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Involuntary Job Loss as a Risk Factor for Subsequent Myocardial Infarction and Stroke: Findings From the Health and Retirement Survey

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Background The role of stress in the development of cardiovascular disease is well established. Previous research has demonstrated that involuntary job loss in the years immediately preceding retirement can be a stressful life event shown to produce adverse changes in physical and affective health. The objective of this study was to estimate the risk of myocardial infarction (MI) and stroke associated with involuntary job loss among workers nearing retirement in the United States.

Methods We used multivariable survival analysis to analyze data from the first four waves of the Health and Retirement Survey (HRS), a nationally representative sample of older individuals in the US. The analytic sample includes 457 workers who experienced job loss and a comparison group of 3,763 employed individuals.

Results The results indicate that involuntary job loss is not associated with subsequent risk of MI (adjusted HR = 1.89; 95% CI = 0.91, 3.93); the risk of subsequent stroke associated with involuntary job loss is more than double (adjusted HR = 2.64; 95% CI = 1.01, 6.94).

Conclusions Our findings present new data to suggest that involuntary job loss should be considered as a plausible risk factor for subsequent cardiovascular and cerebrovascular illness among older workers.

Keywords

job loss; unemployment; incidence; myocardial infarction; stroke

INTRODUCTION

Involuntary job loss in the years immediately preceding retirement can be a stressful event that has been shown to be associated with adverse health and behavioral consequences [Gallo et al., 2000,2001]. Older workers are at increased risk for negative outcomes for a number of reasons. First, workers nearing retirement age are often ill prepared to finance post-employment consumption [Bernheim, 1997]. Second, high pre-displacement wages and non-portable experience may limit reemployment opportunities, resulting in extended unemployment spells [Fallick, 1996;Farber, 1996;Polsky, 1999;Chan and Stevens, 2001]. Research also indicates that the wages of older workers are significantly reduced upon reemployment [Couch, 1998].

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Finally, older individuals also have a greater burden of preexisting financial, social, and medical factors than do younger individuals.

Given substantial epidemiologic evidence indicating the significant role of stress in cardiovascular diseases [Dorian and Taylor, 1984; Rozanski et al., 1999; Kubzansky and Kawachi, 2000], it is plausible that workers who experience involuntary job loss may be at increased risk of such diseases, including myocardial infarction (MI) and stroke. For many older individuals, involuntary job loss is not only associated with a substantial loss of income, but also the severance of work-based social interactions [Iversen and Klausen, 1986] and the stigma of unemployment, which may produce stress. Such stress may, in turn, lead to negative emotions, such as anxiety and depression. Recent reviews of published research [Rozanski et al., 1999; Kubzansky and Kawachi, 2000] conclude that chronic states of anxiety and prolonged depression are consistently associated with elevated risk of coronary heart disease (CHD) events, including both fatal and non-fatal MI.

A number of studies have investigated the relationship between national unemployment rates and the prevalence of various health outcomes related to cardiovascular risk. This research, which was conducted on populations rather than on individuals, has revealed significant associations between unemployment and cardiovascular mortality [Jin et al., 1995; Weber and Lehnert, 1997] and cerebrovascular mortality [Brenner, 1983; Ahmed et al., 1989; Franks et al., 1991]. However, such ecologic studies present aggregate data, and thus cannot confirm that job loss increases cardiovascular disease in individuals.

At the individual level, both cross-sectional and longitudinal studies of the association between unemployment and cardiovascular and cerebrovascular disease have been undertaken. The cross-sectional research [Cook et al., 1982; Iversen et al., 1987; Martikainen, 1990; Brackbill et al., 1995] has found modestly increased prevalence of CHD [Cook et al., 1982], cardiovascular symptoms [Iversen et al., 1987], prevalence of hypertension [Brackbill et al., 1995], and cardiovascular and cerebrovascular mortality [Martikainen, 1990] among unemployed versus employed workers.

The longitudinal research is limited to four relevant studies [Kasl and Cobb, 1980; Iversen et al., 1989; Janlert, 1992; Schnall et al., 1992], and has reported mixed results. In a Danish study of 880 laid-off shipyard workers and 441 controls from another shipyard where no layoffs occurred, Iversen et al. [1989] found among the laid-off workers higher rates of hospital admissions for cardiovascular diseases in a 3-year follow-up period. In a study of 297 laid-off Swedish building laborers, Janlert [1992] reported that those who remained unemployed within the 2-year follow-up had significantly increased blood pressure over the follow-up period relative to reemployed workers. In contrast, the remaining longitudinal studies [Kasl and Cobb, 1980; Schnall et al., 1992], both conducted in the United States, found less evidence of an association between job loss and subsequent cardiovascular risk. Studying workers displaced in a plant closing, Kasl and Cobb [1980] reported that, while blood pressure was modestly increased during the anticipation phase prior to plant closing, this increase did not persist after termination. Schnall et al. [1992], in a study of 139 laid-off employees from a brokerage firm, found limited support for increased blood pressure levels in the anticipation phase, as reported by Kasl and Cobb [1980], but discovered no evidence of a persistent elevation in these levels. The authors of a recent, comprehensive review of the literature [Weber and Lehnert, 1997] have concluded that job loss should not be viewed as a risk factor for poor cardiovascular outcomes.

There are several reasons why the existing research leaves our understanding of the relationship between involuntary job loss and cardiovascular/cerebrovascular disease limited. First, much of the evidence is ecologic, and thus does not represent the experience of individuals. Second,

while several studies indicate a cross-sectional association between unemployment and cardiovascular disease, the causal direction of these associations cannot be inferred. Third, longitudinal studies, whose methodology is better suited to assess any causal relationship, are few, and offer somewhat contrary findings. Fourth, each of the relevant longitudinal studies of involuntary job loss and cardiovascular risk examined a relatively small, selected group of younger individuals, and with one exception [Iversen et al., 1989], assessed changes in blood pressure and serum cholesterol rather than MI or stroke. Moreover, just two of the longitudinal studies [Kasl and Cobb, 1980; Schnall et al., 1992] were conducted in the United States, and none studied older workers. And finally, we could find no study that examined the influence of involuntary job loss on the onset of specific cardiovascular or cerebrovascular outcomes, such as subsequent MI or stroke, as we do in this research.

The objective of this study is to estimate the risk of onset of MI and of stroke associated with involuntary job loss among workers nearing retirement relative to individuals who continue to work. This is a companion study to our earlier studies investigating the impact of job loss on subsequent physical functioning and mental health [Gallo et al., 2000], and subsequent alcohol consumption [Gallo et al., 2001].

MATERIALS AND METHODS

Study Design and Data

This prospective study uses data from the first four waves (1992, 1994, 1996, and 1998) of the Health and Retirement Survey (HRS). The HRS is a national, longitudinal survey designed to investigate the experiences of older workers as they advance into retirement, with particular emphasis on health outcomes. These data are especially well suited to this research for a number of reasons. The HRS is a national survey, is limited exclusively to older adults, and is of unprecedented size. More importantly, the HRS is the only survey of such magnitude and focus to combine considerable information on employment and health.

HRS data are collected at 2-year intervals, and collection of 12 waves of data is planned. At the 1992 baseline, HRS included a sample of 12,652 participants from 7,702 households. In-home, face-to-face interviews were taken from individuals born between 1931 and 1941 and their spouses. Certain subgroups (Blacks, Hispanics, and Florida residents) were oversampled. In 1994, 11,602 respondents from 7,093 households were re-interviewed; in 1996, 11,200 respondents from 7,052 households were re-interviewed. Preliminary estimates indicate that 10,856 individuals were re-interviewed in 1998. Follow-up interviews were conducted by telephone or mail. The HRS is described in greater detail elsewhere [Juster and Suzman, 1995]. HRS data collection is conducted by the Institute for Social Research at the University of Michigan. The National Institute on Aging is the primary funding organization of the Survey.

Analytic Samples

To isolate workers at risk for involuntary job loss, we first identified age-eligible individuals (primary respondents and spouses within the same 10-year age cohort) who reported working at the 1992 baseline ($N = 4,730$), and who were not self-employed. Of the 4,730 individuals, 510 (10.8%) were eliminated due to missing data. Of the 510 with missing data, 114 were missing the type of employment transition, 341 were missing the transition date, and 27 age-eligible participants had a missing person-level sampling weight. Twenty were missing labor income information, 6 had missing race information, and 4 were missing an occupation code. Nine individuals were missing the date of MI, and 18 lacked the date of stroke. The final analytic sample numbered 4,220 individuals.

Next, using retrospective data provided at the 1994, 1996, and 1998 follow-up surveys, we investigated employment transitions of these individuals. Of the total sample ($N = 4,220$), 1,354 individuals were employed without interruption during the 6-year study period; the remainder experienced at least one employment transition. For simplicity, we count only the first such transition. Of the workers with employment transitions, 457 experienced involuntary job loss, 873 retired, 361 reported a temporary work interruption after which they returned to their employers, and 791 left the labor force for “other” reasons. “Other” reasons included quitting, leaving for a better job, or exiting for family care or disability. Finally, 384 individuals either died or were lost to follow-up. These 384 participants were included in the analytic sample because their relevant data are available until the survey prior to their death or attrition.

Differences between individuals included in the analytic samples and those eliminated because of missing data were assessed using appropriate bivariate methods (t-tests and chi-square analysis). Survey participants excluded because of missing data were more likely to experience displacement between survey waves ($P < 0.001$), report diabetes ($P < 0.05$), and be obese ($P < 0.05$) at the baseline than members of the analytic samples. They were less likely to be female ($P < 0.05$).

Outcome Variables

The outcome variables of interest in this study were time in months from the baseline (1992) interview to onset of MI or stroke. For respondents who did not report experiencing an MI or a stroke, the outcome variable was the number of months from the baseline (1992) survey to the month of last follow-up. The month of last follow-up is the 1998 survey date for the continuously employed, the employment transition date for workers reporting job exits, and the survey date prior to attrition for those who died or were lost to follow-up. In all cases, we added one to the number of months so that observations for which a health event or job transition occurred in the initial survey month would be counted in the analysis.

We ascertained the occurrence of an MI based on responses to the following survey questions, asked of survey participants at each administration: “since [last interview date] has a doctor told you that a heart attack, CHD, angina, congestive heart failure, or other heart problems?” [If so] “Did you have a heart attack or MI?” Respondents were then asked for the date of the MI. In the case of multiple heart attacks, interviewers requested the most recent one. Ascertainment of the occurrence of a stroke was based on a single question: “since [last interview date] has a doctor told you that you had a stroke?” In the case of a positive response, participants were next asked for the date on which the stroke occurred.

In 1994, HRS respondents who indicated they had an MI or stroke during the follow-up period between 1992 and 1994 were asked only the year in which that event occurred. In later survey years, information on both the month and year were collected. Thus, for the 1992-1994 interval, months to MI or stroke could not be directly calculated. For each of the onset cases occurring in this interval, we combined information on the 1992 and 1994 survey dates and the year of diagnosis to create the narrowest possible interval in which it is certain that the event took place. We then imputed the onset month by randomly selecting 1 month in that interval.

Exposure Variable

The exposure variable in this investigation was a binary variable for involuntary job loss. Involuntary job loss was measured as job exit due to either plant closing or layoff. We treated involuntary job loss as a time-dependent variable [Crowley and Hu, 1977]. Therefore, in most cases, participants who experienced involuntary job loss have two data records. The first observation describes their experience prior to job loss, and the time in this observation is therefore contributed to the unexposed (working) group. The second describes their experience

subsequent to job loss, and the time in this observation contributed to the exposed (in-voluntary job loss) group. The exception to the two observation case is the group of displaced workers who had an MI or stroke that occurs prior to the date of the job loss. Such persons have only one observation; the time in this observation is contributed to the unexposed (working) group, and they were assigned the time to the event date.

Control Variables

Potential risk factors for disease onset were considered from six domains: demographic, economic, health behaviors/life style, medical, psychological, and functional. Risk factors were selected based on existing evidence of their influence in the development of cardiovascular [Cullen et al., 1998; Wilson et al., 1998; Grundy et al., 1999] and cerebrovascular [Kannel et al., 1970; Wolf et al., 1991; Wolf, 1993; Broderick et al., 1998; Sacco et al., 1999; Wolf and Grotta, 2000] disease. Demographic controls include age, gender, race (white vs. non-white), marital status, and years of education. Economic factors include length of service at the current job (greater than 3 years vs. fewer), occupation class (blue collar vs. white collar), job characteristics, and income. Job characteristics (“My job involves a lot of stress;” “My job requires me to do more difficult things than it used to;” “My employer would let older workers move to move to a less demanding job with less pay if they wanted to;” “I really enjoy going to work”) were assessed on a four-point response, and proxy job stress, job control, dynamic employment conditions/adaptation, and job satisfaction. Reviews of occupational health [Schnall et al., 2000] provide evidence of an association between workplace factors and cardiovascular disease. Income (annualized individual labor earnings for the year prior to baseline) values were divided by 10,000 for consistency of scale, and the natural log was taken to reduce the considerable influence of a single outlier.

Health behaviors/life style controls include tobacco use (smoker vs. non-smoker) and problem drinking (problem drinker vs. non-problem drinker), as defined by responses to the CAGE Questionnaire [Ewing, 1984]. Medical risk factors include binary variables representing the following self-reported chronic conditions: angina, hypertension, diabetes, high cholesterol, and obesity [Flegal et al., 1998], as well as controls for having a history of the conditions investigated. Previous MI was also tested as a predictor of stroke [Lichtman et al., 2002]. The psychological domain includes baseline mental health (range: 0-8; higher values imply poorer mental health), while the functional domain includes baseline physical functioning (range: 0-15; higher values imply poorer function) and physical activity (vigorous physical activity three or more times per week vs. other). Our measures of physical functioning and mental health are described in greater detail in our earlier research [Gallo et al., 2000].

Data Analyses

The objective of this study was to compare the risk of developing MI or stroke among workers who experience involuntary job loss to those who continue to work. To address this objective, we used survival analysis, implemented with the Cox proportional hazards regression [Cox, 1972]. Survival analysis is preferable to traditional cohort (logistic) analysis in this research because survival analysis allows us to describe not only the frequency of occurrence of the two outcomes of interest, but also the time process underlying their occurrence. In a practical sense, this means that with survival analysis, all participants contribute data (time) to the analysis algorithm until a job transition or attrition occurs, whereas with cohort analysis, a significant number of participants would be excluded. That is, in a cohort study comparing displaced workers to working individuals (over 6 years, in this case), participants who make non-involuntary job loss employment transitions and those lost to follow-up before the end of observation would necessarily be excluded.

Separate models were estimated for the MI and stroke outcomes, and the effect of job loss on the outcome was ascertained by the hazard rate associated with the time-dependent binary variable for involuntary job loss. In the Cox model, this hazard rate is interpreted as the relative risk of survival to a disease event for workers who experience an involuntary job loss versus those who do not.

Both bivariate and multivariate proportional hazards models were estimated. The multivariate models were fit using a backward variable selection procedure. Thus, we first estimated the models with the exposure variable and all other potential risk factors. Next, to achieve model parsimony, we removed non-significant covariates from the model iteratively, initially eliminating those variables that added least to the model. With the removal of each covariate or covariates, we assessed the effect of the exclusion of the non-significant variable(s) on the remaining parameter estimates. Covariates were removed if they were non-significant ($P > 0.15$), and if their removal did not change the remaining parameter estimates by more than 20%. Finally, we tested the proportional hazards assumption both globally and on each of the individual variables in the reduced models, and in the case of test failure, identified responsible variables [Grambsch and Therneau, 1994]. In the MI model, the variable indicating a previous MI was found to produce the failure of the global proportional hazards test. We, therefore, stratified the baseline hazard according to previous MI status [Therneau and Grambsch, 2000] to prevent a violation of the key assumption of proportional hazards for this regression model.

The survival models were fit with S-PLUS Version 6.0. All analyzes were weighted by the person-level analysis weight, which was provided by the HRS. This weight is the product of the household analysis weight, the respondent selection weight and the person-level post-stratification weight.

RESULTS

Descriptive Results

Table I provides weighted means of variables used in the analyzes, stratified by involuntary job loss. In the case of binary variables, table values represent weighted proportions. Overall, the analytic sample is about half female and 84% white. Sample members averaged 55 years of age, over 12 years of education, and \$30,173 in annual labor income. Roughly three-quarters of the sample are married. Regarding health, 4% of participants reported a previous MI, one-quarter reported smoking cigarettes, one-quarter reported high cholesterol, about one-third reported high blood pressure, 7% reported diabetes, and 2% reported angina. Based on body mass, one in five sample members was found to be obese; using the CAGE criteria, 12% of sample members were considered to be problem drinkers. The baseline mental health score (range: 0-8) averaged 0.56, and the baseline physical function score (range: 0-15) averaged 2.46.

Unadjusted differences in baseline characteristics between workers who experienced involuntary job loss and those who did not were assessed by t-tests. Significant differences were detected in several variables. Workers who experienced involuntary job loss had, on average, fewer years of education ($P < 0.001$), less labor income ($P < 0.05$), and poorer baseline mental health scores ($P < 0.001$). They were also less likely ($P < 0.001$) to have more than 3 years of service (tenure) in their jobs at baseline.

Over the 6 years studied, 11% of sample members experienced involuntary job loss. A total of 111 (2.4%) sample members reported an MI, and 75 (1.8%) reported a stroke. One hundred of the MIs were reported by members of the working (unexposed) group; the raw incidence rate in this group was 7.08 events per 1,000 person-years. The remaining 11 MIs occurred in the

job loss (exposed) group; the raw incidence rate in this group was 12.56 events per 1,000 person-years. Of the strokes, 67 occurred in the working group, and 8 occurred in the group of job losers. The raw incidence rates of stroke of the working and involuntarily unemployed are 4.74 and 8.95 events per 1,000 person-years, respectively.

Survival Analysis Results

Results of the survival analyses are presented in Table II. For both outcomes (MI and stroke), both unadjusted and adjusted hazard ratios (with associated 95% CI) are presented. The hazard ratios are interpreted as the relative risk of survival to the outcome associated with involuntary job loss.

The results indicate that involuntary job loss not associated with increased risk of MI, both unadjusted for covariates (unadjusted HR = 1.85; 95% CI = 0.89, 3.83), and when controlling for other risk factors (adjusted HR = 1.89; 95% CI = 0.91, 3.93). Two risk factors were found to be significant in the multivariable MI model. Smoking (adjusted HR = 3.90; 95% CI = 2.32, 6.55) and hypertension (adjusted HR = 3.45; 95% CI = 2.00, 5.94) are strongly associated with risk of MI.

Our findings indicate a statistically significant association ($P < 0.05$) between involuntary job loss and subsequent stroke. The unadjusted risk of stroke for sample participants who experience job loss is more than 2.7 times that of people who continue to work (unadjusted HR = 2.72; 95% CI = 1.05, 7.06). The risk of stroke remains large and statistically significant (adjusted HR = 2.64; 95% CI = 1.01, 6.94) in the reduced multivariable model, in which one additional relevant covariate, obesity, was retained in the final model. The results also suggest a strong, but non-significant ($P < 0.10$) relationship between obesity (adjusted HR = 2.15; 95% CI = 0.94, 4.92) and the risk of stroke.

DISCUSSION

The findings of this study indicate that involuntary job loss among older workers is associated with increased risk of subsequent stroke. Further, the magnitude of the effect of involuntary job loss on stroke measured in this study is quite large. Our results suggest that late-career involuntary job loss more than doubles the risk of subsequent stroke. This estimated effect persisted despite adjustments for potential risk factors that might confound the relationship between unemployment and subsequent disease.

The results of this research are generally supportive of those of a number of population-level studies [Brenner, 1983; Ahmed et al., 1989; Franks et al., 1991; Brackbill et al., 1995; Jin et al., 1995; Weber and Lehnert, 1997] which reported cross-sectional associations between employment rates and cardiovascular or cerebrovascular mortality. It is more difficult to relate our findings to those reported in individual-level longitudinal studies [Kasl and Cobb, 1980; Iversen et al., 1989; Janlert, 1992; Schnall et al., 1992], which are far fewer, and whose results are somewhat equivocal. Moreover, among the longitudinal studies, three have assessed high blood pressure rather than MI, and none has explored stroke as an outcome. The findings from this research are somewhat contrary to those of the Danish [Iversen et al., 1989] study, which indicated an increased risk of hospitalization for MI among unemployed shipyard workers. One must, however, interpret this comparison with caution, since the earlier research primarily studied manual workers, the majority of whom were male, whereas the current study analyzes older workers of both sexes who represent a broad range of occupations.

Our findings present new data to suggest that involuntary job loss, at least among older workers, should be considered a plausible risk factor for subsequent cardiovascular and cerebrovascular illness. Although our data cannot assess possible mechanisms underlying this longitudinal

association, there is evidence that the social and economic deprivation associated with job loss may be related to higher levels of depressive symptoms [Gallo et al., 2000; Kasl and Jones, 2000], and may also create stress and anxiety, which may be responsible for the etiologic response observed in the increased risk of MI and stroke estimated in this research. We must recognize, however, that while this is a plausible pathway, it is likely not unique to involuntary job loss, and one could hypothesize such a pathway for several of the other job transitions not investigated in this study, most notably retirement. Nonetheless, identifying such mechanisms would be helpful for establishing not only longitudinal, but also causal, linkages between involuntary job loss and subsequent disease onset.

Several strengths of the study broaden previous research on this topic. The first strength relates to methodology. To our knowledge, this is the first study that employs survival analysis to prospectively estimate the effect of involuntary job loss on the risk of MI or stroke. The chief advantage of such an approach is that it allows the researcher to account for at least part of the time-dependency of the exposure (i.e., involuntary job loss) and the temporal sequence of the exposure and the health event (i.e., MI or stroke). The technique thereby improves the precision and accuracy of the risk estimates obtained, which is important in light of the fact that Weber and Lehnert [1997], in their review of the literature on unemployment and cardiovascular diseases, point to “severe methodologic shortcomings” as the principal reason why one cannot definitively associate unemployment with cardiovascular disease in a causal sense.

Despite its advantages, the approach taken in this study does not, however, describe the entirety of the transition experience. That is, from the time of exposure, our method treats job loss as an absorbing state, ignoring the post-job loss component of its time-dependency. Thus, after a participant experiences job loss, any later transitions are not accounted for in the analysis, creating the possibility of non-differential exposure misclassification. Among the 11 displaced workers who reported a subsequent MI, 4 individuals reported 5 other non-job loss transitions (3 “other” job exits, 1 retirement, 1 temporary unemployment spell). Of these five transitions, three occurred between the date of the job loss and that of the MI, and two occurred after the MI event. Of the eight displaced workers who reported a stroke, two individuals indicated four “other” transitions. One of the three transitions occurred between the dates of the job loss and stroke, whereas the remaining three were dated subsequent to the stroke. Such numbers suggest that the extent of multiple transitions may be non-trivial. Nonetheless, the “single-state” method is appropriate for the limited number of events encountered in these data. When further waves of HRS data are released, with expanded numbers of events, we expect to reanalyze the data with a “multi-state” model [Therneau and Grambsch, 2000], which allows for multiple transitions.

The second strength relates to the data. The data are individual level, and the sample analyzed in this study was drawn from a large, nationally representative sample of older individuals, who are observed over a period of 6 years. Thus, while the HRS was not developed with the specific intention of estimating the risk of disease onset associated with involuntary job loss, the size and 6-year follow period up of the survey permit such an investigation. The final advantage relates to novelty. This is the first study to explore the impact of job loss on stroke, a rare outcome, but one that is moderately prevalent in the age cohort on which the study was conducted.

As a secondary data analysis, this investigation was, however, constrained by the limits of the HRS data. Most importantly, incident MI and stroke are based on respondent self reports with no histologic confirmation. The potential for bias inherent in the self reports is mitigated by the phrasing of the survey question, which asks whether a doctor has told the respondent that he has had an MI or stroke, rather than simply asking the respondent directly whether he or she has experienced the event. The seriousness of the health events considered is further

insurance against biased reporting. That is, it is unlikely that such significant adverse health events would go unnoticed in the population of community-dwelling older adults studied in this research. Moreover, there is evidence, at least in the case of stroke, of the validity of self reports [Engstad et al., 2000]. Secondly, while the HRS data allow for an uncommonly extensive set of risk factors to be controlled, gaps do remain. For example, the data contain no information on family history of cardiovascular or cerebrovascular disease, which means that a potentially important predictor of the outcomes may not be considered. Moreover, despite the unprecedented size of the dataset, the incidence of both MI and stroke were somewhat low, reducing the power to detect large group differences. The problem of limited power was apparent in the MI model, in which the estimated relative risk associated with involuntary job loss was substantial in magnitude, but was only statistically significant at the 90% confidence level. Also, as is often the case in studies using secondary data, we encountered missing data on several relevant variables, including the dates of MI and stroke. Almost 11% of the respondents eligible for this study had missing data, and thus could not be used in the analysis. These missing data limit the generalizability of our findings to the degree that Survey participants with missing data differ from the sample analyzed in this study.

A final notable limitation of the HRS data is its insufficient information on job characteristics, which may confound the association between job loss and the outcomes of interest. In the model building procedure, we evaluated the confounding influence of several proxy measures for domains such as job stress, satisfaction, and job control that were consistently collected across HRS survey waves. While we found no association between job characteristics variables and subsequent MI or stroke, we did find that one of the variables (“My job requires me to do more difficult things than it used to”) consistently predicted the exposure. Judging from its significance as a predictor of job loss, this variable may represent job insecurity or risk of layoff. However, as it was not associated with either outcome, this variable was not regarded as a viable confounder, and we therefore eliminated it as a covariate from the final models.

Notwithstanding the limitations, the advantages of using a national, longitudinal dataset on older adults for this study are compelling, and alternative US data for assessing employment-related health outcomes are currently unavailable.

The implications of our findings for policy are substantial. Downsizing and job loss are common occurrences in the US, and descriptive evidence suggests that older workers represent a growing share of the individuals experiencing job loss [Polsky, 1999]. The design of adequate policies and services to meet the needs of older, displaced workers requires an accurate understanding of the impact of job loss on health among this potentially vulnerable group. The finding that involuntary job loss can increase risk of stroke can inform the development and targeting of such services. Specifically, the research highlights the need for programs that might ameliorate potentially negative health consequences of job loss. Such services might include increased health education concerning potential health risks of job loss, added screening and prevention efforts during employment transitions, extended insurance coverage, or outreach programs to connect displaced worker with needed health care services.

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Table I.
Weighted Means of Regression Variables (N = 4,220); Older Workers Who Experience Involuntary Job Loss

Variable	Full sample	Workers with job loss	Workers without job loss
	Mean	Mean	Mean
Exposure variable			
Involuntary job loss	0.11 (0.27)	1.00	0.00
Demographic risk factors			
Age	55.47 (2.74)	55.45 (2.94)	55.47 (3.08)
Female	0.49 (0.45)	0.46 (0.49)	0.49 (0.50)
White	0.84 (0.33)	0.83 (0.37)	0.84 (0.37)
Married	0.75 (0.39)	0.73 (0.43)	0.75 (0.45)
Education (number of years)	12.79 (2.52)	12.36 ^{**} (2.88)	12.84 (2.81)
Economic risk factors			
Job tenure $\geq$ 3 years	0.84 (0.33)	0.72 ^{**} (0.45)	0.86 (0.35)
Blue collar	0.27 (0.39)	0.29 (0.46)	0.26 (0.44)
Labor income	30,173 (24,176)	27,153 [*] (21,835)	30,547 (28,282)
Health behaviors/lifestyle risk factors			
Current smoker	0.25 (0.39)	0.28 (0.45)	0.25 (0.43)
History of problem drinking	0.12 (0.29)	0.13 (0.34)	0.12 (0.33)
Medical risk factors			
Prevalence of angina	0.02 (0.12)	0.02 (0.13)	0.02 (0.14)
Prevalence of hypertension	0.35 (0.43)	0.33 (0.47)	0.35 (0.49)
Prevalence of diabetes	0.08 (0.24)	0.09 (0.28)	0.08 (0.27)
Prevalence of high cholesterol	0.25 (0.39)	0.23 (0.42)	0.25 (0.43)
Obesity	0.20 (0.36)	0.22 (0.42)	0.20 (0.40)
History of myocardial infarction (MI)	0.04 (0.18)	0.03 (0.17)	0.04 (0.20)
History of stroke	0.01 (0.11)	0.03 (0.17)	0.01 (0.11)
Psychological risk factor			
Mental health score	0.56 (0.97)	0.73 ^{**} (1.37)	0.54 (1.04)
Functional risk factors			
Physical functioning score	2.46 (2.00)	2.50 (2.39)	2.45 (2.23)
Physical activity $\geq$ 3 times/week	0.14 (0.31)	0.09 (0.32)	0.13 (0.35)

SD in parentheses. Where variables are dichotomies means represent weighted proportions. Asterisks denote difference between involuntary job loss and no job loss

* $P < 0.05$

** $P < 0.001$

TABLE II.

Unadjusted and Adjusted Relative Risk of MI and Stroke: The Effect of Involuntary Job Loss

Variable	MI model (N = 4,220)		Stroke model (N = 4,220)	
	Unadjusted model HR (95%CI)	Adjusted model HR (95%CI)	Unadjusted model HR (95%CI)	Adjusted model HR (95%CI)
Involuntary job loss	1.85 (0.89, 3.83)	1.89 (0.91, 3.93)	2.72 (1.05, 7.06)	2.64 (1.01, 6.94)
White	—	2.25 (0.91, 5.56)	—	—
Labor income	—	1.44 (0.88, 2.35)	—	—
Current smoker	—	3.90 (2.32, 6.55)	—	—
Prevalence of hypertension	—	3.45 (2.00, 5.94)	—	—
Obesity	—	—	—	2.15 (0.94, 4.92)