JAMA | Original Investigation

Association of a Negative Wealth Shock With All-Cause Mortality in Middle-aged and Older Adults in the United States

Lindsay R. Pool, PhD; Sarah A. Burgard, PhD; Belinda L. Needham, PhD; Michael R. Elliott, PhD; Kenneth M. Langa, MD, PhD; Carlos F. Mendes de Leon, PhD

IMPORTANCE A sudden loss of wealth—a negative wealth shock—may lead to a significant mental health toll and also leave fewer monetary resources for health-related expenses. With limited years remaining to regain lost wealth in older age, the health consequences of these negative wealth shocks may be long-lasting.

OBJECTIVE To determine whether a negative wealth shock was associated with all-cause mortality during 20 years of follow-up.

DESIGN, SETTING, AND PARTICIPANTS The Health and Retirement Study, a nationally representative prospective cohort study of US adults aged 51 through 61 years at study entry. The study population included 8714 adults, first assessed for a negative wealth shock in 1994 and followed biennially through 2014 (the most recent year of available data).

EXPOSURES Experiencing a negative wealth shock, defined as a loss of 75% or more of total net worth over a 2-year period, or asset poverty, defined as 0 or negative total net worth at study entry.

MAIN OUTCOMES AND MEASURES Mortality data were collected from the National Death Index and postmortem interviews with family members. Marginal structural survival methods were used to account for the potential bias due to changes in health status that may both trigger negative wealth shocks and act as the mechanism through which negative wealth shocks lead to increased mortality.

RESULTS There were 8714 participants in the study sample (mean [SD] age at study entry, 55 [3.2] years; 53% women), 2430 experienced a negative wealth shock during follow-up, 749 had asset poverty at baseline, and 5535 had continuously positive wealth without shock. A total of 2823 deaths occurred during 80 683 person-years of follow-up. There were 30.6 vs 64.9 deaths per 1000 person-years for those with continuously positive wealth vs negative wealth shock (adjusted hazard ratio [HR], 1.50; 95% CI, 1.36-1.67). There were 73.4 deaths per 1000 person-years for those with asset poverty at baseline (adjusted HR, 1.67; 95% CI, 1.44-1.94; compared with continuously positive wealth).

CONCLUSIONS AND RELEVANCE Among US adults aged 51 years and older, loss of wealth over 2 years was associated with an increased risk of all-cause mortality. Further research is needed to better understand the possible mechanisms for this association and determine whether there is potential value for targeted interventions.

Editorial page 1327

Supplemental content

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Lindsay R. Pool, PhD, Department of Preventive Medicine, Northwestern University Feinberg School of Medicine, 680 N Lake Shore Dr, 14th Floor, Chicago, IL 60611 (lindsay.pool@northwestern.edu).

JAMA. 2018;319(13):1341-1350. doi:10.1001/jama.2018.2055

There is strong evidence for a social gradient in health, with substantially poorer health outcomes among people with lower socioeconomic status (SES), including both low income and low wealth.[1-3] Negative wealth shocks are large sudden losses of net worth and may represent another critical component of SES exposure, for these shocks are usually stressful life experiences that leave fewer monetary resources for health-enhancing goods and services.[4-6] Research conducted in the wake of the Great Recession showed significant associations between negative wealth shocks and short-term clinically relevant health changes, including increased risk of depression and anxiety,[7-9] suicide,[10] impaired cardiovascular function,[11] and substance abuse.[12]

A negative wealth shock in late middle and older age may lead to permanent change in economic status because income-earning potential is reduced and thus there is less ability to financially recover from the shock.[6] However, little is known about potential long-term health consequences of negative wealth shocks. Furthermore, because medical expenses from major illness can be a primary trigger of negative wealth shock in middle-aged and older adults,[13] it can be difficult to disentangle the effect of negative wealth shocks on subsequent health outcomes from the effect of the medical illness itself.

Data from a nationally representative study of US older adults were used to determine whether all-cause mortality during a 20-year follow-up period was greater among those who experienced a negative wealth shock than those with consistently positive net worth and those with 0 or negative net worth.

Key Points

Question Is a large, sudden loss of wealth in middle or older age associated with higher risk of all-cause mortality?

Findings In this prospective cohort study that included 8714 adults aged 51 to 61 years at study entry, participants who experienced a negative wealth shock during the 20-year follow-up compared with those with continuous positive wealth had a significantly increased risk of mortality (hazard ratio, 1.50).

Meaning Sudden loss of wealth in middle or older age may be a risk factor for all-cause mortality.

Methods

Study Population

The Health and Retirement Study (HRS) is a nationally representative longitudinal study of US adults aged 51 years and older. We used the original HRS cohort, born in 1931 through 1941.[14] The most recent year of available data was collected in 2014; all data were obtained from the RAND HRS file, version P.[15] At each interview, participants were provided a written informed consent document and asked to consent orally. The HRS was approved by the Institutional Review Board at the University of Michigan.

Negative Wealth Shock

Questions assessing the value of separate wealth components, including housing, businesses, individual retirement accounts, checking and savings accounts, investment holdings, vehicles, and any other substantial assets were asked at each HRS interview, as well as outstanding debts, including home mortgages, home equity loans, and unsecured debt values (eg, credit card balances, student loans, and medical debts).

Respondents were unwilling or unable to give an exact value of a particular wealth component for about 8% of all wealth components questions. In these cases, a series of value ranges were provided to the respondent to determine whether the component fell within a particular range. This unfolding bracket method reduced nonresponse rates by 75% in HRS[16] and was used as part of a nearest neighbor–imputation approach to address missing data.[15] As a result of the imputation, there were no missing values for wealth component variables in the RAND HRS research data set. Validation of financial data in HRS has shown a mean measurement error of 6% to 7%.[17]

A sum of all imputed debts were subtracted from the sum of all imputed assets to calculate total net worth. We adjusted all net worth values to 2014 dollars using the consumer price index. Details on the baseline prevalence and median value of wealth components are available in eTable 1 in the Supplement. Differences in net worth between 2 consecutive interviews were used to calculate a negative wealth shock, defined as a loss of 75% or more in a participant's household net worth. This cut point was determined using predictive performance statistics for goodness of fit and discrimination to minimize misclassification due to measurement error. Further rationale and validation of the 75% cut point is described in detail elsewhere.[7] Although 993 participants experienced more than 1 negative wealth shock during follow-up, we considered the first shock to be the start of mortality follow-up in this analysis. Information on negative wealth shocks experienced prior to the inception of the cohort was not available, and thus, left-censored shocks were possible among all participants.

Mortality

The outcome of interest was all-cause mortality. The deaths among HRS participants were assessed through 2 data sources: HRS postmortem interviews of a family member and the National Death Index. The HRS mortality validation has shown that these sources capture 99.9% of all participant deaths.[18] We identified deceased participants at each survey year from 1994 through 2014.

Covariates

Covariates were chosen based on associations with both wealth shock and mortality as documented in the extant literature. Covariates were included as either indicator variables for categories or a restricted cubic spline with 3 equal knots.[19] All models were adjusted for the following baseline covariates: age at enrollment, self-reported sex, self-reported race/ethnicity (non-Hispanic black, non-Hispanic white, Hispanic, or other race), educational attainment (in years), household net worth, and health behaviors including smoking status, alcohol consumption, physical activity, and body mass index, calculated as weight in kilograms divided by height in meters squared. The

combined race/ethnicity category was created from participant-reported responses to separate questions on race and ethnicity that had investigator-specified answer options. Race/ethnicity was included in this analysis due to previously demonstrated racial differences in both mortality rates and wealth accumulation.[20]

Time-varying covariates included in analyses were lagged by one survey interview to provide temporal patterning in which the covariate preceded the negative wealth shock. Time-varying socioeconomic variables were consumer price index-adjusted household income, marital status, labor force status, and health insurance status. Time-varying health variables were self-rated health, whether health limited the ability to work, hospitalization in the past 2 years, out-of-pocket health care costs over the past 2 years, history of any of 8 chronic conditions (hypertension, diabetes, heart disease, stroke, lung disease, cancer, psychiatric conditions, and arthritis), multimorbidity (≥2 chronic conditions), and limitations in any of 5 activities of daily living (ADLs; walking across a room, getting in and out of bed, dressing, bathing, and eating).

We included 2 indicators measuring financial disposition at baseline: (1) financial risk aversion, to adjust for personality differences that may influence likelihood of experiencing a wealth shock and engaging in higher-risk health behaviors and (2) expectation of leaving a bequest upon death, to adjust for intended rate of spending in older age. Financial risk aversion was a 3-category response (most averse, moderately averse, or least averse) based on answers to a validated series of hypothetical questions on risk taking on a new job that could either double or reduce current income.[21] Bequest expectation was a standard yes or no question on whether one plans to leave a large bequest upon death (the participant determined the amount that constitutes a "large" bequest).[22]

Statistical Analysis

Baseline demographic and health characteristics and crude mortality rates were calculated for 3 mutually exclusive exposure groups: participants who experienced at least 1 negative wealth shock during follow-up, participants who had consistent positive net worth with no shock during follow-up, and participants who had asset poverty (0 or negative net worth) at baseline.

To adjust for the potential confounding due to time-varying changes in health and other variables that may precede negative wealth shocks during follow-up, we used a marginal structural model approach.[23] In this approach, logistic regression was used to predict the probability of a negative wealth shock for each individual at each time point, first using only baseline covariates (the numerator model) and then using baseline and time-varying covariates (the denominator model). The predicted probabilities from these 2 models were used to create inverse probability of treatment weights that were then applied in analysis so that the distribution of confounders was independent of the exposure and allowed for an unbiased estimate of the relationship between negative wealth shocks and mortality. In addition to treatment weights, we also calculated inverse probability of censoring weights that adjust for censoring related to withdrawal from the study prior to the end of follow-up. More detailed information on the calculation of the inverse probability of treatment weights and inverse probability of censoring weights is available in the eMethods section of the Supplement.

To accommodate the time-varying weights, we estimated the association between a negative wealth shock and all-cause mortality using a discrete-time hazard model with a complementary log-log link. The estimated hazard ratio (HR) from this model is equivalent to a HR as estimated by a continuous-time Cox proportional hazard model.[24] The proportional hazards assumption was evaluated graphically and via an interaction term between negative wealth shock and time; there was no violation of the assumption. The marginal structural model-adjusted Kaplan-Meier survival curves were produced.[25]

Statistical significance was defined using a 2-sided α level of .05. All analyses were performed using SAS 9.4 (SAS Institute Inc), using complex survey sampling procedures that incorporated HRS sampling weights.

Sensitivity and Subgroup Analyses

Because the effect of mortality from a negative wealth shock could differ based on when the shock occurred and by the types of wealth lost in the shock, we stratified individuals who experienced a negative wealth shock into subgroups based on whether the wealth shock was experienced during periods of US macroeconomic growth or recession and whether the participant lost his/her primary residence as part of the shock. To consider the possibility of cohort-specific associations, we also examined the prevalence of negative wealth shocks by year and age across other birth-year cohorts included in the HRS and repeated the analyses in these cohorts.

Post hoc subgroup analyses were calculated using interaction terms between negative wealth shock and time-invariant covariates. We examined possible differences in the negative wealth shock and mortality association by race, sex, financial risk aversion and by baseline net worth category.

Results

Patients and Characteristics

Of the 9751 participants in the original HRS cohort, 581 (6.0%) were excluded because of insufficient follow-up information to ascertain negative wealth shocks, and another 456 (4.7%) were excluded due to missing covariate data. These data were assumed to be missing at random. There were 8714 participants in the resulting analytical sample who were followed up for a mean of 17.7 years, totaling 80 683 person-years of follow-up from 1994 through 2014. Eight hundred twenty-three participants (9%) withdrew from the study before reaching the end of follow-up or death.

In the study sample, 2430 experienced a negative wealth shock during follow-up and 749 had asset poverty at baseline (0 or negative net worth). Accounting for the complex survey design of the HRS, this amounted to 26.2% (95% CI, 24.8%-27.7%) experiencing a negative wealth shock and 6.9% (95% CI, 6.3%-7.6%) having long-term asset poverty of the US

population aged 51 years or older during the study period. Compared with those who had positive wealth without shock, those who had a negative wealth shock were more likely to be women, race/ethnicity other than non-Hispanic white, have lower levels household income and net worth, and have poor health (**Table 1**). These differences were even more extreme in the asset poverty group, the majority of whom were not married, not working, and had serious health conditions.

Net Worth and Shocks

The baseline prevalence and median values of asset and debts that comprised net worth are stratified by exposure subgroup in eTable 1 and net worth category in eTable 2 in the Supplement. The majority of the sample has net worth in primary residences, vehicles, and bank accounts. However, those with higher net worth tend to have a variety of asset types, with larger holdings of businesses, real estate, and investments.

The median change between the 2 survey interviews—both in percentage change and value of gain or loss (in 2014 dollars)—are shown in **Table 2** for each asset and debt type as well as overall net worth, calculated only among those who reported ownership of the asset or the debt. The median change percentages and values are stratified by exposure subgroup, and the negative wealth shock subgroup is further stratified by net worth category in eTable 3 in the Supplement. Those with positive wealth without shock experienced median weighted gains in net worth of 7.5% (95% CI, 7.0%-8.1%) over each 2-year period, amounting to a median increase of $13 894 (95% CI, $11 906-$15 881). For those who experienced a negative wealth shock, the median loss of net worth was −92.4% (95% CI, −93.4% to −91.3%) during the 2-year period, amounting to a median decrease in net worth of $101 568 (95% CI, $90 082 to $113 052). Finally, while the asset poverty group had a large median percent gain in overall net worth (34.3%; 95% CI, 27.0% to 41.7%) over each 2-year period, this amounted to a median increase in value of $694 (95% CI, $399 to $990), because of low levels of initial net worth.

Primary Outcome

A total of 2823 participants died during follow-up. In the positive wealth without shock reference group, the crude mortality rate was 30.6 deaths per 1000 person-years (95% CI, 29.1-32.1). By contrast, the crude mortality rates were 64.9 per 1000 person-years (95% CI, 60.4-69.3) for those who experienced a negative wealth shock, and 73.4 per 1000 person-years (95% CI, 66.1-80.7) for those who had asset poverty (**Table 3**). Compared with the reference group, the adjusted HRs for mortality were 1.50 (95% CI, 1.36-1.67) for those who experienced a negative wealth shock, and 1.67 (95% CI, 1.44-1.94) for those who had asset poverty at baseline (Table 3, **Figure 1**).

Sensitivity and Subgroup Analyses

In post hoc subgroup analyses, no significant interactions were detected between negative wealth shock exposure and sex (P = .08), race/ethnicity (P = .37), or baseline category of net worth (P = .96; **Figure 2**). The association between a negative wealth shock and mortality was less strong among those who were the least averse to financial risk (adjusted HR, 1.18; 95% CI, 0.89-1.56) compared with the moderately risk averse (adjusted HR, 1.35; 95% CI, 1.09-1.67) and the most averse to financial risk (adjusted HR, 1.61; 95% CI, 1.42-1.81) (P for interaction = .05).

In sensitivity analyses (eTable 4 in the Supplement), the adjusted HR for a negative wealth shock during macroeconomic growth (1.51; 95% CI, 1.34-1.70) was similar to the adjusted HR for experiencing a negative wealth shock during recession (1.43; 95% CI, 1.22-1.67). A negative wealth shock with loss of primary residence yielded an adjusted HR of 1.87 (95% CI, 1.58-2.21), although negative wealth shocks also remained significantly associated with mortality without the loss of primary residence (adjusted HR, 1.37; 95% CI, 1.22-1.53). The findings were also robust to alternative cut points for the negative wealth shock exposure, with some evidence of a dose-response relationship (eTable 5 in the Supplement).

In comparison analyses in other HRS birth cohorts, prevalence of shocks increased with age and were sensitive to macroeconomic conditions in all cohorts (eFigure 1 in the Supplement). The adjusted HRs for negative wealth shocks were similar in other birth cohorts (eTable 6 in the Supplement).

Discussion

In a nationally representative sample of US adults aged 51 years or older, more than 25% of individuals experienced a negative wealth shock of 75% or more during a 20-year follow-up period, from 1994 through 2014. A negative wealth shock was associated with an HR of 1.50, a risk that was only slightly smaller than the risk associated with asset poverty, an established social determinant of mortality.[3] Furthermore, the association between negative wealth shocks and mortality did not differ by initial levels of net worth; thus, wealth shock may represent a potential risk factor for mortality across the socioeconomic spectrum.

This study adds to research that has shown associations between negative wealth shocks and short-term health outcomes, including depression and anxiety,[7-9] suicide,[10] impaired cardiovascular function,[11] and substance abuse.[12] The lengthy follow-up period in the HRS captured both proximal associations with mortality, from causes such as suicide, as well as associations with causes of death that have longer latency. Several studies have focused specifically on foreclosure,[5,9,10] hypothesizing this type of loss to be a particularly strong stressor; likewise, in this study, wealth shocks with loss of home had a stronger association with mortality than wealth shocks without loss of home, though these shocks were still associated with increased mortality risk.

Declining financial resources can result in reduced spending on health-related goods and services. Delaying needed medical care and incomplete adherence to prescribed medication can have long-term health consequences, including increased mortality.[26] This potential pathway may be especially salient for those individuals whose medical needs triggered a wealth shock, as previous research in chronic disease patient populations has shown those who report financial burden from medical expenses have a poorer prognosis.[27]

Table 1. Baseline Characteristics of Study Participants

Characteristics	Unweighted Sample, No (%)[a]			Weighted to Reflect US Population, % (95% CI)[b]		
	Positive Wealth Without Shock[c]	Negative Wealth Shock[c]	Asset Poverty at Baseline[c]	Positive Wealth Without Shock[c]	Negative Wealth Shock[c]	Asset Poverty at Baseline[c]
Total participants	5535	2430	749	66.8 (65.1 to 68.5)	26.2 (24.8 to 27.7)	6.9 (6.3 to 7.6)
Age, mean (SD), y[d]	55.6 (3.2)	55.3 (3.2)	55.2 (3.0)	55.6 (55.5 to 55.7)	55.4 (55.2 to 55.5)	55.1 (54.9 to 55.4)
Men	2778 (50.2)	1043 (42.9)	283 (37.8)	50.2 (49.3 to 51.2)	43 (40.9 to 45)	40.6 (37 to 44.1)
Race/ethnicity						
Hispanic	335 (6.1)	317 (13.1)	137 (18.3)	3.9 (2.8 to 5.1)	9.6 (7.2 to 12)	15.7 (12.8 to 18.6)
Non-Hispanic black	581 (10.5)	557 (22.9)	319 (42.6)	5.7 (5 to 6.5)	14.3 (12.3 to 16.2)	32.2 (28.4 to 36)
Non-Hispanic white	4521 (81.7)	1498 (61.7)	274 (36.6)	88.4 (86.7 to 90)	73.4 (70.2 to 76.5)	49.5 (45 to 53.9)
Non-Hispanic other race	98 (1.8)	58 (2.4)	19 (2.5)	2 (1.4 to 2.5)	2.8 (1.7 to 4)	2.7 (1.3 to 4.1)
Educational attainment, median (IQR), y	12.0 (12.0 to 14.0)	12.0 (10.0 to 13.0)	11.0 (8.0 to 12.0)	11.8 (11.6 to 12.0)	11.5 (11.2 to 11.7)	10.7 (10.1 to 11.3)
Financial risk aversion[e]						
Most averse to risk	3644 (65.8)	1563 (64.3)	460 (61.4)	65.6 (64 to 67.2)	63.4 (60.1 to 66.7)	59.8 (55.8 to 63.7)
Moderately averse	1225 (22.1)	554 (22.8)	148 (19.8)	22.5 (21.2 to 23.7)	23.9 (21.3 to 26.6)	20.8 (17.2 to 24.4)
Least averse	666 (12)	313 (12.9)	141 (18.8)	11.9 (10.8 to 13.1)	12.7 (11.1 to 14.2)	19.4 (16.1 to 22.7)
Intends to leave bequest	2767 (50)	984 (40.5)	148 (19.8)	50 (47.8 to 52.1)	39.7 (37.3 to 42.1)	19 (14.8 to 23.2)
Household net worth, median (IQR), 2014 US$	223 080 (107 653 to 444 470)	76 151 (18 590 to 207 025)	−571 (−6758 to 0)	250 538 (232 399 to 268 676)	88 347 (75 814 to 100 879)	−1218 (−1952 to −484)
Household income, median (IQR), 2014 US$	75 543 (43 940 to 116 137)	48 195 (24 674 to 82 810)	17 475 (8856 to 39 208)	78 148 (74 450 to 81 845)	50 501 (46 725 to 54 277)	20 259 (16 622 to 23 896)
Marital status						
Married or partnered	4652 (84.1)	1714 (70.5)	302 (40.3)	83.5 (82.4 to 84.6)	70.7 (68.4 to 73.1)	41.8 (36.6 to 47.1)
Divorced or separated	507 (9.2)	427 (17.6)	268 (35.8)	9.5 (8.7 to 10.3)	17.6 (15.8 to 19.4)	36.6 (32.5 to 40.7)
Widowed	236 (4.3)	192 (7.9)	113 (15.1)	4.2 (3.7 to 4.7)	7.5 (6.4 to 8.7)	13.6 (10.3 to 16.9)
Never married	140 (2.5)	97 (4)	66 (8.8)	2.8 (2.2 to 3.4)	4.1 (3.1 to 5.1)	8 (6 to 10)
Labor force status						
Working	3858 (69.7)	1611 (66.3)	328 (43.8)	70 (68.6 to 71.5)	66 (63 to 68.9)	46.2 (41.9 to 50.5)
Unemployed	123 (2.2)	96 (4)	63 (8.4)	2.1 (1.7 to 2.5)	4 (3.1 to 4.8)	8.2 (6 to 10.4)
Retired	909 (16.4)	346 (14.2)	164 (21.9)	16.5 (15.4 to 17.7)	14.5 (12.7 to 16.3)	22 (18.3 to 25.6)
Disabled	102 (1.8)	109 (4.5)	102 (13.6)	1.6 (1.2 to 2)	4.3 (3.2 to 5.3)	12.8 (10 to 15.5)
Homemaker	543 (9.8)	268 (11)	92 (12.3)	9.7 (8.8 to 10.6)	11.3 (9.6 to 13)	10.8 (8.5 to 13.2)
Health insured	5039 (91)	1926 (79.3)	511 (68.2)	92.1 (91.1 to 93.2)	80.4 (78.3 to 82.5)	70.9 (67 to 74.7)
BMI, mean (SD)	26.8 (4.8)	27.8 (5.4)	28.1 (6.2)	26.6 (26.5 to 26.8)	27.7 (27.5 to 27.9)	27.8 (27.3 to 28.3)
Alcohol use[f]						
None	1912 (34.5)	1113 (45.8)	373 (49.8)	31.9 (29.4 to 34.5)	43.2 (41 to 45.5)	48.4 (44 to 52.9)
Moderate	3355 (60.6)	1181 (48.6)	323 (43.1)	63.3 (60.7 to 65.9)	51.3 (49.1 to 53.6)	43.5 (39.2 to 47.9)
Heavy	268 (4.8)	136 (5.6)	53 (7.1)	4.8 (4.3 to 5.4)	5.4 (4.5 to 6.4)	8 (5.7 to 10.4)

(continued)

Table 1. Baseline Characteristics of Study Participants (continued)

Characteristics	Unweighted Sample, No (%)[a]			Weighted to Reflect US Population, % (95% CI)[b]		
	Positive Wealth Without Shock[c]	Negative Wealth Shock[c]	Asset Poverty at Baseline[c]	Positive Wealth Without Shock[c]	Negative Wealth Shock[c]	Asset Poverty at Baseline[c]
Smoking status						
Never smoked	2095 (37.9)	875 (36)	216 (28.8)	37.6 (35.8 to 39.4)	35.3 (33.2 to 37.3)	26.4 (23.1 to 29.8)
Former smoker	2159 (39)	785 (32.3)	211 (28.2)	39.6 (37.8 to 41.4)	32.4 (30.7 to 34.1)	28.4 (24.9 to 31.9)
Current smoker	1281 (23.1)	770 (31.7)	322 (43)	22.8 (20.9 to 24.6)	32.3 (30.5 to 34.2)	45.2 (41.1 to 49.3)
Vigorous physical activity[g]	1108 (20)	474 (19.5)	135 (18)	20.4 (19 to 21.7)	18.4 (16.7 to 20.1)	17.2 (14.4 to 20)
Self-rated health status						
Excellent	1418 (25.6)	455 (18.7)	63 (8.4)	27 (25.4 to 28.7)	20 (18.2 to 21.9)	9.4 (6.7 to 12.1)
Very good	1799 (32.5)	600 (24.7)	105 (14)	33.9 (32.2 to 35.5)	26.1 (24.1 to 28.1)	14.8 (11.9 to 17.7)
Good	1483 (26.8)	710 (29.2)	213 (28.4)	25.4 (23.9 to 26.8)	28.5 (26.2 to 30.9)	28.9 (25 to 32.8)
Fair	581 (10.5)	457 (18.8)	185 (24.7)	9.5 (8.5 to 10.5)	17 (15.3 to 18.7)	24.1 (21.3 to 26.9)
Poor	254 (4.6)	208 (8.6)	183 (24.4)	4.2 (3.6 to 4.8)	8.3 (6.7 to 9.9)	22.8 (18.5 to 27.1)
Health limits ability to work	868 (15.7)	563 (23.2)	333 (44.5)	15.4 (14.2 to 16.5)	23.3 (20.8 to 25.7)	43.6 (38.9 to 48.4)
Multimorbidity[h]	1325 (23.9)	733 (30.2)	360 (48.1)	22.9 (21.4 to 24.4)	29.7 (27.8 to 31.6)	46.8 (42.6 to 51)
Hypertension	1723 (31.1)	846 (34.8)	375 (50.1)	29.8 (28.1 to 31.4)	33.3 (31.1 to 35.5)	46.2 (41.8 to 50.5)
Diabetes	399 (7.2)	260 (10.7)	123 (16.4)	6.4 (5.8 to 7.1)	10.1 (9.1 to 11.1)	14.9 (12.1 to 17.6)
Cancer	260 (4.7)	95 (3.9)	28 (3.7)	4.7 (4.1 to 5.3)	3.9 (3.1 to 4.7)	3.3 (2.1 to 4.5)
Cardiovascular disease	486 (8.8)	233 (9.6)	134 (17.9)	8.6 (7.8 to 9.5)	9.7 (8.2 to 11.2)	17.6 (14.6 to 20.7)
Stroke	90 (1.6)	59 (2.4)	45 (6)	1.5 (1.2 to 1.9)	2.2 (1.5 to 2.9)	5.9 (4.3 to 7.6)
Lung disease	223 (4)	123 (5.1)	69 (9.2)	4 (3.5 to 4.5)	5.4 (4 to 6.8)	10.1 (7.9 to 12.4)
Psychiatric conditions	229 (4.1)	207 (8.5)	121 (16.2)	4.1 (3.5 to 4.7)	8.9 (7.2 to 10.5)	17.1 (14.1 to 20.2)
Arthritis	1697 (30.7)	880 (36.2)	324 (43.3)	30.2 (28.7 to 31.7)	36.9 (34.9 to 38.8)	43.9 (39.9 to 47.9)
ADL limitation	373 (6.7)	323 (13.3)	200 (26.7)	6.1 (5.4 to 6.8)	12.8 (11.2 to 14.4)	26 (21.2 to 30.8)
Hospitalized in past 2 y	508 (9.2)	268 (11)	159 (21.2)	8.7 (7.8 to 9.6)	10.8 (9.7 to 12)	22 (18.4 to 25.6)
Out-of-pocket medical costs, median (IQR), 2014 US$	710 (143 to 2027)	664 (80 to 1887)	658 (66 to 1915)	737 (691 to 783)	702 (646 to 758)	693 (572 to 814)

Abbreviations: ADL, activities of daily living; BMI, body mass index, calculated as weight in kilograms divided by height in meters squared; IQR, interquartile range.

[a] Percentages may not sum to 100 due to rounding.

[b] The Health Retirement Study used complex survey sampling that allows for estimation to represent the US population in the birth cohort born in 1931 through 1941.

[c] Study characteristics reported by 3 mutually exclusive exposure categories: participants who had consistent positive net worth during follow-up and did not experience a negative wealth shock of 75% or more (positive wealth without shock); participants who experienced at least 1 negative wealth shock of 75% or more during follow-up (negative wealth shock); and participants who had 0 or negative net worth at baseline (asset poverty at baseline).

[d] Mean age represents the mean age at study enrollment; participants were selected based on birth cohort, aged 51 through 61 years at enrollment.

[e] Financial risk aversion is based on answers to a set of income gamble questions: the least averse would take a new job that could either double or halve income, the moderately averse would take a new job that could either double or reduce income up to 30%, and the most averse would not take a new job that could possibly reduce income.

[f] Moderate alcohol use is defined as up to 2 drinks per day, and heavy alcohol use is defined as more than 2 drinks per day.

[g] Vigorous physical activity at least 3 times per week.

[h] Multimorbidity defined as history of 2 or more of the following conditions: hypertension, diabetes, cancer, cardiovascular disease, stroke, lung disease, psychiatric conditions, and arthritis.

Table 2. Median Percentage of Asset or Debt Change, and Median Value of Asset or Debt Change in Thousands of 2014 US Dollars

	Positive Wealth Without Shock (n = 5535)		Negative Wealth Shock (n = 2430)		Asset Poverty at Baseline (n = 749)	
	Percent Change, Median (IQR)[a]	Value of Change, Median (IQR)[b]	Percent Change, Median (IQR)[a]	Value of Change, Median (IQR)[b]	Percent Change, Median (IQR)[a]	Value of Change, Median (IQR)[b]
Unweighted Sample						
Asset change						
Primary residence	4.0 (−6.3 to 21.7)	5.8 (−7.6 to 30.2)	−40 (−100 to 0)	−29 (−108 to 0)	7.1 (−15 to 55.6)	5.3 (−10.3 to 32.4)
Other real estate[c]	0 (−92.5 to 100)	0 (−52.8 to 53.1)	−100 (−100 to −92.1)	−72.5 (−278 to −11.9)	50 (−100 to 100)	3.2 (−20.3 to 44.4)
Vehicles[c]	0 (−40 to 66.7)	0 (−7 to 7.6)	−47.7 (−83.3 to 12.5)	−3 (−10.5 to 0.5)	0 (−62.5 to 100)	0 (−2.7 to 3.2)
Businesses[c]	0 (−98.4 to 100)	0 (−75.5 to 103)	−100 (−100 to −94.8)	−151 (−578 to −30.2)	25 (−93.1 to 100)	2.4 (−41.6 to 75.5)
IRAs or Keoghs[d]	7.1 (−37.5 to 100)	2.9 (−20.8 to 38.9)	−93.3 (−100 to 2.1)	−16.6 (−72.3 to 0.6)	16.7 (−100 to 100)	1.4 (−7.6 to 15.1)
Investments[e]	7.3 (−66.7 to 100)	0.8 (−24.8 to 43.5)	−99.1 (−100 to 0)	−12.8 (−90.6 to 0)	16.7 (−100 to 100)	0.1 (−5.4 to 8.8)
Bank accounts	0 (−60 to 100)	0 (−7 to 10.2)	−55.8 (−95.8 to 100)	−0.8 (−7.2 to 0.4)	30 (−83.3 to 100)	0 (−0.6 to 1)
All other assets[f]	0 (−100 to 100)	0 (−17.7 to 20.6)	−100 (−100 to 50)	−11.6 (−48.6 to 0.1)	60 (−100 to 100)	0.4 (−7.3 to 9.6)
Debt change						
Primary mortgage	−7.4 (−50 to 20)	−3.6 (−16 to 10)	0 (−100 to 100)	0 (−22.3 to 50.6)	−3.8 (−66.7 to 77.8)	−2.1 (−19.2 to 21.1)
Home equity loans	−1.2 (−100 to 100)	−0.3 (−14.3 to 15.1)	100 (−100 to 100)	6.0 (−15.8 to 38.3)	0 (−100 to 100)	0 (−19.1 to 15.3)
Unsecured debts[g]	0 (−100 to 100)	0 (−3.3 to 3.5)	100 (−52.9 to 100)	2.8 (−1.1 to 15.1)	−9.6 (−100 to 100)	−0.1 (−4.4 to 2.9)
Overall net worth change	7.3 (−18.3 to 44)	12 (−42 to 97.4)	−93.4 (−102 to −82.6)	−92.1 (−266 to −29.9)	35.0 (−0.64 to 106)	0.6 (−4.1 to 16)
Weighted to Reflect US Population[h]						
Assest change						
Primary residence	4 (3.4 to 4.6)	5.9 (4.9 to 6.9)	−43.2 (−54.2 to −32.2)	−31 (−39.4 to −22.6)	8 (6.5 to 9.4)	6.1 (4.1 to 8.1)
Other real estate[c]	−0.6 (−3.6 to 2.4)	0 (−0.7 to 0.7)	−100 (−102 to −97.6)	−82.9 (−113 to −53.4)	47.6 (7.6 to 87.6)	3 (−0.6 to 6.6)
Vehicles[c]	−0.1 (−2.8 to 2.5)	0 (−0.3 to 0.3)	−44.6 (−49.5 to −39.7)	−3 (−3.5 to −2.5)	−0.1 (−6.1 to 5.9)	0 (−0.1 to 0.1)
Businesses[c]	−0.5 (−5.2 to 4.2)	0 (−1.5 to 1.5)	−100 (−103 to −97.4)	−166.4 (−235 to −97.4)	24.2 (−0.1 to 48.5)	10.6 (−5.5 to 26.8)
IRAs or Keoghs[d]	7.4 (6.3 to 8.6)	3 (2.5 to 3.5)	−87.4 (−97.3 to −77.5)	−16.1 (−22.2 to −10)	16.2 (−1.8 to 34.2)	1.3 (−0.9 to 3.6)
Investments[e]	8.3 (6.5 to 10.2)	1.1 (0.7 to 1.5)	−98.8 (−101 to −96.3)	−13.3 (−21.9 to −4.7)	17.8 (−2.6 to 38.2)	0.1 (−0.3 to 0.4)
Bank accounts	0 (−2.9 to 2.9)	0	−55 (−60.4 to −49.5)	−0.8 (−1.1 to −0.5)	30.2 (20 to 40.3)	0
All other assets[f]	−0.8 (−5 to 3.4)	0 (−0.4 to 0.4)	−100 (−113 to −87)	−13.2 (−16.5 to −9.9)	59.4 (19.9 to 98.8)	0.6 (−0.1 to 1.3)
Debt change						
Primary mortgage	−7.1 (−8 to −6.3)	−4 (−4.5 to −3.5)	−1 (−5.4 to 3.4)	−0.1 (−2.1 to 1.9)	−3.8 (−6.2 to −1.4)	−2.2 (−3.1 to −1.2)
Home equity loans	−2.8 (−6.2 to 0.5)	−0.3 (−0.9 to 0.2)	87.7 (34 to 141)	6.5 (−1.3 to 14.4)	−0.5 (−45.8 to 44.9)	−0.9 (−3.3 to 1.6)
Unsecured debts[g]	−0.3 (−5.7 to 5.2)	0 (−0.1 to 0)	95.2 (71.7 to 118.6)	2.7 (1.8 to 3.7)	−8.1 (−16.3 to 0.2)	−0.1 (−0.1 to 0)
Overall net worth change	7.5 (7 to 8.1)	13.9 (11.9 to 15.9)	−92.4 (−93.4 to −91.3)	−102 (−113 to −90.1)	34.3 (27.0 to 41.7)	0.7 (0.4 to 1)

Abbreviations: IQR, interquartile range; IRA, individual retirement account.

[a] Median change between 2 survey interviews, including those who reported the asset or debt (prevalence of asset and debt holdings, eTable 1 in the Supplement).

[b] Median change between 2 survey interviews, including those who reported the asset or debt (in thousands of US $ using the consumer price index).

[c] Estimated net value that takes into account debts owed on asset.

[d] Tax-deferred retirement savings plans funded by individual contributions. The types of IRAs depend on employment and household income; Keogh accounts are for self-employed small-business owners.

[e] Includes stocks, mutual funds, investment trusts, bonds, bond funds, certificates of deposit, government savings bonds, and treasury bills.

[f] Includes jewelry, money owed, a collection for investment purposes, rights in a trust or estate, or an annuity.

[g] Includes credit card balances, medical debts, life insurance policy loans, and loans from relatives.

[h] The Health Retirement Study used complex survey sampling to allow for estimates representing the US population in the cohort born from 1931 through 1941.

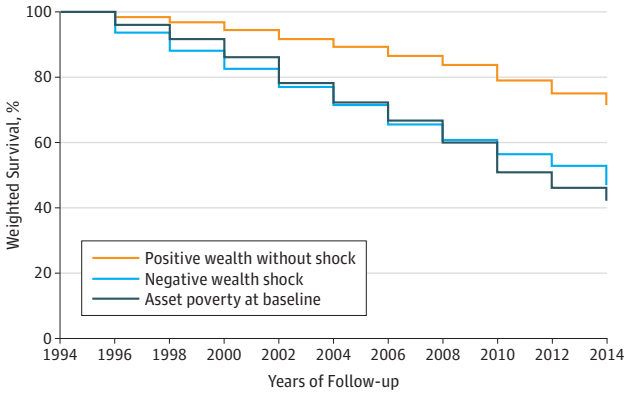
Table 3. Rates and Adjusted Hazard of Death for Negative Wealth Shock Exposure Categories

	Positive Wealth Without Shock[a]	Negative Wealth Shock[a]	Asset Poverty at Baseline[a]
Person-years, No.	52 788	12 621	5274
All deaths, No.	1617	819	387
Unadjusted rate/1000 person-years (95% CI)	30.6 (29.1-32.1)	64.9 (60.4-69.3)	73.4 (66.1-80.7)
Unadjusted rate difference (95% CI)	0 [Reference]	34.3 (29.6-39.0)	42.8 (35.3-50.2)
Adjusted hazard ratio (95% CI)[b]	1 [Reference]	1.50 (1.36-1.67)	1.67 (1.44-1.94)

[a] Reported by 3 mutually exclusive exposure categories: participants who had consistent positive net worth during follow-up and did not experience a negative wealth shock of 75% or more (positive wealth without shock); participants who experienced at least 1 negative wealth shock of 75% or more during follow-up (negative wealth shock); and participants who had 0 or negative net worth at baseline (asset poverty at baseline).

[b] Adjusted hazard was derived from the marginal structural hazard model for time to outcome, with both inverse probability of treatment and inverse probability of censoring weights applied.

Figure 1. Adjusted Survival Curves for All-Cause Mortality by Asset Status, 1994-2014



No. at risk											
Positive wealth without shock	7473	6936	6360	5912	5473	5071	4766	4446	4077	3705	3427
Negative wealth shock	429	846	1106	1279	1414	1516	1604	1650	1725	1674	1647
Asset poverty at baseline	749	720	680	639	597	542	502	461	411	352	323

No. of deaths										
Positive wealth without shock	123	123	161	208	156	205	213	353	272	275
Negative wealth shock	23	30	36	41	22	34	36	47	33	45
Asset poverty at baseline	31	31	36	54	35	41	44	58	29	25

Survival estimates are adjusted for covariates using weights estimated in the marginal structural models. Negative wealth shock was a time-varying exposure, and participants may contribute person-years at risk to both the positive wealth without shock and negative wealth shock groups across follow-up. Negative wealth shock vs positive wealth without shock (reference) had an adjusted hazard ratio of 1.50 (95% CI, 1.36-1.67); asset poverty at baseline vs positive wealth without shock, 1.67 (95% CI, 1.44-1.94).

Median follow-up times were 20 years (interquartile range [IQR], 12-20 years) in the positive wealth without shock group, 12 years (IQR, 8-20 years) in the negative wealth shock group, and 16 years (IQR, 8-20 years) in the asset poverty at baseline group.

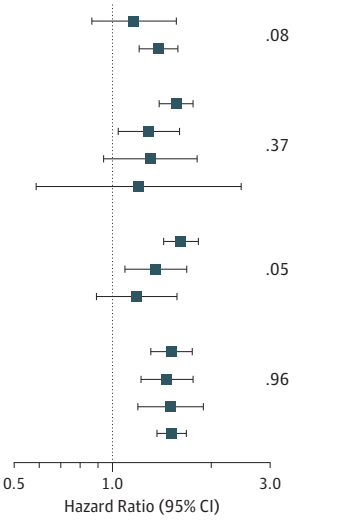
Another potential pathway from negative wealth shocks to all-cause mortality is through the psychosocial stress of economic loss. Experimental research has shown brain region activation following a negative wealth shock,[28] which may contribute to the higher risk of mental health conditions and substance abuse found in observational research.[7-10,12] In addition to suicide's immediate contribution to elevated mortality, mental disorders and substance abuse are associated with long-term risk of mortality.[29] Stress of wealth shocks may also produce physiological changes; wealth shocks have been associated with short-term increases in systolic blood pressure and inflammation,[11] which in turn may increase risk of cardiovascular mortality.[30] Personality traits like greater tolerance of financial risk may buffer the stress of the shock. In post hoc subgroup analysis, there was suggestion of an interaction between financial risk aversion and negative wealth shock. Furthermore, the associations with stress and mental health may be confined to negative wealth shocks, as research on positive wealth shocks has shown no associations with changes in psychological health.[31]

Limitations

This study has several limitations. First, misclassification of the negative wealth shock exposure was minimized by using a large percentage change in net worth that is unlikely to be attributable to routine consumption or planned dissaving.[7] Sensitivity analyses showed that less acute shock within 2 years (such as >25% or >50% loss) were associated with increased mortality risk, but less acute negative wealth shocks that take more than 2 years to be fully realized may have been missed. Second, because study enrollment and follow-up began at ages 51 through 61 years, shocks that occurred prior to the study start were not captured and could have occurred in any of the exposure groups, potentially introducing bias toward the null. Third, despite adjusting for conditions that frequently precipitate wealth shocks, including marital disruption, unemployment, and a variety of health status and access to care indicators, residual confounding is likely. Covariates were lagged from 1 interview prior to the negative wealth shock exposure to establish temporality, but this may increase residual confounding if changes in the covariate occurred in the 2 years

Figure 2. Adjusted Hazard of Death by Post Hoc Subgroup Populations of Asset Status

	Negative Wealth Shock			Positive Wealth Without Shock				
	No. of Person-Years	No. of Deaths	Unadjusted Rate per 1000 Person-Years (95% CI)	No. of Person-Years	No. of Deaths	Unadjusted Rate per 1000 Person-Years (95% CI)	Hazard Ratio (95% CI)	*P* Value for Interaction
Sex								
Men	5361	412	76.9 (69.4-84.3)	25080	957	38.2 (35.7-40.6)	1.16 (0.86-1.55)	.08
Women	7260	407	56.1 (50.6-61.5)	27708	660	23.8 (22-25.6)	1.37 (1.20-1.57)	
Race/ethnicity								
Non-Hispanic white	7432	511	68.8 (62.8-74.7)	42261	1268	30 (28.4-31.7)	1.55 (1.38-1.75)	
Non-Hispanic black	3006	210	69.9 (60.4-79.3)	6079	227	37.3 (32.5-42.2)	1.28 (1.04-1.59)	.37
Hispanic	1839	82	44.6 (34.9-54.2)	3558	97	27.3 (21.8-32.7)	1.30 (0.94-1.80)	
Other	344	16	46.5 (23.7-69.3)	890	25	28.1 (17.1-39.1)	1.19 (0.58-2.45)	
Financial risk aversion								
Most averse	7961	551	69.2 (63.4-75.0)	34709	1058	30.5 (28.6-32.3)	1.61 (1.42-1.81)	
Moderately averse	2942	165	56.1 (47.5-64.6)	12012	351	29.2 (26.2-32.3)	1.35 (1.09-1.67)	.05
Least averse	1718	103	60.0 (48.4-71.5)	6067	208	34.3 (29.6-38.9)	1.18 (0.89-1.56)	
Net worth category, US $								
<100000	7588	533	70.2 (64.3-76.2)	13276	496	37.4 (34.1-40.6)	1.50 (1.30-1.74)	
100000-300000	2942	184	62.5 (53.5-71.6)	19319	624	32.3 (29.8-34.8)	1.46 (1.21-1.75)	.96
>300000	2091	102	48.8 (39.3-58.2)	20193	497	24.6 (22.4-26.8)	1.49 (1.19-1.18)	
Overall	12621	819	64.9 (60.4-69.3)	52788	1617	30.6 (29.1-32.1)	1.50 (1.36-1.67)	



Data markers indicate the marginal structural model–adjusted hazard ratios comparing the negative wealth shock group with the positive wealth without shock group; the error bars, corresponding 95% CIs. *P* values correspond with the statistical test for differences in the hazard ratios by the subgroup categories.

between covariate measurement and wealth shock measurement. Fourth, study results are generalizable to US adults aged 51 years or older that may not be applicable to wealth shocks occurring at younger ages. Fifth, the results may have period and cohort interpretability restrictions. Sensitivity analysis stratified on macroeconomic conditions tested for possible differences, but it was not possible to discern the causes of the negative wealth shock with certainty. Even in recession periods, it is unknown whether the wealth shock was triggered due to macroeconomic causes or personal circumstances. Likewise, follow-up in this study occurred prior to the implementation of the Affordable Care Act (ACA), which has significantly reduced the number of uninsured adults and lowered out-of-pocket costs.[32] It is possible that increased insurance coverage through the ACA has reduced the prevalence of negative wealth shocks driven by medical issues, and there may also be a reduced prevalence of delaying needed medical care after experiencing wealth shock. There may be birth cohort differences in the associations between negative wealth shock and mortality. Similar associations in 2 alternative birth cohorts were observed in sensitivity analyses, but differing years and ages during follow-up made it difficult to disentangle true cohort similarities and differences.

Conclusions

Among US adults aged 51 years or older, loss of wealth over 2 years was associated with an increased risk of all-cause mortality. Further research is needed to better understand the possible mechanisms for this association and determine whether there is potential value for targeted interventions.

ARTICLE INFORMATION

Accepted for Publication: February 24, 2018.

Author Affiliations: Department of Preventive Medicine, Northwestern University Feinberg School of Medicine, Chicago, Illinois (Pool); Department of Sociology, University of Michigan, Ann Arbor (Burgard); Department of Epidemiology, University of Michigan, Ann Arbor (Burgard, Needham, Mendes de Leon); Institute for Social Research, University of Michigan, Ann Arbor (Burgard, Elliott, Langa); Department of Biostatistics, University of Michigan, Ann Arbor (Elliott); Department of Internal Medicine, University of Michigan Medical School, Ann Arbor (Langa); Veterans Affairs Center for Clinical Management Research, Ann Arbor, Michigan (Langa); Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor (Langa).

Author Contributions: Dr Pool had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Pool, Needham, Mendes de Leon.
Acquisition, analysis, or interpretation of data: Pool, Burgard, Elliott, Langa, Mendes de Leon.
Drafting of the manuscript: Pool, Elliott, Mendes de Leon.
Critical revision of the manuscript for important intellectual content: Pool, Burgard, Needham, Elliott, Langa.
Statistical analysis: Pool, Elliott.
Supervision: Burgard, Needham, Elliott, Mendes de Leon.

Conflict of Interest Disclosures: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Funding/Support: This work was supported by grant T32AG027708 from the US National Institute on Aging (Dr Mendes de Leon). The Health and Retirement Study is sponsored by grant U01AG009740 from the US National Institute on Aging and is conducted by the University of Michigan.

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

REFERENCES

1. Sorlie PD, Backlund E, Keller JB. US mortality by economic, demographic, and social characteristics: the National Longitudinal Mortality Study. *Am J Public Health*. 1995;85(7):949-956.

2. Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J. Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. *JAMA*. 1998;279(21):1703-1708.

3. Hajat A, Kaufman JS, Rose KM, Siddiqi A, Thomas JC. Long-term effects of wealth on mortality and self-rated health status. *Am J Epidemiol*. 2011;173(2):192-200.

4. Mejía ST, Settersten RA Jr, Odden MC, Hooker K. Responses to financial loss during the Great Recession: an examination of sense of control in late midlife. *J Gerontol B Psychol Sci Soc Sci*. 2016;71(4):734-744.

5. Keene DE, Cowan SK, Baker AC. "When you're in a crisis like that, you don't want people to know": mortgage strain, stigma, and mental health. *Am J Public Health*. 2015;105(5):1008-1012.

6. Butrica BA, Smith KE, Toder EJ. What the 2008 stock market crash means for retirement security. *J Aging Soc Policy*. 2010;22(4):339-359.

7. Pool LR, Needham BL, Burgard SA, Elliott MR, de Leon CFM. Negative wealth shock and short-term changes in depressive symptoms and medication adherence among late middle-aged adults. *J Epidemiol Community Health*. 2017;71(8):758-763.

8. McInerney M, Mellor JM, Nicholas LH. Recession depression: mental health effects of the 2008 stock market crash. *J Health Econ*. 2013;32(6):1090-1104.

9. McLaughlin KA, Nandi A, Keyes KM, et al. Home foreclosure and risk of psychiatric morbidity during the recent financial crisis. *Psychol Med*. 2012;42(7):1441-1448.

10. Fowler KA, Gladden RM, Vagi KJ, Barnes J, Frazier L. Increase in suicides associated with home eviction and foreclosure during the US housing crisis: findings from 16 National Violent Death Reporting System states, 2005-2010. *Am J Public Health*. 2015;105(2):311-316.

11. Boen C, Yang YC. The physiological impacts of wealth shocks in late life: evidence from the Great Recession. *Soc Sci Med*. 2016;150:221-230.

12. Kalousova L, Burgard SA. Unemployment, measured and perceived decline of economic resources: contrasting three measures of recessionary hardships and their implications for adopting negative health behaviors. *Soc Sci Med*. 2014;106:28-34.

13. Himmelstein DU, Thorne D, Warren E, Woolhandler S. Medical bankruptcy in the United States, 2007: results of a national study. *Am J Med*. 2009;122(8):741-746.

14. Sonnega A, Faul JD, Ofstedal MB, Langa KM, Phillips JW, Weir DR. Cohort profile: the Health and Retirement Study (HRS). *Int J Epidemiol*. 2014;43(2):576-585.

15. Bugliari D, Campbell N, Chan C, et al. *Rand Hrs Data Documentation, Version P*. Santa Monica, CA: RAND Center for the Study of Aging; 2016.

16. Juster FT, Smith JP. Improving the quality of economic data: lessons from the HRS and AHEAD. *J Am Stat Assoc*. 1997;92(440):1268-1278.

17. Bricker J, Engelhardt GV. Measurement error in earnings data in the health and retirement study. *J Econ Soc Meas*. 2008;33(1):39-61.

18. Weir DR. Socio-economic status and mortality: perceptions and outcomes. Paper presented at: Population Association of America 2010 Annual Meeting; April 15-17, 2010; Dallas, TX. http://paa2010.princeton.edu/papers/101560. Accessed February 6, 2018.

19. Howe CJ, Cole SR, Westreich DJ, Greenland S, Napravnik S, Eron JJ Jr. Splines for trend analysis and continuous confounder control. *Epidemiology*. 2011;22(6):874-875.

20. Cubbin C, Pollack C, Flaherty B, et al. Assessing alternative measures of wealth in health research. *Am J Public Health*. 2011;101(5):939-947.

21. Barsky RB, Juster FT, Kimball MS, Shapiro MD. Preference parameters and behavioral heterogeneity: an experimental approach in the health and retirement study. *Q J Econ*. 1997;112(2):537-579.

22. Hariharan G, Chapman KS, Domian DL. Risk tolerance and asset allocation for investors nearing retirement. *Financ Serv Rev*. 2000;9(2):159-170.

23. Robins JM, Hernán MA, Brumback B. Marginal structural models and causal inference in epidemiology. *Epidemiology*. 2000;11(5):550-560.

24. Singer JD, Willett JB. *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. New York, NY: Oxford University Press; 2003.

25. Westreich D, Cole SR, Tien PC, et al. Time scale and adjusted survival curves for marginal structural Cox models. *Am J Epidemiol*. 2010;171(6):691-700.

26. Heisler M, Choi H, Rosen AB, et al. Hospitalizations and deaths among adults with cardiovascular disease who underuse medications because of cost: a longitudinal analysis. *Med Care*. 2010;48(2):87-94.

27. Rahimi AR, Spertus JA, Reid KJ, Bernheim SM, Krumholz HM. Financial barriers to health care and outcomes after acute myocardial infarction. *JAMA*. 2007;297(10):1063-1072.

28. Pammi VSC, Ruiz S, Lee S, Noussair CN, Sitaram R. The effect of wealth shocks on loss aversion: behavior and neural correlates. *Front Neurosci*. 2017;11:237.

29. Schulz R, Beach SR, Ives DG, Martire LM, Ariyo AA, Kop WJ. Association between depression and mortality in older adults: the Cardiovascular Health Study. *Arch Intern Med*. 2000;160(12):1761-1768.

30. Strandberg TE, Tilvis RS. C-reactive protein, cardiovascular risk factors, and mortality in a prospective study in the elderly. *Arterioscler Thromb Vasc Biol*. 2000;20(4):1057-1060.

31. Fichera E, Gathergood J. Do wealth shocks affect health? new evidence from the housing boom. *Health Econ*. 2016;25(S2)(suppl 2):57-69.

32. Obama B. United States health care reform: progress to date and next steps. *JAMA*. 2016;316(5):525-532.