Negative Wealth Shock & Mortality

Susan Glenn, Jeanne Li, Stewart Kerr, Jingcheng Xu

Goal

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.

Editorial page 1327
Supplemental content

This paper claims that experiencing a wealth shock (defined as losing 75% of your wealth over a 2-year period) is strongly associated with increased risk of mortality

We aimed to explore the **causal effect** of experiencing a wealth shock with respect to mortality using **risk-set matching**

Data

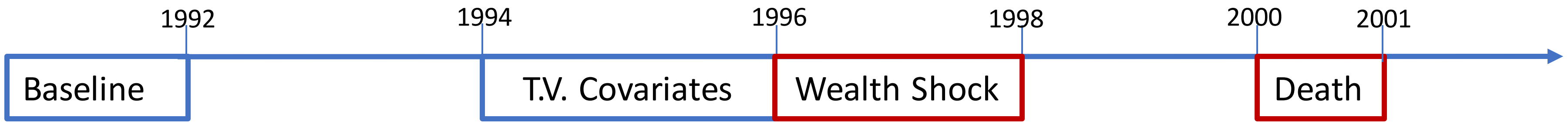
The data for the study comes from the University of Michigan's Health and Retirement Study (HRS), a longitudinal panel study that surveys a representative sample of approximately 20,000 people in America

The JAMA paper looks at people from the first wave of the HRS study

- Born between 1931 – 1941, first surveyed in 1992

The study is **longitudinal**, so there are two types of variables available for study

- Baseline (e.g. Gender, birth year, race, etc.)
- Time-varying (e.g. Marital status, wealth, job status, health conditions, etc.)
    - Time-varying covariates were lagged by one period so that they preceded the treatment



Baseline Characteristics

Characteristics	Positive Wealth Without Shock (Jama Paper)	Negative Wealth Without Shock (Jama Paper)	Our Study
Total participants	5535	2430	10507
Men	2778 (50.2)	1043 (42.9)	4990 (47.5)
Race or ethnicity			
Hispanic	335 (6.1)	317 (13.1)	1000 (9.52)
Non-Hispanic black	581 (10.5)	557 (22.9)	1807 (17.2)
Non-Hispanic white	4521 (81.7)	1498 (61.7)	7464 (71.04)
Non-Hispanic other race	98 (1.8)	58 (2.4)	2342 (22.29)
Mean BMI	26.8	27.8	27.46
Alcohol use			
None	1912 (34.5)	1113 (45.8)	6888 (65.56)
Moderate	3355 (60.6)	1181 (48.6)	655 (6.23)
Heavy	268 (4.8)	136 (5.6)	250 (2.38)
Smoking status			
Never smoked	2095 (37.9)	875 (36)	3831 (36.47)
Current or former smoker	4254 (62.1)	1660 (64)	6675 (63.53)
Self-rated health status			
Excellent	1418 (25.6)	455 (18.7)	1899 (18.07)
Very good	1799 (32.5)	600 (24.7)	2484 (23.64)
Good	1483 (26.8)	710 (29.2)	2375 (22.6)
Fair	581 (10.5)	457 (18.8)	1247 (11.87)
Poor	254 (4.6)	208 (8.6)	590 (5.62)

(Balanced) Risk Set Matching

Risk Set Matching is a method proposed by Rosenbaum et al. (2001) to match subjects treated at time *t* with a control that looks similar up to time *t*

- <u>Control may or may not be treated later</u>

Balanced risk set matching includes an additional penalty to risk set matching which enforces balance on important covariates

$$\min_{\mathbf{f},\mathbf{g}} \sum_{e \in \mathcal{E}} f_e \cdot \delta_e + \sum_{k=1}^{K} \lambda_k (g_{k+} + g_{k-}) \tag{A.1}$$

subject to

$$S = \sum_{\{e: \in \mathcal{E}\}} f_e, \tag{A.2}$$

$$1 \geq \sum_{\{e \in \mathcal{E}: e=(\alpha_p,\alpha_q) \text{ or } e=(\alpha_q,\alpha_p)\}} f_e \quad \text{for} \quad \alpha_q \in \mathcal{A}, \tag{A.3}$$

$$g_{k+} \geq \sum_{e=(\alpha_p,\alpha_q)\in\mathcal{E}} f_e \cdot B_{pk} - \sum_{e=(\alpha_p,\alpha_q)\in\mathcal{E}} f_e \cdot B_{ek} \quad \text{for} \quad k=1,\dots,K, \tag{A.4}$$

$$g_{k-} \geq \sum_{e=(\alpha_p,\alpha_q)\in\mathcal{E}} f_e \cdot B_{ek} - \sum_{e=(\alpha_p,\alpha_q)\in\mathcal{E}} f_e \cdot B_{pk} \quad \text{for} \quad k=1,\dots,K, \tag{A.5}$$

$$g_{k+} \geq 0, \quad g_{k-} \geq 0 \quad \text{for} \quad k=1,\dots,K, \quad f_e \in \{0,1\} \quad \text{for} \quad e \in \mathcal{E}. \tag{A.6}$$

$$\delta_e = \begin{array}{c} \text{Controls} \\ \begin{bmatrix} d_{11} & d_{12} & \dots & d_{1m} \\ d_{21} & \dots & & \\ \dots & & \dots & \\ d_{n1} & & & d_{nm} \end{bmatrix} \end{array} \text{Treated}$$

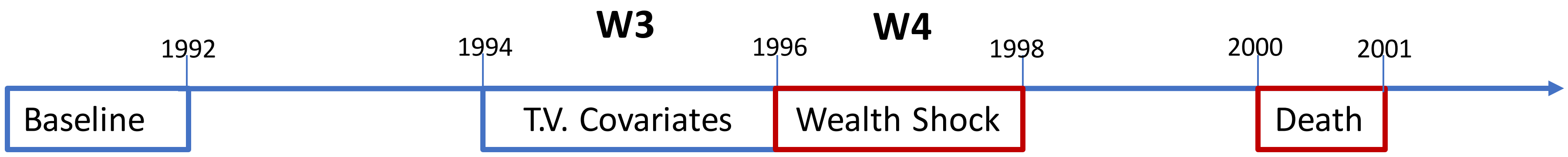
$$n << m$$

Distance Matrix

$$\delta_e = \begin{array}{cc} \text{Controls} & \\ \begin{bmatrix} d_{11} & d_{12} & \dots & d_{1m} \\ d_{21} & \dots & & \\ \dots & & \dots & \\ d_{n1} & & & d_{nm} \end{bmatrix} & \text{Treated} \end{array}$$

$$n << m$$

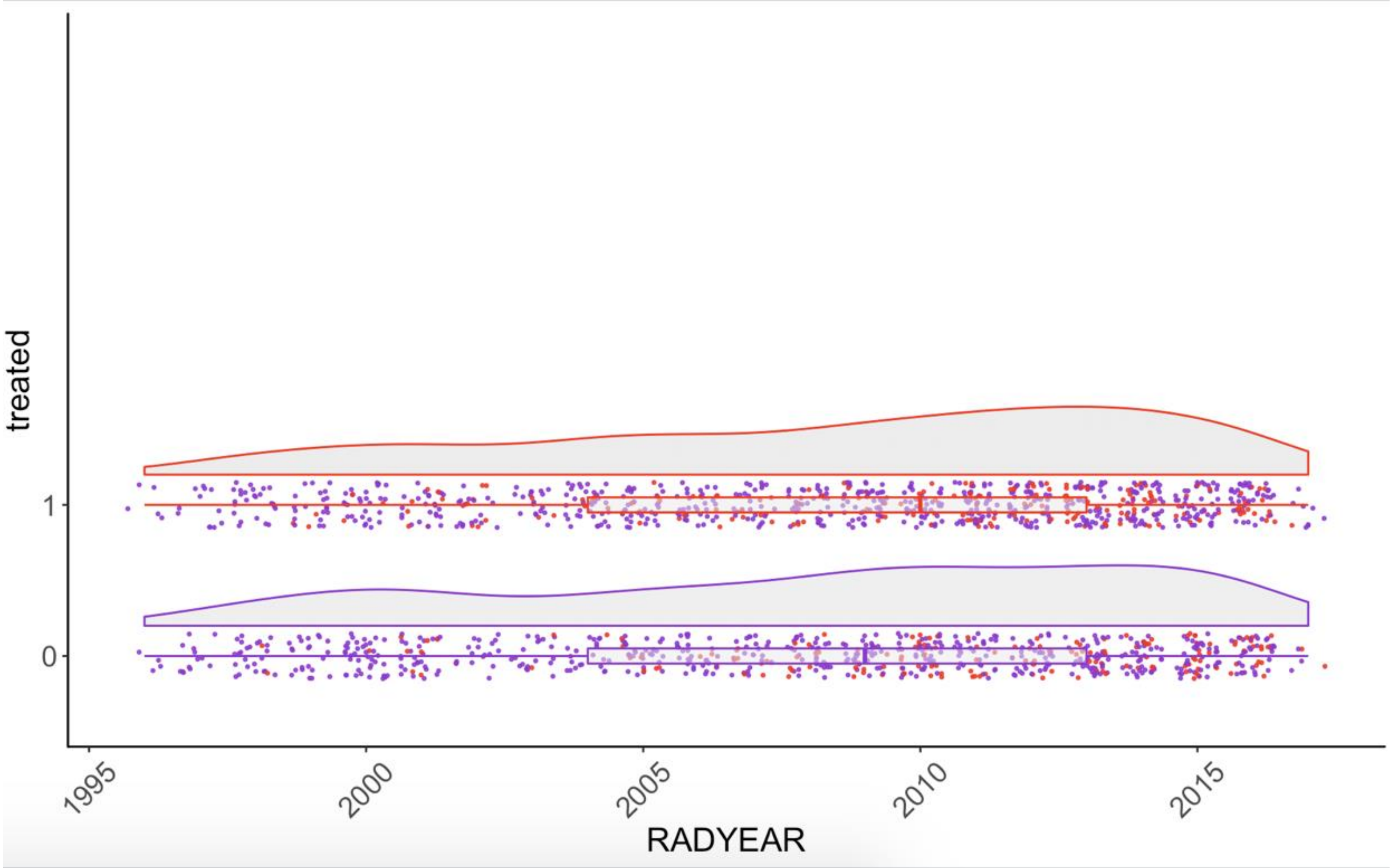
Pairwise Mahalanobis Distance: $d_{nm} = (\mathbf{x_n} - \mathbf{x_m})^{\mathbf{T}} \mathbf{\Sigma}^{-1} (\mathbf{x_n} - \mathbf{x_m})$



$$\begin{array}{cc} & \dots \\ \text{W3} & \begin{bmatrix} \dots & & \dots \\ x^3_{n1} & \dots & x^3_{nk} \\ x^3_{m1} & \dots & x^3_{mk} \\ \dots & & \dots \end{bmatrix} \\ \text{W4} & \begin{bmatrix} \dots & & \dots \\ x^4_{n'1} & \dots & x^4_{n'k} \\ x^4_{m1} & \dots & x^4_{mk} \\ \dots & & \dots \end{bmatrix} \\ & \dots \end{array}$$

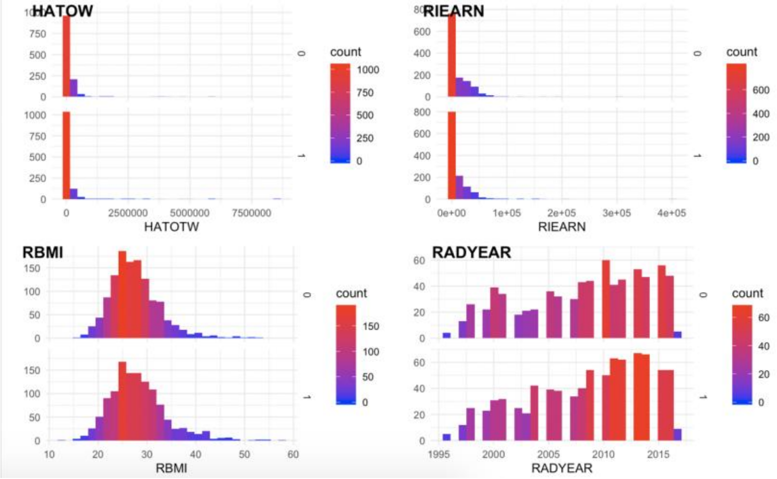
Matching Results & Outcome

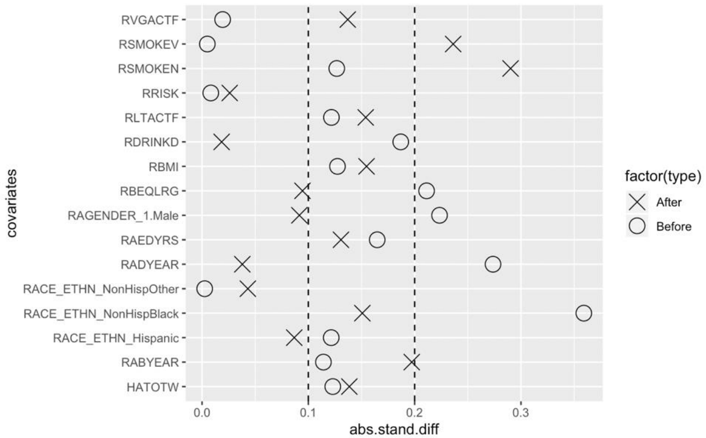
- 2182 pairs in total:
  - 654 treated died first, 571 treated died last, 1225 died in the same wave (or didn't die in the follow-up period)
- Binary response: die first = 0 ,die second = 1, Died together = -1
- More people who were controls died after people who got the treatment



Balance

Checked balance for baseline or covariates which did not vary with time

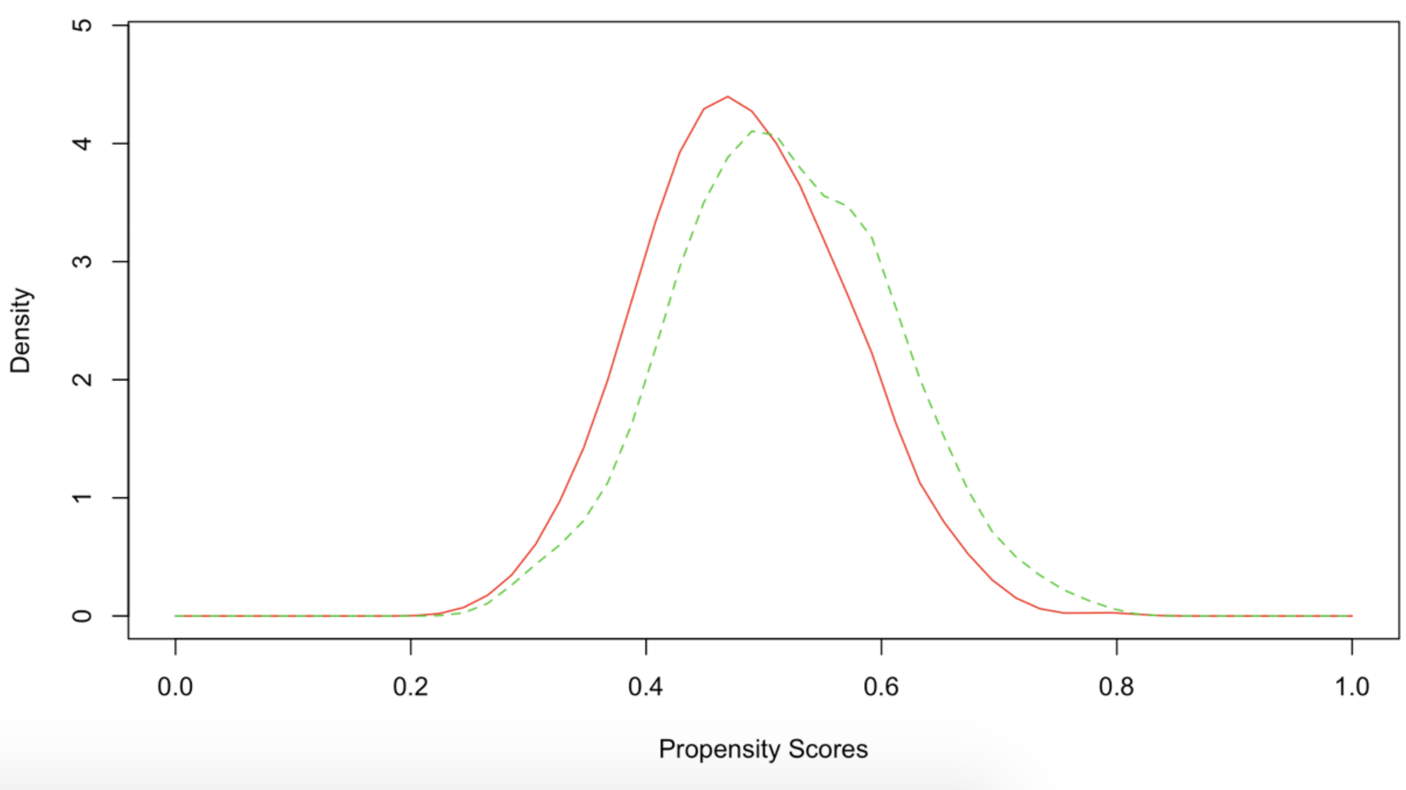




	Before Match (Standardized Diff)	After Match (Standardized Diff)
RADYEAR	0.274	0.197
RABYEAR	0.114	0.139
HATOTW	0.123	0.236
RSMOKEV	0.005	0.290
RSMOKEN	0.127	0.018
RDRINKD	0.187	0.154
RLTACTF	0.122	0.137
RVGACTF	0.019	0.155
RBMI	0.127	0.026
RRISK	0.008	0.094
RBEQLRG	0.211	0.092
RAGENDER_1.Male	0.223	0.087
RACE_ETHN_Hispanic	0.121	0.151
RACE_ETHN_NonHispBlack	0.359	0.043
RACE_ETHN_NonHispOther	0.002	0.197

Treatment Effect

- Paired T test:
  - average treated: 0.53
    average control: 0.47
  - the differences between means is -0.068 and the p-value = 0.0177
- Wilcoxon Rank Sum test:
  - p-value = 0.0177
- ATE: used IPW -0.06



Sensitivity Analysis

- Goal:
  - Unmeasured confounding covariates
  - Magnitude of hidden bias
- Rosenbaum's R packages:
  - "sensitivitymw" and "sensitivitymv"
  - Sensitivity parameter Gamma
  - Point estimates, confidence intervals
  - Amplification of sensitivity parameter

- H0: There is no treatment effect of wealth shock on mortality.
- H1: Having a wealth shock leads to a negative impact on length of life span.

Sensitivity Parameter

```
##       Gamma unweighted M-test using Huber's psi-function trimmed mean test
##  [1,]  1.00                                         0.009           0.009
##  [2,]  1.01                                         0.014           0.014
##  [3,]  1.02                                         0.021           0.021
##  [4,]  1.03                                         0.032           0.032
##  [5,]  1.04                                         0.046           0.046
##  [6,]  1.05                                         0.064           0.064
##  [7,]  1.06                                         0.088           0.088
##  [8,]  1.07                                         0.117           0.117
##  [9,]  1.08                                         0.152           0.152
## [10,]  1.09                                         0.194           0.194
## [11,]  1.10                                         0.240           0.240
## [12,]  1.11                                         0.292           0.292
## [13,]  1.12                                         0.348           0.348
## [14,]  1.13                                         0.407           0.407
## [15,]  1.14                                         0.467           0.467
## [16,]  1.15                                         0.528           0.528
```

Range of Point Estimates and Confidence Intervals

```
## $PointEstimate
## minimum maximum
##  0.0247  0.0456
##
## $Confidence.Interval
## minimum maximum
##   6e-04     Inf
```

Amplification of Sensitivity Parameter Gamma

$$\Gamma = \frac{\beta_{UA}\beta_{UY} + 1}{\beta_{UA} + \beta_{UY}}$$

$$\beta_{UA} = \beta_{UY} = \boldsymbol{E}$$

- E-value = 1.33
- To overturn our conclusion, an unmeasured confounder needs to have a 1.33 odds of increasing the outcome and treatment
- Or Gamma = 1.05

Thank you!