THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Social Sciences
cite as: *J Gerontol B Psychol Sci Soc Sci*, 2018, Vol. 73, No. 4, 744–754
doi:10.1093/geronb/gbx035
Advance Access publication April 11, 2017

OXFORD

Original Article

Economic Downturns, Retirement and Long-Term Cognitive Function Among Older Americans

Philipp Hessel,[1,2] Carlos J. Riumallo-Herl,[3] Anja K. Leist,[4] Lisa F. Berkman,[1,5] and Mauricio Avendano[5,6]

[1]Harvard University, Center for Population and Development Studies, Cambridge, Massachusetts. [2]Universidad de los Andes, Escuela de Gobierno Alberto Lleras Camargo, Bogotá, Colombia. [3]Harvard T.H. Chan School of Public Health, Department of Global Health, Boston, Massachusetts. [4]University of Luxembourg, PEARL Institute for Research on Socio-Economic Inequality, Luxembourg. [5]Harvard T.H. Chan School of Public Health, Department of Social and Behavioral Sciences, Boston, Massachusetts. [6]King's College London, Department of Global Health and Social Medicine, UK.

Correspondence should be addressed to Philipp Hessel, PhD, Harvard University, Center for Population and Development Studies, 9 Bow Street, Cambridge, MA 02139. E-mail: phessel@hsph.harvard.edu

Received: April 20, 2016; Editorial Decision Date: March 7, 2017

Decision Editor: James Raymo, PhD

Abstract

Objective: Workers approaching retirement may be particularly vulnerable to economic downturns. This study assesses whether exposure to economic downturns around retirement age leads to poorer cognitive function in later life.

Method: Longitudinal data for 13,577 individuals in the Health and Retirement Study were linked to unemployment rates in state of residence. Random- and fixed-effect models were used to examine whether downturns at 55–64 years of age were associated with cognitive functioning levels and decline at ≥65 years, measured by the Wechsler Adult Intelligence Scale-Revised.

Results: Longer exposure to downturns at 55–64 years of age was associated with lower levels of cognitive function at ≥65 years. Compared to individuals experiencing only up to 1 year in a downturn at 55–64 years of age, individuals experiencing two downturns at these ages had 0.09 point (95% Confidence Interval [CI, −0.17, −0.02]) lower cognitive functioning scores at ≥65 years (3 years: b = −0.17, 95%CI [−0.29, −0.06]; 4 years: b = −0.14, 95%CI [−0.25, −0.02]; ≥5 years: b = −0.22, 95%CI [−0.38, −0.06]). Downturns at 55–64 years of age were not associated with rates of cognitive decline.

Discussion: Exposure to downturns around retirement is associated with a long-lasting decline in cognitive function in later life. Policies mitigating the impact of downturns on older workers may help to maintain cognitive function in later life.

Keywords: Cognition—Economic—Life course—Recession—Social

Cognitively stimulating activities at work may help older workers accumulate cognitive reserves and increase resilience to the cognitive decline associated with normal ageing (Stern et al., 1995). Furthermore, working longer and retiring later may preserve cognitive function in old age (Bonsang, Adam, & Perelman, 2012). However, examining the relationship between employment and cognitive function is complex due to multiple confounding influences. For example, innate cognitive ability and educational attainment are associated with both better cognitive functioning and employment outcomes in older ages. An approach to circumvent this bias is to exploit unanticipated changes in macroeconomic conditions uncorrelated with workers' cognitive abilities but affecting employment opportunities and retirement decisions.

The period of transition from employment to retirement is a period potentially sensitive to the consequences of economic downturns on the ability to maintain cognitive function by continued use of cognitive skills and learning.

Downturns in the years leading up to retirement could critically impact timing and circumstances at which older workers transit to retirement (Avendano & Berkman, 2014). Older workers displaced during downturns are less likely to find new employment than their younger counterparts (Coile & Levine, 2007). As a result, they are often forced to accept lower wages, permanently leave the labor market, or collect Social Security benefits early (Coile & Levine, 2007). These workers will face major losses in present and future income (Daly & Delaney, 2013), diminished financial and physical well-being, and reduced opportunities to uphold cognitive function through work. Economic downturns may also increase job insecurity and work-related stress associated with fear of job loss, and through this psychosocial mechanism impairs cognition (Juster, McEwen, & Lupien, 2010).

This paper examines how a downturn in the years leading up to retirement affects cognitive function after retirement among older Americans. Exploiting fluctuations in the economy across U.S. states between 1977 and 2010, we compare cognitive functioning at ≥65 years in older workers who lived through a period of economic turmoil at 55–64 years, to cognitive function of workers who experienced more favorable economic conditions during the same period. We hypothesized that longer exposure to downturns just prior to retirement leads to lower cognitive functioning and steeper cognitive decline after retirement.

Background

Psychosocial Effects of Downturns

By decelerating economic activity, downturns generally increase experiences of job loss, job and financial insecurity. Consequently, downturns are generally associated with increases in stress levels in the general population. While economic hardship is arguably one of the most significant stressors in life (Kahn & Pearlin, 2006), reasons for increased stress triggered by an economic downturn can be manifold. For example, individuals losing their job as a direct consequence of a downturn may experience financial difficulties, losses of health insurance, or reductions in retirement savings. Also, workers retaining their jobs during a downturn may suffer from increased stress due to increased job insecurity, asset devaluations, and financial difficulties as a result of a weakening of the financial and housing markets or foreclosure rates in the community (Burgard & Kalousova, 2015; Cagney, Browning, Iveniuk, & English, 2014). Furthermore, negative consequences of stress may also result from reduced access to basic social services as a result of spending cuts in government budgets (Karanikolos et al., 2013).

Experiences of such adverse life-events, caused by a decline in economic activity, will likely have a negative effect on cognitive performance due to psychosocial changes caused by increased stress. Such a hypothesis is in line with the allostatic load model, referring to the body's "wear and tear" experiences as a result of responding to stressful demands (Sterling & Eyer, 1988), which in turn may reduce the ability to process information and hence cognitive performance (Juster et al., 2010). Similarly, a large body of research has shown adverse consequences of negative labor market outcomes or economic hardship on stress on the one hand (Catalano & Dooley, 1983; Pearlin, Schieman, Fazio, & Meersman, 2005), and the effects of stress on cognitive performance on the other hand (Lupien, McEwen, Gunnar, & Heim, 2009).

In contrast, many studies have argued that a slowing down of economic activity, for example during a recession, on average leads to reductions in stress levels due to reductions in working hours as well as more healthy behaviors—which may explain why population health generally improves when the economy worsens (Ruhm, 2000, 2005). In turn, it is possible that economic downturns may reduce overall stress levels and improve cognitive performance. Studies have shown that downturns are associated with healthier lifestyles, for example leading to increases in leisure time physical activity as well as reductions in tobacco and alcohol consumption (Xu, 2013). Given the evidence showing that healthier lifestyles are associated with improved cognitive functioning (Sabia et al., 2009), downturns could positively affect cognition through related pathways.

Economic Downturns, Cognitive Reserve and Early Retirement

Other than their effect on stress, economic downturns also affect working conditions and, in turn, opportunities to maintain cognitive reserves by reducing opportunities to engage in intellectually stimulating activities. Several studies have shown that working conditions and labor market status—that are likely to be negatively affected by economic downturns—are consistently associated with cognitive functioning (Dartigues et al., 1992). Hence, occupational complexity (Finkel, Andel, Gatz, & Pedersen, 2009), higher occupational class (Dartigues et al., 1992), more favorable career trajectories (Li et al., 2002) as well as leisure time cognitive activity and workplace complexity in preretirement years ((Andel, Finkel, & Pedersen, 2016) have been found to be significant predictors of cognitive functioning in later life, equally allowing individuals to increase their cognitive reserves (Stern, 2002) as well as their ability to maintain cognitive performance at higher ages.

Economic downturns may also negatively affect cognitive functioning among older individuals due to their effect on retirement. Evidence suggests that adverse labor market conditions around the time of retirement significantly increase the likelihood of withdrawing from the labor force and claiming Social Security benefits (Coile & Levine, 2007, 2011). Repeated studies have shown that early retirement is causally related to lower cognitive functioning in later life, arguably due to a reduced involvement in work-based mentally stimulating activities and reduced opportunities

to uphold cognitive reserves, as well as reduced financial resources to engage in cognitively stimulating activities throughout retirement (Bonsang et al., 2012; Calvo, Sarkisian, & Tamborini, 2013).

Heterogeneity in the Relationship Between Economic Downturns and Cognitive Functioning

Although downturns may have adverse effects on cognitive functioning for the general population, it is likely that the latter are not equally distributed across persons of different gender, education, racial background, and labor market status. Much of the expected heterogeneity in terms of vulnerability to economic shocks and potential effects on cognitive functioning may be driven by differences in industry and occupational affiliation. Hence, evidence suggests that men, lower educated individuals as well as members of minorities are particularly affected by economic downturns, and in turn likely also in terms of their cognitive functioning, as they are more likely to work in industries that are more affected by fluctuations in the economy such as construction and manufacturing (Hoynes, Miller, & Schaller, 2012). In contrast, women, higher educated individuals as well as whites are more likely to work in less "cyclical" industries such as public administration or services.

Another likely source of heterogeneity in the relationship between downturns and cognitive functioning is labor market status. While individuals who retain their jobs during a downturn may experience reductions in cognitive functioning due to increased stress and decreased occupational complexity, those that either lose their jobs or are denied re-entry into the labor force due to adverse macroeconomic conditions may suffer a "double burden" as a result of significantly reduced opportunities to engage in cognitively stimulating activities at work on the one hand, and the psychosocial consequences related to losses in socio-economic status, self-efficacy, or social capital on the other hand (Holtzman et al., 2004; Mejía, Settersten, Odden, & Hooker, 2016; Turrell et al., 2002). Hence, in addition to material losses, older workers who become temporarily unemployed or are forced to withdraw from the labor force due to a recession are likely to experience disruptions in their career identity, coping resources as well as social ties with colleagues, friends, and family members, which have been extensively described in the literature (Adams, Prescher, Beehr, & Lepisto, 2002; Elwell & Maltbie-Crannell, 1981; Gallo et al., 2006).

Methods

Data

Data came from two sources: The Health and Retirement Study (HRS) (Juster & Suzman, 1995) and the Current Population Survey (CPS) (U.S. Bureau of Labor Statistics, 2009).

The HRS is a multidisciplinary longitudinal survey representative of the non-institutionalized population of Americans aged ≥50 years. Participants were interviewed every 2 years from 1992 to 2010 about their income, employment, and health, and underwent detailed assessments of physical, mental, and cognitive functioning. Our study focuses on cognitive functioning after retirement, therefore, we restrict the sample of HRS participants to those aged 65 years and older.

The CPS is an annual nationally representative survey on labor force participation carried out by the U.S. Census Bureau and the Bureau of Labor Statistics. To assess individual experiences of economic shocks in years leading up to retirement, trends in aggregate unemployment rates for older workers in each U.S. state and year obtained from the CPS were linked to individual data from HRS participants.

Given that comparable information on state-level unemployment rates from the CPS was only available since 1977, our analysis includes individuals born between 1923 (reaching age 55 years in 1977) and 1945 (reaching age 64 years in 2009). Our sample includes all individuals participating in the HRS between 1993 and 2010 with at least one interview at age 65 years or above (N = 20,580). We furthermore excluded individuals with missing information on covariates or state of residence (n = 7,003), resulting in a final sample of 13,577 respondents (Supplementary Appendix I).

Measures

Cognitive function

Cognitive function was assessed based on the *mental status* exam, assessed through the Wechsler Adult Intelligence Scale-Revised capturing individuals' cognitive and intellectual abilities based on measures of knowledge, language, and orientation (Fisher, Hassan, Faul, Rodgers, & Weir, 2015). *Orientation* was measured by asking respondents to name several dates, provide names of objects, and name the current American President and Vice President. In the *serial seven-subtraction test*, respondents were asked to subtract 7 from 100 and continue subtracting 7 from each subsequent number for a total of five trials. Respondents were also asked to define five words from one of two randomly assigned word sets. Each response was classified as either "incorrect," "partially correct," or "correct." *Numeracy* was measured by asking respondents to count backwards from 20. Two points were assigned if successfully counting 10 continuous numbers backwards in the first attempt, one point if successful in the second attempt, and zero if unsuccessful. From wave three onwards, respondents were also instructed to count backwards as quickly as possible. A *total mental status score* was constructed by adding all individual test scores, with a range from 0 to 15.

Years lived through downturns at 55–64 years

We used time-series data on annual unemployment rates at 55–64 years of age in each state and year from the

CPS to construct an indicator of state economic conditions. Data used for analysis comprised the years 1977–2010. To establish whether there was a downturn in a given year, cyclical deviations from the secular trend in unemployment in each state were identified using the Hodrick–Prescott Filter with a smoothing parameter of 100 (Hodrick & Prescott, 1997). Annual deviations from state unemployment trends were categorized into quartiles (Leist, Hessel, & Avendano, 2013). We classified years in the highest quartile, reflecting years of exceptionally high unemployment with respect to state trends, as "downturn" years. This information was linked to individual records from the HRS respondents based on year of birth and state of residence at study enrollment to identify whether respondents experienced a downturn for each year between ages 55–64 years. To derive a measure of cumulative exposure, we estimated the number of years each respondent lived through a downturn in this 10-year period. We classified individuals based on whether they had experienced ≤1, 2, 3, 4, or ≥5 years of downturns at 55–64 years of age. Supplementary Appendix II shows downturns by year and state.

Individual-level controls

We controlled for age, gender, race/ethnicity (white, black, or Hispanic), marital status (never married, married/partnership, single/divorced, or widowed), and educational attainment. We also assessed whether respondents were active in the labor force at 54 years of age using a linkage of the HRS with Social Security administration data.

Although the HRS includes very detailed information on a wide range of individual characteristics, we only included those covariates for two reasons. On the one hand, although age, sex, education as well as marital and labor force status (at 54 years of age) are associated with cognitive function, all variables are determined before the exposure of interest starts (age 55 years) and therefore were not affected by exposures to downturns at 55–64 years of age. Furthermore, controlling for additional individual-level characteristics, such as income or labor force status at 55–64 or ≥65 years, would have implied a condition on a potential mediator and hence have potentially blocked the causal path between downturn and cognitive function. On the other hand, because our sample includes individuals who approached retirement (aged 55–64 years) before being first interviewed in the HRS, we lacked time-variant information on individual-level characteristics for those years.

Methods of Analysis

This study is based on linking prospective individual-level data from the HRS with ecological information on macroeconomic conditions derived from the CPS. After confirming linearity, we used linear random- and fixed-effects regression models to assess associations between number of years lived through downturns at 55–64 years of age and level and change in cognitive function at ≥65 years.

Mean cognitive function at ≥65 years of age

In random-effects models, we regressed individual cognitive scores at ≥65 years of age on the number of years spent in a downturn at 55–64 years. State economic conditions provide a natural experiment to examine the impact of downturns because they are often unpredictable and independent of individual characteristics. To control for systematic differences between states and secular changes in cognitive function, models included state- and cohort-fixed-effects. State-fixed-effects control for unmeasured time-invariant differences between states. Models use only variation between individuals born in different years in the same state for estimation. Estimates can be interpreted as the impact of an additional year lived in a downturn at 55–64 years of age on mean cognitive function at ≥65 years, controlling for differences by state of birth, year of birth, and secular trends over time. Models additionally included age, gender, race and ethnicity, and marital status as controls.

The model can be written as:

$$y_{it} = \mu + \beta_1 X_{it} + \beta_2 \text{State}_s + \beta_3 \text{Year of Birth}_i + \beta_4 \text{Downturns}_i + \varepsilon_{it} \quad (1)$$

Where y_{it} is the cognition measure at ≥65 years of age of person i in year t, μ is the average cognition score for the entire sample, X_{it} is a vector of individual-level characteristics (age, sex, race/ethnicity, and marital status), State_s is a fixed-effect for state of residence, Year of Birth_i is a fixed-effect for year of birth, and Downturns_i is an index of the number of downturns at 55–64 years of age. ε_{it} is an individual-specific error term.

In addition, we also include a set of models which include interactions between the number of downturns at 55–64 years of age and age, sex, race/ethnicity, marital and labor force status at 54 years of age, as well as main career occupation.

Cognitive decline at ≥65 years of age

We used individual fixed-effects models to assess the relationship between number of years lived through a downturn at 55–64 years of age and cognitive decline at ≥65 years. We assessed differences in age-related decline in cognitive function by introducing an interaction term between number of years lived through a downturn at 55–64 years of age and age. Estimates can be interpreted as the difference in the age-related change in cognition after the age of 65 years between individuals exposed to a different numbers of years in a downturn at 55–64 years of age.

The model can be written as:

$$y_{it} = \mu_i + \beta_1 X_{it} + \beta_2 \text{Age}_{it} \times \text{Downturns}_i + \varepsilon_{it} \quad (2)$$

Where y_{it} is the cognition measure at ≥65 years of age of person i in year t, μ_i is an individual fixed-effect that

controls for all time-invariant heterogeneity, and X_{it} is a vector of time-variant controls (including marital status and age). $Age_{it} \times Downturns_i$ is an interaction between age and the number of downturns at 55–64 years of age, which captures the consequences of downturns in the preretirement years on age-related cognitive decline.

Standard errors were clustered on the state-level in all models.

Results

Mean age was 67 years (Supplementary Appendix III). A total of 56% of respondents were female, 14% black, 2% Hispanic, and almost three quarters were married. Respondents had on average 12 years of schooling and 60% were working at the age of 54 years. On average, respondents experienced 2.6 years in a downturn at 55–64 years of age.

Mean Cognitive Function at ≥65 Years of Age

Table 1 shows the results of the random-effects models assessing the associations between cognitive functioning and the number of downturns at 55–64 years of age. Older age was associated with lower mental and total cognitive scores. Lower education, male gender, black race, Hispanic origin, and non-marriage (separated or divorced, widowed or never married) were each independently associated with lower cognitive functioning.

Number of years spent in a downturn at 55–64 years of age was associated with lower cognitive function at ≥65 years (Table 1). Compared to respondents who experienced one or less years in a downturn at 55–64 years of age, respondents who lived through 2 (b = –0.09, 95%CI [–0.17, –0.02]), 3 (b = –0.17, 95%CI [–0.29, –0.06]), 4 (b = –0.14, 95%CI [–0.25, –0.02]), or ≥5 years (b = –0.22, 95%CI [–0.38, –0.06]) of downturn had significantly lower cognitive functioning scores at age 65 years and above.

Figure 1 shows predicted means for cognitive functioning scores at ≥65 years of age according to the number of downturns experienced at 55–64 years of age derived from the model shown in Table 1.

Heterogeneity

We also assessed interactions between the number of downturns at 55–64 years of age with labor force status at 54 years, education, race, and gender. As predicted means presented in Figure 2 show, downturns were only associated with reduced cognitive function among whites, but not blacks or Hispanics (Panel A). For both men and women, downturns were negatively associated with cognitive functioning (Panel B). Furthermore, downturns around retirement age were only associated with lower cognitive function among individuals out of the labor force at 54 years of age, but not among individuals working at

Table 1. Random-Effects Model: Effects of Downturns in the Preretirement Years on Cognitive Functioning at ≥65 Years of Age, United States, 1992–2010

	Cognitive functioning score	
Outcome	Coeff.	95% CI
Downturns (ages 55–64): 0–1 years (ref.)		
Downturns: 2 years	–0.09	–0.17, –0.02
Downturns: 3 years	–0.17	–0.29, –0.06
Downturns: 4 years	–0.14	–0.25, –0.02
Downturns: 5 or more years	–0.22	–0.38, –0.06
Age (over 65)	–0.06	–0.10, –0.02
Years of education	0.32	0.30, 0.34
Male (ref.)		
Female	–0.28	–0.35, –0.21
White (ref.)		
Black	–1.70	–1.85, –1.55
Hispanic	–0.78	–1.15, –0.42
Married (ref.)		
Separated/Divorced	–0.17	–0.28, –0.05
Widowed	–0.09	–0.15, –0.03
Never Married	–0.19	–0.37, –0.01
Intercept	9.57	9.13, 10.01
RMSE		1.44
N		56,997
Individuals		13,577

Notes. Coeff. = unstandardized regression coefficient; *N* = number of observations; RMSE = root-mean-square deviation; 95% CI = confidence interval. The table shows the results of a random-effects model (see Equation 1). Model controls for interview year, state-fixed-effects, and birth cohort. Standard errors clustered at state-level.

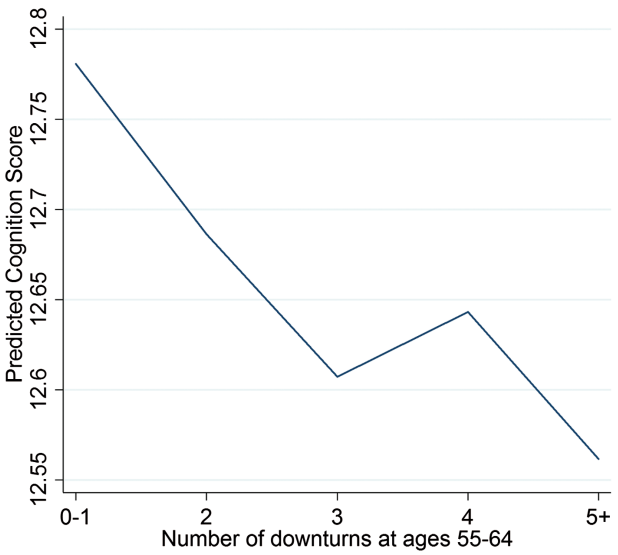

Figure 1. Downturns around retirement and cognitive function at ages ≥65. The figure shows the predicted average cognition scores at ages 65 relative to the number of downturns at ages 55–64, derived from the random effects models shown in Table 1. All models include controls for age, sex and fixed-effects for state of residence and year of birth.

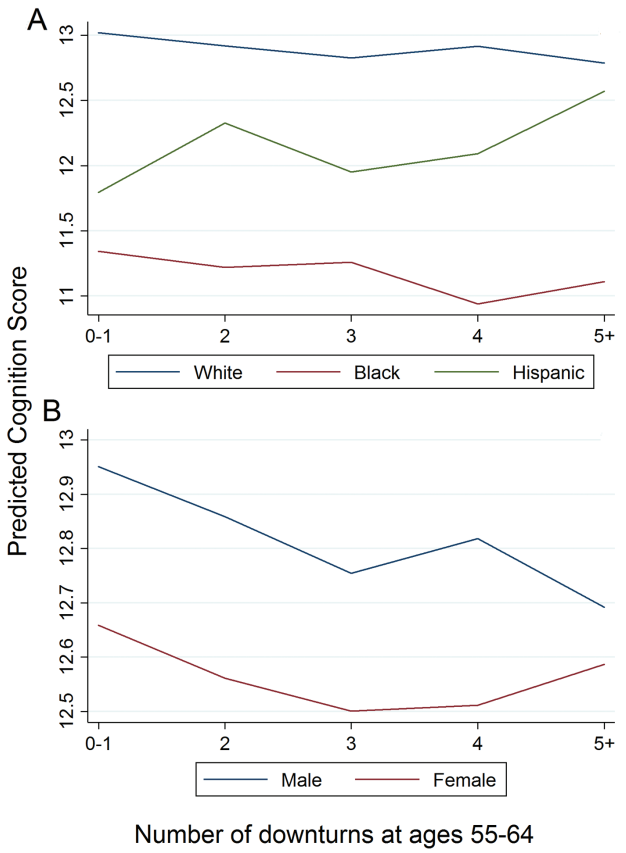

Figure 2. Downturns around retirement and cognitive function at ages ≥65, stratified by race and gender. The figure shows the predicted average cognition score at ages 65 relative to the number of downturns at ages 55–64 stratified by race and gender. All models include controls for age, sex and fixed-effects for state of residence and year of birth.

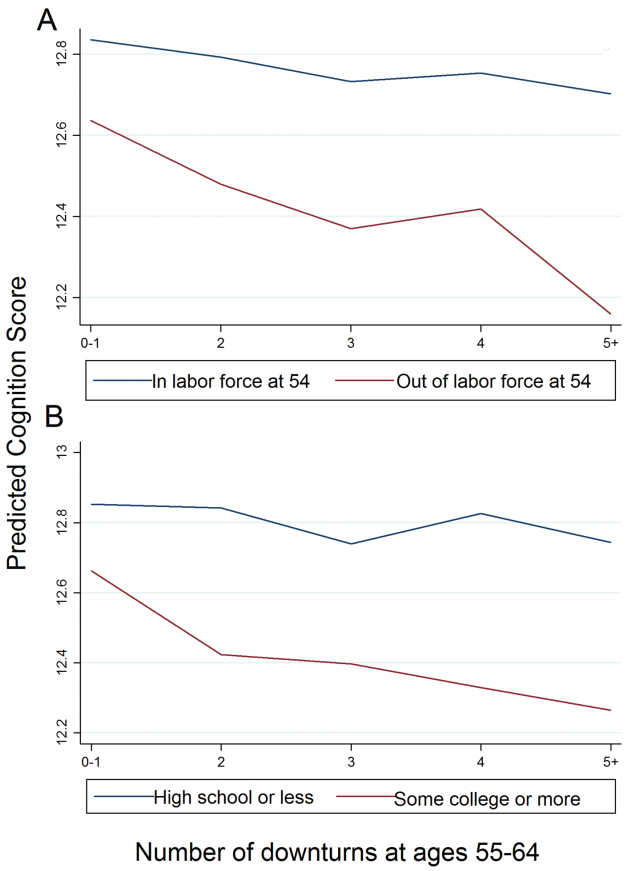

Figure 3. Downturns around retirement and cognitive function at ages ≥65, United States, 1992–2010 (by Labor Force Status at age 54 and education). The figure shows the predicted average cognition score at ages ≥65 according to the number of downturns at ages 55–64, stratified by education and labor force status at age 54. Detailed results from the interaction models are included in the Supplementary Appendix.

the same age (Figure 3, Panel A). Finally, downturns at 54–65 years of age were associated with lower cognitive functioning among individuals with higher and lower education (Figure 3, Panel B). Effects of downturns did not systematically differ according to marital status or main career occupation (Supplementary Appendix IV).

Cognitive Decline at ≥65 Years of Age

As indicated by the interactions between downturns and age, years in a downturn at 55–64 years of age were not associated with age-related cognitive changes beyond 65 years (Table 2). Estimating the model using random-effects equally shows no significant interaction between downturns and age.

Downturns, Timing of Retirement and the Role of Social Networks

We also investigated whether the probability of retiring early might offer a potential mechanism for the impact of downturns on cognition (before 65 years). Results in Figure 4 (Panel A) suggest that experiencing more years in downturn at 55–64 years of age was associated with lower probability of retiring before 65 years, albeit these estimates were not statistically significant. More years in downturn at 55–64 years of age were associated with a higher probability of retiring early among those who were not employed at 54 years, but not for employed workers (Panel B). This association did not significantly differ by educational level (Panel C) (Supplementary Appendix V). We also assessed whether social networks may mitigate the adverse effect of downturns, finding that negative effect of downturns at 55–64 years of age appears to be particularly pronounced among individuals not involved in either volunteering or helping friends at ≥65 years (Supplementary Appendix VI).

Discussion

Based on a nationally representative sample of older Americans, we found that the number of years spent in a downturn around retirement age is negatively associated with cognitive function at 65 years and older. These adverse

Table 2. Fixed-Effects Model: Effects of Downturns in the Preretirement Years on Age-Related Changes in Cognitive Functioning at ≥65 Years of Age, United States, 1992–2010

	Cognitive functioning score	
Outcome	Coeff.	95% CI
Downturns (ages 55–64): 0–1 years (ref.)		
Downturns: 2 years × age	−0.01	−0.02, 0.01
Downturns: 3 years × age	0.00	−0.01, 0.02
Downturns: 4 years × age	0.01	−0.01, 0.03
Downturns: 5 or more years × age	0.01	−0.01, 0.03
Age (over 65)	−0.15	−0.19, −0.12
Married (ref.)		
Separated/Divorced	−0.12	−0.28, 0.03
Widowed	−0.03	−0.11, 0.05
Never Married	−0.33	−0.66, 0.00
RMSE		1.26
N		56,997
Individuals		13,577

Note. Coeff. = unstandardized regression coefficient; *N* = number of observations; RMSE = root-mean-square deviation; 95% CI = confidence interval. The table shows the results of a fixed-effects model (see Equation 2). The term downturns × age refers to the effect of age-related cognitive decline at ≥65 years (see term Age_{it} × $Downturns_i$ in Equation 2). Baseline category is 0–1 years of downturn. Standard errors clustered at state-level.

consequences of downturns on cognition may result from a combination of increased stress, losses in career identity, or material resources among workers who have to retire later in order to compensate for losses in retirement savings on the one hand; and reduced opportunities to uphold cognitive function through workplace participation among discouraged workers who withdraw from the labor force on the other hand. In contrast to the negative association between downturns and levels of cognitive function at 65 years and above, we found no evidence that exposure to downturns in the years around retirement was associated with rates of cognitive decline.

Our findings are in line with previous studies showing that downturns experienced around birth can have long-lasting negative consequences on cognitive function (Doblhammer et al., 2013; van den Berg, Deeg, Lindeboom, & Portrait, 2010). Although studies conceptualize birth as a sensitive period during which exposure to negative economic shocks can have long-lasting consequences for later life health due to fetal under nutrition (van den Berg et al., 2010), our findings suggest that later periods can also have long-lasting consequences for cognitive function. A possible differentiation is that although exposure to economic adversity earlier in life might affect the early development of cortical networks or regions underlying the formation of cognitive abilities, late-life exposure to economic adversity may be crucial at an age in which reduced engagement in cognitively stimulating activities may accelerate cognitive aging by affecting neurodegenerative or cerebrovascular disease.

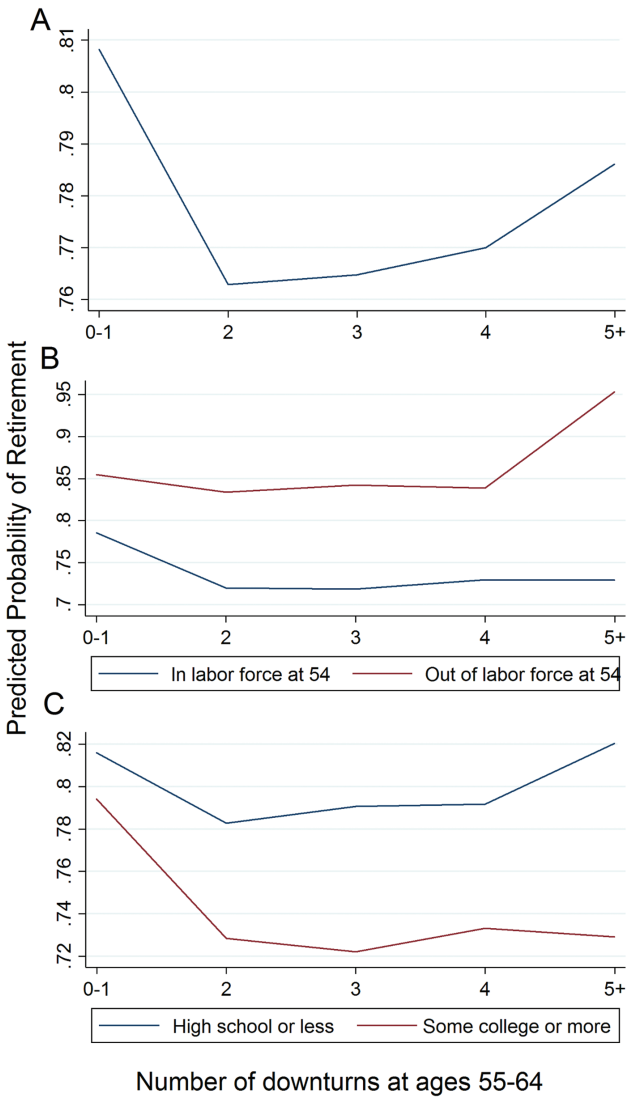

Figure 4. Predicted probability of retiring early (before age 65) according to downturns at ages 55–64 (by Education and Labor Force Status at age 54). Results are from linear probability model, regressing a binary indicator of being retired at age 65 on the number of downturns at ages 55–64 and a full set of controls. Detailed results from the interaction models are included in the Supplementary Appendix. Age 65 was used as cut-off since the latter represents the age-eligibility for Medicare that has been unchanged over the study-period.

Our results echo earlier findings from a cross-sectional study suggesting that downturns experienced during midlife (25–49 years) have negative consequences on cognition after the age of 50 years among European men and women (Leist et al., 2013). Although in the latter study the negative association between downturns and cognitive function was particularly pronounced for women, we found no evidence that the association between downturns at 55–64 years of age and cognitive function differed between men and women in the United States. A potential explanation for this difference between Europe and the United States may be the stronger labor market attachment of women in the United States compared to their European counterparts.

Although we expected men to be more affected by downturns due to a higher propensity to work in manufacturing and construction, we found no differences according to gender. A potential explanation may be couples' joint decision-making regarding labor supply (Butt, Barton, & Oala, 2012), as well as within-household spillover effects of stress (Larson, Wilson, & Beley, 1994).

Our results suggest that individuals out of work at 54 years of age are particularly vulnerable. For this group, downturns experienced at 55–64 years of age were associated with a higher likelihood of retiring early. Previous studies suggest that early retirement is associated with decreased cognitive functioning (Bonsang et al., 2012), as it decreases opportunities to engage in cognitively stimulating tasks. Looking at the characteristics of those individuals not working at 54 years of age we find that this group was primarily female (71%) and unlikely to re-enter the labor force. Hence, only around 6% of this group became employed at 55–64 years of age. Those out of work at 54 years of age may be a particularly vulnerable group. In the final stages of their careers, women in particular may be discouraged by downturns to re-enter employment; they may retire early, which may in turn reduce financial well-being and engagement in cognitively stimulating activities.

Although, judging by the interactions, downturns at 55–64 years of age would seem to be unrelated to long-term cognitive functioning among individuals employed at 54 years of age, this does not imply that experiencing job loss at 55–64 years of age as a result of a downturn is unrelated to cognitive functioning. Rather, it is possible that the probable adverse effect of job loss on cognition is outweighed by the absence of such an effect in the working population. Investigating differences in the effects of downturns on long-term cognitive functioning is considerably complicated by the lack of prospective information on labor force status at 55–64 years of age for most of our sample and the circumstance that unemployment may be both a cause as well as a consequence of (lower) cognitive abilities. However, given the evidence showing that, on the one hand downturns increase the risk of job loss as well as involuntary retirement, as well as the large number of studies showing far-reaching negative psychosocial, health, as well as material effects of unemployment on the other hand (Gallo et al., 2006; Noelke & Avendano, 2015; Noelke & Beckfield, 2014), it seems likely that individuals experiencing unemployment are particularly vulnerable to suffer declines in cognitive functioning.

Although previous evidence suggests that members of minorities carry the largest burden with regard to the short-term health effects of downturns due to their higher representation in jobs most affected by the business cycle, for example, manufacturing and construction (Hoynes et al., 2012), we find that the negative effects of downturns only seem to occur among whites. Although there are no systematic differences in the percentage working at 54 years of age, average retirement age or labor market status around 55–64 years of age according to race in our sample, blacks or Hispanics are significantly more likely to work in production or manufacturing jobs. Although we lack an explanation for the absence of an effect of downturns among blacks and Hispanics, the coefficients for the interaction between downturns and blacks, although insignificant, are all negative and generally greater than for whites. A potential explanation may be that we lack statistical power to detect a significant effect given the relatively small number of blacks and Hispanics in the sample.

We found a consistent association between downturns around retirement age on cognitive function, but not between downturns and rates of cognitive decline. A potential explanation is that differences in cognitive function in later life arise primarily from differences in peak cognitive performance achieved earlier in life and less from late-life declines (Karlamangla et al., 2009). A similar explanation has been offered for the weak association between educational attainment and rates of cognitive decline (Karlamangla et al., 2009). Alternatively, the consequences of a downturn on cognitive function may arise from short-term, but long-lasting events during ages from 55 to 64 years, rather than from consequences of cognitive decline beyond 65 years of age. Looking empirically at the short-term effects of downturns at 55–64 years of age on cognition at the same ages by using a smaller sub-sample, we only found a significant negative effect of downturns at t-2, but not for downturns in the same (t) or the preceding year (t-1) (Supplementary Appendix VII). Although this supports the above view, judging by the regression coefficients, the estimated short-term effect is considerably smaller than the long-term effect, suggesting that there exists a process leading to increasing disadvantage over time (Dannefer, 2003; Ferraro, Shippee, & Schafer, 2009).

The finding that downturns during later life can have significant negative effects on cognition has important policy-implications. Hence, although the latter does not directly conflict with the argument that early-childhood investments are very important (Heckman, 2006), they also suggest that late-life experiences can also have sizable effects on an important dimension of human capital. The fact that macroeconomic shocks and their consequences are amenable to policy-interventions highlights the potential of the latter in helping to preserve cognition among older individuals and prevent an acceleration of cumulative disadvantage processes (Dannefer, 2003) due to differential vulnerability to economic shocks. Although no evidence exists on specific policies in potentially mitigating adverse effects of downturns on cognitive functioning, policies including short-time compensation, marginal employment subsidies, public employment services, training, and work-incentives programs are generally acknowledged to reduce layoffs and increase re-employment (OECD, 2010). Furthermore, active labor market programs and more generous unemployment insurance benefits have been shown to have protective effects on health during downturns

(Cylus, Glymour, & Avendano, 2015; Stuckler, Basu, Suhrcke, Coutts, & McKee, 2009) and plausibly also cognitive functioning by reducing stress as a result financial difficulties. Finally, policies to mitigate adverse effects of non-employment during downturns could include tax reductions for voluntary work or work in charitable organizations, as it exists for example in Germany.

Limitations

Strengths of this study include longitudinal assessments, use of fixed-effect models to control for time-invariant confounders at both state- and individual-level; and availability of a number of control variables, including fixed birth and period effects. In particular, the circumstance that individuals have no direct influence on the state of the economy, other than migration, represents a quasi-experimental design which is able to overcome potential biases associated with purely observational studies which have assessed the association between adverse work-related events and cognitive function.

Yet, some limitations should be considered. Information on downturns at 55–64 years of age was assigned according to state of residence at first assessment. If healthier workers are more likely to change state of residence as result of poor economic prospects, this would upwardly bias estimates of the impact of downturns. However, we did not find empirical evidence suggesting that downturns are significantly related to inter-state mobility at 55–64 years of age (Supplementary Appendix VIII). Although we control for year and state of birth, cohorts experiencing a different number of years of downturns around retirement age may also share other unobserved characteristics. However, our study exploited state-to-state variations in severity of economic downturns, thus partially controlling for country-wide downturns affecting the entire United States. Estimates of impact of a downturn on cognitive change may be influenced by practice and learning effects (Rabbitt, Diggle, Smith, Holland, & Mc Innes, 2001). However, to the extent that these do not differ for cohorts experiencing different years in a downturn, this bias is unlikely to fully explain our results. Although the identification of downturns based on cyclical variations in the economy does not fully capture differences in severity of unemployment, estimates using average unemployment rates lead to substantially similar conclusions (Supplementary Appendix IX). Although the sub-group analyses and related studies provide important clues regarding the mechanisms linking downturns and cognition, we acknowledge that we are not able to provide a more definite answer to the question regarding what exactly explains this relationship. Although the latter is complicated not only by the complexity of the relationship between macroeconomic conditions and cognition but also issues of reverse causality, our findings should serve as a starting point to further investigate exactly why and how downturns negatively affect cognition.

Conclusions

Individuals experiencing more years in a downturn in the decade preceding expected retirement age have poorer cognitive function after 65 years of age than individuals experiencing more favorable economic conditions. Policies and preventive strategies alleviating negative consequences of collective and individual trauma associated with downturns on older workers, including job loss and financial distress, may preserve cognitive skills after retirement. In particular, helping older workers out of work to regain employment or postpone retirement may be beneficial to uphold cognitive function. Similarly, interventions increasing engagement in cognitively stimulating activities such as volunteering or other forms of social participation, may increase or preserve cognitive function and independent living well beyond retirement.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

Funding

P. Hessel is funded by a David E. Bell Fellowship from the Harvard Center for Population and Development Studies. M. Avendano, Carlos J. Herl and P. Hessel are supported by a Starting Researcher Grant from the European Research Council (ERC grant 263683). M. Avendano and L. Berkman are also supported by the McArthur Foundation Research Network on Aging as well as the National Institute on Aging (grants R01AG037398 and R01AG040248). A. K. Leist is supported by the Fonds National de la Recherche Luxembourg (grants FNR/P11/05 and FNR/P11/05bis).

Acknowledgments

Author contributions: Philipp Hessel and Mauricio Avendano had the idea for the study and planned the methodological approach. Philipp Hessel and Carlos Ruimallo-Herl implemented the statistical analyses and compiled the figures and tables. Philipp Hessel wrote the first draft of the paper. All authors jointly revised the final version of the manuscript.

Conflict of Interest

All authors are pleased to report no conflicts of interest.

References

Adams, G. A., Prescher, J., Beehr, T. A., & Lepisto, L. (2002). Applying work-role attachment theory to retirement decision-making. *The International Journal of Aging and Human Development*, **54**(2), 125–137. doi:10.2190/JRUQ-XQ2N-UP0A-M432

Andel, R., Finkel, D., & Pedersen, N. L. (2016). Effects of preretirement work complexity and postretirement leisure activity on cognitive aging. *The Journals of Gerontology. Series*

B, Psychological Sciences and Social Sciences, **71**, 849–856. doi:10.1093/geronb/gbv026

Avendano, M., & Berkman, L. F. (2014). Labor markets, employment policies, and health. In L. F. Berkman, I. Kawachi, & M. Glymour (Eds.), *Social epidemiology* (pp. 182–233). New York: Oxford University Press.

Bonsang, E., Adam, S., & Perelman, S. (2012). Does retirement affect cognitive functioning? *Journal of Health Economics*, **31**, 490–501. doi:10.1016/j.jhealeco.2012.03.005

Burgard, S. A., & Kalousova, L. (2015). Effects of the great recession: health and well-being. *Annual Review of Sociology*, **41**(1), 181–201. doi:10.1146/annurev-soc-073014-112204

Butt, A., Barton, K., & Oala, C. R. (2012). Families and retirement. In R. Bliesznер & V. Hilkevitch Bedford (Eds.), *Handbook of families and aging* (pp. 461–489). Santa Barbara: Praeger.

Cagney, K. A., Browning, C. R., Iveniuk, J., & English, N. (2014). The onset of depression during the great recession: foreclosure and older adult mental health. *American Journal of Public Health*, **104**, 498–505. doi:10.2105/AJPH.2013.301566

Calvo, E., Sarkisian, N., & Tamborini, C. R. (2013). Causal effects of retirement timing on subjective physical and emotional health. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, **68**, 73–84. doi:10.1093/geronb/gbs097

Catalano, R., & Dooley, D. (1983). Health effects of economic instability: a test of economic stress hypothesis. *Journal of Health and Social Behavior*, **24**, 46–60. doi:10.1007/978-3-662-07891-4_8

Coile, C. C., & Levine, P. B. (2007). Labor market shocks and retirement: Do government programs matter? *Journal of Public Economics*, **91**(10), 1902–1919.

Coile, C. C., & Levine, P. B. (2011). Recessions, retirement, and social security. *The American Economic Review*, **101**(3), 23–28. doi:10.1016/j.jpubeco.2007.01.005

Cylus, J., Glymour, M. M., & Avendano, M. (2015). Health effects of unemployment benefit program generosity. *American Journal of Public Health*, **105**, 317–323.

Daly, M., & Delaney, L. (2013). The scarring effect of unemployment throughout adulthood on psychological distress at age 50: estimates controlling for early adulthood distress and childhood psychological factors. *Social Science & Medicine (1982)*, **80**, 19–23. doi:10.1016/j.socscimed.2012.12.008

Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, **58**(6), S327–S337. doi:10.1093/geronb/58.6.S327

Dartigues, J. F., Gagnon, M., Letenneur, L., Barberger-Gateau, P., Commenges, D., Evaldre, M., & Salamon, R. (1992). Principal lifetime occupation and cognitive impairment in a French elderly cohort (Paquid). *American Journal of Epidemiology*, **135**, 981–988. doi:10.1093/oxfordjournals.aje.a116410

Doblhammer, G., van den Berg, G. J., & Fritze, T. (2013). Economic conditions at the time of birth and cognitive abilities late in life: evidence from ten European countries. *PloS One*, **8**(9). e74915. doi:10.1371/journal.pone.0074915

Elwell, F., & Maltbie-Crannell, A. D. (1981). The impact of role loss upon coping resources and life satisfaction of the elderly. *Journal of Gerontology*, **36**, 223–232.

Ferraro, K. F., Shippee, T. P., & Schafer, M. H. (2009). Cumulative inequality theory for research on aging and the life course. *Handbook of Theories of Aging*, 413–433.

Finkel, D., Andel, R., Gatz, M., & Pedersen, N. L. (2009). The role of occupational complexity in trajectories of cognitive aging before and after retirement. *Psychology and Aging*, **24**, 563–573. doi:10.1037/a0015511

Fisher, G. G., Hassan, H., Faul, J. D., Rodgers, W. L., & Weir, D. R. (2015). Health and Retirement Study Imputation of Cognitive Functioning Measures. Retrieved from http://hrsonline.isr.umich.edu/modules/meta/xyear/cogimp/desc/COGIMPdd.pdf

Gallo, W. T., Bradley, E. H., Dubin, J. A., Jones, R. N., Falba, T. A., Teng, H. M., & Kasl, S. V. (2006). The persistence of depressive symptoms in older workers who experience involuntary job loss: results from the health and retirement survey. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, **61**, 221–228. doi:10.1093/geronb/61.4.S221

Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science*, **312**(5782), 1900–1902. doi:10.1126/science.1128898

Hodrick, R. J., & Prescott, E. C. (1997). Postwar US business cycles: An empirical investigation. *Journal of Money, Credit, and Banking*, **1**(29), 1–16. doi:10.2307/2953682

Holtzman, R. E., Rebok, G. W., Saczynski, J. S., Kouzis, A. C., Wilcox Doyle, K., & Eaton, W. W. (2004). Social network characteristics and cognition in middle-aged and older adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, **59**, 278–284. doi:10.1093/geronb/59.6.P278

Hoynes, H. & Miller, D. L. & Schaller, J. (2012). Who suffers during recessions? *The Journal of Economic Perspectives*, **26**(3), 27–47. doi:10.1257/jep.26.3.27

Juster, R. P., McEwen, B., & Lupien, S. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. *Neuroscience & Biobehavioral Reviews*, **35**(1), 2–16.

Juster, F. T., & Suzman, R. (1995). An overview of the Health and Retirement Study. *Journal of Human Resources*, **30**, 7–56. doi:10.1016/j.neubiorev.2009.10.002

Kahn, J. R., & Pearlin, L. I. (2006). Financial strain over the life course and health among older adults. *Journal of Health and Social Behavior*, **47**, 17–31. doi:10.1177/002214650604700102

Karlamangla, A. S., Miller-Martinez, D., Aneshensel, C. S., Seeman, T. E., Wight, R. G., & Chodosh, J. (2009). Trajectories of cognitive function in late life in the United States: demographic and socioeconomic predictors. *American Journal of Epidemiology*, **170**, 331–342. doi:10.1093/aje/kwp154

Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., Stuckler, D., … McKee, M. (2013). Financial crisis, austerity, and health in Europe. *The Lancet*, **381**(9874), 1323–1331. doi:10.1016/S0140-6736(13)60102-6

Larson, J. H., Wilson, S. M., & Beley, R. (1994). The impact of job insecurity on marital and family relationships. *Family Relations*, **43**(2), 138–143. doi:10.2307/585315

Leist, A., Hessel, P., & Avendano, M. (2013). Do economic recessions during early and mid-adulthood influence cognitive function in older age? *Journal of Epidemiology and Community Health,* **68**,151–158. doi:10.1136/jech-2013–202843

Li, C.-Y., Wu, S. C., & Sung, F.-C. (2002). Lifetime principal occupation and risk of cognitive impairment among the elderly. *Industrial Health*, **40**(1), 7–13.

Lupien, S. J., McEwen, B. S., Gunnar, M. R., & Heim, C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature reviews. Neuroscience*, **10**, 434–445. doi:10.1038/nrn2639

Mejía, S. T., Settersten, R. A. Jr, Odden, M. C., & Hooker, K. (2016). Responses to financial loss during the great recession: an examination of sense of control in late midlife. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, **71**, 734–744. doi:10.1093/geronb/gbv054

Noelke, C., & Avendano, M. (2015). Who suffers during recessions? Economic downturns, job loss, and cardiovascular disease in older Americans. *American Journal of Epidemiology*, **182**, 873–882. doi:10.1093/aje/kwv094

Noelke, C., & Beckfield, J. (2014). Recessions, job loss, and mortality among older US adults. *American Journal of Public Health*, **104**(11), 126–134. doi:10.2105/AJPH.2014.302210

OECD. (2010). Moving Beyond the Jobs Crisis. Retrieved from Paris: /content/chapter/empl_outlook-2010-2-en http://dx.doi.org/10.1787/empl_outlook-2010-2-en

Pearlin, L. I., Schieman, S., Fazio, E. M., & Meersman, S. C. (2005). Stress, health, and the life course: some conceptual perspectives. *Journal of Health and Social Behavior*, **46**, 205–219. doi:10.1177/002214650504600206

Rabbitt, P., Diggle, P., Smith, D., Holland, F., & Mc Innes, L. (2001). Identifying and separating the effects of practice and of cognitive ageing during a large longitudinal study of elderly community residents. *Neuropsychologia*, **39**(5), 532–543. doi:S0028-3932(00)00099-3

Ruhm, C. J. (2000). Are recessions good for your health? *Quarterly Journal of Economics*, **115**(2), 617–650. doi:10.1162/003355300554872

Ruhm, C. J. (2005). Healthy living in hard times. *Journal of Health Economics*, **24**(2), 341–363.

Sabia, S., Nabi, H., Kivimaki, M., Shipley, M. J., Marmot, M. G., & Singh-Manoux, A. (2009). Health behaviors from early to late midlife as predictors of cognitive function: The Whitehall II study. *American Journal of Epidemiology*, **170**, 428–437. doi:10.1093/aje/kwp161

Sterling, P., & Eyer, J. (1988). Allostasis: A new paradigm to explain arousal pathology. In S. Fisher, & J. Reason (Eds.), *Handbook of life stress, cognition and health* (629–649). New York: John Wiley & Sons.

Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsychological Society: JINS*, **8**, 448–460. doi:10.1017/S1355617702813248

Stern, Y., Alexander, G. E., Prohovnik, I., Stricks, L., Link, B., Lennon, M. C., & Mayeux, R. (1995). Relationship between lifetime occupation and parietal flow: Implications for a reserve against Alzheimer's disease pathology. *Neurology*, **45**(1), 55–60. doi:10.1212/wnl.45.1.55

Stuckler, D., Basu, S., Suhrcke, M., Coutts, A., & McKee, M. (2009). The public health effect of economic crises and alternative policy responses in Europe: An empirical analysis. *The Lancet*, **374**(9686), 315–323. doi:10.1016/s0140-6736(09)61124–7

Turrell, G., Lynch, J. W., Kaplan, G. A., Everson, S. A., Helkala, E. L., Kauhanen, J., & Salonen, J. T. (2002). Socioeconomic position across the lifecourse and cognitive function in late middle age. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, **57**, S43–S51.

U.S. Bureau of Labor Statistics. (2009). Labor Force Statistics from the Current Population Survey. Retrieved from http://www.bls.gov/cps/cps_htgm.htm

van den Berg, G. J., Deeg, D. J. H., Lindeboom, M., & Portrait, F. (2010). The role of early-life conditions in the cognitive decline due to adverse events later in life. *The Economic Journal*, **120**(548), 411–428. doi:10.1093/geronb/57.1.S43

Xu, X. (2013). The business cycle and health behaviors. *Social Science & Medicine*, **77**, 126–136. doi:10.1111/j.1468-0297.2010.02396.x