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Race, Marital History, and Risks for Stroke in US Older Adults

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Abstract

Stroke is among the leading causes of disability and death in the United States, and racial differences are greater for stroke than for all other major chronic diseases. Considering the equally sizeable racial disparities in marital life and associated risks across adulthood, the current study hypothesizes that black-white differences in marital history play an important role in the large racial inequalities in the incidence of stroke. The major objective are to (i) demonstrate how marital history is associated with the incidence of stroke, (ii) examine how marital factors mediate and/or moderate racial disparities in stroke, and (iii) examine the factors that may explain the associations. Using retrospective and prospective data from the Health and Retirement Study ($n = 23,289$), the results show that non-Hispanic (NH) blacks have significantly higher rates of marital instability, greater numbers of health-risk factors, and substantially higher rates of stroke compared with NH whites. Contrary to the cumulative disadvantage hypothesis, findings from discrete-time-hazard models show that the effects of marital history are more pronounced for NH whites than for NH blacks. Risks for stroke were significantly higher in NH whites who were currently divorced, remarried, and widowed, as well as in those with a history of divorce or widowhood, compared with NH whites who were continuously married. In NH blacks, risks for stroke were elevated only in those who had either never married or had been widowed—with no significant risks attributable to divorce. The potential mechanisms underlying the associations are assessed, and the implications of the findings are discussed.

Introduction

Research over the past century has shown that marital status is an enduring institutional marker of adult health and well-being in the United States (Barrett 2000; Durkheim [1897] 1997; Liu and Umberson 2008; Ross, Mirowsky, and Goldsteen 1990; Waite and Gallagher 2000). It is well documented that adults who are divorced or widowed generally have higher rates of chronic illness (e.g., Dupre and Meadows 2007; Eaker et al. 2007; Zhang and Hayward 2006), disability (e.g., Lee and Carr 2007; Pienta, Hayward, and Jenkins 2000), and mortality (e.g., Brockmann and Klein 2004; Molloy et al. 2009) compared to adults who are married. More recently, life course studies have increasingly identified the role of marital transitions—particularly marital dissolutions—as major sources of strain that are linked to multiple social, emotional, and physiological risks for poor health (Dupre, Beck, and Meadows 2009; Green et al. 2012; Hughes and Waite 2009; Williams and Umberson 2004).

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Despite recent conceptual and empirical advances in the literature, we still know surprisingly little about how marital (in)stability is associated with distinct disease processes over the life course. With few exceptions (c.f., Maselko et al. 2009; Zhang and Hayward 2006), the existing research focuses primarily on marital status and marital histories (also referred to as marital trajectories or biographies) as they relate to general measures of health status—such as number of chronic conditions, self-rated health, and overall mortality. Although richly detailed in marital experiences, these studies lack disease specificity and thus are limited in providing insights into the direct mechanisms at play. Likewise, most studies of defined health outcomes (e.g., diabetes, myocardial infarction) lack specificity with regard to lifetime exposure to social stressors such as marital instability. Therefore, addressing the duality of these shortcomings is a critical step in understanding how social relationships produce adult health disparities.

According to the US Census, more than a third of all adults will divorce by age 50 and upward of a quarter will have married two or more times by the same age (Kreider and Ellis 2011). Although overall rates of divorce have stabilized in recent decades, traditional marital continuity has continued to decrease over time as fewer adults enter marital unions, more adults delay first marriages to later ages, and overall marital longevity (duration) is shortened (Elliot and Simmons 2001; Kreider and Ellis 2011). Moreover, these statistics are significantly bifurcated by race. Compared to non-Hispanic (NH) whites in the United States, NH blacks are much less likely to ever marry and much more likely to be divorced, become widowed at a younger age, and spend overall less time married (Aughinbaugh, Robles, and Sun 2013; Bryant and Wickrama 2005; Kreider and Ellis 2011). Although the greater heterogeneity in marital experiences among US blacks has recently been linked to major risk factors for cardiovascular disease (see Green et al. 2012), the extent to which marital life has a differential impact on health outcomes for whites and blacks remains unclear.

Of the leading causes of adult disability and death in the United States—that is, heart disease, cancer, and stroke—racial differences are greatest for stroke (National Center for Health Statistics [NCHS] 2013). In 2010, US black men and women were nearly twice as likely to have a stroke compared to US white men and women (NCHS 2013); and the risk of dying due to stroke was double for blacks compared to whites (National Stroke Association 2016; NCHS 2013). Strokes often occur at younger ages for blacks than for whites, and their strokes tend to be more severe and disabling than for their white counterparts (National Stroke Association 2016). Previous studies on the factors attributable to racial disparities in stroke are abundant yet inconclusive. The prevailing view is that black–white differences in the prevalence of hypertension and diabetes mellitus are the major contributing factors for racial differences in stroke incidence. However, research consistently shows that the disparities in stroke largely persist despite accounting for racial inequalities in hypertension, diabetes, and many other previously identified risk factors (e.g., Bravata et al. 2005; Gorelick 1998; Kittner et al. 1990).

Currently, racial differences in marital history and stroke are well documented in separate bodies of literature. However, there are several important reasons why the associations among race, marital life, and stroke should be integrated. First, stroke is a widely prevalent

and preventable condition that signals an acute presentation of cardiovascular disease that occurs with the progression of vascular decline at older ages (Go et al. 2014). As with most degenerative diseases, the etiological pathways of stroke are largely attributable to lengthy patterns of acquired risk exposure and life course disadvantages that have accumulated over time. Second, and relatedly, the major social stress accumulated risk factors for stroke that have been previously identified—for example, poor health behaviors, inadequate socioeconomic resources, and coexisting health conditions—are also strongly correlated with marital status (Gallo et al. 2003; McFarland, Hayward, and Brown 2013; Molloy et al. 2009; Ross, Mirowsky, and Goldsteen 1990; Waite 1995). Most notably, studies show that never-married, divorced, and widowed adults generally have fewer resources and social controls to manage pre-existing conditions such as diabetes (e.g., August and Sorkin 2010; Peyrot, McMurry, and Kruger 1999), have higher (or less controlled) blood pressure (e.g., Bell, Thorpe, and LaVeist 2010; Kamon et al. 2008; Trivedi et al. 2008), have less access to healthcare (e.g., Becker 1981; Zuvekas and Taliaferro 2003), and are less equipped to maintain an overall healthy lifestyle (e.g., Di Castelnuovo et al. 2009; Meyler, Stimpson, and Peek 2007). Third, blacks are impacted by social adversity and stroke disproportionately more than any other racial group in the United States (Grusky 2001; National Stroke Association 2016). Despite the apparent intersection of these several factors, it is currently unknown whether and to what extent black–white differences in marital history have implications for the development of stroke in older adults.

This study is the first prospective investigation of the long-term impact of marital instability on risks for stroke in US white and black older adults. Data from a nationally representative sample of middle-aged and older adults (1992 to 2010) was used to address four primary research objectives. First, I demonstrate how marital status and cumulative marital transitions are associated with the incidence of stroke in older adults. Second, I examine whether and to what extent marital history contributes to racial disparities in stroke. Third, I examine how the associations between marital status/transitions and stroke differ in NH whites and NH blacks. Finally, I examine the factors that may explain marital differences in the risks of stroke in NH whites and blacks. The implications of the findings are discussed in the context of life course inequalities in chronic disease and directions for future research.

Background

More than 80 million Americans—approximately one in three adults—currently live with one or more forms of cardiovascular disease (CVD), and more than 7 million hospitalizations occur each year because of CVD-related illnesses (Go et al. 2014; NCHS 2013). Stroke is the fourth leading cause of death in the United States and the number-one cause of adult disability.¹ A stroke occurs when the blood flow to part of the brain is blocked or severely diminished—depriving oxygen and other vital nutrients to brain tissue—causing brain cells to die. According to recent estimates, stroke and stroke-related disabilities cost the United States an estimated \$72 billion total medical costs—which are projected to nearly

¹According to the American Heart Association Statistics Committee and Stroke Statistics Subcommittee, cardiovascular diseases (ICD-9 codes 390–495) include hypertension, peripheral artery disease, heart disease, stroke, and other diseases of the circulatory system (Go et al. 2014).

triple over the next 15 years (Go et al. 2014). These human and societal costs are further staggering when it is estimated that upward of 80 percent of strokes are preventable (National Stroke Association 2016).

Of the leading causes of adult disability and death in the United States, racial differences are shown to be greatest for stroke (Gorelick 1998; NCHS 2013). Compared to whites, strokes generally occur at younger ages and are more severe, disabling, and deadly among blacks (National Stroke Association 2016; NCHS 2013). There is also evidence to suggest that racial differences in stroke are more pronounced in middle adulthood than in later adulthood (Chong and Sacco 2005; Go et al. 2014; National Stroke Association 2016). According to some estimates, middle-aged blacks are two to four times more likely to die from stroke than middle-aged whites (Morgenstern et al. 1997; Wang and Wang 2013).

Dozens of studies have been published on the association between marital status and many forms of cardiovascular disease, including stroke (e.g., Gallo et al. 2003; Luttkik et al. 2006; Molloy et al. 2009). The results of these studies generally show that married adults have significantly lower rates of stroke incidence and survival, whereas those who are divorced or widowed are much more likely to have a stroke (and die sooner from the disease) than those who are married (Boden-Albala et al. 2005; Maselko et al. 2009). For example, a recent large-scale study of middle-aged and older adults showed that risks for stroke were significantly elevated following divorce and widowhood compared with those who were married (Engström et al. 2006). Studies also find that risks for stroke are higher in adults who have never married relative to those who are married (Maselko et al. 2009).

Less documented, however, is whether the effect of marital loss on stroke accumulates over the life course. Although direct evidence is limited, research shows that adults with a history of divorce have higher rates of chronic illness (including stroke) compared with adults who are continuously married over time (Dupre and Meadows 2007; Zhang and Hayward 2006), and those with a history of multiple marital losses incurred monotonically higher risks of disease (Dupre and Meadows 2007; Hughes and Waite 2009). Indeed, Zhang (2006) shows that rates of stroke are especially high in those with two or more past marital dissolutions—regardless of current marital status—relative to those who remained stably married. Studies also demonstrate strong associations between marital losses and many of the leading risk factors for stroke, including smoking, heavy alcohol consumption, and metabolic status (e.g., Green et al. 2012; McFarland, Hayward, and Brown 2013).

Collectively, the evidence is clear that race and marital life have consequences for cardiovascular health and subsequent stroke over the life course. Yet, studies have stopped short of integrating the associations among race, marital history, and rates of stroke in older adults. The following sections (i) discuss two theoretical frameworks for understanding differential stroke risks in white and black adults with a history of marital discontinuity, (ii) describe the major factors thought to explain the associations, and (iii) summarize the central hypotheses proposed for analysis.

Theoretical Background

For the past several decades, the life course perspective and the applications of its central tenets have increasingly shaped the landscape of sociological research on aging and health disparities. Central to this theoretical orientation is an emphasis on individual biographies that reflect long-term patterns of stability and change in social statuses over the life course (Elder 1985; George 1999; Giele and Elder 1998). Perhaps more than any other area of inquiry, research has increasingly demonstrated the importance of past and present marital experiences as they relate to the health and well-being of adults in later life (e.g., Barrett 2000; Brockmann and Klein 2004; Dupre, Beck, and Meadows 2009; Williams and Umberson 2004). These contributions notwithstanding, only a few studies have examined how marital history relates to specific health conditions over the life course (e.g., Maselko et al. 2009; Zhang 2006), and none have investigated whether marital history plays a role in racial differences in adult chronic diseases. Support for one of two major hypotheses is possible and is described below.

Cumulative Disadvantage Theory

To date, much of the research on life course inequalities in health rests upon theoretical variations of cumulative disadvantage (Dupre and Meadows 2007; Ferraro and Shippee 2009; O'Rand and Hamil-Luker 2005; Ross and Wu 1996). Originally termed the Matthew effect (Merton 1968), the principal hypothesis of cumulative disadvantage theory is that socioeconomic disadvantage places individuals in diverging trajectories of achievement or hardship over the life course. Those situated near the top of the social and economic hierarchy will generally add to their resources over time, whereas individuals situated at the bottom of the hierarchy will increasingly face hardship relative to their advantaged counterparts. In terms of health, the theory posits that social disadvantages trigger a proliferation of adversities and acquired risks that result in accelerated rates of disease, disability, and death relative to the more advantaged (see Ferraro and Kelley-Moore 2003; Hayward and Gorman 2004; Kuh and Ben-Shlomo 1997).

It is hypothesized that black–white differences in marital history play a role in the large racial inequalities in stroke. According to one form of cumulative disadvantage theory (see DiPrete and Eirich [2006] for a full discussion of other forms of cumulative disadvantage), the onset of stroke will occur over the life course at a faster rate for those with cumulative exposure to marital instability compared with those without a history of marital dissolution. Whether the cumulative effect of marital life differs by race, however, is not known. Compatible with the cumulative disadvantage perspective, the “double jeopardy” argument suggests that black older adults with a history of marital instability face multiple adversities that may significantly accelerate the onset of stroke relative to white older adults (see Ferraro and Farmer 1996; Kuh and Ben-Shlomo 1997). In this regard, marital loss may trigger or exacerbate material and economic losses that are compounded in black adults who generally face greater socioeconomic adversities than white adults (see Addo and Lichter 2013). Support for this general argument would show that older blacks who are not married or who have a history of marital dissolution(s) will have higher risks for stroke than older whites with comparable marital experiences.

Race Theory

An alternative hypothesis is based on the sizeable literature on race and inequality. Contrary to the cumulative disadvantage argument, it is proposed that exposure to marital life and marital instability will have *less* of an impact on blacks than on whites. Although the literature lacks a unifying theory, the reasons to support this argument are threefold. First, there is evidence to suggest that US blacks are investing later and less in the institution of marriage than US whites. For example, studies show that blacks are much less likely to marry than whites, and among those who wed, are marrying at later ages (Kreider and Ellis 2011). By age 50, upward of 30 percent of black women have never married, compared with less than 10 percent of white women (Kreider and Ellis 2011).

Explanations for the discrepancy are multifactorial and often attributed to the availability and perceived suitability of marriageable black men—because of high rates of incarceration, early onset disease and mortality, and limited socioeconomic and employment prospects (Dixon 2009; Pinderhughes 2002; Sweeney 2002). Moreover, health selection may be an important confounder of the association between marriage and stroke in NH whites and blacks. It can be argued, therefore, that NH blacks spend fewer years married than NH whites and thus may limit the cumulative health benefits afforded from longer periods of the life course spent in the “protective” status of marriage (see Addo and Lichter 2013; Dupre, Beck, and Meadows 2009).

A second factor is that marriage is less central to the norms and structure of black families in this society. A distinctive feature of many black households—particularly those with low socioeconomic status (SES)—is a multigenerational family structure with a system of interdependent kinship and obligation to relatives. (Bryant et al. 2010). With this, the expectations and sources of support are found outside marital relationships, and thus reduce the protective functions of marriage that are often observed in the larger segments of society. Likewise, an intergenerational family structure (i.e., matriarchal) may mitigate the negative consequences of spousal loss among blacks relative to whites. In terms of health and its correlates, this suggests that marital dissolution may result in less emotional distress, fewer financial losses, and less change in social support networks among NH blacks compared with NH whites.

A final factor noted in the literature suggests race differences in the qualitative characteristics of marital relationships. For example, studies show that marriages in the NH black community are less integrative and often more unbalanced in expected gender roles and power dynamics than marriages among NH whites (e.g., Dixon 2009; Pinderhughes 2002). Research also suggests that marital instability is more common in NH blacks than NH whites because of the greater marital discord and conflict that accompany relational inequality, socioeconomic adversity, and structural deprivations (Byant et al. 2010; Liu and Waite 2014; Pinderhughes 2002; Zheng and Thomas 2013). For NH black couples, therefore, marriage may not confer the same qualitative and concordant health benefits as it does among NH white couples. In turn, it can be argued that marital dissolution is more normative and consequently a less socially stressful transition in black adults than white adults (Dixon 2009; Pinderhughes 2002).

Proposed Mechanisms

A body of literature too large to summarize here consistently identifies racial differences in many of the major risk factors for stroke—such as poor health behaviors, inadequate socioeconomic and psychosocial resources, and coexisting health conditions (e.g., Bell, Thorpe, and LaVeist 2010; Gorelick 1998; Pandey and Gorelick 2005; Sacco et al. 2001). Noticeably lacking in the literature is attention to how social stress accumulates over the life course to increase risks of a detrimental yet preventable health event such as stroke. Indeed, the risk factors associated with race have also been linked to marital status and marital instability (see Gallo et al. 2003; McFarland, Hayward, and Brown 2013; Molloy et al. 2009; Ross, Mirowsky, and Goldsteen 1990; Waite 1995).

According to the stress process, acute and/or chronic exposure to social stress (e.g., marital dissolution) is associated with a constellation of mediating risk factors that can lead to severe physiological manifestations such as stroke (Pearlin 2010; Pearlin et al. 1981; Rabkin and Struening 1976; Selye 1955). For example, divorce is a stressful life event that may cascade from losses in income and health insurance (distal mechanisms) to increases in anxiety, depressive symptoms, and poor health behaviors, which in turn may contribute to changes in body mass and blood pressure (proximate mechanisms) (Dupre, Beck, and Meadows 2009; Lantz et al. 2005; Steptoe and Kivimäki 2012). The following paragraphs discuss the major categories of risk factors—from distal to proximate mechanisms—that may be attributable to the associations.

Socioeconomic Factors

Socioeconomic status and its resources are widely recognized as key factors contributing to why married adults generally have better health than unmarried adults. The conventional argument is that marriage provides a shared context of acquired financial and material resources and that marital dissolution severs these socioeconomic bonds (McManus and DiPrete 2001; Wilmoth and Koso 2002). Indeed, studies show that the stably married have more wealth, better occupations, and less unemployment than those with marital disruptions (Addo and Lichter 2013; Smith 1994; Waite 1995). Married couples also have greater access to medical insurance and prescription drug coverage through work or their spouse (Becker 1981; Fletcher 1988; Waite 1995; Zuvekas and Taliaferro 2003).

Psychosocial Factors

The prevailing argument is that marriage confers emotional well-being, social support, family cohesion, coping resources, and a shared sense of problem-solving that are important for preventing, detecting, and treating illness (Brown and Smith 1992; Gerstel, Riessman, and Rosenfield 1985; Ross and Mirowsky 1989). Indeed, studies show that unmarried adults are typically more vulnerable to stress because they are less socially and psychologically equipped to minimize the harmful effects of adversity compared to married adults (Peters and Liefbroer 1997; Ross, Mirowsky, and Goldsteen 1990). However, marriage is not a universal indicator of spousal support and psychological capital (Waite, Luo, and Lewin 2009). An increasing body of work shows that marital stress and poor marital quality can

have detrimental effects on cardiovascular health (Baker et al. 2003; Gallo et al. 2003; Luttik et al. 2006; Trivedi et al. 2008).

Behavioral Factors

Behavioral factors are a related class of mechanisms that are often correlated with psychosocial attributes and psychological disposition. The most frequently cited behaviors are smoking, diet, exercise, and alcohol consumption (Franks, Pienta, and Wray 2002; Pettee et al. 2006; Power, Rodgers, and Hope 1999; Umberson 1992). The effects of most health practices on cardiovascular health are well established and fairly intuitive, but their distributions across marital groups are not always straightforward. For example, studies generally show that marriage promotes social control and obligations to others that encourage a healthy diet, regular medical checkups, moderate alcohol consumption, and the avoidance of smoking (e.g., Husaini et al. 2001; Kamon et al. 2008; Umberson 1992). Indeed, recent research shows that spouses with concordant dispositions toward health regularly motivate each other to maintain healthy lifestyles to avoid premature illness and death (Di Castelnuovo et al. 2009; Meyler, Stimpson, and Peek 2007).

Physiological Factors

The most proximate mechanisms linking marital history to cardiovascular events such as stroke are physiological status and pre-existing conditions. Diabetes, hypertension, hyperlipidemia, and obesity are well-known risk factors for stroke (Go et al. 2014; NCHS 2013), yet they are the least studied pathways as they relate to marital history and health. The general expectation is that marital dissolution is an antecedent of numerous socioeconomic, psychosocial, and behavioral risk factors, which in turn are associated with increased risks for chronic health conditions such as hypertension and excess body mass (see Das 2013). Indeed, research shows that married adults generally have greater resources and more social controls to manage conditions such as diabetes and high blood pressure (Bell, Thorpe, and LaVeist 2010; August and Sorkin 2010; Kamon et al. 2008; Peyrot, McMurry, and Kruger 1999; Trivedi et al. 2008), have greater access to healthcare (Becker 1981; Zuvekas and Taliaferro 2003), and are more equipped to sustain healthy lifestyles (Di Castelnuovo et al. 2009; Meyler, Stimpson, and Peek 2007).

Hypotheses

A life course perspective serves as the overarching framework to understand how past and present exposure to marital instability increases risks for stroke with advancing age. The general expectation is that marital loss is associated with numerous risk factors that are detrimental for preventing (or delaying) stroke in older adults. The first hypothesis draws from the literature on marriage and suggests that current marital status and past marital instability will be associated with the onset of stroke. Existing research suggests that older adults who are not continuously married will have risks for stroke that are significantly higher than older adults with a life course of stable marriage. Therefore, I posit:

Hypothesis 1 (H1): Risks for stroke will be elevated in older adults who (a) are not currently married and (b) have past marital dissolutions.

Next, it is hypothesized that marital experiences contribute to the large racial differences in stroke at older ages. Studies show that black older adults have greater risks for stroke than white older adults. Previous studies also show that US blacks and whites differ in the continuity of marital relationships across adulthood. From a life course standpoint, it is argued that the higher incidence of stroke among older blacks than among older whites can be explained in part by the risks associated with past, current, and cumulative exposure to marital relationships over the life course.

Hypothesis 2 (H2): Current marital status and cumulative marital transitions will mediate the association between race and stroke in older adults.

Whether the effect of marital life on stroke differs by race, however, has not been shown. Based on the literature, two alternative hypotheses are tested. First, according to cumulative disadvantage theory, it is argued that black older adults with a history of marital disruption face additional disadvantages that may significantly increase the incidence of stroke relative to white older adults. According to this argument, marital dissolutions will lead to material and economic adversities that are more consequential for black adults who generally face greater socioeconomic disadvantages than white adults. Therefore:

Hypothesis 3a (H3a): Older blacks with a current or past history of marital instability will have higher risks for stroke than older whites with marital stability.

Conversely, the race literature suggests that overall exposure to marital life will have less of an impact on blacks than on whites. Studies show that the prevalence, perception, and protective function of marriage may be lower in US blacks than in US whites. Furthermore, research suggests that marital instability is more common in blacks compared with whites because of a context of socio-economic adversity that increases marital discord (and conflict) and reinforces an intergenerational family structure (i.e., matriarchal) that is less impacted by spousal loss. Thus, the following hypothesis is tested:

Hypothesis 3b (H3b): Current marital status and cumulative marital transitions will have less of an association with stroke in older blacks than in older whites.

The last set of hypotheses focuses on the potential mechanisms thought to explain the associations. Although no existing studies have examined the pathways among race, marital life, and subsequent stroke, the expectation is that the mechanisms will differ by race. For white older adults, it is argued that divorce and widowhood will be most consequential in terms of the psychological distress and maladaptive behaviors that may result from experiencing marital loss. For black older adults, however, it is predicted that marital instability will operate most directly through the socioeconomic hardships that have been shown to accompany marital instability. Physiological factors are the most proximate mechanisms and are expected to operate similarly in older whites and blacks.

Hypothesis 4a (H4a): Psychosocial and behavioral factors will have the greatest explanatory power for the associations in older whites.

Hypothesis 4b (H4b): Socioeconomic factors will have the greatest explanatory power for the associations in older blacks.

Hypothesis 4c (H4c): Physiological factors will have commensurate explanatory power for older whites and blacks.

Data and Methods

This study uses 10 waves of nationally representative data from the Health and Retirement Study (HRS) for analysis. The HRS is an ongoing prospective cohort study of US adults over the age of 50 sponsored by the National Institute on Aging and the Institute for Social Research at the University of Michigan (HRS 2014). The original study cohort included 9,824 age-eligible respondents born in 1931 to 1941 who have been interviewed biennially since 1992. The initial response rate was 82 percent in 1992, and re-interview response rates were approximately 94 percent for 1994–2010, with minimal attrition due to non-response and lost tracking. Since 1998, the HRS has been supplemented with age-selective birth cohorts to replenish the nationally representative sample of older adults. Comprehensive details of the multistage sampling design, survey implementation, and response rates have been documented elsewhere (HRS 2014; Juster and Suzman 1995).

Data for the study come from 30,077 participants from the original HRS birth cohort, the Asset and Health Dynamics Among the Oldest Old cohort (AHEAD: 1923), Children of Depression (CODA: 1924–1930), War Baby cohort (WB: 1942–1947), and Early Baby-Boom cohort (EBB: 1948–1953) who were first interviewed in 1992, 1993, 1998, and 2004, respectively, and re-interviewed through 2010. Data for 2012 were not used for this analysis because information on respondent mortality is not currently available/complete for this period (refer to sensitivity analyses below). Respondents identified by race other than NH white or NH black ($n = 3,351$; 11 percent), those aged 50 and younger ($n = 2,439$; 8 percent), and those with missing data at baseline ($n = 998$; 3 percent) were excluded. The final analytic sample includes 23,289 adults aged 51–95 who contributed, on average, approximately 8 person-years over the 18-year study period. A total of 2,027 strokes (9 percent) were reported during the 260,687 person-years of observation.

Measurement

More than 50 years of prospective and retrospective data from the HRS were used to reconstruct marital histories for each study member. Marital information was ascertained from detailed responses to questions about the beginning/ ending dates (in years and/or months) of all marriages and marital losses reported by HRS participants. The subjects' month/year-specific information was converted to age-specific data using date of birth, date of interview, and date of event. The coding of study measures was facilitated by using HRS data files provided by RAND (HRS 2014). Marital status and marital transitions were operationalized with two sets of measures. First, four time-varying dichotomous measures (each coded 1) were used to capture changes in marital status for respondents who were never married, continuously married (reference group), divorced, widowed, or remarried. Second, time-varying continuous measures of cumulative marital transitions were used to indicate respondents with a history of divorce (range = 0–5) and widowhood (range = 0–3).

Race in this study was categorized as NH white (reference group) and NH black (coded 1). The multivariate models were adjusted for background characteristics that include age (in

years), HRS study cohort (AHEAD, CODA, WB, and EBB each coded 1 and the initial HRS as the reference group), gender (male coded 1), urban–rural residence (rural coded 1), and geographic region (South coded 1). Several categories of previously identified risk factors and resources are also examined as possible mechanisms. Socioeconomic factors include the respondents' educational attainment (in years), employment status (coded 1 if not currently working),² income from all sources in thousands of dollars (logarithmic scale), and health insurance coverage from any source (coded 1 if no health insurance). *Psychosocial factors* include living arrangement (coded 1 if lives alone), multigenerational household (coded 1 if lives with either parent), number of depressive symptoms measured by the eight-item abbreviated Center for Epidemiologic Studies Depression Scale (CES-D; range = 0–8), and whether the respondent was diagnosed with an anxiety, emotional, or other psychiatric condition (coded 1). *Behavioral factors* include current smoking status (coded 1 if currently smoking), alcohol use (coded 1 if ≥ 3 drinks per day), and frequency of vigorous physical exercise (coded 1 if < 3 times per week). *Physiological factors* include body mass index (calculated as weight in kilograms divided by height in meters squared; < 18.5 [underweight; coded 1], 18.5–24.9 [normal weight; reference group], 25.0–29.9 [overweight; coded 1], or ≥ 30.0 [obese; coded 1]), hypertension (coded 1 if diagnosed), and diabetes mellitus (coded 1 if diagnosed).

Preliminary analyses also included variables to adjust for children, occupational status, and spouses from the same household; however, results were not significant and the variables were dropped from the final models. In addition, the timing of respondents' first marriage (early, on time, and late) was examined extensively in preliminary analyses. Although there was some evidence to suggest that early marriage (age ≤ 19) is associated with increased risk of stroke relative to marriages at age 20 and older, the findings did not differ by race and were not significant in the fully adjusted model. Furthermore, additional analyses showed that early marriage was not associated with stroke at older ages once subsequent marital loss(es) were taken into account—consistent with previous research suggesting that early marriage is strongly associated with marital disruption (Booth and Edwards 1985; Heaton 1991; Morgan and Rindfuss 1985). Cohabitation also was assessed in preliminary analyses and was not significantly associated with stroke—although sample size was limited. Less than 2 percent of older adults reported cohabitation, and most (> 85 percent) had been previously married; therefore, cohabiting respondents were categorized to their respective non-married status (i.e., divorced, widowed, never married).

With the exception of gender and race, all measures were time varying and time lagged (observed in the previous wave [i.e., the prior 24 months]—with the exception of age) to maintain temporal order (Allison 1995) and to capture changes in the explanatory factors thought to account for the precipitating and subsequent risks associated with marital loss and stroke. Alternative lag times (e.g., no lag, 12 months, 48 months, etc.) were assessed in preliminary analyses and produced largely consistent results. Alternative coding strategies were also assessed for the continuous variables (e.g., logged, polynomial, and grouped-

²A measure for retirement also was assessed but was ultimately dropped due to the lack of variance in older cohorts, particularly the AHEAD cohort, with almost all participants reporting being retired.

ordinal scales) and categorical variables (e.g., different cutpoints, categories, and reference groups) and did not alter the central findings.

The incidence of stroke was the main outcome for analysis. At each interview, participants were asked whether “a doctor ever told you that you had a stroke” and in what year (and month after 1994) it occurred. Although subjects’ reports of stroke are less precise than clinical data, studies show considerable consistency between diagnostic reports of serious health events from survey respondents and those from medical evaluations (Bush et al. 1989; Okura et al. 2004). For persons who experienced a stroke ($n = 2,027$), the outcome corresponds to the age of the event (calculated from the dates of birth and the event). For persons who did not have a stroke, the outcome corresponds to the age when respondents were last observed in the absence of an event. A total of 3,081 subjects (13 percent) died during the study period and were censored at their age of death.

Statistical Analysis

Baseline characteristics of the HRS sample were computed for all participants and for NH whites and NH blacks. Comparisons by race were calculated with two-tailed t -tests for continuous and count variables and χ^2 tests for categorical variables. Discrete-time-hazard models were then used to estimate odds ratios (ORs) for the incidence of stroke associated with race, marital factors, and other covariates. Various functional forms (e.g., piecewise exponential, log-linear, curvilinear) were evaluated using graphical plots and standard Bayesian information criterion (BIC) statistics to determine the parametric specification that best captured the distribution of strokes across age (Raftery 1995). A linear function of the log odds was the best fitting and most parsimonious of those evaluated. The log odds of stroke is specified as a linear function of increasing age and a set of time-invariant (e.g., race) and time-varying (e.g., marital status and transitions) variables, expressed as

$$\ln[P_{it}/(1 - P_{it})] = \alpha_t + \beta' \mathbf{X}_{it},$$

so that

$$\alpha_t = \alpha_0 + \alpha_1 t,$$

where the log odds of a stroke in a sample of n independent observations ($i = 1, 2, 3 \dots n$) at time t is a function of time, α_t , and a vector of independent variables $\mathbf{X}$, where β is a vector of parameters to be estimated. Time (α_t) is specified as a linear function of age, so that time begins at baseline age (α_0) and increases ($\alpha_1 t$) until the age at which a stroke occurs or becomes a censored observation. All models include an interaction term for race $\times$ age to account for changes in racial differences in stroke across age (Chong and Sacco 2005; Go et al. 2014).

The first set of multivariate models estimated risks of stroke associated with race and the time-varying measures of marital status and marital transitions. Model 1 included race and adjusted for age, study cohort, gender, urban-rural residence, and geographic region; model 2 further included variables for marital status and transitions to assess the direct effects of

the marital indicators (H1) and the degree to which they mediate the relationship between race and stroke (H2); and model 3 tested interactions between race and the marital variables to assess whether racial differences in stroke are moderated by marital status and/or marital transitions (H3a–b). Predicted odds (PO) were then estimated from model 3 and plotted to illustrate the adjusted differences in the rates of stroke incidence across age. A second set of multivariate analyses were stratified by race to examine the socioeconomic, psychosocial, behavioral, and physiological mechanisms hypothesized to explain the marital differences in stroke for NH whites and NH blacks (H4a–c). Model fit and reductions in estimated ORs across models (i.e., mediating effects) were assessed using BIC statistics and KHB methods (Karlson, Holm, and Breen 2010), respectively.

Four sets of sensitivity analyses were also conducted. First, although mortality was relatively low during the study period (< 15 percent), competing-risk-hazard models were estimated to account for potential bias due to selective mortality. Results were nearly identical to those presented here, with only negligible changes in the point estimates and CIs ($\pm .01$ –.001). Second, although the analyses adjust for a large number and range of covariates, it is possible that additional unmeasured confounding (i.e., residual confounding) may have contributed to the findings. Therefore, a series of discrete-time random effect frailty models were estimated to assess potential bias from unobserved measures (Allison 1995; Jenkins 1995).³ The analyses indicated no significant bias and suggest that unobserved heterogeneity is not significantly altering the central findings. Third, I assessed whether selective survival may have contributed to the findings. Excluding adults over the age of 85 at baseline ($n = 781$; 3 percent) produced results that were largely unchanged with those presented here. Finally, separate models were run for the marital status and marital transitions measures because preliminary analyses indicated a moderate degree of bivariate correlation and multicollinearity in the models—condition values were > 60 , with the largest variance decomposition proportions and variance inflation factors among the marital variables.

All models were weighted for the complex sampling design to produce unbiased variance estimates, and robust standard errors were calculated using sandwich estimators of variance to account for the intra-individual correlation in the repeated observational data. The associations are also assessed for differences by gender and across age. Preliminary analyses also showed that the ORs can be safely interpreted as relative risks (RR) due to their close approximation—for example, OR = 1.3203 vs. RR = 1.3176 for divorce—because overall rates of stroke are low. Analyses were conducted using Stata 12.0 (StataCorp 2011).

Results

Characteristics of the study participants are presented for the entire sample and by race in table 1. Non-Hispanic blacks were more likely to be younger, female, live in rural areas, and reside in the South compared with NH whites. Non-Hispanic blacks also had less education,

³Unobserved frailty was assessed by estimating two discrete-time proportional hazards regression models using maximum likelihood (“pgmhaz” command). A gamma-mixture distribution (model 2) summarized the unobserved heterogeneity, where the gamma term is a random positive quantity with an assumed mean of one and variance σ^2 . Estimates of the frailty variance components were near zero, and the likelihood-ratio tests suggested no systematic bias. However, the assumed underlying distribution of overdispersion cannot be confirmed, and thus the presence of unmeasured confounding cannot be fully ruled out.

had lower levels of income, were less likely to have any health insurance, exercised less, lived alone, resided in multigenerational households, and had more depressive symptoms than NH whites. Rates of smoking, obesity, diagnoses of hypertension or diabetes mellitus, and the occurrence of stroke were also significantly higher in NH blacks than NH whites. In terms of marital experiences, NH whites were more likely to be continuously married or remarried at baseline than NH blacks, whereas NH blacks had significantly higher rates of being currently divorced or widowed compared with NH whites. With regard to marital transitions, NH blacks were significantly more likely to have a history of divorce and/or widowhood than NH whites.

Table 2 presents the sociodemographically adjusted ORs for the association between race and stroke and the mediating and moderating effects of the marital variables. Model 1 shows that risks for the incidence of stroke are significantly higher in NH blacks than in NH whites ($OR = 1.82$; $p < .001$). Model 2 shows that risks for stroke are elevated in almost all older adults who are not continuously married (H2), as predicted by hypothesis 1. Compared with continuously married adults, risks are significantly higher among those who were never married ($OR = 1.41$), divorced ($OR = 1.28$), remarried ($OR = 1.31$), and widowed ($OR = 1.65$). In terms of cumulative marital transitions, the incidence of stroke significantly increases for adults with every additional divorce ($OR = 1.22$) and widowhood ($OR = 1.37$). However, the addition of measures for marital status and marital transitions in model 2 provides only limited evidence of their mediating role in the association between race and stroke (H2).

Model 3 includes interaction terms and indicates that the association between race and risks for stroke is significantly moderated by marital status and marital transitions. Overall, the findings for hypothesis 3 are mixed—although more consistent with H3b than with H3a. Results suggest that NH blacks who are never married have significantly greater risks of developing stroke at older ages than NH whites who never married (interaction term $p < .05$). For NH whites, there are no significant differences in stroke between those who never married and those who were continuously married. By age 70, for example, the findings indicate that NH blacks who never married are at substantially greater risk of developing stroke relative to NH whites who never married (predicted odds $[.017_{(NH\ black)} / .006_{(NH\ white)}] = OR = 2.83$). Conversely, the excess risks associated with a history of divorce(s) are significantly less among NH blacks than among NH whites (interaction term $p < .01$). For illustrative purposes, these results are plotted as predicted odds in figure 1 to further demonstrate the differential patterns of risk for NH whites and NH blacks across age.

Table 3 presents the results from a series of models examining the potential mechanisms contributing to marital differences in stroke for NH whites and NH blacks. Overall, it can be seen that marital status and marital transitions have a significantly greater impact on the incidence of stroke among NH whites than among NH blacks (H3b). Furthermore, the inclusion of more than a dozen socioeconomic, psychosocial, behavioral, and physiological variables only partially attenuated these associations. For NH whites, behavioral factors (model 4) are attributable to the largest significant reductions in ORs for those who are currently divorced or widowed (19 and 12 percent reduction, respectively). Psychosocial factors (model 3) significantly reduced the ORs (by 13 percent) and significance level most

for NH whites who are currently remarried. For NH blacks, the excess risks for stroke associated with being never married—and to some extent being currently widowed—are attenuated most due to socioeco-nomic factors (model 2)—by approximately 11–12 percent ($p < .05$). Together, these findings lend partial support for hypotheses H4a and H4b. According to estimated BIC statistics (not presented), cumulative marital transitions are more predictive of stroke than current marital status for NH whites; however, there are no significant differences for NH blacks. The models with physiological factors (model 5) have the greatest overall model fit for estimating the incidence of stroke—although these factors appear to be operating largely independent of race and marital factors.

Finally, supplementary analyses were conducted to examine whether the associations varied for men and women and/or across age. Of the more than two dozen interactions that were tested, there was no evidence that the key findings differed across age or by gender.

Discussion

The current study is the first to examine racial differences in the longitudinal association between marital experiences and the incidence of stroke at older ages. The results demonstrate that marital status and marital transitions operate differently according to race and extend our understanding of how cumulative exposure to social relationships contributes to inequalities in cardiovascular health over the life course. Overall, NH blacks have significantly higher rates of marital instability, greater numbers of health-risk factors, and substantially higher rates of stroke compared with NH whites. Somewhat contrary to the cumulative disadvantage hypothesis, however, the effects of marital history are more pronounced for NH whites than for NH blacks. The odds of having a stroke are significantly higher in NH whites who were currently divorced, remarried, and widowed, as well as in those with a history of divorce or widowhood, compared with NH whites who are continuously married. In NH blacks, however, risks for stroke are only elevated in those who never married or who had been widowed—with no significant risks attributable to divorce.

For the past several decades, life course research has made innumerable contributions to our understanding of how social factors and health interrelate over personal and historic time. The current study contributes to this body of work in several important ways. First, this study uses longitudinal data (spanning 20 years) from the largest representative panel of US white and black adults over the age of 50. Second, this study considered the widest array of explanatory factors for racial differences in stroke related to marital instability. Moreover, the time-varying covariates captured changes in many of the socioeconomic, psychosocial, behavioral, and physiological factors thought to explain the elevated rates of stroke following a divorce or widowhood. Nevertheless, many of the distinct marital effects for NH whites and NH blacks remained statistically significant despite accounting for more than a dozen possible mechanisms. Third, the results of this study also contribute to mounting evidence that the cardiovascular risks associated with social stressors are comparable in magnitude to established risk factors such as smoking, diabetes, and hypertension (Dupre et al. 2012; Gallo et al. 2004). In NH whites, for example, the risks associated with hypertension (OR = 1.61) and diabetes (OR = 1.55) are similar in size to the risks observed in NH whites who are widowed (OR = 1.59) or have a history of two divorces (OR = 1.53).

The adjusted risks in NH blacks who never marry are even larger (OR = 1.72). Moreover, these rates are largely mirrored in terms of absolute risks—for example, approximately 13 percent of NH blacks who smoke experienced a stroke, whereas 14 percent of NH blacks who never married experienced a stroke. In much the same way, the findings for marital status and marital history are comparable to the protracted and cumulative associations recently documented between lifetime exposure to job loss and risks for a heart attack (Dupre et al. 2012).

The general finding that marital dissolution is less consequential for NH blacks than for NH whites is not unexpected (H3b). According to the literature on race and inequality, the institution of marriage has become less central in the American black family (Dixon 2009; Pinderhughes 2002), and thus is hypothesized to be less impactful to health. The analyses support this argument and suggest that exposure to divorce and widowhood has no significant association with risks for stroke in NH blacks. Rather, it is the absence of any marital involvement (i.e., never married) that poses the greatest risk for stroke in older NH blacks. Alternatively, any experience of marital loss elevates rates of stroke in older NH whites. Several explanations for these findings are postulated.

The first possible explanation is related to the concept of resilience (see Suedfeld 1997). Resilience is viewed as a clustering of psychological resources that promote social competence, effective problem-solving, and a proactive stance toward the environment (Affleck and Tennen 1996; Smith 2006). In this regard, marital life may have had less of an impact on blacks than on whites because of a potential resilience that some black adults may have acquired from a life course of disadvantage. Thus, some NH blacks in this study may have benefited from an unmeasured form of resilience or hardiness that permits them to sustain health despite deprivation. Unfortunately, direct measures of resilience and related traits, such as self-efficacy, a sense of control, and optimism, are not available for analysis.

Second, it also is plausible that divorce is a less normative and consequently more socially stressful transition in NH whites than in NH blacks. The HRS data provide some support to this argument. Table 1 shows that NH blacks are more than twice as likely as NH whites to be divorced at baseline. Furthermore, supplemental analyses demonstrate stronger correlations between marital loss and increases in most risk factors (particularly psychosocial distress) in NH whites. Contrary to expectations and the existing literature, however, the multivariate results show that psychosocial factors and maladaptive health behaviors—as well as losses of income and health insurance—did not fully account for the associations. A final possible explanation is that marital instability increases risks for stroke more for NH whites than for NH blacks because of the low underlying rates of stroke in whites and already elevated rates in blacks. In other words, there may be a “ceiling effect” that contributes to greater attributable increases in stroke in NH whites than in NH blacks. However, these interpretations remain guarded until more research is conducted to validate and further explain these findings.

The finding that NH blacks (and not NH whites) who never married had higher risks for stroke than their continuously married counterparts was notable, but not entirely unexpected. Past research has shown that never-married adults are at greater risk of stroke than adults

who are married (Maselko et al. 2009). To my knowledge, however, no existing studies have examined whether this association differs in NH whites and blacks. The explanation for the current finding may be twofold. First, some research suggests that NH blacks who never marry (or marry much later in life) may be selectively more disadvantaged than NH whites who never marry in terms of health status, socioeconomic standing, and other marriageable factors—for example, incarceration, adverse childhood conditions, and limited educational/employment opportunities (Dixon 2009; Pinderhughes 2002; Sweeney 2002). Second, and relatedly, although most NH blacks will marry in their lifetime, their median age at first marriage (approx. age 31) is the highest among all major racial groups in the United States (Dixon 2009; Kreider and Ellis 2011; Payne 2012). Therefore, it can be argued that a delay in becoming married may limit the cumulative health benefits afforded from longer durations of the life course spent in the “protective” status of marriage (see Addo and Lichter 2013; Dupre, Beck, and Meadows 2009). However, these interpretations are cautious until more research corroborates the current findings.

This study also showed that NH whites who are remarried have risks for stroke that are nearly equivalent in magnitude to NH whites who are divorced relative to continuously married NH whites. This pattern suggests that the increased likelihood of stroke among those who were divorced or widowed is not ameliorated with remarriage later in the life course. Indeed, there is evidence for this finding in related research. For example, research shows that remarried adults have significantly greater levels of physical and psychological illness than adults who are continuously married—especially among women (Barrett 2000; Dupre et al. 2012; Hughes and Waite 2009). The present findings further corroborate this pattern in NH whites to suggest that remarriage after divorce or widowhood may not confer the same health benefits for those who remarried stably married.

An important area for future research will be to further investigate the mechanisms underlying these findings. The prevailing argument is that marital dissolution has a negative impact on the economic, behavioral, and emotional well-being of individuals that reduces their ability to prevent, detect, and treat illness (LaPierre 2012; Lavelle and Smock 2012; O’Rand and Hamil-Luker 2005; Umberson 1992). The results of this study suggest that additional factors may be important to consider. For example, although most adults in the study married at a young age (92 percent by age 30), it is possible that health selection played a role in the likelihood of entering/exiting marriage, as well as contributing to underlying risks for stroke. Alternatively, and consistent with literature on the stress process and the physiological reactivity to psychosocial stressors, it is suspected that the acute and chronic stress associated with marital loss may have played an important and unmeasured role in the findings (see Eaker et al. 2007; Pearlin 2010; Steptoe and Kivimäki 2012). Indeed, studies have recently identified possible biological mechanisms—for instance, blood pressure reactivity, elevated cortisol, and hemoglobin A_{1c}—related to the stress of marital loss that warrant additional exploration as they relate to the incidence of stroke (Molloy et al. 2009; Sbarra et al. 2009). Therefore, I encourage future studies to explore these and other mechanisms to explain how exposure to marital life incurs differential risks for stroke at older ages.

This study also has potential public health and policy implications. Although marital loss is not a modifiable risk factor or amenable to medical intervention (like smoking or hypertension), increased knowledge about the risks associated with marital history can assist health providers and policymakers in improving quality of care and potentially lowering risks for stroke. For example, NH whites who experienced divorce or widowhood—particularly those who experienced multiple losses—may benefit from additional screening and/or treatment for symptoms of distress or other risks for stroke. Likewise, older NH blacks who never married are at especially high risk for stroke and should be monitored vigilantly.

Despite the strengths of this study, several limitations are acknowledged. Although the data are rich in the number and scope of measured covariates, certain clinical parameters and potentially important qualitative measures are lacking. First, the analyses of stroke are based on self-reported data—and not medical evaluations—which may bias the true rates of stroke. Therefore, future studies are warranted to validate these findings with medical assessments. Second, data were not available for the treatment and control of hypertension, diabetes, and/or high cholesterol prior to stroke, or other prophylactic measures to reduce the likelihood of a cerebrovascular event (e.g., prior cardiac revascularization). Relatedly, although the study included several time-varying adjustments for socioeconomic background and health status, the potential influence of selection bias on the findings cannot be ruled out.

A third limitation is that the study could not identify the characteristics or quality of past marriages or the circumstances of divorce. In particular, more information on concordant behaviors and the extent of integrative unions among NH white and NH black spouses may shed additional light on marital differences in stroke. Although detailed measures of marital relationships were not available, the multivariate analyses showed that depressive symptoms and maladaptive behaviors—presumed correlates of marital quality—did not account for the associations. Relatedly, the study lacked direct measures of stress, anxiety, and the loss of social support that may have contributed to the associations.

In sum, this study showed how marital status and cumulative marital transitions are associated with the onset of a major health event that is responsible for significant racial inequalities in premature disability and death. Exposure to marital instability over the life course is more consequential to the incidence of stroke for NH whites than for NH blacks and should be recognized with other traditional risk factors to better understand how risks for stroke vary by race. Despite the robust and moderated associations between marital history and stroke, racial disparities in stroke remained. Therefore, more studies are needed to investigate additional mechanisms contributing to these associations and to build on this evidence to inform health policy and practice to ultimately lessen the burden of CVD in vulnerable segments of the population.

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Biography

Matthew E. Dupre is an associate professor in the Department of Community and Family Medicine and the Department of Sociology at Duke University. His research is dedicated to the interdisciplinary study of health disparities and uses a life course orientation to understand how cumulative exposure to disadvantage shapes inequalities in disease onset and survival. His work has appeared in *JAMA*, *American Journal of Epidemiology*, *American Journal of Public Health*, *Demography*, *Journal of Health and Social Behavior*, *Journals of Gerontology*, *Social Forces*, and *Social Science and Medicine*.

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Non-Hispanic White

— Continuously married ····▲···· Never married - - - Divorced —●— Remarried ······ Widowed

Non-Hispanic Black

Non-Hispanic White

— Continuously married - - - One divorce —●— Two divorces ······ One widowhood

Non-Hispanic Black

Figure 1.

Predicted odds of stroke by marital status and marital transitions in non-Hispanic white and black older adults, HRS 1992–2010 ($n = 23,289$)

Note: Predicted odds are estimated from model 3 in table 2.

Table 1

Characteristics of Study Participants from the Health and Retirement Study at Baseline

	Total (n = 23,289)	NH white (n = 19,462)	NH black (n = 3,827)
Sociodemographic background			
Age in years	63.52 (11.05)	63.80 (11.06)	62.13 (10.88) ***
Study cohort, 1923	32.09	32.87	28.09 ***
Study cohort, 1924–1930	8.54	9.25	4.96 ***
Study cohort, 1931	59.37	57.88	66.95 ***
Male	45.36	46.33	40.48 ***
Rural	19.73	21.39	11.34 ***
Lives in the South	39.56	36.71	54.01 ***
Marital status			
Never married	3.54	2.95	6.56 ***
Continuously married	35.10	37.02	25.37 ***
Divorced	12.51	10.33	23.57 ***
Remarried	32.09	33.92	22.79 ***
Widowed	16.76	15.78	21.71 ***
Marital transitions			
Number of divorces	0.30 (0.60)	0.30 (0.60)	0.32 (0.58) ***
Number of widowhoods	0.20 (0.41)	0.19 (0.40)	0.25 (0.44) ***
Socioeconomic factors			
Years of education	12.17 (3.14)	12.47 (2.91)	10.65 (3.75) ***
Not currently working	53.22	53.08	53.93
Household income in thousands of dollars	15.88 (40.67)	16.58 (43.46)	12.33 (21.06) ***
No health insurance	8.22	7.10	13.93 ***
Psychosocial factors			
Lives alone	19.92	19.22	23.49 ***
Multigenerational household	1.71	1.44	3.06 ***
CES-D depressive symptoms	1.73 (1.91)	1.63 (1.86)	2.19 (2.10) ***
Anxiety or emotional condition	7.36	7.41	7.08
Behavioral factors			
Current smoker	20.08	19.14	24.88 ***
Excess alcohol consumption	10.15	10.53	8.23 ***
No vigorous exercise	80.93	80.53	82.96 ***
Physiological factors			

	Total (n = 23,289)	NH white (n = 19,462)	NH black (n = 3,827)
Underweight, BMI < 18.5	2.07	2.13	1.80
Overweight, BMI 25.0–29.9	40.01	40.07	39.72
Obese, BMI ≥ 30.0	14.91	13.74	20.83***
Diagnosed hypertension	38.60	35.59	53.91***
Diagnosed diabetes	10.45	8.98	17.93***
Stroke during study period	8.78	8.41	10.66***

Note: Abbreviations: NH, Non-Hispanic; CES-D, Center for Epidemiologic Studies Depression Scale; BMI, body mass index.

Significance tests for race differences were calculated by analysis of variance or χ^2 tests.

*
p .05

**
p .01

p .001 (two-tailed test)

Table 2

Discrete-Time Odds Ratios for Stroke Associated with Race, Marital Status, and Marital Transitions in US Older Adults, HRS ($n = 23,289$)

	Odds ratio		
	Model 1	Model 2	Model 3
Non-Hispanic black (vs. NH white)	1.82 ***	1.71 ***	1.75 ***
Marital status (vs. continuously married)			
Never married		1.41 **	1.16
Divorced		1.28 **	1.30 **
Remarried		1.31 ***	1.34 ***
Widowed		1.65 ***	1.67 ***
Never married*NH black			1.79 *
Divorced*NH black			0.95
Remarried*NH black			0.88
Widowed*NH black			0.96
Non-Hispanic black (vs. NH white)	1.82 ***	1.76 ***	2.06 ***
Marital transitions			
Number of divorces		1.22 ***	1.29 ***
Number of widowhoods		1.37 ***	1.38 ***
Number of divorces*NH black			0.73 **
Number of widowhoods*NH black			0.93

Note: Models adjusted for age, gender, study cohort, urban–rural residence, and geographic region. Models are estimated separately for each marital component.

* $p < .05$

** $p < .01$

*** $p < .001$ (two-tailed test)

Table 3

Adjusted Discrete-Time Odds Ratios for Stroke Associated with Marital Status and Marital Transitions in Non-Hispanic White and Black US Older Adults, HRS ($n = 23,289$)

Odds ratio						
	Model 1: Demographic factors	Model 2: Socioeconomic factors	Model 3: Psychosocial factors	Model 4: Behavioral factors	Model 5: Physiological factors	Model 6: Full model
Marital status ^a						
Non-Hispanic white						
Continuously married (ref.)						
Never married	1.18	1.15	1.19	1.14	1.16	1.14
Divorced	1.32 **	1.30 **	1.28 *	1.25 *	1.33 **	1.22
Remarried	1.34 ***	1.31 ***	1.29 ***	1.31 ***	1.33 ***	1.25 **
Widowed	1.71 ***	1.65 ***	1.71 ***	1.61 ***	1.67 ***	1.59 ***
Non-Hispanic black						
Continuously married (ref.)						
Never married	1.75 **	1.63 *	1.75 *	1.72 **	1.84 **	1.72 *
Divorced	1.18	1.17	1.12	1.16	1.18	1.11
Remarried	1.17	1.15	1.13	1.15	1.16	1.13
Widowed	1.47 *	1.41 *	1.42 *	1.43 *	1.42 *	1.33
Marital transitions ^b						
Non-Hispanic white						
Number of divorces	1.29 ***	1.28 ***	1.26 ***	1.27 ***	1.29 ***	1.24 ***
Number of widowhoods	1.39 ***	1.37 ***	1.42 ***	1.35 ***	1.38 ***	1.37 ***
Non-Hispanic black						
Number of divorces	0.95	0.98	0.93	0.94	0.97	0.96
Number of widowhoods	1.24	1.20	1.19	1.23	1.20	1.15

Note: Model 1 adjusts for age, gender, study cohort, urban-rural residence, and geographic region. Model 2 includes model 1 covariates and adds education, employment status, income, and health insurance. Model 3 includes model 1 covariates and adds living arrangement, CES-D depressive symptoms, and anxiety or emotional conditions.

Model 4 includes model 1 covariates and adds smoking, alcohol use, and exercise.
Model 5 includes model 1 covariates and adds BMI, hypertension, and diabetes.
Model 6 includes all covariates.

^aRace differences are statistically significant ($p < .05$) for never married except in model 2.
^bRace differences are statistically significant ($p < .05$) for number of divorces in all models.

[*]	p	.05
^{**}	p	.10
^{***}	p	.001 (two-tailed test).