



Stroke-attributable death among older persons during the great recession



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ARTICLE INFO

Article history:

Received 25 October 2014

Received in revised form 3 November 2015

Accepted 6 November 2015

Available online 12 December 2015

Keywords:

Stroke

Mortality

Great recession

ABSTRACT

Epidemiological evidence indicates an elevated risk for stroke among stressed persons, in general, and among individuals who have lost their job, in particular. We, therefore, tested the hypothesis that stroke accounted for a larger fraction of deaths during the Great Recession than expected from other deaths and from trends, cycles, and other forms of autocorrelation. Based on vital statistics death data from California spanning 132 months from January 2000 through December 2010, we found support for the hypothesis. These findings appear attributable to non-Hispanic white men, who experienced a 5% increase in their monthly odds of stroke-attributable death. Total mortality in this group, however, did not increase. Findings suggest that 879 deaths among older white men shifted from other causes to stroke during the 36 months following the start of the Great Recession. We infer the Great Recession may have affected social, biologic, and behavioral risk factors that altered the life histories of older white men in ways that shifted mortality risk toward stroke.

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1. Introduction

The Great Recession, which officially began in December 2007 (National Bureau of Economic Research, 2014), affected virtually all sectors of the U.S. economy and induced the deepest downturn in employment since the end of World War II (Goodman and Mance, 2011). Despite the intuition that such a circumstance would adversely affect public health, studies of the relationship between the Great Recession and mortality in the U.S. and elsewhere have produced inconsistent findings (Burgard et al., 2013; Stuckler et al., 2014). Indeed, this inconsistency characterizes the larger research studying the association

between mortality and economic contraction (Catalano et al., 2011). Some research has hypothesized and found that mortality from several common causes (e.g., work accidents) falls when labor markets weaken (e.g., Catalano, 1979; Gerdtham and Ruhm, 2006), while other research reports deaths from other causes rising during economic contraction (e.g., Stuckler et al., 2009).

Reviews (Catalano et al., 2011; Stuckler et al., 2014) of the literature connecting recessions to mortality have noted that the disparate findings may arise not only from differences in method, but also from heterogeneity in the spatial and temporal mix of mechanisms that set older persons, who disproportionately contribute to mortality, on trajectories to death. While some of these mechanisms may accelerate in response to economic circumstances, others may slow. This possibility suggests a research strategy that focuses, at least at the outset, on causes of mortality for

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which recession would likely “harvest” deaths among older persons whose trajectories would otherwise have spread their deaths more evenly over time or across causes.

Although earlier literature suggests that the distribution of causes of death shift during recessions (Gallo et al., 2004), the hypothesis has not previously been tested. For reasons described below, we suspect that economic contraction may accelerate death by stroke and thereby “harvest” deaths from other causes or from the future. We test this suspicion using stroke deaths in California before and during the Great Recession.

Although each individual has a unique history of genetic endowment as well as of social experiences and environmental exposures, commonalities among these histories allow epidemiologists and demographers to identify groups that differ significantly in morbidity and longevity (Olshansky et al., 2005; Vaupel, 2010; Yoon et al., 2014). The distribution of older individuals across these groups, in turn, predicts the frequency and causes of death among the elderly (Galea, 2007; Halfon and Hochstein, 2002; Vasunilashorn and Crimmins, 2009; Worthman and Kuzara, 2005). The Great Recession may have changed this distribution in the United States and elsewhere by affecting, among other factors, income, time use, access to medical care, exposure to work-related hazards, as well as by inducing stress and anxiety.

The causes of death suspected to increase during bad economic times include those responsive to stressful experiences. The biological precursors of stroke, for example, likely develop over the life course but the timing of an ischemic event appears affected by “triggers” including stressful experiences (Guiraud et al., 2013). This circumstance has, in fact, led to the suspicion that job loss may trigger stroke. Research supporting this hypothesis shows that workers over 50 years old who suffer layoff exhibit a twofold increase in stroke compared to similar workers who remain employed (Gallo et al., 2004). The association presumably arises because late-career job loss decreases income and savings and severs social interactions thereby inducing significant anxiety and psychological stress while reducing social and material support (Gallo et al., 2004). Non-transferable firm or industry-specific skills can, moreover, lead to poor prospects of reemployment with equivalent wages and benefits (Brand et al., 2008).

The above circumstances led us to hypothesize that monthly stroke deaths among older persons exceeded those expected from deaths attributable to other causes during the Great Recession. We tested our hypothesis among 2268,288 deaths to persons over 50 years old in California for the 132 months starting January 2000 and ending December 2010. We tested the hypothesis for the population as well as separately for men and women of white, Hispanic, and black race/ethnicity, given prior research indicating that these groups have significantly different risks for stroke mortality (Ayala et al., 2001).

2. Methods

2.1. Data

The California Department of Public Health, Center for Health Statistics & Informatics, Vital Statistics Section

provided the data for this test (California Department of Public Health, Center for Health Statistics and Informatics, 2012). Each year, the Vital Statistics section produces a file that includes data from all the death certificates registered in California as well as death certificates for California residents who die in other states. For our study period, causes of death were classified according to the International Classification of Diseases, Tenth Revision (ICD-10) (World Health Organization, 1993). We considered the following ICD-10 codes as stroke deaths: intracerebral hemorrhages (I61.0–I61.9), cerebral infarctions (I63.0–I63.9), and stroke not specified as hemorrhage or infarction (I64.0–I64.9). All other causes of death, including unknown or missing causes, were coded as non-stroke mortality. Following the epidemiologic research, we constrained our analyses to person over 50 years of age.

2.2. Analyses

Our test asks whether monthly stroke deaths among older Californians during the Great Recession exceeded those expected from monthly deaths attributed to other causes. We answered that question via the following steps.

- (1) We regressed the 132 monthly counts of stroke deaths on the monthly counts of non-stroke deaths for the entire population and for the six sex-by-race/ethnicity groups.
- (2) We identified and modeled autocorrelation in the residuals of the regressions estimated in step 1. We performed this step because regressing one time series on another often leaves residuals that exhibit autocorrelation including trends, cycles, or the tendency to remain elevated or depressed, or to oscillate, after high or low values. Autocorrelated residuals violate the assumption of independence necessary to “trust” the accuracy of confidence intervals of regression parameters. Identifying and estimating autocorrelation in residuals has the added benefit of precluding a Type I error that would otherwise arise from trends that yield higher, or lower, counts of stroke deaths later in the test period and, therefore, coincidentally during the Recession.

We implemented step 2 with methods devised by Box et al. (2008). These well-developed methods appear widely accepted in the epidemiologic literature (Catalano and Serxner, 1987; Zeger et al., 2006). Box–Jenkins methods mathematically express various filters through which time series without known patterns can pass. Each filter, or combination of filters, imposes a unique pattern. The Box–Jenkins approach uses an iterative model-building process by which the researcher infers the filter that imposed the observed pattern. The error terms of these models (i.e., the differences between the values predicted by the inferred model and the observed series) express the “unexpectedness” of observed values.

- (3) We created a binary “Great Recession” variable scored 0 for the 95 months before the December 2007 NBER-designated start of the Great Recession and 1 for the following 37 months.

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