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Mending Broken Hearts: Marriage and Survival Following Cardiac Surgery

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Abstract

Marriage has long been linked to lower risk for adult mortality in population and clinical studies. In a regional sample of patients (*n* = 569) undergoing cardiac surgery, we compared 5-year hazards of mortality for married persons with those of widowed, separated or divorced, and never married persons using data from medical records and psychosocial interviews. After adjusting for demographics and pre- and postsurgical health, unmarried persons had 1.90 times the hazard of mortality of married persons; the disaggregated widowed, never married, and divorced or separated groups had similar hazards, as did men and women. The adjusted hazard for immediate postsurgical mortality was 3.33; the adjusted hazard for long-term mortality was 1.71, and this was mediated by married persons' lower smoking rates. The findings underscore the role of spouses (both male and female) in caregiving during health crises and the social control of health behaviors.

Keywords

CABG, coronary artery bypass surgery, gender, marriage, mortality, survival

In 1977, Croog and Levine published *The Heart Patient Recovers*, reporting on a longitudinal study of 345 men in Boston and Worcester, Massachusetts, who had suffered first heart attacks. The motivation for their study was the 1.3 million heart attacks suffered each year by Americans, mostly men; they examined the impact of the events on several areas of social life, including work, finances, religion, and especially patients' marriages and families. In 1970, the death rate for heart diseases was 492.7 per 100,000. By 2009, that figure had been reduced to 195.0 per 100,000 (Kochanek et al. 2011:5), but heart disease remains the leading cause of death in the United States. In 2007 alone, nearly 7 million cardiovascular surgeries (including coronary artery bypass grafting [CABG] and valve procedures) were performed in the United States (Hall et al. 2010:16). The crisis of heart disease–related hospitalization is still an extremely common event facing American men and, increasingly, American women. The role of family and, especially, spousal support is as critical to examine today as it was when Croog and Levine did so.

BACKGROUND

One of the most well-studied and consistent findings in social science has been the association of marriage with greater survival. In the nineteenth

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century, William Farr (1858) observed that marriage protected against early mortality in France. With modern analytic techniques applied to archival historical data, contemporary analysts have shown higher risks of mortality for the widowed, never married, and divorced as robust as those reported by Farr (Murray 2000). This is notable given the considerable change over time in the predominant causes of death, which were primarily acute infectious diseases in the nineteenth and early twentieth centuries and are largely chronic disease-related today.

Population-Based Studies

A recent meta-analysis by Manzoli et al. (2007) reviewed 40 studies examining marital status and mortality among 256,243 older persons in the United States, Europe, East Asia and South Asia, Israel, and Australia. The overall relative risk for all-cause mortality for married elderly persons compared with unmarried counterparts was 0.88 (95 percent confidence interval [CI] = 0.85 to 0.91), or about 12 percent lower; relative risks for men and women were quite similar, and all subjects of unmarried statuses were at higher risk than the married. Younger populations have shown similar findings; in a large Finnish study of persons aged 30 to 64 years, the authors estimated that about 15 percent of deaths for those aged 30 and older would not have occurred if the unmarried had had the same age-specific death rates as the married (Martikainen et al. 2005). Similar findings emerged in the National Longitudinal Mortality Study (Johnson et al. 2000) and seven European countries (Murphy, Grundy, and Kalogirou 2007). Thus, the evidence from population-based studies is strong and consistent: Marriage is protective against all-cause mortality in adults of all ages.

Studies of cause-specific mortality by marital status began with Durkheim ([1897] 1951), who found higher rates of suicide among the widowed, particularly men. Gove (1973) grouped causes of death and found marital status to be more strongly associated with (a) deaths from external (non-disease-related) causes such as suicide, (b) causes such as cirrhosis of the liver for which there were known behavioral risks, and (c) deaths from chronic diseases such as diabetes, for which extended periods of care were necessary, than it was with (d) causes of death without social factors involved in their etiologies or extended need for care. Data from large U.S. and European studies (Johnson et al. 2000; Malyutina et al. 2004; Rogers 1995; Rutledge et al. 2003) show quite similarly that marriage protects most strongly from external causes of death, particularly suicide, but that married men, and to a lesser extent married women, also show lower relative risks of cardiovascular and other behaviorally related and care-requiring deaths than the unmarried.

Patient Samples

In comparison with data from populations, there are fewer studies of the impact of marital status on mortality in clinical samples. Yet this group is critically important if marriage is thought to provide protection for individuals in health crises or for those needing high levels of care. One might argue that population-based studies convey the primary prevention effect of marriage among mostly healthy baseline population and that studies of patients provide the opportunity to examine potential secondary or tertiary preventive effects, once disease processes are already under way.

One group of patient-based studies examined the impact of marital status on outcomes for patients beginning from the point of diagnosis. Goodwin et al. (1987), using data from tumor registry files for more than 25,000 cases of newly diagnosed cancers in New Mexico, found that unmarried persons were more likely than married persons to be diagnosed after their cancer had already spread. Furthermore, after adjusting for stage of the cancer, unmarried persons were less likely to be treated, and after adjusting for stage and treatment, unmarried persons were less likely to survive. A second large study, in Norway, found that the divorced or separated, widowed, and never married persons had significantly higher mortality than married persons for combined types of cancer, even after stage of diagnosis and treatment had been controlled (Kravdal 2001). Two additional studies found more mixed but generally similar results: Married patients received more aggressive lung cancer treatment than unmarried (Greenberg et al. 1988); and widowed (but not never married or divorced) persons were diagnosed at a later stage and, subsequently, had significantly poorer survival with melanoma (Ortiz et al. 2007).

Two more patient-based studies more closely approximate our own, in that they began at hospitalization rather than initial diagnosis. In a large sample of admissions at a midwestern medical center, Gordon and Rosenthal (1995) found differences between the unmarried and married for several endpoints: Unmarried patients were more severely ill at admission, more likely to be discharged to a nursing home, and more likely to die in the hospital following surgery. Liu and Sullivan (2003) followed 646 elderly Veterans Administration patients prospectively for 1 year after discharge; after adjustments for demographic factors and health status, unmarried persons were twice as likely to die during the follow-up period as married persons. Thus, even as the focus narrows to the role of marriage in serious illness requiring hospitalization, the protective effect of marriage appears to remain robust.

The Social Force of Selection

The association of marriage with survival may reflect processes of selection, or causation, or both (Lillard and Panis 2003; Waite and Gallagher 2000). This is no less true of patient-based studies than population-based studies, for which the issue is more often raised. Healthier men and women may be more likely to marry and consequently less likely to be hospitalized or diagnosed with heart disease and therefore would be selected out of patient-based studies. Moreover, if married persons are present in such samples, they may have been diagnosed at an earlier stage and therefore have less severe disease at baseline (Goodwin et al. 1987; Gordon and Rosenthal 1995), and earlier intervention may underlie more favorable outcomes. Additionally, men and women with higher levels of education and income may be disproportionately selected into marriage; these initial resource advantages are then augmented by economic advantages of marriage, which could include the greater likelihood of having health insurance and access to better care that permits earlier diagnosis (Rogers 1995). Evaluating the role of health status and socioeconomic advantage at baseline to some extent addresses the issue of selection, but it does not untangle selection and causation processes that would already have occurred prior to hospitalization. Thus, selection should be addressed as much as possible before causation is considered, but the interwoven nature of selection and causation continues through surgery and into the postoperative period.

The Social Force of Causation

Durkheim ([1897] 1951:202) first theorized that marriage protected against suicide because it brought men and women into families, and the larger and more "strongly constituted" the families, the more protective they were; this is the force of social integration that protected against egoistic suicide. Marriage was protective against anomic suicide as well because it "regulates the life of passion": controlling behavior and subjecting men to a state of "salutary discipline" (Durkheim [1897] 1951:270). In more recent research, marriage is associated with a greater quantity of life, and in addition, a higher quality of life, as measured by the better mental health of both husbands and wives (Horwitz, White, and Howell-White 1996; Simon 2002) and their higher levels of happiness (Waite and Gallagher 2000).

The twin forces of social control and social support underlie the general importance of social ties in health (House, Landis, and Umberson 1988), but they are especially exemplified by the marriage relationship, in which the other's health is of considerable salience to both partners (Waite and Lehrer 2003). Married persons may fare better than unmarried persons during acute health crises because they receive more visits and social support while hospitalized (Kulik and Mahler 1989). These higher levels of social support, in turn, may lead to better psychological resources for the patient. Compared with married persons, unmarried persons may be less optimistic generally (Scheier et al. 1999) or have fewer positive expectations for postsurgical recovery (Flood et al. 1993). There is a strong link between depression and outcomes following myocardial infarction and CABG surgery (Contrada et al. 2008; Frasure-Smith, Lespérance, and Talajic 1993; Goyal et al. 2005), and these studies often show that married persons are less depressed than the unmarried (Frasure-Smith et al. 1993).

Although we might think of these studies as relevant primarily to the supportive, integrating functions of social ties, particularly in the context of health crises, they also suggest the exposure to opportunities for spousal monitoring and the social regulation of behaviors and emotions. Research has documented the influence of spousal control on everyday health behaviors (Umberson 1992), and the health crisis situation may be just a high-stakes instance of such influence. A crisis such as cardiac surgery may bring new life-or-death importance to previously tolerated health risk behaviors such as smoking or overeating and give new force to attempts to exert control over the spouse's behavior. The regulation of emotions may also be critically important in health crises: Higher hostility levels among the unmarried may contribute to poorer outcomes, particularly for coronary disease (Miller et al. 1996).

Cognitive and instrumental marital support may be even more critical in health crises than emotional support. Iwashyna and Christakis (2003) found that, in newly diagnosed, seriously ill spouses, the husband or wife played a crucial role as decision maker, with the result that married patients consistently entered higher quality hospitals and had shorter lengths of stay. Married persons have higher odds of receiving earlier, more, and better care (Goodwin et al. 1987; Greenberg et al. 1988) and higher rates of discharge to home rather than nursing home (Gordon and Rosenthal 1995). After discharge, married persons may adhere more closely to recommended treatments because of the availability of someone to consult with and be reminded by (DiMatteo 2004).

Thus, we might see the crisis of cardiac surgery as a revealing moment when the social, emotional, and cognitive support resources of marriage are tested. We chose cardiac surgery to study because it is simultaneously quite common and very serious. The large numbers of patients undergoing such surgeries each year provided us with sufficient numbers of patients with similar diagnoses, risk factors, and treatment requirements as well as a common set of relevant, well-measured biomedical indicators. This is an excellent array of well-controlled conditions for testing the effects of psychosocial factors in health.

Potential Mediating Factors

In keeping with virtually all research on the effect of marriage on survival, we expect cardiac patients to show greater risk for mortality if they are unmarried than if they are married. We expect that some of that association will be reduced by the potential confounding effects of age, education, and pre- and postsurgical health.

We then examine health behaviors as a mechanism by which marriage affects the outcome of surgery, on the basis of the potential role of social control. If husbands and wives (compared with unmarried counterparts) have lower smoking rates and/or lower body mass index (BMI), and if by introducing those factors we see a reduced benefit of being married, it will suggest that the effect of marriage is at least partially explained by higher levels of spousal social control over health risk behaviors.

Next, we examine the potential role of social integration as a mechanism by which marriage affects the outcome of surgery by introducing social support, social strain, affect, and recovery expectancies as mediators of the association. If husbands and wives (compared with unmarried men and women) have greater social support, less social strain, greater generalized optimism, less depression, and/or more positive expectancies for the experience and outcome of surgery, and if by introducing those factors we see a reduced benefit of being married, it will suggest some specific ways in which effects of marriage may be explained by higher levels of social integration. There are a large number of potential pathways through which the social and psychological resources of married patients could contribute to better outcomes; the marriage relationship is singularly important in bringing so many types of resources to bear on a life-and-death situation.

Potential Moderating Conditions

The population-based studies have found generally similar protective effects of marriage for both men and women. Patient-based studies, however, are fewer, and some have been done with men only (Liu and Sullivan 2003; Wiklund et al. 1988). Kiecolt-Glaser and Newton (2001) argued that marriage benefits men more than women because women perform health functions for the family—including providing personal care, monitoring health states, coordinating professional care, and in general controlling the health of others—presumably to their husbands' benefit. Thus, gender differences in the benefits of marriage in the more narrow circumstances of health crises, in which women's traditional roles may be more salient, will be explored, but on the basis of existing studies, we expect no differences by gender in the effect of marriage on mortality.

A second area for the potential moderating influence of marital status is in the timing of death following hospitalization. The benefit of marriage may be especially strong in the immediate crisis period; Gordon and Rosenthal (1995) studied only the inpatient period, finding significant benefits for the married, both in terms of survival and length of stay. However, spousal caregiving responsibilities (relative to those of medical professionals) should become greater in the longer term recovery period.

Liu and Sullivan (2003) began their follow-up period at discharge, excluding in-hospital deaths; they still found a higher hazard for the married. Eventually, the risks for mortality in patient samples should return to levels similar to those for population-based samples. Potential differences in the impact of marriage over the entire period of the health crisis can be explored only by including both in-hospital and postdischarge deaths. Given the available short- and long-term evidence, we expect to see a somewhat stronger protective effect of marriage in the acute period following surgery, but overall we expect significant protective effects both in the long term and short term.

In the present study we seek to extend research on marriage and health by examining differences by marital status in survival following cardiac surgery. The analysis provides a unique opportunity to understand the mechanisms by which marriage may affect outcomes following serious health events because it contains detailed medical records for surgery and hospitalization as well as extensive patient interview data on psychosocial states prior to surgery; it also includes both men and women, follows patients beginning from surgery for up to 5 years, and uses survival methods.

Research Hypotheses

The research hypotheses in this study are as follows:

Main effect hypothesis: Married persons will have lower risk for mortality following cardiac surgery compared with widowed, divorced or separated, or never married persons, and this will persist when demographics and pre- and postsurgical health status are adjusted.

Health behavior mediation hypothesis: Introducing health-related behaviors will reduce the hazard of being unmarried, because married persons will be less likely to smoke or be overweight.

Social support mediation hypothesis: Introducing the number of social network roles, perceived social support, and reported social strain will reduce the hazard of being unmarried, because married persons will have overall greater social support.

Affective factors mediation hypothesis: Introducing presurgical affective factors, including optimism, trait anger, hopelessness, anxiety, and depressive symptoms, will reduce the hazard of being unmarried, because married persons will have higher positive and lower negative affect.

Social cognitive factors mediation hypothesis: Introducing social cognitive constructs, including positive reinterpretation, coping by meaning making, and positive expectations in three separate domains (surgical preparation, managing distress, and surgical outcome), will reduce the hazard of being unmarried, because married persons will have a more positive outlook.

Gender (null) hypothesis: The protective effect of marriage will not differ for men and women.

Buffering hypothesis: The protective effect of marriage will be greater during the crisis period of hospitalization and recovery than it is later in the follow-up period.

DATA AND METHODS

Sample

Respondents were 576 participants in a study of open-heart surgery who underwent CABG and/or heart valve replacement or repair between October 2000 and October 2003. The study was conducted at a major medical center, with a large staff of cardiothoracic surgeons and a high volume of surgery, in an ethnically diverse area in the northeastern United States. Elective patients were recruited at the time of preadmission testing, when staff and interview rooms were available. Urgent and emergent patients were recruited following hospital admission if their health permitted and nursing staff members were available to interview them bedside. Patients were considered eligible and approached for participation if they spoke English and were alert and capable of participating. Of 1,078 patients approached, 677 (63 percent) agreed to participate. However, for 101 of those who agreed, presurgical interviews could not be arranged because of research staff member and patient scheduling constraints, resulting in a final sample of 576 patients (53 percent of those approached). The study was approved by the institutional review boards of Rutgers University and the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School. Interviewers were psychology graduate students and registered nurses.

Study Design

This research was part of a prospective survey interview and records-based study of biomedical and quality-of-life outcomes in heart surgery; findings for other outcomes (Contrada et al. 2004, 2008) have been published previously. Participants underwent initial interviews an average of 5.0 days prior to surgery. Biomedical data, including preoperative, intraoperative, and postoperative treatments, procedures, and test results, were obtained both manually and electronically from hospital medical charts by medical student research assistants; two coders independently extracted data and a third resolved discrepancies.

Measures

Sociodemographic characteristics. Data on age (years), gender (female), race (non-white), and education (years) were collected by interview. Marital status was also ascertained during the interview (currently married, never married, separated or divorced, widowed); for most analyses we aggregate all unmarried statuses.

Self-reported physical health. Physical functioning was measured using a four-item scale from the Medical Outcomes Study Patient Questionnaire (Stewart and Ware 1992), including limitations in climbing stairs; bending, kneeling, or stooping; walking one block; and bathing and dressing.

Biomedical risk factors. A biomedical risk factor index was created from medical charts, indicating the presence or absence of 19 presurgical conditions and treatments following standardized definitions of the Society for Thoracic Surgery (Peterson et al. 2002). Scores ranged from 0 to 10. Further details may be found in Contrada et al. (2008); the present study dropped smoking history from the index so it could be examined separately. Angina (chest pain, scored 0 to 2) and dyspnea (shortness of breath, scored 0 to 4) were measured using the Rose Questionnaire (Rose and Blackburn 1986). Other biomedical variables coded from hospital charts and treated separately from the biomedical index score included ejection fraction (proportion of blood pumped with each heart beat; scores ranged from 15 percent to 93 percent) and the number of arteries with significant blockage (zero to three).

Surgical measures. Postoperative complications (most common were atrial fibrillation, prolonged ventilation, and renal failure; range = 0 to 9) and hospital length of stay (range = 1 to 155 days) were abstracted from medical charts. Both variables were log transformed because of skewed distributions.

Behavioral risk factors. Smoking history (0 or 1) and BMI (range = 15.2 to 49.6 kg/m^2) were abstracted from medical charts.

Social support constructs. Social network roles were assessed with the Social Network Index (Cohen et al. 1997) (marriage, usually included in this index, was excluded and examined separately). Perceived social support was measured using 9 items from the 12-item Multidimensional Scale of Perceived Social Support (Contrada et al. 2008; Zimet et al. 1988). Social strain was assessed with 3 items that asked respondents to rate on 5-point scales the degree to which their friends and relatives were demanding, critical, or intrusive.

Affective constructs. Dispositional optimism was assessed using the Life Orientation Test–Revised (Scheier, Carver, and Bridges 1994), a 6-item measure of generalized expectancies for positive outcomes. Trait anger was assessed using a 7-item subscale of the Buss-Perry Aggression Questionnaire (Buss and Perry 1992). Hopelessness was measured using a 3-item scale developed from a 2-item measure previously linked to mortality (Everson et al. 1996). Anxiety experienced over the past month was measured using a 4-item subscale of the Medical Outcomes Study Patient Questionnaire (Stewart and Ware 1992). Depressive symptoms were assessed with the 20-item Center for Epidemiologic Studies Depression Scale (Radloff and Teri 1986).

Social cognitive constructs. Constructs based on the concepts of self-efficacy, coping, and outcome expectancies were assessed using items written originally for this study. Some focus on the present (time of presurgery interview) and some on the near future (immediately before and after surgery).

Positive reinterpretation was measured using three statements, including "I have been trying to focus on the benefits of undergoing heart surgery." Coping by finding meaning was assessed using three statements, including "I have spent time trying to understand why this is happening to me." Positive expectation for preparation for surgery was assessed using four statements, including "Beginning on the night before and leading up to surgery, there is a lot that you are going to have to do. Overall, how much difficulty do you think you will have scrubbing with the special disinfecting soap in preparation for surgery, as instructed?" Positive expectation for managing distress was assessed using three statements, including "I think I will be able to manage my worries about surgery." Positive expectation for the outcome of surgery was measured using four statements, including "I expect a speedy recovery from surgery."

Mortality. Information regarding date and cause of all deaths occurring through 2006 was obtained from the National Death Index. Deaths totaled 111 for the full follow-up period; 24 occurred in the first 3 months.

Analysis

We examined survival and hazard curves for each category of marital status using the life-table method, with event times measured in days but expressed in months. To assess proportionality of hazard, we used Wilcoxon's and log-rank tests for equality over strata of marital status. For multivariate tests, we used Cox regression models to estimate the hazard of mortality (Allison 1995) and effects of potential mediators and moderators of that association (Baron and Kenny 1986). We tested both aggregated (unmarried vs. married) and disaggregated (never married, separated or divorced, and widowed vs. married) specifications. Finally, we examined differences between short- and long-term mortality. On the basis of visual evidence in Figure 1, and the clinical significance of the 3-month point in recovery, we divided the follow-up period into 0 to 3 months (24 deaths; n = 565) by right-censoring all observations at 3 months, and more than 3 months (87 deaths; n = 545) by excluding deaths that occurred earlier.

RESULTS

Descriptive statistics for the sample are shown in Table 1. Missing data on marital status reduced the effective sample size to 569. The sample is 27.1 percent female and 12.1 percent non-white; men were more likely to be non-white than women. Both men and women had average levels of education beyond high school. Ages ranged from 28 to 89 years (M = 65.3 years), with men averaging 4.5 years younger than women. Women were less likely to be married at the time of surgery; 51.3 percent of women were married, compared with 79.4 percent of men. Women were 4 times as likely as men to be widowed (32.5 percent vs. 8.2 percent). This is largely comparable to the 2000 U.S. population, in which 87.2 percent of those aged 55 years and older were white (U.S. Census Bureau 2011), 80.4 percent had at least a high school education (U.S. Census Bureau 2010), and 79.6 percent of men and 56.0 percent of women aged 65 to 74 years were married (U.S. Census Bureau 2000).

Women had mixed indicators of presurgical health, including higher cardiac risk factor index and dyspnea scores and a similar level of angina compared with men, but higher (better) ejection fractions and smaller numbers of diseased vessels. Postsurgically, they did less well, with more complications and longer hospital lengths of stay. Overall, 80.1 percent of the sample underwent CABG and 27.9 percent had valve procedures (some had both, and 2.1 percent had additional procedures); women were less likely to have CABG and more likely to have valve procedures. Contrada et al. (2008) provided a detailed comparison of biomedical characteristics of this sample with two large multisite studies (Mathew et al. 2004; Shroyer et al. 2003) and found them to be quite similar.

Women had less history of smoking, 56.3 percent, compared with 71.7 percent of men. Men and women both had mean BMI scores in the overweight range, at 28.4 and 29.8 kg/m^2, respectively.

Table 1. Descriptive Statistics for Full Sample, Men, and Women

	All			Men			Women		
Variable (range)	%	*M*	*SD*	%	*M*	*SD*	%	*M*	*SD*
Married	71.8			79.4			51.3		
Never married	5.5			5.1			6.5		
Separated or divorced	7.9			7.3			9.7		
Widowed	14.8			8.2			32.5		
Age (28-89 years)		65.3	11.6		64.1	11.2		68.6	11.8
Gender (female)	27.1			72.9			27.1		
Non-white	12.1			14.0			7.1		
Education years (8-22)		13.4	3.0		13.8	3.1		12.5	2.5
SF-36 physical function (1 = "not limited" to 3 = "limited a lot")		1.6	.5		1.5	.5		1.8	.6
Cardiac risk factor index (0-10)		3.7	1.9		3.6	1.9		4.1	1.8
Angina (0-2)		.5	.7		.5	.7		.4	.7
Dyspnea (0-4)		1.5	1.5		1.3	1.4		2.0	1.5
Ejection fraction (15%-93%)		48.8	12.4		47.5	12.4		52.1	11.9
Number of diseased vessels (0-3)		2.0	1.1		2.2	1.0		1.6	1.2
Postoperative complications (0-9)		.7	1.3		.7	1.2		1.0	1.5
Length of stay (1-155 days)		8.6	10.2		8.1	9.7		10.2	11.2
Smoking history	67.5			71.7			56.3		
BMI (15.2-49.6 kg/m^2)		28.8	5.4		28.4	4.9		29.8	6.4
Social network roles (0-11)		5.4	1.8		5.4	1.8		5.1	1.8
Social support (1-7) (α = .87)		6.0	.9		6.0	.9		6.1	.8
Social strain (1-5) (α = .76)		1.9	.8		2.0	.8		1.9	.9
Optimism (1-5) (α = .76)		3.7	.7		3.7	.7		3.6	.7
Trait anger (1-5) (α = .84)		2.3	.9		2.4	.9		2.2	.9
Hopelessness (1-5) (α = .74)		2.1	.9		2.1	.9		2.2	.9
Anxiety (1-5) (α = .86)		2.5	1.0		2.4	1.0		2.9	1.1
CES-D (0-48) (α = .89)		11.2	9.0		9.8	8.2		14.9	9.9
Positive reinterpretation (1-5) (α = .78)		4.1	.8		4.1	.8		4.1	.8
Coping by meaning making (1-5) (α = .73)		2.9	1.1		3.0	1.1		2.9	1.2
Positive expectations: preparation for surgery (0.7-4.0) (α = .52)		1.4	.5		1.3	.4		1.5	.5
Positive expectations: managing distress (1-5) (α = .76)		4.3	.7		4.3	.6		4.2	.7
Positive expectations: surgical outcome (2-5) (α = .78)		4.4	.6		4.4	.6		4.3	.6
% deaths from all causes, full follow-up	19.5			18.1			23.4		
Number of deaths, full follow-up		111			75			36	
Number of deaths, 0- to 3-month follow-up		24			14			10	
Number of deaths, ≥3-month follow-up		87			61			26	
n		569			415			154	

Note: BMI = body mass index; CES-D = Center for Epidemiologic Studies Depression Scale.

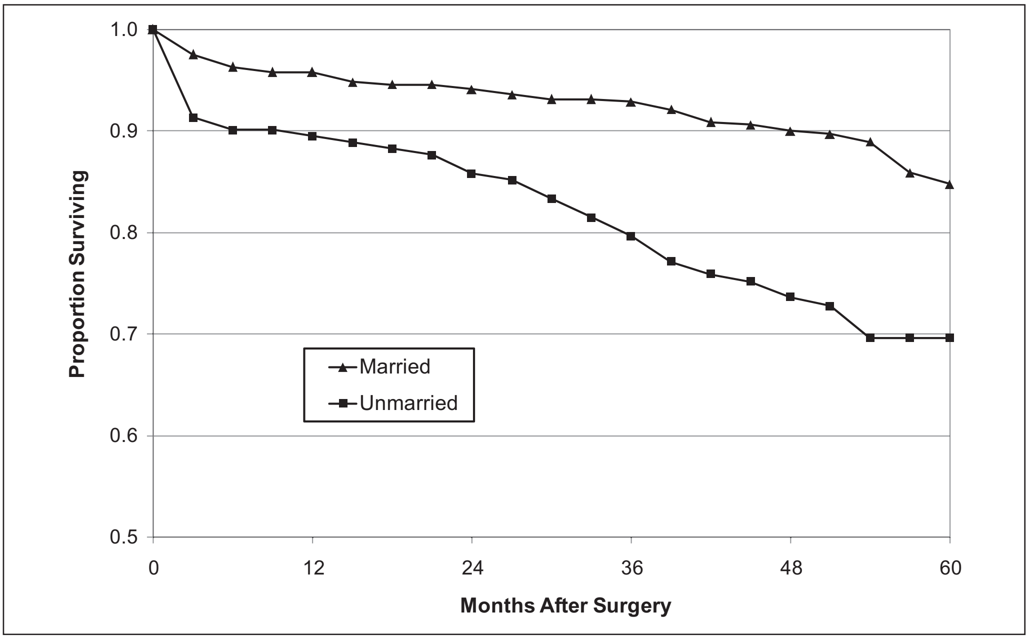

Figure 1. Unadjusted Survival Curves for Married and Unmarried Respondents

Men and women were similar with respect to the social integration measures of social network roles, support, and strain; the affect measures of optimism, anger, hopelessness, and anxiety; and the social cognitive constructs of reinterpretation, coping through meaning making, and positive expectations. The only exception to this pattern was women's higher mean level of depressive symptoms (14.9 vs. 9.8).

Although the unadjusted death rate for women (23.4 percent) was higher than for men (18.1 percent), this difference was not statistically significant. The bivariate association for marital status and mortality, however, was statistically significant: The observed number of deaths for the married was fewer than expected and for the unmarried (particularly widowed) was more than expected (Mantel-Haenszel χ^2 = 18.74, df = 3, p < .0001). This relationship was similar for men (Mantel-Haenszel χ^2 = 8.73, df = 3, p = .0031) and women (Mantel-Haenszel χ^2 = 7.39, df = 3, p = .0066). The percentage of married men who survived was 84.4 percent, almost identical to the percentage of married women, 84.8 percent. Of the 111 deaths, 53.2 percent were due to cardiovascular causes (International Classification of Diseases Codes 390 to 448).

Figure 1 displays the unadjusted survival curves for the married and grouped unmarried statuses. The increased mortality among unmarried participants is especially marked during the first three months and less dramatic during the remainder of the follow-up period.

The unadjusted hazard for the unmarried was 2.22 (95 percent CI = 1.53 to 3.24); unmarried patients were 122 percent more likely to die following their surgery than those who were married. We tested for proportionality with an interaction term for unmarried by number of days since surgery (Allison 1995); the hazard ratio (HR) was 0.985, meaning that the effect of being unmarried declined over the follow-up period. However, because the 95 percent CI includes 1.0 and p > .08, we retain the assumption of effect proportionality over the follow-up. We also tested an interaction term for gender by marital status and found it was not significant (HR = 0.96, 95 percent CI = 0.41 to 2.28).

We adjusted the bivariate association for age, gender, race/ethnicity, and education. Older persons had a significantly higher hazard of mortality, but hazards did not differ by gender, race/ethnicity, or education. Next we adjusted for presurgical health status. Patients with poorer baseline physical function and higher cardiac risk factor index scores showed significantly higher hazards of mortality. Those with higher ejection fractions had a significantly reduced hazard. The presence of angina and dyspnea and the number of diseased vessels were not related to the hazard of mortality. We then adjusted for postsurgical health status and found that although length of hospital stay was not associated with the hazard of mortality, there was a strong association with postoperative complications. We retained all significant variables from these preliminary analyses, along with gender. This model is shown in column 1 of Table 2. Adjusting for this set of variables reduced the hazard associated with being unmarried from 2.22 to 1.90. Nevertheless, the hazard of mortality for the unmarried remains virtually twice that of the married, even when the effects of pre- and postsurgical differences, some of which could themselves have been influenced by marital status, have been removed.

Next we introduced potential explanatory or mediating variables. In column 2 of Table 2, we test if health risk behaviors increase the hazard of mortality. Smoking history does not, but there is a borderline significant association of higher BMI with survival, and there is also a borderline significant contribution to the model χ^2. The addition of these variables slightly reduces the hazard of being unmarried to 1.73.

In column 3 of Table 2, we test if the number of social roles or the amount of social support or social strain experienced by the patient explains the effect of marital status. None of these measures has a significant association with mortality, and they do not contribute to the model χ^2; the HR for the unmarried is reduced to 1.67 but remains significant.

In column 4 of Table 2, we examine the effect of five affective measures: optimism, trait anger, hopelessness, anxiety, and depressive symptoms. Again, none of these measures has a significant association with the outcome individually, and they do not contribute to the model χ^2. The HR increases to 1.89.

In column 5 of Table 2, we introduce the five newly created measures of patient expectations prior to surgery. One of the measures is significantly associated with the hazard of mortality. Patients who, prior to surgery, held positive expectations about managing their distress (i.e., that they would be able to manage their worries about surgery and cope with pain, discomfort, and the disruption that surgery may cause) showed a significantly lower hazard of mortality. However, the addition of these variables did not result in a significantly higher model χ^2, nor did they show evidence of mediation, because the hazard for the unmarried did not change. Thus, although it may be the case that a stronger sense of positive expectations prior to surgery is associated with better outcomes, this does not explain the effect of marriage in this model.

In additional analyses (not shown), we disaggregated the widowed, separated or divorced, and never married patients. The HRs remained quite similar (never married: HR = 2.00, 95 percent CI = 0.85 to 4.69; separated or divorced: HR = 1.84, 95 percent CI = 0.92 to 3.68; widowed: HR = 1.88, 95 percent CI = 1.16 to 3.04), but because of the smaller numbers, significance levels were reduced.

Finally, we examined short-term deaths (n = 24) separately from long-term deaths (n = 87). Given the prior test for proportionality, we had established that there was a significant main effect of marriage across the follow-up period, but it was possible that mediating effects could differ in the 3-month postoperative period compared with the longer term. The unadjusted hazard of being unmarried for short-term deaths was 3.64 (95 percent CI = 1.62 to 8.20); when adjusted for demographic and health status, it remained significant at 3.33 (95 percent CI = 1.33 to 8.35). Mediation analyses for short-term deaths (not shown but available from the authors) revealed no mediation effects of health behaviors, social support, or affective factors but a marginally significant effect of two social cognitive factors: managing distress and outcome expectancies. The addition of these variables did reduce the HR for the unmarried to nonsignificance, but as a set, they did not contribute significantly to the model χ^2, given the small number of deaths, and thus, although suggestive of a role for cognitive factors as explanatory mechanisms for the effect of marriage on short-term mortality, do not constitute strong evidence of mediation.

Mediation analyses for longer term deaths are shown in Table 3. The unadjusted HR is 1.93 (95 percent CI = 1.25 to 2.97). When adjusted for demographic and health status, it remains

Table 2. Hazard Ratios and 95 Percent Confidence Intervals for All-Cause Mortality Following Cardiac Surgery, Full Follow-Up Period

Variable	Demographic and Health Status Adjusted Model	Health Behaviors Mediation Model	Social Support Mediation Model	Affective Factors Mediation Model	Social Cognitive Factors Mediation Model
Not married (vs. married)	1.90 (1.26-2.85)*	1.73 (1.14-2.64)*	1.67 (1.05-2.66)*	1.89 (1.25-2.87)*	1.90 (1.24-2.91)*
Age	1.68 (1.34-2.11)*	1.64 (1.30-2.05)*	1.72 (1.35-2.18)*	1.70 (1.34-2.14)*	1.68 (1.33-2.11)*
Female	.82 (.52-1.29)	.94 (.59-1.51)	.84 (.53-1.33)	.88 (.55-1.42)	.77 (.48-1.21)
SF-36 physical function	1.41 (.98-2.02)	1.54 (1.07-2.25)*	1.45 (1.01-2.09)*	1.48 (1.01-2.20)*	1.45 (1.01-2.09)*
Cardiac risk factor index	1.18 (1.06-1.32)*	1.14 (1.02-1.27)*	1.16 (1.04-1.30)*	1.17 (1.04-1.30)*	1.19 (1.06-1.33)*
Ejection fraction	.98 (.96-0.99)*	.98 (.96-0.99)*	.97 (.96-0.99)*	.98 (.96-0.99)*	.97 (.96-0.99)*
Postoperative complications	2.42 (1.79-3.27)*	2.43 (1.80-3.28)*	2.51 (1.85-3.42)*	2.51 (1.85-3.41)*	2.52 (1.85-3.42)*
Smoking history		1.53 (0.94-2.49)			
BMI		.96 (.93-1.00)			
Social network roles			.89 (.79-1.02)		
Social support			1.13 (.88-1.44)		
Social strain			1.12 (.88-1.44)		
Optimism				1.16 (.80-1.70)	
Trait anger				1.18 (.94-1.49)	
Hopelessness				1.12 (.85-1.48)	
Anxiety				.91 (.71-1.18)	
CES-D				1.00 (.97-1.03)	
Positive reinterpretation					1.00 (.75-1.34)
Coping by meaning making					.88 (.73-1.08)
Positive expectations: preparation for surgery					.99 (.66-1.49)
Positive expectations: managing distress					.63 (.44-0.89)*
Positive expectations: surgical outcome					1.45 (.95-2.23)
Likelihood ratio χ^2 (*df*)	134.02 (7)*	139.63 (9)*	137.35 (10)*	136.75 (12)*	141.67 (12)*
χ^2 difference (*df*)		5.59 (2), p = .0612	3.60 (3), p = .3085	3.07 (5), p = .6891	8.16 (5), p = .1484
n	569	565	565	565	565

Note: *p < .05 two-tailed test. BMI = body mass index; CES-D = Center for Epidemiologic Studies Depression Scale.

Table 3. Hazard Ratios and 95 Percent Confidence Intervals for All-Cause Mortality 3 or More Months Following Cardiac Surgery

Variable	Demographic and Health Status Adjusted Model	Health Behaviors Mediation Model	Social Support Mediation Model	Affective Factors Mediation Model	Social Cognitive Factors Mediation Model
Not married (vs. married)	1.71 (1.08-2.73)*	1.46 (.90-2.36)	1.43 (.84-2.45)	1.71 (1.06-2.74)*	1.74 (1.07-2.81)*
Age	1.63 (1.27-2.08)*	1.56 (1.21-2.00)*	1.62 (1.25-2.11)*	1.69 (1.30-2.19)*	1.60 (1.25-2.06)*
Female	.78 (.47-1.31)	.95 (.56-1.62)	.80 (.47-1.35)	.81 (.47-1.40)	.74 (.44-1.25)
SF-36 physical function	1.70 (1.14-2.54)*	1.91 (1.26-2.91)*	1.73 (1.15-2.59)*	1.83 (1.19-2.81)*	1.74 (1.67-2.61)*
Cardiac risk factor index	1.15 (1.02-1.31)*	1.11 (.98-1.25)*	1.15 (1.01-1.30)*	1.15 (1.01-1.31)*	1.16 (1.02-1.32)*
Ejection fraction	.97 (.96-0.99)*	.97 (.96-0.99)*	.97 (.95-0.99)*	.97 (.96-0.99)*	.97 (.96-.99)*
Postoperative complications	1.88 (1.31-2.71)*	1.83 (1.27-2.64)*	1.92 (1.33-2.78)*	1.88 (1.31-2.73)*	1.90 (1.31-2.74)*
Smoking history		1.93 (1.09-3.42)*			
BMI		.95 (.90-0.99)*			
Social network roles			.88 (.76-1.02)		
Social support			1.11 (.86-1.44)		
Social strain			1.06 (.81-1.39)		
Optimism				1.03 (.68-1.56)	
Trait anger				1.24 (.96-1.60)	
Hopelessness				.99 (.73-1.35)	
Anxiety				.96 (.71-1.29)	
CES-D				1.00 (.96-1.03)	
Positive reinterpretation					1.11 (.80-1.53)
Coping by meaning-making					.83 (.67-1.03)
Positive expectations: preparation for surgery					.93 (.58-1.50)
Positive expectations: managing distress					.67 (.45-0.99)*
Positive expectations: surgical outcome					1.30 (.80-2.10)
Likelihood ratio χ^2 (*df*)	86.37 (7)*	95.58 (9)*	89.45 (10)*	89.08 (12)*	91.99 (12)*
χ^2 difference (*df*)		8.50 (2), p = .014*	3.11 (3), p = .376	2.81 (5), p = .729	5.80 (5), p = .326
n	545	542	542	542	542

Note: *p < .05 two-tailed test. BMI = body mass index; CES-D = Center for Epidemiologic Studies Depression Scale.

significant at 1.71 (95 percent CI = 1.08 to 2.73). When health risk behaviors are added, they contribute significantly to the model χ^2 (p = .0142), and the effect of being unmarried loses significance (HR = 1.46, 95 percent CI = 0.90 to 2.36). Although both smoking history and lower BMI increased the hazard of mortality, further analysis showed that smoking history alone was responsible for eliminating the association of marriage with long-term mortality. In column 5 of Table 3, there is also a significant effect of positive expectations for managing distress, as there is for the full follow-up in Table 2. However, this effect did not change the hazard of being unmarried, nor did it contribute significantly to the model χ^2. Thus, we find that married persons' advantage of lower smoking rates explains their long-term (but not short-term) survival.

DISCUSSION

Overall, our results showed a strong protective effect of marriage on survival for up to 5 years following cardiac surgery. The hazard of mortality is overall approximately twice as great for unmarried as it is for married patients, male or female, about to undergo cardiac surgery. Unmarried persons were 233 percent more likely to die during the 3-month postoperative period and were 71 percent more likely to die in the following 5 years, compared with married persons.

There was evidence of a mediating pathway specific for deaths that occurred months or years after the hospitalization: the lower likelihood that married persons were smokers. This suggests that spousal social control over smoking behavior produces long-term health benefits, although our data do not permit us to establish the time ordering of smoking history and marriage. Our findings extend the research on the health-protective effects of marriage to a sample of patients in a health crisis, from inpatient, postoperative, and recovery periods to a point long after they shed their cardiac surgery patient identity, finding protective effects of marriage all along the way.

One limitation of the study is its regional location and relatively small size, in comparison with both population-based and administrative data studies. We would note, however, that in Manzoli et al.'s (2007) meta-analysis, the significant association of survival with being married was robust even in smaller studies (a number of which were in fact smaller than ours and equally regional). Most important, our data have the optimal combination of abstracted medical records and detailed self-report data not available in large-sample alternatives.

Two other limitations concern measurement of marital status. First, we did not have data on changes in marital status during the follow-up period. There is research showing increased mortality from cardiovascular and noncardiovascular causes following divorce (Ebrahim et al. 1995) and a large body of research on the "widowhood effect": the increased mortality of bereaved spouses from all causes and from a broad array of specific causes (Elwert and Christakis 2008). However, because postbaseline changes in marital status would represent either increased risk for our married respondents (because of the loss of a spouse) or reduced risk for unmarried respondents (because of a new marriage), the effect on the analysis would likely be to increase rather than decrease the hazards we report.

Second, we did not have data on marital quality. Within the overall more protected married group, some marriages may be more protective than others. Another large body of research documents negative health effects of marital strain and stress (Holt-Lunstad, Birmingham, and Jones 2008; Kiecolt-Glaser and Newton 2001; Orth-Gomér et al. 2000; Umberson et al. 2005). Although we did not ask respondents specifically about their marital relationships—given the proximity to life-threatening surgery, many spouses were present during the interviews, and such questioning would not have been appropriate—we did have measures of social support and social strain, which include spousal support and strain. As we saw, these measures were not related to the outcome independently, nor did they mediate or suppress the association of marital status with mortality. Moreover, given the older age of our respondents, we might argue that the process of selection out of unsatisfactory marriages may have already taken place, and continuing marriages represent relatively stable and supportive relationships. Again, however, we might expect marital strain to be dampening, not inflating, the overall effect of marriage in the study.

Marriage is an intimate and long-lasting relationship, and in those ways, it differs from the more generalized form of social support received from relatives, friends, or caregivers. Physiological pathways were not measured in this study, but the potential effect of a "warm touch" on reducing stress-sensitive biomarkers has shown positive effects in experimental studies (Holt-Lunstad et al. 2008). The mere presence of another person can cause biological changes and a sense of calmness (Kamarck, Manuck, and Jennings 1990). Naturalistically, a "warm touch" between adults is most likely to occur regularly in the context of marriage.

Importantly, the health crisis of surgery may act as a trigger for increasing "warm touches" and, hence, marital quality. Yorgason, Booth, and Johnson (2008) looked at whether health declines or the onset of disability might have an impact on subsequent marital quality; their longitudinal data showed that the onset of disability was accompanied by increases in marital happiness and marital interaction. And beyond the enhanced emotional caregiving elicited by the health crisis, there is the practical, instrumental, physical, and cognitive support given by spouses in the context of what may be a sudden, unexpected emergency accompanied by extreme pain and intense distress that may be far outside the realm of their previous experience. Future research should be focused on the "crisis caregiver" role. Work on spousal caregiving in older populations has largely been limited to the long-term functionally and cognitively impaired. But the role of the spousal caregiver may be just as, or even more, critical in a period of acute crisis, and we have very little research in this area. Future work could profitably take a more micro-social, qualitative approach to examining postsurgical caregiving by spouses. We believe that the crisis-caregiving role of the spouse, in fact, may be to some extent driving the overall protective effect of marriage.

Finally, we return to the issue of gender differences to make two points. First, men's and women's mortality outcomes did not differ initially or after covariates were taken into account. We also found no evidence that the effect of marriage on survival was different for men and women. Although the number of women receiving CABG surgery was growing during the study period, it is still more frequently performed on men. Thus, even though more than a quarter of our sample were women, and the unadjusted death rates for married men and women were nearly identical, we may have lacked sufficient statistical power to detect subtle differences. But although we are concentrating on the absence of differences on the patient side, we might also consider the absence of differences on the caregiver side: What mattered in the study was having a spousal caregiver, and evidently the gender of the spouse did not matter. Second, in the face of this apparent equality of effect, it should be noted that marriage is a resource that is not evenly distributed. Thus, although we find that the association of marriage with better outcomes appears to work in the same way for men and women, it is a disproportionate benefit to men, because nearly 80 percent of men in the sample were married, while barely 50 percent of women were. So marriage is a resource that men have much more of, for numerous reasons, including the powerful combination of lower male life expectancy, the tendency of men to marry younger, and men's higher remarriage rate if they lose a spouse.

And there is additional cause for concern because this unevenly distributed social resource is becoming scarcer, for both men and women. In 1960, 71.1 percent of U.S. men and 67.4 percent of women were married. In 2002, the corresponding figures were 57.4 percent and 54.2 percent (U.S. Census Bureau 2003). Because of a combination of factors, including delays in the age at first marriage, more couples cohabiting instead of marrying, a decrease in the tendency of divorced persons to remarry, and an increase in lifelong singlehood, the proportion married has declined steadily. U.S. postwar baby boomers, now entering their 50s and 60s, have lower rates of marriage than any of the previous twentieth-century cohorts (Hughes and O'Rand 2004) and thus enter the period of greatest risk for heart disease without the level of protection from marriage enjoyed by current cohorts of older persons. Notably, U.S. marriage rates remain considerably higher than European rates. While studying the role of marital caregivers, we should be cognizant that this is a unique resource that is becoming less available in many aging industrialized societies around the world.

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REFERENCES

Allison, Paul D. 1995. *Survival Analysis Using SAS: A Practical Guide*. Cary, NC: SAS Publishing.

Baron, Reuben M. and David A. Kenny. 1986. "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations." *Journal of Personality and Social Psychology* 51:1173-82.

Buss, Arnold H. and Mark Perry. 1992. "The Aggression Questionnaire." *Journal of Personality and Social Psychology* 63:452-59.

Cohen, Sheldon, William J. Doyle, David P. Skoner, Bruce S. Rabin, and Jack M. Gwaltney. 1997. "Social Ties and Susceptibility to the Common Cold." *JAMA* 277:1940-44.

Contrada, Richard J., David A. Boulifard, Eric B. Hekler, Ellen L. Idler, Tanya Spruill, Eric W. Labouvie, and Tyrone J. Krause. 2008. "Psychosocial Factors in Heart Surgery: Pre-Surgical Vulnerability and Post-Surgical Recovery." *Health Psychology* 27:309-19.

Contrada, Richard J., Tanya M. Goyal, Cori Cather, Luba Rafalson, Ellen L. Idler, and Tyrone J. Krause. 2004. "Psychosocial Factors in Outcomes of Health Surgery: The Impact of Religious Involvement and Depressive Symptoms." *Health Psychology* 23:227-38.

Croog, Sydney H. and Sol Levine. 1977. *The Heart Patient Recovers: Social and Psychological Factors.* New York: Human Sciences Press.

DiMatteo, M. Robin. 2004. "Social Support and Patient Adherence to Medical Treatment: A Meta-Analysis." *Health Psychology* 23:207-18.

Durkheim, Emile. [1897] 1951. *Suicide*. Translated by George Simpson. New York: Free Press.

Ebrahim, Shah, Goya Wannamethee, Alison McCallum, Mary Walker, and A. G. Shaper. 1995. "Marital Status, Change in Marital Status, and Mortality in Middle-aged British Men." *American Journal of Epidemiology* 142:834-842.

Elwert, Felix and Nicholas A. Christakis. 2008. "The Effect of Widowhood on Mortality by the Causes of Death of Both Spouses." *American Journal of Public Health* 98:2092-98.

Everson, Susan A., Debbie E. Goldberg, George A. Kaplan, Richard D. Cohen, Egro Pukkala, Jaako Tuomilehto, and Jukka T. Salonen. 1996. "Hopelessness and Risk of Mortality and Myocardial Infarction and Cancer." *Psychosomatic Medicine* 58:113-21.

Farr, William. 1858. "The Influence of Marriage on the Mortality of the French People." *Transactions of the National Association for the Promotion of Social Science* 504:1-24.

Flood, Ann B., Daniel P. Lorence, Jiao Ding, Klim McPherson, and Nicholas A. Black. 1993. "The Role of Expectations in Patients' Reports of Post-Operative Outcomes and Improvement Following Therapy." *Medical Care* 31:1043-56.

Frasure-Smith, Nancy, Francois Lespérance, and Mario Talajic. 1993. "Depression Following Myocardial Infarction." *JAMA* 270:1819-25.

Goodwin, James S., William C. Hunt, Charles R. Key, and Jonathan M. Samet. 1987. "The Effect of Marital Status on Stage, Treatment, and Survival of Cancer Patients." *JAMA* 258:3125-30.

Gordon, Howard S. and Gary E. Rosenthal. 1995. "Impact of Marital Status on Outcomes in Hospitalized Patients." *Archives of Internal Medicine* 155:2465-71.

Gove, William R. 1973. "Sex, Marital Status, and Mortality." *American Journal of Sociology* 79:45-67.

Goyal, Tanya M., Ellen L. Idler, Tyrone J. Krause, and Richard J. Contrada. 2005. "Quality of Life Following Cardiac Surgery: Impact of the Severity and Course of Depressive Symptoms." *Psychosomatic Medicine* 67:759-65.

Greenberg, E. Robert, C. G. Chute, Therese Stukel, John A. Baron, Daniel H. Freeman, J. Yates, and R. Korson. 1988. "Social and Economic Factors in the Choice of Lung Cancer Treatment. A Population-Based Study in Two Rural States." *New England Journal of Medicine* 318:612-17.

Hall, Margaret Jean, Carol DeFrances, Sonja Williams, Aleksandr Golosinskiy, and Alexander Schwartzman. 2010. *National Hospital Discharge Survey: 2007 Summary*. National Health Statistics Reports No. 29. Hyattsville, MD: National Center for Health Statistics.

Holt-Lunstad, Julianne, Wendy Birmingham, and Brandon Q. Jones. 2008. "Is There Something Unique about Marriage? The Relative Impact of Marital Status, Relationship Quality, and Network Social Support on Ambulatory Blood Pressure and Mental Health." *Annals of Behavioral Medicine* 35:239-44.

Horwitz, Allan V., Helene R. White, and Sandra Howell-White. 1996. "Becoming Married and Mental Health: A Longitudinal Analysis of a Cohort of Young Adults." *Journal of Marriage and the Family* 58: 895-907.

House, James S., Karl R. Landis, and Debra Umberson. 1988. "Social Relationships and Health." *Science* 241:540-45.

Hughes, Mary E. and Angela O'Rand. 2004. *The Lives and Times of the Baby Boomers*. New York: Russell Sage Foundation.

Iwashyna, T. J. and Nicholas Christakis. 2003. "Marriage, Widowhood, and Health Care Use." *Social Science and Medicine* 57:2137-47.

Johnson, Norman J., Eric Backlund, Paul D. Sorlie, and Catherine A. Loveless. 2000. "Marital Status and Mortality: The National Longitudinal Mortality Study." *Annals of Epidemiology* 10:224-38.

Kamarck, T. W., S. B. Manuck and J. R. Jennings. 1990. "Social Support Reduces Cardiovascular Reactivity to Psychological Challenge: A Laboratory Model." *Psychosomatic Medicine* 52:42-58.

Kiecolt-Glaser, Janice K. and Tamara L. Newton. 2001. "Marriage and Health: His and Hers." *Psychological Bulletin* 127:471-503.

Kochanek, Kenneth, Jiaquan Xu, Sherry L. Murphy, Arialdi M. Miniño, and Hsiang-Ching Kung. 2011. "Deaths: Preliminary Data for 2009." *National Vital Statistics Reports* 59:1-51.

Kravdal, Øystein. 2001. "The Impact of Marital Status on Cancer Survival." *Social Science and Medicine* 52:357-68.

Kulik, James A. and Heike I. M. Mahler. 1989. "Social Support and Recovery from Surgery." *Health Psychology* 8:221-38.

Lillard, Lee A. and Constantijn W. A. Panis. 1996. "Marital Status and Mortality: The Role of Health." *Demography* 33:313-327.

Liu, Longjian and Dennis H. Sullivan. 2003. "Relationship between Social Demographic Factors and Survival within One Year of Hospital Discharge in a Cohort of Elderly Male Patients." *Journal of Epidemiology* 13:203-10.

Malyutina, Sofia, Martin Bobak, Galina Simonova, Valery Gafarov, Yuri Nikitin, and Michael Marmot. 2004. "Education, Marital Status, and Total and Cardiovascular Mortality in Novosibirsk, Russia: A Prospective Cohort Study." *Annals of Epidemiology* 14:244-49.

Manzoli, Lamberto, Paolo Villari, Giovanni M. Pirone, and Antonio Boccia. 2007. "Marital Status and Mortality in the Elderly: A Systematic Review and Meta-Analysis." *Social Science and Medicine* 64:77-94.

Martikainen, Pekka, Tuija Martelin, Elina Nihtilä, Karoliina Majamaa, and Seppo Koskinen. 2005. "Differences in Mortality by Marital Status in Finland from 1976 to 2000: Analyses of Changes in Marital-Status Distributions, Sociodemographic and Household Composition, and Cause of Death." *Population Studies* 59:99-115.

Mathew, J. P., M. L. Fontes, I. C. Tudor, J. Ramsay, P. Duke, C. D. Mazer et al. 2004. "A Multicenter Risk Index for Atrial Fibrillation after Cardiac Surgery." *Journal of the American Medical Association* 291:1720-1729.

Miller, Todd Q., Timothy W. Smith, Charles W. Turner, Margarita L. Guijarro, and Amanda J. Hallet. 1996. "A Meta-Analytic Review of Research on Hostility and Physical Health." *Psychological Bulletin* 119:322-48.

Murphy, Michael, Emily Grundy, and Stamatis Kalogirou. 2007. "The Increase in Marital Status Differences in Mortality Up to the Oldest Age in Seven European Countries, 1990-99." *Population Studies* 61:287-98.

Murray, John E. 2000. "Marital Protection and Marital Selection: Evidence from a Historical-Prospective Sample of American Men." *Demography* 37:511-21.

Orth-Gomer, Kristina, Sarah P. Wamala, Myriam Horsten, Karin Schenck-Gustafsson, Neil Schneiderman, and Murray A. Mittleman. 2000. "Marital Stress Worsens Prognosis in Women with Coronary Heart Disease." *Journal of the American Medical Association* 284:3008-3014.

Ortiz, Carlos A. R., Jean L. Freeman, Yong-Fang Kuo, and James S. Goodwin. 2007. "The Influence of Marital Status on Stage at Diagnosis and Survival of Older Persons with Melanoma." *Journal of Gerontology: Medical Science* 62A:892-98.

Peterson, E. D., L. P. Coombs, T. B. Ferguson, A. L. Shroyer, E. R. DeLong, F. L. Grover, and F. H. Edwards. 2002. "Hospital Variability in Length of Stay after Coronary Artery Bypass Surgery: Results from the Society of Thoracic Surgeon's National Cardiac Database." *Annals of Thoracic Surgery* 74:464-73.

Radloff, Lenore S. and Linda Teri. 1986. "Use of the Center for Epidemiological Studies-Depression Scale with Older Adults." *Clinical Gerontology* 5:119-36.

Rogers, Richard G. 1995. "Marriage, Sex, and Mortality." *Journal of Marriage and the Family* 57:515-26.

Rose, Geoffrey and Henry Blackburn. 1986. *Cardiovascular Survey Methods*. 2nd ed. Geneva, Switzerland: World Health Organization.

Rutledge, Thomas, Karen Matthews, Li-Yung Lui, Katie L. Stone, and Jane A. Cauley. 2003. "Social Networks and Marital Status Predict Mortality in Older Women: Prospective Evidence from the Study of Osteoporotic Fractures (SOF)." *Psychosomatic Medicine* 65:688-94.

Scheier, Michael F., Charles S. Carver, and Michael W. Bridges. 1994. "Distinguishing Optimism from Neuroticism (and Trait Anxiety, Self-Mastery, and Self-Esteem): A Re-Evaluation of the Life Orientation Test." *Journal of Personality and Social Psychology* 67:1063-78.

Scheier, Michael F., Karen A. Matthews, Jane F. Owens, Richard Schulz, Michael W. Bridges, George J. Magovern, and Charles S. Carver. 1999. "Optimism and Rehospitalization after Coronary Artery Bypass Graft Surgery." *Archives of Internal Medicine* 159:829-35.

Shroyer, Laurie W., Laura P Coombs, Eric D Peterson, Mary C Eiken, Elizabeth R. DeLong, Anita Chen, T. Bruce Ferguson, Jr., Frederick L Grover, and Fred H. Edwards. 2003. "The Society of Thoracic Surgeons: 30-Day Operative Mortality and Morbidity Risk Models." *Annals of Thoracic Surgery* 75:1856-1865.

Simon, Robin W. 2002. "Revisiting the Relationship among Gender, Marital Status, and Mental Health." *American Journal of Sociology* 10:1065-96.

Stewart, Anita L. and John E. Ware. 1992. *Measuring Functioning and Wellbeing: The Medical Outcomes Study Approach*. Durham, NC: Duke University Press.

Umberson, Debra 1992. "Gender, Marital Status, and the Social Control of Health Behavior." *Social Science & Medicine* 34:907-17.

Umberson, Debra, Kristi Williams, Daniel P. Powers, and M. D. Chen. 2005. "As Good As It Gets? A Life Course Perspective on Marital Quality." *Social Forces* 84:493-511.

U.S. Census Bureau. 2000. "55. Marital Status of the Population by Sex and Age." In *Current Population Reports, P20-514*. Retrieved February 14, 2011 (http://www.allcountries.org/uscensus/55_marital_status_of_the_population_by.html).

U.S. Census Bureau. 2003. "Table No. HS-11. Marital Status of the Population by Sex: 1900 to 2002." In *Statistical Abstract of the United States: 2003*. Washington, DC: U.S. Census Bureau.

U.S. Census Bureau. 2010. "State & County QuickFacts." Retrieved February 14, 2011 (http://quickfacts.census.gov/qfd/states/34000.html).

U.S. Census Bureau. 2011. "Table 9. Resident Population by Race, Hispanic Origin, and Age: 2000 and 2009." In *Statistical Abstract of the United States: 2011*. Retrieved February 14, 2011 (http://www.census.gov/compendia/statab/2011/tables/11s0011.pdf).

Waite, Linda and Maggie Gallagher. 2000. *The Case for Marriage: Why Married People are Happier, Healthier, and Better Off Financially*. New York: Doubleday.

Waite, Linda and Evelyn Lehrer. 2003. "The Benefits from Marriage and Religion in the United States: A Comparative Analysis." *Population and Development Review* 29:255-75.

Wiklund, Ingela, Anders Oden, Harald Sanne, Göran Ulvenstam, Claes Wilhelmsson, and Lars Wilhelmsen. 1988. "Prognostic Importance of Somatic and Psychosocial Variables after a First Myocardial Infarction." *American Journal of Epidemiology* 128:786-95.

Yorgason, Jeremy B., Alan Booth, and David Johnson. 2008. "Health, Disability, and Marital Quality: Is the Association Different for Younger versus Older Cohorts?" *Research on Aging* 30:623-48.

Zimet, Gregory D., Nancy W. Dahlem, Sara G. Zimet, and Gordon K. Farley. 1988. "The Multidimensional Scale of Perceived Social Support." *Journal of Personality Assessment* 52:30-41.

Bios

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