L. S. Cohen, & M. Moser (Eds.), *The Yale University school of medicine heart book* (pp. 237 – 246). New York: Hearst Books.

Ross, C. E., Mirowsky, J., & Goldsteen, K. (1990). The impact of the family on health: The decade in review. *Journal of Marriage and the Family*, *52*, 1059 – 1978.

Stansfeld, S. A., Fuhrer, R., Shipley, M. J., & Marmot, M. G. (2002). Psychological distress as a risk factor for coronary heart disease in the Whitehall II Study. *International Journal of Epidemiology*, *31*, 248 – 255.

Trovato, F., & Lauris, G. (1989). Marital status and mortality in Canada: 1951-1981. *Journal of Marriage and the Family*, *51*, 907 – 922.

Tucker, J. S., Friedman, H. S., Wingard, D. L., & Schwartz, J. E. (1996). Marital history at midlife as a predictor of longevity: Alternative explanations to the protective effects of marriage. *Health Psychology*, *15*, 94 – 101.

Umberson, D. (1992). Gender, marital status, and the social control of health behavior. *Social Science and Medicine*, *34*, 907 – 917.

Waite, L. J. (1995). Does marriage matter?*Demography*, *32*, 483 – 507.

Waite, L. J., & Gallagher, M. (2000). *The case for marriage: Why married people are happier, healthier, and better off financially*. New York: Doubleday.

White, L. K. (1979). Sex differentials in the effect of remarriage on global happiness. *Journal of Marriage and the Family*, *41*, 869 – 876.

Williams, K., & Umberson, D. (2000). Women, stress, and health. In M. B. Goldman & M. C. Hatch (Eds.), *Women and health* (pp. 553 – 562). San Diego, CA: Academic Press.

Williams, K., & Umberson, D. (2004). Marital status, Marital transitions, and health: A gendered life course perspective. *Journal of Health and Social Behavior*, *45*, 81 – 98.