ONLINE FIRST

The Cumulative Effect of Unemployment on Risks for Acute Myocardial Infarction

Matthew E. Dupre, PhD; Linda K. George, PhD; Guangya Liu, PhD; Eric D. Peterson, MD, MPH

Background: Employment instability is a major source of strain affecting an increasing number of adults in the United States. Little is known about the cumulative effect of multiple job losses and unemployment on the risks for acute myocardial infarction (AMI).

Methods: We investigated the associations between different dimensions of unemployment and the risks for AMI in US adults in a prospective cohort study of adults (N = 13 451) aged 51 to 75 years in the Health and Retirement Study with biennial follow-up interviews from 1992 to 2010. Unadjusted rates of age-specific AMI were used to demonstrate observed differences by employment status, cumulative number of job losses, and cumulative time unemployed. Cox proportional hazards models were used to examine the multivariate effects of cumulative work histories on AMI while adjusting for sociodemographic background and confounding risk factors.

Results: The median age of the study cohort was 62 years, and 1061 AMI events (7.9%) occurred during the 165 169 person-years of observation. Among the sample, 14.0% of subjects were unemployed at baseline, 69.7% had 1 or more cumulative job losses, and 35.1% had spent time unemployed. Unadjusted plots showed that age-specific rates of AMI differed significantly for each dimension of work history. Multivariate models showed that AMI risks were significantly higher among the unemployed (hazard ratio, 1.35 [95% CI, 1.10-1.66]) and that risks increased incrementally from 1 job loss (1.22 [1.04-1.42]) to 4 or more cumulative job losses (1.63 [1.29-2.07]) compared with no job loss. Risks for AMI were particularly elevated within the first year of unemployment (hazard ratio, 1.27 [95% CI, 1.01-1.60]) but not thereafter. Results were robust after adjustments for multiple clinical, socioeconomic, and behavioral risk factors.

Conclusions: Unemployment status, multiple job losses, and short periods without work are all significant risk factors for acute cardiovascular events.

Arch Intern Med.
Published online November 19, 2012.
doi:10.1001/2013.jamainternmed.447

Author Affiliations: Duke Clinical Research Institute (Drs Dupre and Peterson), Departments of Community and Family Medicine (Dr Dupre) and Sociology (Dr George), Division of Cardiology, Department of Medicine (Dr Peterson), and School of Law (Dr Liu), Duke University, Durham, North Carolina.

More than 1 million Americans experienced a first or a recurrent acute myocardial infarction (AMI) in 2010, and more than half died as a result.[1-4] Although major risk factors for coronary heart disease have been well documented (eg, inactivity, obesity, hypertension),[3,5-8] the effect of social stressors on AMI are still poorly understood. For more than a century, studies have shown that the lack of employment is a direct or indirect risk factor for poor health.[9-15] Unemployment has now been linked to a myriad of risk factors and deficient resources that may contribute to elevated rates of cardiovascular disease.[11,16-21] To date, however, the evidence has been based almost entirely on cross-sectional associations that ignore lifetime variability in employment, with its immediate and long-term consequences for cardiovascular health.[13,21-25]

According to the US Department of Labor, most adults will have had multiple jobs by middle age, and most will have had 1 or more periods of unemployment.[26-29] Although recent research has shown that job loss at older ages substantially increased risks of AMI,[30] the longitudinal evidence linking unemployment to cardiovascular events has been limited and inconclusive.[21,31] The purpose of the present study was to extend these findings and

See Invited Commentary

provide the first prospective investigation of the short- and long-term effects of multiple dimensions on risks for AMI. We used data from a nationally representative sample of middle-aged and older adults followed up biennially from 1992 to 2010 to examine the effect of unemployment status, cumulative job losses, and duration of unemployment on risks for AMI. The

associations were examined with adjustments for multiple socioeconomic, behavioral, psychological, and clinical factors. We also examined whether the associations between job instability and AMI risk differed by sex and race/ethnicity.

METHODS

STUDY POPULATION

We used nationally representative data from the Health and Retirement Study (HRS) for analysis. The HRS is an ongoing prospective cohort study of US adults older than 50 years sponsored by the National Institute on Aging and the Institute for Social Research at the University of Michigan, Ann Arbor.[32] The original HRS cohort included 9824 age-eligible respondents (ie, ages 51-61 years) who have been interviewed biennially since 1992. The initial participation rate was 81.7%, and reinterview rates were 93.7% for 1994 through 2010, with low rates of attrition due to nonresponse and lost tracking. Since 1998, the HRS has been supplemented with age-selective birth cohorts to replenish the nationally representative sample of older adults. Details of the multistage sampling design, implementation, and response rates have been documented in detail elsewhere.[32,33]

The analytic sample for the study included 13 451 participants from the original HRS birth cohort (1931-1941), the war baby cohort (1942-1947), and early baby-boomer cohort (1948-1953) who were first interviewed in 1992, 1998, and 2004, respectively, and reinterviewed through 2010. A person-year file was constructed from the respondents' age-specific cumulative exposure to AMI so that each observation was a record for every additional year beyond their age at entry in the study. Analyses were restricted to adults aged 51 to 75 years who reported having ever worked (95.8%). On average, HRS participants contributed approximately 8 person-years of exposure during the 18-year study period. A total of 1061 AMI events (7.9%) were reported during the 165 169 person-years of observation.

MEASUREMENT

We used more than 50 years of prospective and retrospective data from the HRS to reconstruct employment histories for each study participant. Information about past employment was collected at the respondents' baseline interview, and information about current jobs (and changes) was obtained from the prospective interviews. Work-history timing was ascertained from detailed responses to questions about the beginning and ending dates (in years and/or months) of all jobs reported by HRS participants. Although we could not confirm the retrospective dates of employment status and change, studies have shown substantial congruence between dates reported retrospectively and those reported by the same individuals in a panel design.[34] Nevertheless, recall or omissions (eg, brief employment in early adulthood) may have led to undercounts of the total number of jobs—and potential job losses—reported for some participants. The subjects' month- and year-specific information was converted to age-specific data using the dates of birth, interview, and event. Established literature and extensive preliminary analyses were used to determine the measures that were most psychometrically sound and substantively appropriate for analysis.

The complex coding of study measures was facilitated by using RAND HRS data files provided by the RAND Center for the Study of Aging and funded by the National Institute on Aging and the Social Security Administration.[35] Time-varying measures for each dimension of employment history were categorized as follows: employment status (employed or unemployed, excluding retirement), cumulative number of job losses (0, 1, 2, 3, or ≥4), and cumulative time unemployed (0, >0 to 1, 2 to 4, or ≥5 years). Job losses and their respective time-varying durations were defined by the age-specific ending and beginning dates of employment statuses. Retirement status (without active employment) also was included as a time-varying control (yes or no), and retirement status, transitions, and duration were excluded from the respective work-history measures. Adjustments for persons out of the labor force were not significant, and the variable was dropped from the analysis. Persons who were not employed and not retired were considered unemployed in this study. Preliminary analyses showed that bivariate correlations were relatively low among employment history variables (coefficients were 0.01 to 0.33, with a mean correlation of <0.10).

Multivariate models were adjusted for background sociodemographic factors, including age at study entry, sex, race/ethnicity (non-Hispanic white, non-Hispanic black, or Hispanic), marital status (married or not married), and geographic region (South or other). Several previously identified cardiovascular risks also were examined as possible factors contributing to the associations and included educational level (<high school education or ≥high school education), household income (lowest quartile or upper quartiles), health insurance coverage from any source (yes or no), current smoking status (yes or no), alcohol use (0, 1-2, or ≥3 drinks per day), vigorous physical exercise (<3 or ≥3 times per week), regular cholesterol screenings (within 24 months, yes or no), body mass index (calculated as weight in kilograms divided by height in meters squared; 25.0-29.9 [overweight] or ≥30.0 [obese]), hypertension (yes or no), diabetes mellitus (yes or no), any limitations in activities of daily living (yes or no), and number of depressive symptoms measured by the 8-item Center for Epidemiologic Studies Depression Scale. Preliminary analyses also included variables to adjust for the sampling of cohorts, number of children, timing of first employment, and primary occupational status; however, results were not significant and the variables were dropped from the final models. With the exception of baseline age, sex, and race/ethnicity, all covariates were time varying and time lagged (observed at the previous year) in the prospective analyses to establish temporal order when estimating the effects of the covariates on subsequent AMI, as previously shown.[36,37]

OUTCOME

Incidence of AMI was the main outcome for analysis. Study participants were asked whether they had "a heart attack or myocardial infarction" at each interview and in what year (and month after 1994) it occurred. Although subjects' reports of AMI are less precise than clinical data, studies have shown considerable consistency between diagnostic reports of health events from survey respondents and those from medical evaluations.[38-40] The short time between interviews (approximately 24 months) and the life-threatening nature of these events also minimized the potential for recall bias. For persons who experienced AMI, the outcome corresponds to the age of the event (calculated from the dates of birth and the event). For persons not experiencing AMI, the outcome corresponds to the age when respondents were last observed to be free of disease. Forty-one adults reported an AMI before baseline and were excluded. Three hundred twenty-nine subjects (2.4%) died during the study and were censored at their age of death. Of the 1061 AMIs, 92 (8.7%) were reported at ages that were difficult

Table 1. Characteristics of Study Participants From the Health and Retirement Study at Baseline[a]

	All (N = 13 451)	AMI Group (n = 1061)	Non-AMI Group (n = 12 390)	*P* Value[b]
Sociodemographic background				
Age, mean (SD), y	55.2 (3.3)	56.0 (3.5)	55.1 (3.3)	<.001
Male sex	6890 (51.2)	699 (65.9)	6191 (50.0)	<.001
Non-Hispanic black	2193 (16.3)	168 (15.8)	2025 (16.3)	.67
Hispanic	1232 (9.2)	72 (6.8)	1160 (9.4)	.005
Not married	3609 (26.8)	273 (25.7)	3336 (26.9)	.39
Living in the South	5378 (40.0)	490 (46.2)	4888 (39.5)	<.001
Employment status				
Employed	9924 (73.8)	687 (64.8)	9237 (74.6)	<.001
Unemployed	1881 (14.0)	170 (16.0)	1711 (13.8)	
Retired	1646 (12.2)	204 (19.2)	1442 (11.6)	
Cumulative No. of job losses[c]				
0	4079 (30.3)	293 (27.6)	3786 (30.6)	.31
1	4213 (31.3)	362 (34.1)	3851 (31.1)	
2	2538 (18.9)	188 (17.7)	2350 (19.0)	
3	1344 (10.0)	116 (10.9)	1228 (9.9)	
≥4	1277 (9.5)	102 (9.6)	1175 (9.5)	
Cumulative time unemployed, y[c]				
0	8728 (64.9)	708 (66.7)	8020 (64.7)	.007
>0 to 1	801 (6.0)	87 (8.2)	714 (5.8)	
2 to 4	1700 (12.6)	128 (12.1)	1572 (12.7)	
≥5	2222 (16.5)	138 (13.0)	2084 (16.8)	
Socioeconomic factors				
<High school educational level	3109 (23.1)	342 (32.2)	2767 (22.3)	<.001
Household income in lowest quartile	3156 (23.5)	312 (29.4)	2844 (23.0)	<.001
No health insurance	2079 (15.5)	196 (18.5)	1883 (15.2)	.005
Behavioral factors				
Current smoker	3469 (25.8)	398 (37.5)	3071 (24.8)	<.001
No alcohol consumption	4918 (36.6)	461 (43.4)	4457 (36.0)	<.001
Excess alcohol consumption	1636 (12.2)	89 (8.4)	1547 (12.5)	<.001
No vigorous exercise	9989 (74.3)	856 (80.7)	9133 (73.7)	<.001
No cholesterol screening	6616 (49.2)	375 (35.3)	6241 (50.4)	<.001
Clinical and psychological factors				
Overweight (BMI, 25.0-29.9)	5654 (42.0)	479 (45.2)	5175 (41.8)	.03
Obese (BMI, ≥30.0)	3389 (25.2)	318 (30.0)	3071 (24.8)	<.001
Hypertension	4498 (33.4)	513 (48.4)	3985 (32.2)	<.001
Diabetes mellitus	1246 (9.3)	180 (17.0)	1066 (8.6)	<.001
ADL disability	1265 (9.4)	184 (17.3)	1081 (8.7)	<.001
CES-D depressive symptoms, mean (SD)	1.9 (2.0)	2.6 (2.2)	1.8 (2.0)	<.001

Abbreviations: ADL, activities of daily living; AMI, acute myocardial infarction; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CES-D, Center for Epidemiologic Studies Depression Scale.

[a] Unless otherwise indicated, data are expressed as number (percentage) of participants. Percentages have been rounded and might not total 100.

[b] *P* values calculated by analysis of variance or χ^2 tests.

[c] Based on the cumulative number of job losses and years unemployed.

to distinguish temporally from the time of job loss. However, by design, the time-varying measures of job loss were time lagged to ignore job losses that were reported concurrently with AMI for these 92 subjects.[36,37]

STATISTICAL ANALYSIS

Baseline characteristics of the HRS sample were computed for all participants and by outcome. Comparisons by outcome were calculated with 2-tailed *t* tests for continuous and counted variables and χ^2 tests for categorical variables. We based *P* values on 2-tailed tests and considered $P < .05$ to represent statistical significance. Unadjusted plots were used to describe differences in age-specific rates of AMI for each time-varying dimension of employment. Cox proportional hazards models were used to estimate the hazard ratios (HRs) and 95% confidence intervals of AMI associated with employment status, cumulative number of job losses, and cumulative time unemployed. This method is particularly effective for using the rich time-varying data and for taking into account the temporal order of exposure to unemployment and AMI events.[37] The number of tied events relative to the number at risk was low (<1%), and partial likelihood estimation was nearly identical using Breslow (reported herein) and Efron approximations.

The first set of multivariate models examined the unadjusted associations for each of the 3 groups of work-history measures and AMI and adjusted associations that included age, sex, race/ethnicity, marital status, retirement, and geographic region. The second set of multivariate analyses examined the associations for all the work-history variables and AMI while adjusting for age, sex, race/ethnicity, marital status, retirement, and region. A final model adjusted for the confounding effects of additional cardiovascular risk factors. Variance inflation factors, tolerance levels, and condition values were used to confirm the absence of multicollinearity in the fitted models.[41,42] Interactions also were examined by sex and race/ethnicity.

Multivariate models were adjusted for the complex HRS sampling design to produce unbiased variance estimates. Tests of

interactions with analysis time and tests of Schoenfeld residuals using robust variance-covariance matrix estimation indicated that the proportional hazards assumption was not violated. Analyses were conducted using commercially available software.[43]

RESULTS

Characteristics of the study participants are presented in **Table 1**. Adults who had an AMI were more likely to be older, male, non-Hispanic, and living in the South than those without an event. Those who had low levels of education and income, had no health insurance, smoked, abstained from alcohol, failed to exercise, were overweight or obese, had been diagnosed with hypertension or diabetes mellitus, were disabled in their activities of daily living, or had depressive symptoms also had substantially higher levels of AMI than their counterparts. Rates of AMI were significantly higher in study participants who were unemployed and retired compared with employed participants ($P < .001$). Distributions of AMI were not significantly different for the cumulative number of job losses ($P = .31$), and there was an inverse trend between cumulative time unemployed and AMI ($P = .007$).

Unadjusted plots shown in **Figure 1** demonstrate significant differences ($P < .001$) in age-specific rates of AMI for each time-varying dimension of job history. **Figure 2** illustrates the unadjusted and sociodemographically adjusted HRs for the 3 work-history components related to AMI. Results showed that each major dimension of employment instability was significantly associated with incident AMI after adjusting for differences in age, race/ethnicity, marital status, retirement, and geographic region.

Table 2 reports the sociodemographically and fully adjusted associations between all the work-history variables and AMI. The initial model showed that unemployment status, cumulative number of job losses, and cumulative time unemployed were all associated with AMI independent of the other work-history dimensions. Model adjustments for sociodemographic, socioeconomic, behavioral, psychological, and clinical risk factors did not attenuate these effects. The fully adjusted model showed that unemployment status (HR, 1.35 [95% CI, 1.10-1.66]) and 1 (1.22 [1.04-1.42]), 2 (1.27 [1.05-1.54]), 3 (1.52 [1.22-1.90]), and 4 or more cumulative job losses (1.63 [1.29-2.07]) were independently associated with incident AMI. Risks of AMI were significantly elevated within the first year of being out of work (HR, 1.27 [95% CI, 1.01-1.60]) but not after longer periods of unemployment. The multivariate findings were significant and comparable to other major risk factors in the model, such as smoking (HR, 1.44 [95% CI, 1.24-1.68]), diabetes mellitus (1.51 [1.30-1.75]), and hypertension (1.62 [1.42-1.86]).

Although the magnitudes of the HRs were generally greater among men, Hispanics, and non-Hispanic blacks than among women and non-Hispanic whites, none of the interaction terms for sex and race/ethnicity were statistically significant.

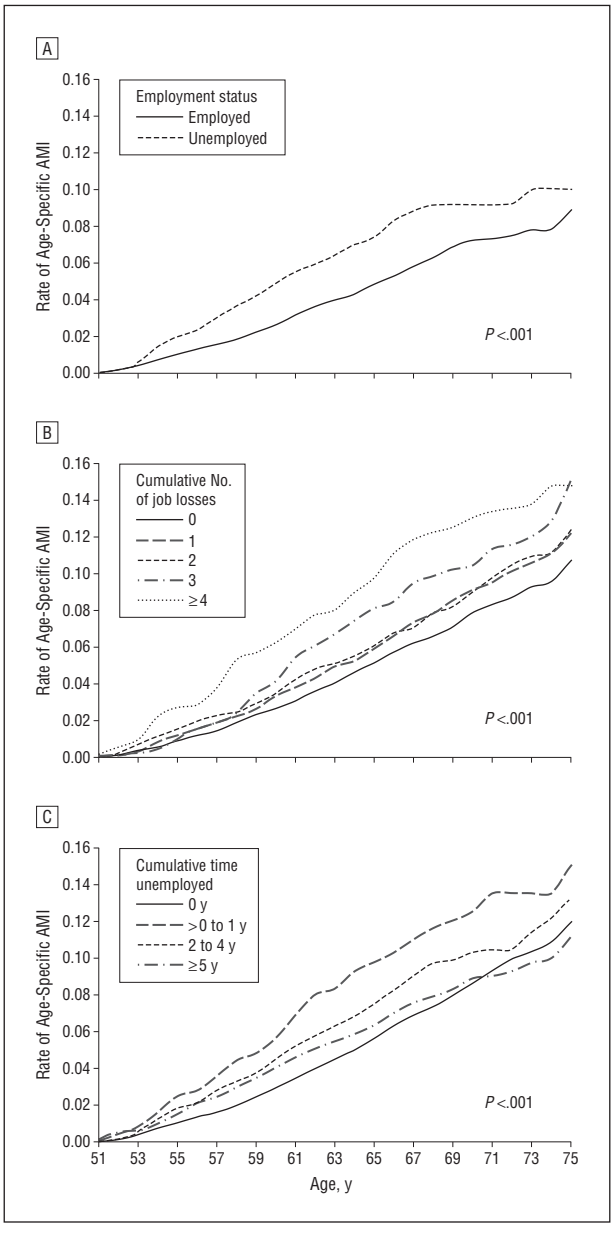

Figure 1. Unadjusted rates of age-specific acute myocardial infarction (AMI) by multiple dimensions of unemployment in US older adults. A, Employment status (unemployed excludes retired). B, Cumulative number of job losses. C, Cumulative time unemployed. *P* values are based on log-rank tests for group differences.

COMMENT

Our study is the first, to our knowledge, to examine the cumulative effect of multiple dimensions of unemployment on the risks for AMI. Results demonstrated that several features of one's past and present employment increased risks for a cardiovascular event. Although the risks for AMI were most significant in the first year after job loss, unemployment status, cumulative number of job losses, and cumulative time unemployed were each independently associated with increased risk for AMI. Disruptions in employment remained significant after adjustments for established cardiovascular risk factors. We found that the elevated risks associated with multiple job

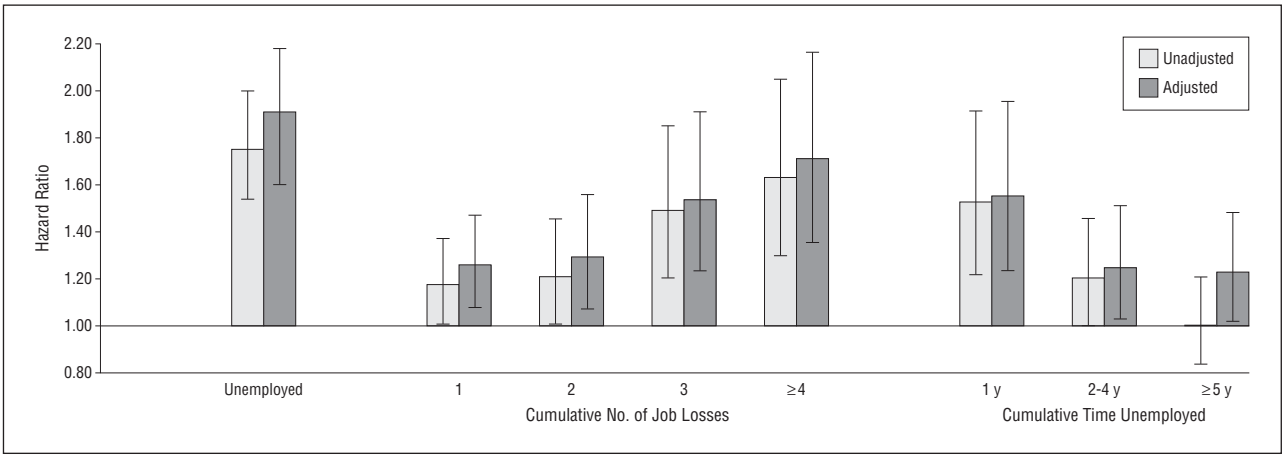

Figure 2. Risks for acute myocardial infarction by employment status, cumulative number of job losses, and cumulative time unemployed in US older adults (N = 13 451). Hazard ratios are adjusted for age, sex, race/ethnicity, marital status, retirement, and geographic region. Error bars indicate 95% confidence intervals.

Table 2. HRs for Acute Myocardial Infarction Associated With Employment Status, Cumulative Job Losses, and Cumulative Time Unemployed in 13 451 US Older Adults

	HR (95% CI)	
	Adjusted Model[a]	Full Model[b]
Employment status		
Employed	1 [Reference]	1 [Reference]
Unemployed	1.74 (1.42-2.14)	1.35 (1.10-1.66)
Retired	1.20 (0.97-1.48)	1.20 (0.97-1.48)
Cumulative No. of job losses		
0	1 [Reference]	1 [Reference]
1	1.19 (1.02-1.39)	1.22 (1.04-1.42)
2	1.24 (1.03-1.50)	1.27 (1.05-1.54)
3	1.47 (1.18-1.83)	1.52 (1.22-1.90)
≥4	1.62 (1.28-2.05)	1.63 (1.29-2.07)
Cumulative time unemployed, y		
0	1 [Reference]	1 [Reference]
>0 to 1	1.35 (1.07-1.69)	1.27 (1.01-1.60)
2 to 4	1.08 (0.89-1.31)	0.96 (0.79-1.17)
≥5	1.05 (0.87-1.28)	0.90 (0.74-1.09)

Abbreviation: HR, hazard ratio.

[a] Adjusted for age, sex, race/ethnicity, marital status, and geographic region.

[b] Adjusted for variables in the first model and educational level, income, health insurance, smoking, alcohol use, physical exercise, cholesterol screening, body mass index, hypertension, diabetes mellitus, activities of daily living disability, and Center for Epidemiologic Studies Depression Scale depressive symptoms.

losses were of the magnitude of other traditional risk factors, such as smoking, diabetes mellitus, and hypertension. In the context of the current US economy and projected increases in job instability and unemployment among workers,[28,29] additional studies should investigate the mechanisms contributing to work-related disparities in AMI to identify viable targets for successful interventions.

The present study demonstrates that cumulative exposure to unemployment increased risks for AMI and that the associations were not accounted for by conventional social, behavioral, psychological, or clinical factors. Overall, our results remained robust after adjustments for more than a dozen confounding factors. In addition, we found no evidence that differences in occupational status or time of entry in the work force (because of educational level, children, and/or health status) were related to the incidence of AMI when the 3 dimensions of employment history were taken into account. These findings were consistent in men and women and major race/ethnic groups, and they corroborate recent evidence linking involuntary job loss and AMI in older adults.[30]

The findings for the longitudinal association between employment instability and AMI complement and extend our understanding of lifetime exposure to cardiovascular risks. The association between job loss and AMI is analogous to risks attributable to smoking. Although current smoking status is a known risk factor for cardiovascular events, long-term patterns of tobacco use (ie, pack-years) are more powerful predictors of risk.[44,45] Likewise, the onset of hypertension or type 2 diabetes mellitus does not increase the risk for AMI; instead, the strain that these illnesses exact on the cardiovascular system over time increases the risk. Our findings for employment history largely mirror these protracted and cumulative associations.

Eliminating or lessening exposure to acquired risk factors undoubtedly reduces their toll on health outcomes, although lifetime risks may persist.[7] Smoking cessation, for example, reduces the risk for AMI; however, it does not eliminate the effect of total pack-years of tobacco use.[46,47] Likewise, reemployment may only in part diminish the negative effects of past disruptions and commensurate losses. An important area for future research will be to identify the extent to which reducing long-term exposure to risk factors lowers the odds of AMI and other health outcomes. A related line of inquiry should investigate whether unemployment earlier in adulthood can be ameliorated by biomedical, psychological, and social resources acquired later in life.

Major strengths of this study included the use of panel data from a large representative sample of middle-aged and older US adults, the use of retrospective histories and prospective data spanning almost 20 years, and multi-

variate hazards models that used time-varying covariates to estimate risks for AMI. Nonetheless, the study was not without limitations. Although the data were rich in the number and scope of measured covariates, we lacked data on certain clinical factors. For example, data were not available for the treatment and control of hypertension, diabetes mellitus, and hyperlipidemia before AMI or other prophylactic measures to reduce the likelihood of infarction (eg, prior revascularization). We also could not identify the characteristics of all jobs and the reasons for job loss. Studies have shown that the nature of work (eg, job strain and decision latitude) plays a role in the association between employment and AMI.[48,49] Although detailed measures of employment characteristics were not available, preliminary analyses showed that primary lifetime occupation had no effect on the findings. In addition, results indicated that voluntary transitions out of work (ie, retirement) were not associated with increased AMI, independent of age, health status, and other confounders. Future studies should consider whether other job-related factors (eg, seasonal employment, underemployment, multiple jobs, or family demands) may be sources of employment instability, stress, and increased cardiovascular events. The timing of job loss (eg, young vs old or in the context of family) is an additional dimension of unemployment that warrants investigation. Finally, although this study adjusts for a number of confounding risk factors, additional studies should examine the mechanisms by which different dimensions of employment history affect AMI at older ages.

CONCLUSIONS

Results from our large prospective cohort study demonstrated the powerful effect of one's lifetime employment history and cumulative job losses on risks for a major cardiovascular event. As rates of job instability continue to increase and unemployment reaches 30-year highs after recent constrictions to the US economy,[26,28,29] the cardiovascular costs of repeated job losses in younger cohorts are yet unknown. Although employment background is not amenable to medical intervention, knowledge about employment status, number of job losses, and the amount of time unemployed may help to identify individuals at elevated risk for AMI. Additional studies are needed to assess how such information can be used to target and aggressively treat vulnerable segments of the population.

Accepted for Publication: July 9, 2012.
Published Online: November 19, 2012. doi:10.1001/2013.jamainternmed.447
Correspondence: Matthew E. Dupre, PhD, Duke Clinical Research Institute, Duke University Medical Center, PO Box 17969, Durham, NC 27715 (matthew.dupre@duke.edu).
Author Contributions: Dr Dupre had full access to the data in the study and takes responsibility for the accuracy of the data analysis. *Study concept and design*: Dupre and George. *Acquisition of data*: Dupre and Peterson. *Analysis and interpretation of data*: Dupre, George, Liu, and Peterson. *Drafting of the manuscript*: Dupre. *Critical revision of the manuscript for important intellectual content*: Dupre, George, Liu, and Peterson. *Statistical analysis*: Dupre, Liu, and Peterson. *Administrative, technical, or material support*: George. *Supervision:* Dupre and Peterson.
Conflict of Interest Disclosures: None reported.
Disclaimer: The views expressed in this article are those of the authors and do not necessarily reflect those of Duke University.

REFERENCES

1. Lloyd-Jones DM, Larson MG, Beiser A, Levy D. Lifetime risk of developing coronary heart disease. *Lancet*. 1999;353(9147):89-92.
2. Xu J, Kochanek KD, Murphy S, Tejada-Vera B. Deaths: final data for 2007. *Natl Vital Stat Rep*. 2010;58(19):1-136. http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_01.pdf. Accessed January 20, 2012.
3. Roger VL, Go AS, Lloyd-Jones DM, et al; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2011 update: a report from the American Heart Association [published corrections appear in *Circulation*. 2011;123(6):e240 and *Circulation*. 2011;124(16):e426]. *Circulation*. 2011;123(4):e18-e209. doi:10.1161/CIR.0b013e3182009701.
4. Centers for Disease Control and Prevention; National Center for Health Statistics. Health Data Interactive. http://www.cdc.gov/nchs/hdi.htm. Accessed November 1, 2011.
5. Yusuf S, Hawken S, Ounpuu S, et al; INTERHEART Study Investigators. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART Study): case-control study. *Lancet*. 2004;364(9438):937-952.
6. Greenland P, Knoll MD, Stamler J, et al. Major risk factors as antecedents of fatal and nonfatal coronary heart disease events. *JAMA*. 2003;290(7):891-897.
7. Maruthur NM, Wang NY, Appel LJ. Lifestyle interventions reduce coronary heart disease risk: results from the PREMIER Trial. *Circulation*. 2009;119(15):2026-2031.
8. Zhao G, Ford ES, Li C, Mokdad AH. Are United States adults with coronary heart disease meeting physical activity recommendations? *Am J Cardiol*. 2008;101(5):557-561.
9. Price RH, Choi JN, Vinokur AD. Links in the chain of adversity following job loss: how financial strain and loss of personal control lead to depression, impaired functioning, and poor health. *J Occup Health Psychol*. 2002;7(4):302-312.
10. Kasl SV, Gore S, Cobb S. The experience of losing a job: reported changes in health, symptoms and illness behavior. *Psychosom Med*. 1975;37(2):106-122.
11. Kaplan GA, Keil JE. Socioeconomic factors and cardiovascular disease: a review of the literature. *Circulation*. 1993;88(4, pt 1):1973-1998.
12. Durkheim E. *Suicide: A Study in Sociology*. New York, NY: Free Press; 1897. Reprinted 1997.
13. O'Rand AM, Hamil-Luker J. Processes of cumulative adversity: childhood disadvantage and increased risk of heart attack across the life course. *J Gerontol B Psychol Sci Soc Sci*. 2005;60(special issue 2):117-124.
14. Kessler RC, House JS, Turner JB. Unemployment and health in a community sample. *J Health Soc Behav*. 1987;28(1):51-59.
15. Minnesota Population Center and State Health Access Data Assistance Center. Integrated Health Interview Series: Version 4.0. Minneapolis: University of Minnesota, 2011. http://www.ihis.us. Accessed November 5, 2011.
16. Centers for Disease Control and Prevention (CDC). Racial/ethnic and socioeconomic disparities in multiple risk factors for heart disease and stroke: United States, 2003. *MMWR Morb Mortal Wkly Rep*. 2005;54(5):113-117.
17. Holme I, Helgeland A, Hjermann I, Lund-Larsen PG, Leren P. Coronary risk factors and socioeconomic status: the Oslo study. *Lancet*. 1976;2(8000):1396-1398.
18. Van Domelen DR, Koster A, Caserotti P, et al. Employment and physical activity in the U.S. *Am J Prev Med*. 2011;41(2):136-145.
19. Hedblad B, Jonsson S, Nilsson P, Engström G, Berglund G, Janzon L. Obesity and myocardial infarction—vulnerability related to occupational level and marital status: a 23-year follow-up of an urban male Swedish population. *J Intern Med*. 2002;252(6):542-550.
20. Carson AP, Rose KM, Catellier DJ, Diez-Roux AV, Muntaner C, Wyatt SB. Employment status, coronary heart disease, and stroke among women. *Ann Epidemiol*. 2009;19(9):630-636.
21. Weber A, Lehnert G. Unemployment and cardiovascular diseases: a causal relationship? *Int Arch Occup Environ Health*. 1997;70(3):153-160.

22. Dupre ME, Beck AN, Meadows SO. Marital trajectories and mortality among US adults. *Am J Epidemiol*. 2009;170(5):546-555.
23. George LK. Sociological perspectives on life transitions. *Annu Rev Sociol*. 1993; 19:353-375. doi:10.1146/annurev.so.19.080193.002033.
24. Virtanen P, Vahtera J, Kivimäki M, Liukkonen V, Virtanen M, Ferrie J. Labor market trajectories and health: a four-year follow-up study of initially fixed-term employees. *Am J Epidemiol*. 2005;161(9):840-846.
25. Zhang ZM. Marital history and the burden of cardiovascular disease in midlife. *Gerontologist*. 2006;46(2):266-270.
26. US Bureau of Labor Statistics. *Number of Jobs Held, Labor Market Activity, and Earnings Growth Among the Youngest Baby Boomers: Results From a Longitudinal Survey*. Washington, DC: US Dept of Labor; 2010. USDL 10-1243.
27. US Bureau of Labor Statistics. National Longitudinal Survey of Youth 1979. http://bls.gov/nls/nlsy79r23unempbyedu.pdf. Accessed August 18, 2011.
28. US Bureau of Labor Statistics. *Number of Jobs Held, Labor Market Activity, and Earnings Growth Over Two Decades: Results From a Longitudinal Survey* . Washington, DC: US Dept of Labor; 2000. USDL 00-119.
29. Sincavage JR. The labor force and unemployment: three generations of change. *Monthly Labor Review*. 2004;127(6):34-41.
30. Gallo WT, Teng HM, Falba TA, Kasl SV, Krumholz HM, Bradley EH. The impact of late career job loss on myocardial infarction and stroke: a 10 year follow up using the Health and Retirement Survey. *Occup Environ Med*. 2006;63:683-687.
31. Gallo WT, Bradley EH, Falba TA, et al. Involuntary job loss as a risk factor for subsequent myocardial infarction and stroke: findings from the Health and Retirement Survey. *Am J Ind Med*. 2004;45(5):408-416.
32. Juster FT, Suzman R. An overview of the Health and Retirement Study. *J Hum Resour*. 1995;30(5):S7-S56.
33. Health and Retirement Study: a longitudinal study of health, retirement, and aging. Sponsored by the National Institute on Aging. http://hrsonline.isr.umich.edu. Accessed August 18, 2010.
34. Peters HE. Retrospective versus panel data in analyzing lifecycle events. *J Hum Resour*. 1988;23(4):488-513.
35. RAND HRS data, version L. RAND Center for the Study of Aging. Santa Monica, CA. http://hrsonline.isr.umich.edu/index.php?p=shoavail&iyear=X7. Accessed December 14, 2010.
36. Fisher LD, Lin DY. Time-dependent covariates in the Cox proportional-hazards regression model. *Annu Rev Public Health*. 1999;20:145-157.
37. Allison PD. *Survival Analysis Using the SAS System: A Practical Guide*. Cary, NC: SAS Institute; 1995.
38. Ferraro KF, Farmer MM. Utility of health data from social surveys: is there a gold standard for measuring morbidity? *Am Sociol Rev*. April 1999;64:303-315.
39. Guralnik JM, Fried LP, Williamson JD, Hochberg MC. *The Women's Health and Aging Study* . Bethesda, MD: National Institute on Aging; 1996. NIH publication 95-40009.
40. Harlow SD, Linet MS. Agreement between questionnaire data and medical records: the evidence for accuracy of recall. *Am J Epidemiol*. 1989;129(2):233-248.
41. Chatterjee S, Hadi AS, Price B. *Regression Analysis by Example*. 3rd ed. New York, NY: John Wiley & Sons Inc; 2000.
42. Kleinbaum DG, Kupper LL, Muller KE, Nizam A. *Applied Regression Analysis and Other Multivariable Methods*. Pacific Grove, CA: Duxbury Press; 1998.
43. StataCorp. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP; 2011.
44. Tracy RP, Psaty BM, Macy E, et al. Lifetime smoking exposure affects the association of C-reactive protein with cardiovascular disease risk factors and subclinical disease in healthy elderly subjects. *Arterioscler Thromb Vasc Biol*. 1997; 17(10):2167-2176.
45. Howard G, Wagenknecht LE, Burke GL, et al. Cigarette smoking and progression of atherosclerosis: the Atherosclerosis Risk in Communities (ARIC) Study. *JAMA*. 1998;279(2):119-124.
46. Lim SH, Tai BC, Yuan JM, Yu MC, Koh WP. Smoking cessation and mortality among middle-aged and elderly Chinese in Singapore: the Singapore Chinese Health Study [published online December 14, 2011]. *Tob Control*. doi:10.1136/tobaccocontrol-2011-050106.
47. Ockene JK, Kuller LH, Svendsen KH, Meilahn E. The relationship of smoking cessation to coronary heart disease and lung cancer in the Multiple Risk Factor Intervention Trial (MRFIT). *Am J Public Health*. 1990;80(8):954-958.
48. Hammar N, Alfredsson L, Johnson JV. Job strain, social support at work, and incidence of myocardial infarction. *Occup Environ Med*. 1998;55(8):548-553.
49. Karasek RA, Theorell T, Schwartz JE, Schnall PL, Pieper CF, Michela JL. Job characteristics in relation to the prevalence of myocardial infarction in the US Health Examination Survey (HES) and the Health and Nutrition Examination Survey (HANES). *Am J Public Health*. 1988;78(8):910-918.