Published in final edited form as:

J Fam Issues. 2010 September ; 31(9): 1211–1229. doi:10.1177/0192513X10365487.

Marital Status, Hypertension, Coronary Heart Disease, Diabetes, and Death Among African American Women and Men: Incidence and Prevalence in the Atherosclerosis Risk in Communities (ARIC) Study Participants

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INTRODUCTION

Heart disease, which accounts for 30% of all deaths, is the leading cause of death for both men and women in the United States (Kung, Hoyert, Xu, & Murphy, 2008). Among the heart disease conditions, coronary heart disease (CHD) is the most common, accounting for approximately 68% of all heart disease deaths (American Heart Association, 2008). CHD occurs when the arteries that route blood to the heart narrow due to atherosclerosis (hardening of the arteries). As a consequence, symptoms develop due to a decrease (angina, or chest pain), or halt (myocardial infarction, or heart attack) in blood flow and oxygen to the heart muscle.

Diabetes was the seventh-leading cause of death in the United States in 2006; however, due to under-reporting, deaths attributable to diabetes are likely greater than what is currently reported (Centers for Disease Control and Prevention [CDC], 2008a). Diabetes occurs when insulin is not used effectively and/or is not produced by the body. When insulin is not used properly or is not available, the body cannot convert food into energy. Diabetes and hypertension (high blood pressure) are major risk factors for CHD. Among people diagnosed with Type 2 diabetes, 75% eventually die of cardiovascular causes whereas only one in three people without diabetes die from cardiovascular disease (Kapur et al., 2005). Poor diet, physical inactivity, and consequent obesity are risk factors for hypertension, diabetes, and CHD (CDC, 2008b). About one in three adults (32%) ages 19 or older in the United States is considered obese (CDC, 2007).

African Americans, particularly African American women, suffer disproportionately from CHD, hypertension, and diabetes. Among white men and women, 9% and 6%, respectively, have CHD; 33% and 32% have hypertension; and 7% and 6% have diabetes. Among African American men and women, respectively, 7% and 8% have CHD; 43% and 27% have hypertension; and 11% and 13% have diabetes (Rosamond et al., 2007). African Americans are 1.8 times more likely to suffer from diabetes than whites of the same age (CDC, 2008a). Not only are African Americans more likely to have diabetes, they are more

likely to die from diabetes. African American women diagnosed with diabetes are 40% more likely to die than white women and white men with diabetes, after accounting for age (Melkus, Whittemore, & Mitchell, 2009).

Marital status is associated with health; please see the first paper in this volume by Moiduddin, Koball, Henderson, Goesling, and Besculides for a general overview of the research literature on the relationship between marriage and health in the African American community. In this paper, we focus on marital status and its association with cardiovascular health and all-cause mortality. Recent evidence suggests that losing a spouse has differential impacts on men's and women's cardiovascular health in older ages. It has been shown that marital disruption is associated with the onset of cardiovascular disease in middle-aged women but not in men (Zhang & Hayward, 2006). Based on longitudinal data from a British cohort, being "single" (never married, divorced, or widowed) was significantly related to higher mortality in single men compared with married men. Being never married put women at no greater risk for mortality, but being widowed, divorced, or separated increased their risk of death compared with married women (Gardner & Oswald, 2004). Using cross-sectional data from six European countries, Murphy, Grundy, and Kalogirou (2007) found—at all ages and for both genders—there was a significant protective effect of marriage on mortality. In general, marriage is thought to be protective against mortality (Manzoli, Villari, Pirone, & Boccia, 2007) and against adverse health outcomes (Waite & Lehrer, 2003), including cardiovascular disease (Kiecolt-Glaser & Newton, 2001).

In this study, we examine the relationship between marital status and change in marital status on three cardiovascular outcomes (hypertension, CHD, and diabetes) as well as all-cause mortality. Earlier studies have suffered from the inability to disentangle the direction and association of observed relationships between cardiovascular outcomes and marital status. This has been particularly problematic because most studies do not analyze longitudinal data. Many studies have a limited ability to control for potential confounders, selection into marriage, and potential gender differences. In addition, few studies have been conducted with data from the African American community and few have as extensive a database on CHD as the Atherosclerosis Risk in Communities (ARIC) study.

RESEARCH QUESTIONS AND HYPOTHESES

We use marital status reported in 1987–1989 and 1990–1992 among self-identified African American ARIC cohort members to determine whether marriage, or change in marriage, confers health benefits for middle-aged African American adults. In addition, we assess selection bias into marriage. Due to the known gender differences in the timing and acquisition of these outcomes, as well as differences in health benefits of marriage by gender, we present sex-stratified models to explore the potential for different patterns between men and women.

Research Questions

1. Among African Americans, is staying married associated with a lower prevalence of hypertension in midlife compared with staying never married, divorced, separated, or widowed?

Hypothesis 1.1: Compared with African American men and women who remain married, those who remain never married, divorced, separated, or widowed will be more likely to have hypertension.

2. Do married African Americans experience a lower risk of CHD, diabetes, or death than their single counterparts? Is the protection the same for men and women? Do changes in marital status change incidence?

Hypothesis 2.1: African American men and women who stay married will have lower incidence of CHD, diabetes, and death than African American men and women who remain never married, divorced, separated, or widowed, or who change marital status.

Hypothesis 2.2: Changes in marital status in African Americans will more adversely affect women's incidence of coronary heart disease and diabetes than men's.

METHODS

Data Source

ARIC was designed to investigate the etiology and natural history of atherosclerosis, which is the hardening of arteries; the etiology of clinical atherosclerotic diseases; and variations in cardiovascular risk factors, medical care, and disease by race, gender, location, and date. The ARIC cohort was recruited from four U.S. communities: Forsyth County, North Carolina; Jackson, Mississippi; seven northwest suburbs of Minneapolis, Minnesota; and Washington County, Maryland. A sample of 15,792 persons ages 45 to 64 was selected at baseline—approximately 4,000 study participants from each study community. In Jackson, only African Americans were included in the cohort; in the other three sites, all races were eligible. In Forsyth County, households were identified by area sampling. In the other communities sampling was done from listings of age-eligible persons from voter registration, driver's license, and state identification card registries. All persons who met the age criteria (between the ages of 45 and 69) and were usual residents were identified as potential members of the study. Additional details of the data collection are described elsewhere (The ARIC Investigators, 1989). For the current analyses, we limited the sample to participants in Forsyth County, North Carolina and Jackson, Mississippi because the proportion of the sample that was African American in the two other centers was very small. We also limited the sample to those who participated in the baseline (Visit 1) and first followup (Visit 2) survey.

At baseline ARIC participants received an extensive examination that collected medical, social, and demographic data. The study participants were reexamined every three years with Visit 1 (baseline) occurring in 1987–1989, the second in 1990–1992, the third in 1993–1995, and the fourth and final exam in 1996–1998. Followup occurs annually by telephone to maintain contact with cohort participants to assess health status (<http://www.csc.unc.edu/aric/>) as well as disease outcomes. Surveillance for death is conducted through annual followup and monitoring of the National Death Index. All potential CHD events lead to medical chart retrieval and events are defined following standardized abstraction and

committee review. The current study has been approved by the ARIC steering committee, the ARIC publications committee, and the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Dependent Variables

This analysis has four main outcomes: hypertension, CHD, diabetes, and all-cause mortality. The outcomes and measures are described below:

- **Hypertension:** At each study visit, sitting blood pressure was measured three times by a trained technician with a random-zero sphygmomanometer. The hypertension measures used in this study reflect the average of the three measurements. Hypertension is defined as high blood pressure (systolic blood pressure ≥ 140 mm/Hg or diastolic blood pressure ≥ 90 mm/Hg) measured during the ARIC study visit or use of antihypertensive medications. Prevalent hypertension is hypertension that is already diagnosed, incident hypertension is new cases of hypertension, that is, it has not previously been diagnosed.

Because more than half of the African American participants had hypertension at baseline, we focus on prevalent hypertension (current cases) at Visit 2. Analysis of incident hypertension (new cases) would include less than half of the original sample, and combining prevalent and incident cases is problematic because the age at onset of the prevalent cases is uncertain.

- **Coronary Heart Disease:** A CHD event is defined as a definite or probable myocardial infarction (heart attack), definite CHD death, bypass surgery, or angioplasty. Only incident, or new cases, of CHD are included in the analysis. Incident CHD was determined by contacting participants annually and monitoring discharge lists from local hospitals and death certificates for potential cardiovascular events. Annual followup data were available through 2005. All potential CHD clinical events were adjudicated by the ARIC Morbidity and Mortality Classification Committee using published criteria (White et al., 1996).
- **Diabetes:** Type 2 diabetes is defined as a fasting glucose level of ≥ 126 mg/dl or a nonfasting glucose level of ≥ 200 mg/dl at an ARIC study visit. In addition, self-report of physician-diagnosed diabetes and report of medication for diabetes could also define a study participant as having diabetes. Only incident diabetes cases were included in the analysis. Diabetes status was obtained only during an ARIC visit. To determine the exact date of diabetes onset, interpolation methods were utilized (White et al., 1996).
- **Death:** Mortality was determined by cohort surveillance of the National Death Index as well as annual followup calls (with a surviving family member answering by proxy). We include death from all causes and examine the relationship between marital status and death prospectively from 1990–1992 to 2005.

Independent Variables

We focus on marital status at two time points. The first, Visit 1, collected in 1987–1989, is based on data collected on the household enumeration form. Interviewers asked participants about their current marital status. Respondent options included married, never married, divorced, separated, and widowed. Seven percent of our sample was missing on baseline marital status. We used deterministic conditional mean imputation to impute marital status for those missing these data using independent variables that significantly differed between those missing and those not missing data on marital status. Change in marital status is based on the difference between marital status reports from Visit 1 to Visit 2, three years later. For Visit 2 (1990–1992) the same current marital status question was asked of participants. Marital status was not asked in Visits 3 or 4; therefore, we defined marital status change utilizing information from Visits 1 and 2. We created a categorical marital status change variable with three levels to reflect the most common combinations: (1) stayed married; (2) stayed single: never married, divorced, separated, or widowed; and (3) any marital status change (never married to married; divorced, separated, or widowed to married; and married to divorced, separated, or widowed). We excluded cases in which the change in marital status was unlikely a representation of true change and more likely a result of data entry error, such as reporting a never-married status at Visit 2 when the marital status at Visit 1 required a period of marriage, or reporting a marital status change from never married at Visit 1 to divorced, separated, or widowed at Visit 2. In addition, we include age (continuous) and education (categorized into did not complete high school and completed high school), based on responses to questions during Visit 1.

Individual health status included a number of measures also obtained during Visit 1. Body mass index (BMI) was based on participants' height and weight, measured in person by ARIC data collectors at a study visit, and is reported in kilograms per meter squared. Measures of blood cholesterol levels, high-density lipoprotein (HDL) cholesterol ("good cholesterol") and low-density lipoprotein (LDL) cholesterol ("bad cholesterol") measures were ascertained through fasting serum samples collected at Visit 1. The physical activity score, or sport index, included a sum of the yearly frequency, weekly duration, and coded intensity (low, medium, or high) of up to four self-reported sport activities, as well as self-rated amount of leisure time activity compared with others of the same age, frequency of sweating, and general frequency of sport play. Current smoking status was based on self-report.

Statistical Analyses

First, we describe the sample and the background factors associated with marital status. Next, we examine the relationship between marital status and the individual (age, sex, and education) and health status (BMI, cholesterol, physical activity score, and smoking status) using Chi-square and t-tests at the $p < 0.05$ significance level to better understand how people differ by marital status at Visit 1. This is a cross-sectional analysis. We then consider the association of change in marital status with concurrent hypertension and incident CHD, diabetes, and death. When modeling the association between CHD and the change in marital status between Visit 1 and Visit 2 we use "new" or incident cases of CHD at any time following the date of Visit 2. The same is true for the other outcomes we examine

prospectively, diabetes and death. We also model this outcome in bivariate logistic (prevalent hypertension) and Cox proportional hazards (incident CHD, diabetes, death) models with individual characteristics as well as the relevant health status factors. Finally, we use multivariable logistic and Cox proportional hazards regression to assess the association of marital status or change in marital status with our cardiovascular outcomes while controlling for other factors associated with marital status at baseline.

We used block modeling (only full models shown) to assess potential confounders between change in marital status and the outcomes (Pedhazur, 1982). This procedure enables the researcher to see how the addition of each set of variables has an effect on the main predictor variable, in this case marital status. In our block models we started with simple models, including only marital status. The second model included individual characteristics (age, education, sex) and finally, the third included individual health characteristics (BMI, smoking, physical activity, and so on). For all analyses we present results stratified by sex as well as overall. For the overall multivariable model, we include robust standard errors based on clustering of spouse pairs in the data set. The multivariable model also includes a control for site (Forsyth County, North Carolina or Jackson, Mississippi).

RESULTS

Description of the Sample

In Table 1 we show the sample characteristics for Visits 1 and 2 and the cardiovascular outcomes during the 13 years of followup from Visit 2 to 2005 for the 3,425 study participants. At Visit 1, 56% of females and 78% of males were married; 2% of females and males were never married. Twenty-four percent of females and 16% of males reported being divorced or separated; 18% of women and 3% of men were widowed. In considering the change in marital status between Visit 1 and Visit 2, most individuals stayed in the same category they were in at Visit 1. Again, more men than women were married and more women than men were divorced, separated, or widowed. Status changed for 9% of the women and 6% of the men. Although the change could be in many combinations, by far the most common was change from being married to being divorced, separated, or widowed (6% of the women and 4% of the men). On average, participants were 54 years old at the first visit. Sixty-two percent of the women were high school graduates; the same was true for 59% of the men. The majority of the sample, 63%, was women.

Less than a quarter of the female sample reported smoking at baseline, compared with 37% of the males. Women's HDL values were, on average, 58 mg/dL, compared with men's at 50 mg/dL. Higher levels of HDL are better, less than 40 mg/dL for men and 50 mg/dL for women are considered risk factors for heart disease (CDC, 2008b). Given these guidelines, the average HDL levels among men and women in this sample are at acceptable levels. Women's and men's LDL values were 138.6 mg/dL and 138.1 mg/dL, respectively. Lower levels of LDL are better; according to the American Heart Association, an LDL level of less than 100 mg/dL is optimal and an LDL level above 160 mg/dL is high; therefore, the average LDL levels in this sample are borderline high (CDC, 2008b). Given the recruitment strategy for ARIC (only African Americans were recruited in Jackson; the other three sites

recruited eligible participants not based on race), the majority of African Americans in this sample reside in Jackson (89%).

At Visit 1, 60% of women and 54% of men had hypertension; at Visit 2, the proportion of individuals with prevalent hypertension was similar at 58% for women and 53% for men. Over a median of 13 years of followup, 10% of women and 16% of men developed incident CHD and 18% of women and 17% of men developed incident diabetes. Nearly one-fifth of the African American females and just under one-third of the males died during the study period.

Selectivity of Marriage

In Table 2 we show the associations between marital status and individual characteristics as well as the associations between marital status and health based on Visit 1 data among African Americans. For significance testing, all categories are compared with married. Compared with married individuals, those who were never married were significantly younger at baseline and those widowed were significantly older (53.2 years versus 56.4 years). On average, married people were more educated than unmarried people in the sample. Never married, divorced, separated, and widowed individuals were significantly more likely to be female compared with married individuals.

Compared with married individuals, widowed individuals had higher BMI scores. The mean physical activity score is fairly comparable across the marital status categories, but divorced, separated, and widowed people were less active. Married people were less likely to smoke than never married, divorced, or separated individuals. Never married individuals were most likely to report smoking at Visit 1. In general, married people had a somewhat healthier profile; however based on these cross-sectional analyses we cannot determine whether healthier people are more likely to get married or whether marriage improves an individual's health and health-related behaviors.

Unadjusted Associations Between Marital Status and Cardiovascular Outcomes and Death

In Table 3 we show the unadjusted associations between the cardiovascular outcomes of interest and marital status change between Visit 1 and Visit 2 with individuals organized into those who stayed in their original marital status categories and those who changed from one category to another in the preceding three years. In terms of prevalent hypertension, women who stayed single (never married, divorced, separated, or widowed) were more likely to have hypertension at Visit 2 (odds ratio [OR] = 1.21) compared with women who stayed married. For CHD, women who stayed single had a slightly elevated risk (hazard ratio [HR] = 1.29, $p < 0.10$) compared with women who stayed married. Both incident diabetes (HR = 1.34), and death (HR = 1.51) were more common for women who stayed single compared with women who stayed married. In the unadjusted models, all-cause mortality was more common in men who stayed single compared with those who stayed married (HR = 1.60). For males, the only statistically significant association observed between marital status and the outcomes was mortality—like females, males who stayed single were more likely to die during the observation period than their married counterparts.

The individual characteristics were in the expected direction—older participants and less-educated participants were, in general, more likely to experience poorer health outcomes than younger, better-educated participants. Compared with females, males were less likely to have hypertension and were more likely to develop CHD or die during the period of observation as shown by the significant sex coefficients in Table 3. In contrast, few individual characteristics were associated with incident diabetes—except education for women. Individual health status operated in the expected direction—people with higher BMIs were more likely to experience hypertension and incident diabetes than those with lower BMIs. Physical activity was protective against incident CHD and death for males. Females who smoke were at twice the risk of developing CHD and were more likely to die during the followup period compared with nonsmokers. The associations were the same for men, although smoking is a stronger predictor of mortality than of developing CHD for men. A higher HDL was protective against CHD and death, and a higher LDL was a risk factor for CHD for women and men, and death for women. Both men and women with prevalent hypertension and CHD were at increased risk of CHD and death, respectively, over the followup period than those without the conditions.

Adjusted Associations Between Marital Status and Cardiovascular Outcomes and Death

Block modeling was used to explore further the relationships between marital status and the outcomes after multivariable adjustment. We used block modeling to determine the set of variables that attenuated observed associations—the individual characteristics or both the individual and health status characteristics (only full models shown). As expected, many of the results were attenuated due to the strength of the other predictors (particularly individual characteristics) in the multivariable models. As shown in Table 4, for incident diabetes staying single and being female was associated with an increased risk of developing diabetes (HR = 1.38). In addition, men were 1.36 times more likely to die at a younger age if they remained single compared with married men. We found through block modeling that it was most often the addition of individual characteristics—such as age and education—that attenuated the relationship between the outcomes examined and marital status.

DISCUSSION

We find some limited support for our research questions and hypotheses in our data. Prevalent hypertension was significantly associated with staying single for women; however, it was explained by including demographic and health status variables in the fully adjusted model. Among men, hypertension was no more common among those who stayed single compared with those who stayed married or changed marital status. Thus, we found no support for Hypothesis 1.1. Marriage was generally protective against incident diabetes, particularly among women, and protective against mortality for men and women. The introduction of demographic factors attenuated the mortality results for women, but not for men. In contrast to expectations, incident CHD was unrelated to marital status. Thus, we have partial support for Hypothesis 2.1. In contrast to expectations was the lack of predictive power for changes in marital status and the outcomes under study. The lack of any marital status change findings might be due to the need to combine multiple marital status change categories into a single variable due to limited sample size for analysis. Thus, we have no

support for Hypothesis 2.2, but larger studies are needed to explore this hypothesis adequately.

Research among African American women with diabetes has found that they are more likely to be single than white women with diabetes (Melkus, Whittemore, & Mitchell, 2009). Unlike all other outcomes studied, individual characteristics were not strong predictors of diabetes. Women who stayed single between the first two study visits were much more likely to develop diabetes subsequently. These results suggest an effect of unmarried marital status on incident diabetes among African American women and the potential implications to target diabetes-prevention messages among this high-risk population.

Unmarried men in some studies have been shown to have an increased risk of mortality compared with married men (Ben-Shlomo, Smith, Shipley, & Marmot, 1993); research among women found an increased risk of mortality among never-married women (Cheung, 2000). Other researchers using data on both males and females from Scotland found an increased risk of all-cause mortality among all unmarried statuses for both sexes, except separated or divorced women (Molloy, Stamatakis, Randall, & Hamer, 2009). Our study showed that both men and women who remained single were more likely to die during followup than those who stayed married. However, for women, this association was attenuated in the presence of age and education.

There are a few limitations to this study. First, marital status is measured at an arbitrary point in midlife—when participants entered the ARIC data set. Additionally, there is no information on marital duration. Second, at Visit 1, 7% of participants had missing marital status data; although some data reentry decreased the initial number of missing data points, imputation was needed to be able to include the full sample of African American participants. Third, the marital status question did not have an option for cohabitation. As this category of marital status was not available, some participants who were cohabiting might have responded that they were single and others that they were married, leading us to analyze persons with similar marital status in different categories of marital status. Fourth, most persons in the sample did not change marital status between Visits 1 and 2, forcing us to combine very different marital status change categories into one overall change categorization, an issue previously highlighted as problematic in the literature (Ben-Shlomo, Smith, Shipley, & Marmot, 1993). Fifth, the period of followup during which marital status could change was short, three years; a longer followup period would have been ideal. Finally, data in this study come from two locations in the United States; therefore, these data are not nationally representative of all African Americans in the United States.

There are also strengths of this study. Namely, the outcomes were measured via three different routes: medical examination, self-report, and clinical record cross-reference. Therefore, in this study, disparities in health care access by socioeconomic status are less likely to affect accurate outcome measurement because these data do not rely only on self-reports of disease diagnoses. Also, the outcomes measured here included three cardiovascular diseases and all-cause mortality, as opposed to examining only cardiovascular disease overall or CHD alone. In addition, the followup period in this study

was quite long, a total of 13 years. Finally, the marital status measure was not limited to current marital status but included change in marital status between two points in time.

We found that individual characteristics, such as age and education, have a stronger affect on cardiovascular disease (except diabetes for women) and death (except for men) than marital status. Unmarried aging adults might need additional services and support both to prevent the onset of CHD as well as to develop healthier lifestyles. With the ability to look carefully at incident CHD, diabetes, and death, as well as markers of risk such as cholesterol and smoking, we found that individual characteristics override the effect of marital status in this high-risk community.

Although marital status, or changes in marital status, did not emerge as the most important predictor of the outcomes measured, we still find some consistency in the fact that individuals who remained single at both study time points experienced an elevated risk of cardiovascular outcomes and mortality using prospective data. Further studies are needed to determine the importance of change in marital status in predicting cardiovascular outcomes across racial and ethnic groups in the United States.

Conclusions

Although the United States currently is faced with many health care issues, the future is likely to hold even more challenges with an aging population, such as the ARIC cohort. Chronic disease incidence is increasing in the United States; this increase is expected to continue until high-risk individuals and groups are able to make significant lifestyle changes to improve their health, have better access to health care, receive high-quality health care, and have outlets for stress-reducing activities. African American women are a high-risk group for the experience of chronic disease and African American men have high mortality rates and increased risk for premature death. Reasons for the higher rates of chronic disease and premature mortality among the African American population could include repetitive experiences of discrimination, poor access to nutritious foods, limited access to safe areas to exercise, and lack of high-quality health care. Although many diseases have multiple causes—including some that are relatively immutable, such as genetic disposition—lifestyle issues and access to and use of drugs are increasingly seen as an important target for the prevention of cardiovascular diseases (Appel, 2009; Kazmi & Taylor, 2009; Williams et al., 2006). More attention is needed to address the risks that African Americans face to reduce their elevated risks of cardiovascular disease and premature mortality. Targeted primary prevention, increased access to the medical system, and early diagnosis are essential components for closing the racial gap in cardiovascular diseases and mortality in the United States.

Acknowledgments

The Atherosclerosis Risk in Communities Study is carried out as a collaborative study supported by National Heart, Lung, and Blood Institute contracts N01-HC-55015, N01-HC-55016, N01-HC-55018, N01-HC-55019, N01-HC-55020, N01-HC-55021, and N01-HC-55022. The authors thank the staff and participants of the ARIC study for their important contributions. The authors would also like to thank Mathematica and the Department of Health and Human Services for the funding of this research and the thoughtful manuscript reviews.

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Table 1

Background Characteristics of the Sample and Cardiovascular Outcomes by Sex

	Female	Male	Overall	
	%	%	%	n
Marital Status (1987–1989)				
Married	56.1	78.4	64.4	2,204
Never married	2.4	2.2	2.3	79
Divorced/separated	23.7	16.1	20.9	716
Widowed	17.8	3.3	12.4	426
Total	100.0	100.0	100.0	3,425
Marital Status Change (1987–1989 to 1990–1992)				
Stayed married	49.8	74.5	59.0	2,019
Stayed never married, divorced/separated or widowed	41.4	19.2	33.1	1,135
Any change	8.9	6.3	7.9	271
Married -> divorced/separated or widowed	6.3	3.9	5.4	(185)
Never married, divorced/separated or widowed -> Married	2.6	2.4	2.5	(86)
Total	100.0	100.0	100.0	3,425
Individual Characteristics (1987–1989)				
Age, mean years (44–66)	53.3	53.6	53.5	3,425
Education, % high school graduate	61.8	58.7	60.6	3,425
Sex, % female	--	--	63.0	3,425
Individual Health Status (1987–1989)				
BMI, mean kg/m ² (14–66)	30.7	27.8	29.7	3,425
Physical activity score, mean (1–5)	2.1	2.3	2.2	3,425
Smoke, % current smoker	22.8	36.5	27.9	3,425
Prevalent CHD, % yes	2.8	5.5	3.8	3,425
High-density lipoprotein, mean, (mg/dL)	58.1	49.9	55.1	3,425
Low-density lipoprotein, mean, (mg/dL)	138.6	138.1	138.4	3,425
Site, %				
Jackson, Mississippi	89.3	88.6	89.1	3,050
Forsyth County, North Carolina	10.7	11.4	11.0	375
Cardiovascular Outcomes				
Hypertension Prevalence				
Visit 1 (1987–1989)	59.9	53.9	57.7	3,425
Visit 2 (1990–1992)	57.6	52.7	55.8	3,402
Proportion developing events during followup:				
Coronary Heart Disease 1990–1992 to 2005	9.6	15.8	11.8	3,294
Diabetes, 1990–1992 to 1996–1998	18.2	16.8	17.7	2,708
Death, 1990–1992 to 2005	19.2	28.9	22.7	3,425

Table 2

Association of Marital Status with Baseline Background Characteristics

Characteristic 1987–1989	Married (n = 2,204)	Never Married (n = 79)	Divorced/Separated (n = 716)	Widowed (n = 426)
Individual Characteristics				
Age, mean years	53.2	51.7 [*]	52.8	56.4 ^{***}
Education, % high school graduate	65.2	44.3 ^{***}	56.0 ^{***}	47.9 ^{***}
Sex, % female	54.9	64.6 ⁺	71.5 ^{***}	90.1 ^{***}
Individual Health Status				
BMI, mean kg/m ²	29.6	29.0	29.4	30.3 [*]
Physical activity score, mean	2.2	2.1	2.1 ⁺	2.1 ⁺
Current smoker, % yes	25.1	40.5 ^{**}	35.1 ^{***}	27.9

Note: Chi-square and t-tests compare each category with married.

p 0.001;**
p 0.01;*
p 0.05;+
p 0.10.

Unadjusted Results of Cardiovascular Outcomes by Change in Marital Status, Background Characteristics, and Health, by Gender

Table 3

	Prevalent Hypertension (OR) 1990–1992			Incident Coronary Heart Disease (HR) 1990–2005			Incident Diabetes (HR) 1990–1998			Death (HR) 1990–2005		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
Marital Status Change 1987–1989 to 1990–1992												
Stayed married (reference)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Stayed single	1.21*	0.91	1.17*	1.29+	0.83	0.93	1.34*	1.09	1.27*	1.51***	1.60***	1.31***
Any change	1.15	0.90	1.09	1.23	0.88	0.96	0.86	0.68	0.80	1.38+	0.84	1.05
Individual Characteristics (1987–1989)												
Age	1.07***	1.05***	1.06***	1.07***	1.07***	1.07***	1.00	0.99	1.00	1.10***	1.09***	1.09***
Education (reference = < HS grad)	0.57***	0.69**	0.62***	0.50***	0.91	0.66***	0.76*	1.18	0.89	0.50***	0.61***	0.54***
Sex (reference = female)	--	--	0.82**	--	--	1.75***	--	--	0.93	--	--	1.58***
Individual Health Status (1987–1989)												
BMI, mean kg/m ²	1.06***	1.09***	1.07***	1.01	1.02	1.00	1.06***	1.11***	1.07***	1.01	1.00	1.00
Physical activity score	0.94	0.92	0.92+	0.85	0.75**	0.83*	1.16+	0.94	1.06	0.96	0.78**	0.90+
Smoke (reference = no)	0.96	0.93	0.92	2.01***	1.43*	1.82***	0.93	0.89	0.90	1.59***	1.99***	1.88***
Hypertension (reference = none)	--	--	--	3.21***	2.08***	2.43***	--	--	--	2.22***	2.09***	2.07***
HDL	--	--	--	0.97***	0.98**	0.97***	--	--	--	0.98***	1.00	0.99***
LDL	--	--	--	1.01***	1.01***	1.01***	--	--	--	1.00***	1.00+	1.00
Prevalent CHD	--	--	--	--	--	--	--	--	--	2.68***	2.75***	2.89***
N	2,140	1,262	3,402	2,096	1,198	3,294	1,691	1,017	2,708	2,157	1,268	3,425

Note: Total columns control for clustering at the spouse-pair level.

p 0.001;**
p 0.01;*
p 0.05;+
p 0.10.

-- = Not Applicable.

Cardiovascular Outcomes by Change in Marital Status by Gender, Adjusted for Individual Characteristics and Health Status Among African Americans

Table 4

	Prevalent Hypertension (OR) 1990–1992			Incident Coronary Heart Disease (HR) 1990–2005			Incident Diabetes (HR) 1990–1998			Death (HR) 1990–2005		
	Females	Males	Total	Females	Males	Total	Females	Males	Total	Females	Males	Total
Change in Marital Status 1987–1989 to 1990–1992												
Stayed married (reference)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Stayed single	1.07	1.01	1.05	0.97	0.79	0.91	1.38**	1.28	1.35**	1.18	1.36*	1.25**
Any change	1.05	0.93	1.02	1.03	1.01	1.03	0.86	0.62	0.78	1.17	0.91	1.09
Individual Characteristics (1987–1989)												
Age (centered)	1.07***	1.05***	1.06***	1.05***	1.06***	1.06***	0.99	1.00	1.00	1.08***	1.08***	1.08***
Education (reference = < HS grad)	0.74**	0.78+	0.76***	0.69*	1.09	0.84	0.90	1.21	1.01	0.69***	0.89	0.76***
Sex (reference = female)	--	--	0.96	--	--	1.49***	--	--	1.25*	--	--	1.52***
Individual Health Status (1987–1989)												
BMI	1.06***	1.10***	1.07***	1.00	1.00	1.00	1.06***	1.11***	1.07***	1.00	1.01	1.01
Physical activity score	0.96	0.95	0.96	0.89	0.75*	0.82*	1.23*	0.93	1.10	0.96	0.81*	0.89*
Smoke (reference = nonsmoker)	1.17	1.09	1.12	2.05***	1.64**	1.83***	1.04	1.05	1.03	1.70***	2.06***	1.92***
Hypertension	--	--	--	2.55***	1.85***	2.16***	--	--	--	1.67***	1.75***	1.73***
HDL	--	--	--	0.97***	0.98**	0.98***	--	--	--	0.99**	1.00	1.00
LDL	--	--	--	1.01***	1.01***	1.01***	--	--	--	1.00	1.00	1.00
Prevalent CHD	--	--	--	--	--	--	--	--	--	1.85***	2.29***	2.06***
N	2,140	1,262	3,402	2,096	1,198	3,294	1,691	1,017	2,708	2,157	1,268	3,425

Note: Total columns control for clustering at the spouse-pair level, all models control for site.

p 0.001;**
p 0.01;*
p 0.05;+
p 0.10

-- = Not Applicable.

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