

# Education Gradients in Mortality Trends by Race and Gender

Adam A. Leive (UVA) and Christopher J. Ruhm (UVA &  
NBER)

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# Motivation

- Interest in social disparities & health for many years
  - “Whitehall” studies in U.K. (Marmot et al. 1984, 1991). U.S. (Kitagawa and Hauser 1973)
  - Positive relationship between education & health (“SES gradient”)
  - Changes in group-specific mortality rates as indicators of social progress
- Reversals in progress reducing mortality rates
  - U.S. life expectancy, 2014-2017 ↓ from 78.9 to 78.6
  - 1<sup>st</sup> 3-year decline in a century
- “Deaths of Despair” (Case & Deaton 2015, 2017, 2020)
  - Focus on 45-54 or 50-54 non-Hispanic whites (“Whites”)
  - Mortality ↑ concentrated among non-college educated
  - Taken as evidence of economic/social breakdown in society

## Empirical Challenge: Negative Selection

- Most research measures education in discrete categories:  
< high school, high school, some college, college+
- Disparities could reflect rising educational attainment over time (Preston and Elo 1995, Dowd & Hamoudi 2014; Bound et al. 2015)
  - Less educated groups become more negatively selected
  - Some people who failed to complete high school in previous cohort now graduate high school
  - “Will Rogers Phenomenon”: all groups have lower quality
- Recent efforts to adjust for changes in education levels over time
  - Bound et al. 2015; Goldring et al. 2016; Novosad, et al. 2020
  - Different methods, data, time periods, and results

# This Project

- Estimate  $\Delta$ 's in mortality trends by education **quartile**
  - Construct quartiles by sex, race, 5-year age group (25-64 year olds)
  - Combine administrative + survey data from 2001-2018
- Race & gender patterns for specific causes of death

## Conceptual Framework

- Patterns of absolute mortality rate  $\Delta$ 's often taken to indicate size of health shocks to different groups
- Not true if initial differences in stock of health capital
- Equal size  $\Delta$  in health capital
  - larger mortality  $\Delta$  for less educated
  - but possibly smaller absolute  $\Delta$
- Examine logs and levels of mortality rates

## Death Rates

$$mort_{arit} = \frac{deaths_{arit}}{pop_{arit}}$$

*age group a*

*race/ethnicity r*

*education quartile i*

*year t*

- calculate rates for 5-year age groups, from 25-64
- stratified by sex

# Data

- Deaths: CDC *Multiple Cause of Death Files (MCOF)*
  - Available 1999-2018
- Population: *Surveillance Epidemiology & End Results (SEER)* database
  - Age, sex & race-specific populations
- Educational Share: *American Community Survey (ACS)*
  - Starts in 2001
- Analysis Period: 2001-2018

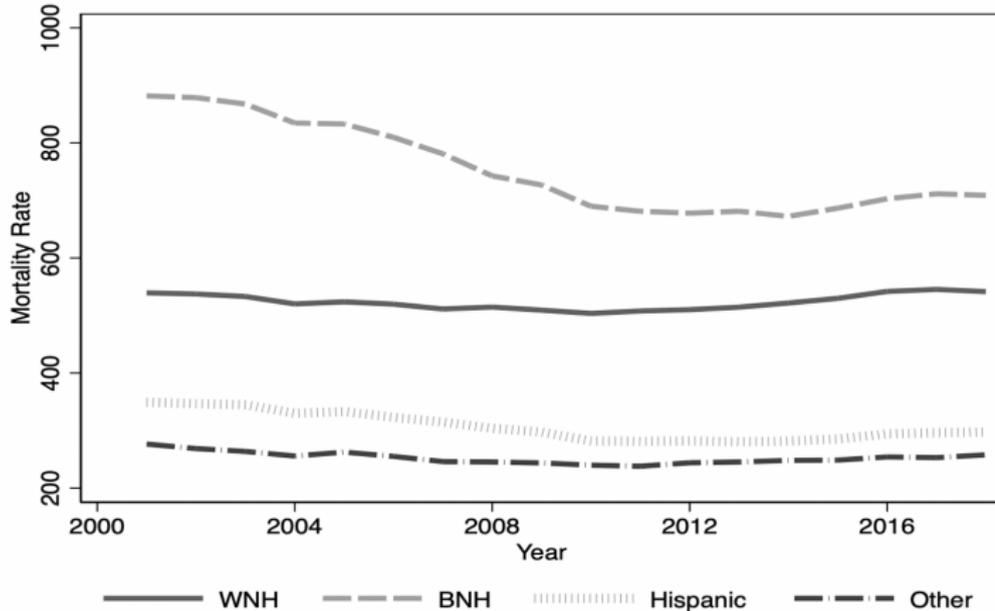
## Complicating Factors

- Education on death certificates switches from continuous to categorical
- Education-Specific Populations
  - *SEER Population*  $\times$  *ACS Education Share*
  - ACS education switches from categorical to continuous
- A single year of education may span quartiles

# Causes of Death

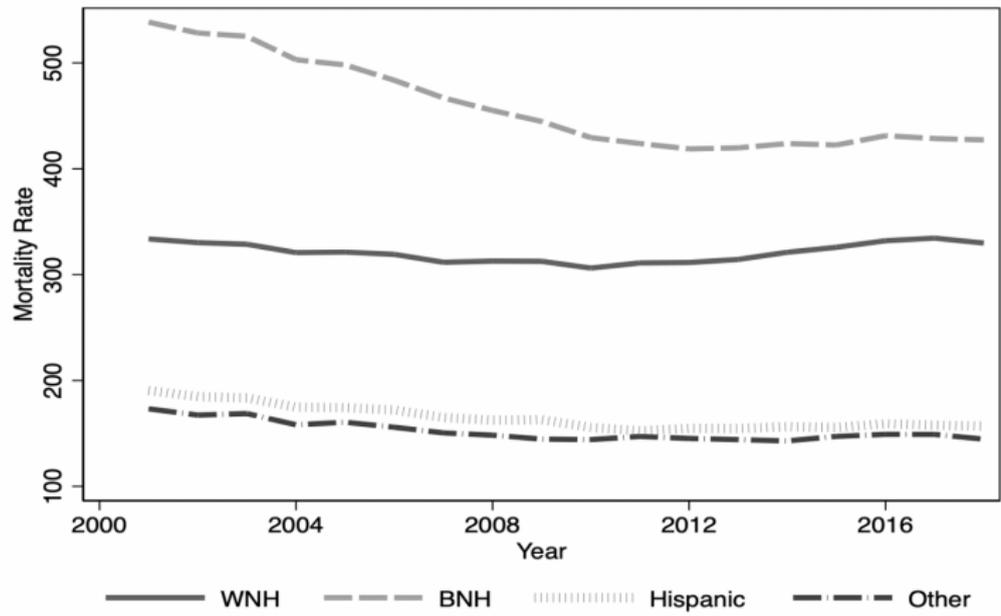
- Total mortality
- Specific causes
  - 10 highest causes for each age subgroup (cardiovascular disease, cancer etc.) plus
  - non-drug accidental deaths
  - non-intentional drug deaths
  - suicide
  - residual category
- “Major” vs. “Minor” causes

## Total Mortality trends by race: males



- age-standardized trends: 25-64 year olds
- larger declines (but higher levels) for Blacks than whites

# Total Mortality trends by race: females



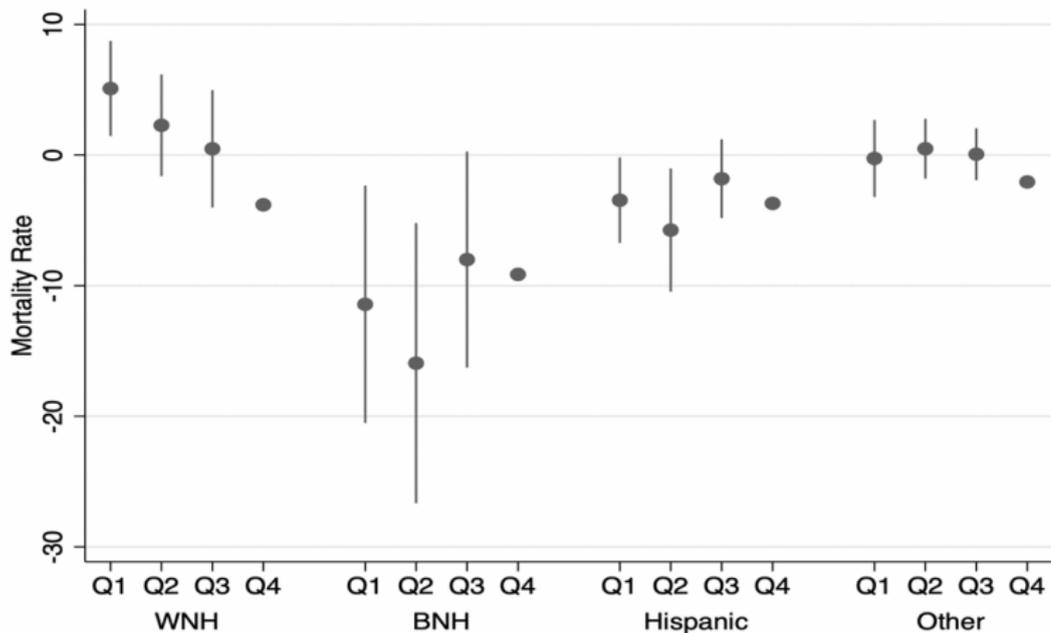
- Lower overall rates but similar trends to males

## Regression Specification

$$\begin{aligned} \text{mort}_{arit} = & \sum_{a \in A} \sum_{r \in R} \sum_{i=1}^4 \beta_{ari} [\text{age}_a \times \text{race}_r \times Q_i] + \sum_{r \in R} \pi_r [\text{trend} \times \text{race}_r] \\ & + \sum_{r \in R} \sum_{i \neq 4} \pi_{ri} [\text{trend} \times \text{race}_r \times Q_i] + \epsilon_{arit} \end{aligned}$$

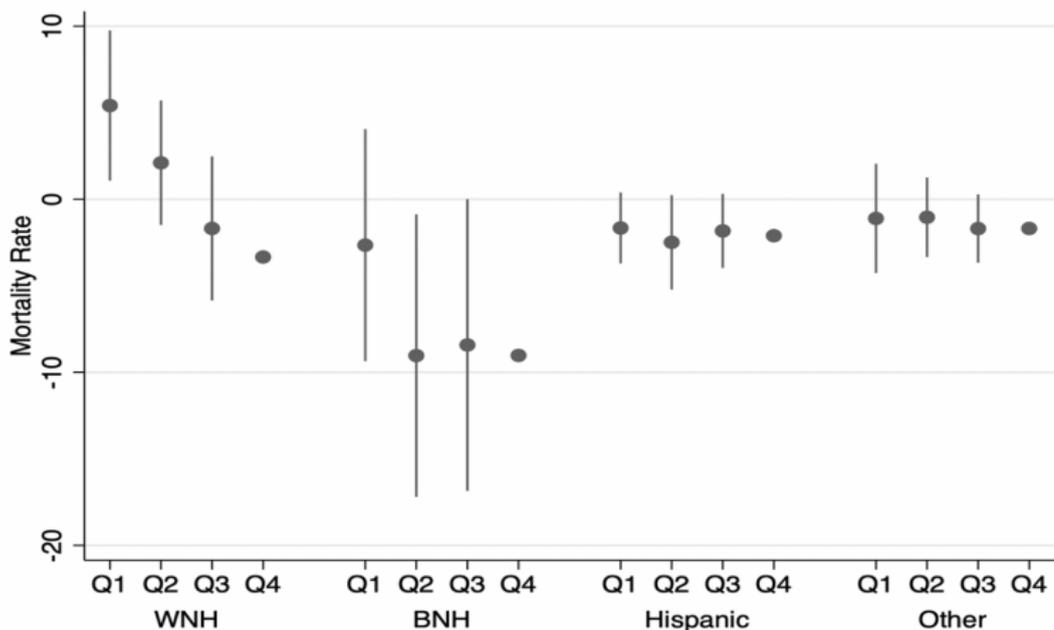
- $Q_i$ : education quartile ( $Q_4$  reference group)
- $\text{age}_a$ : 5-year age group
- $\text{race}_r$ : race/ethnicity       $\text{trend}$ : year
- $\beta_{ari}$ : group fixed-effect
- $\pi_r$ : race-specific trend for reference quartile ( $Q_4$ )
- $\pi_{ri}$ : race-specific trend difference vs.  $Q_4$

## Quartile-specific total mortality trends: males



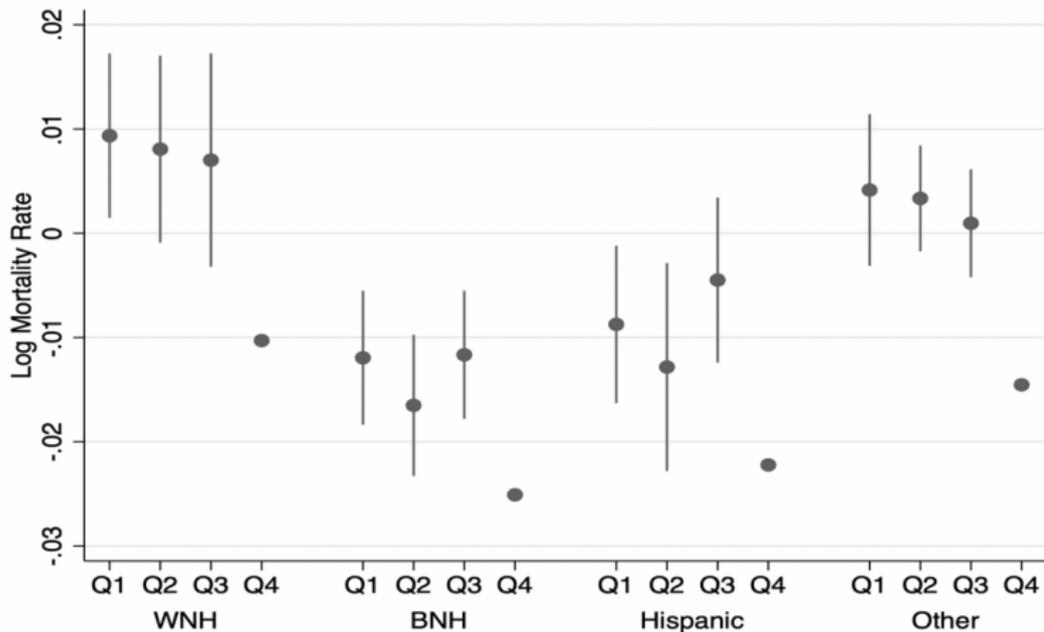
- monotonic trends for whites only

## Quartile-specific total mortality trends: females



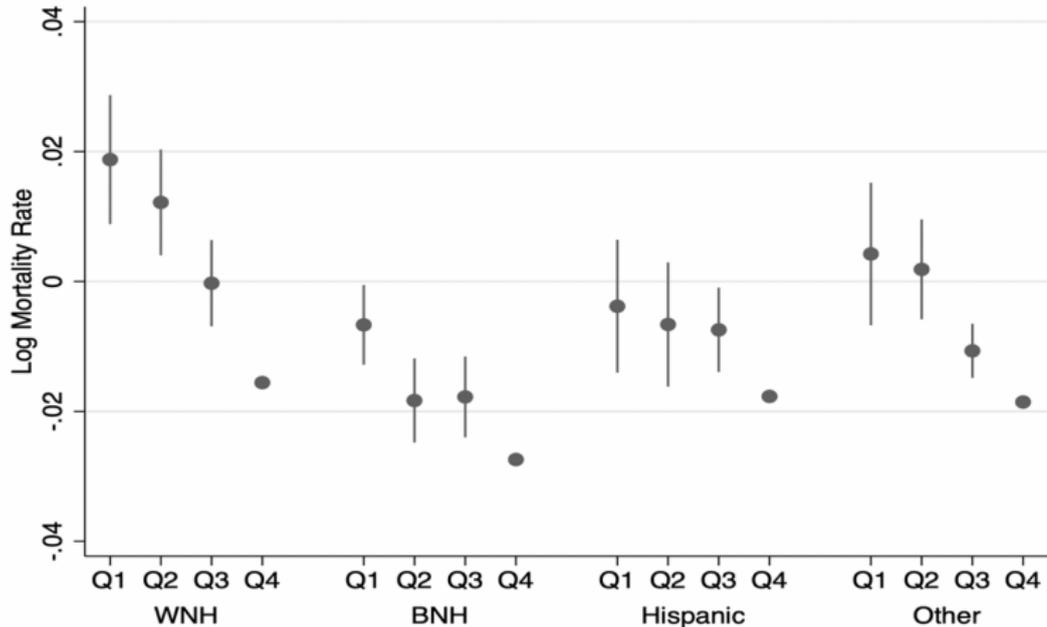
- similar to males

## Quartile-specific log mortality trends: males



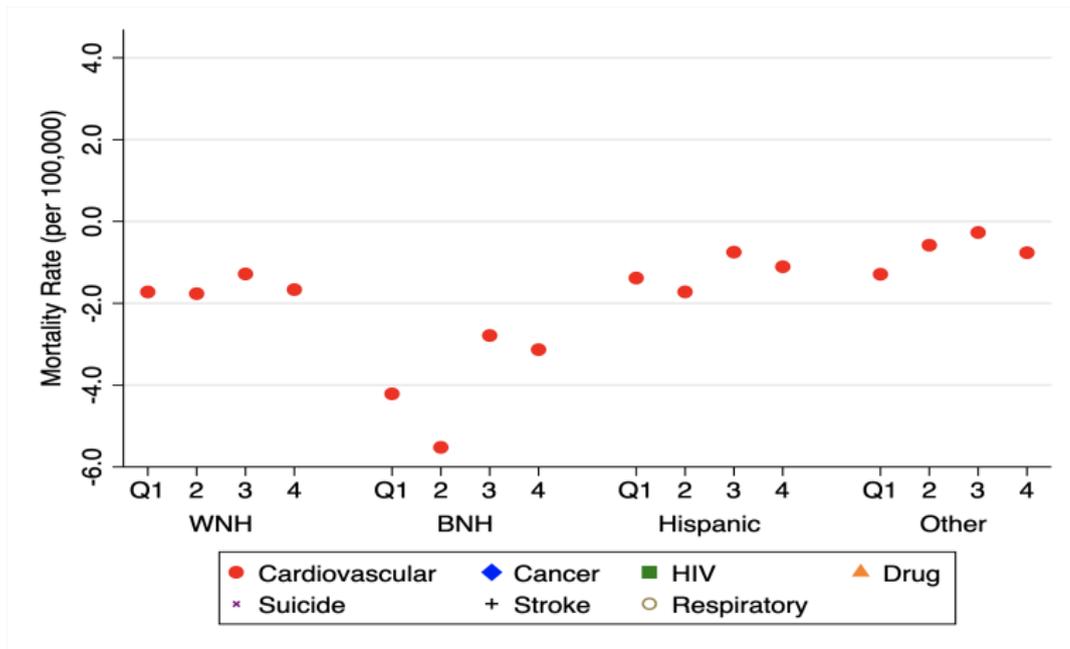
- 4th quartile does best
- little difference for Q1 - Q3

## Quartile-specific log mortality trends: females



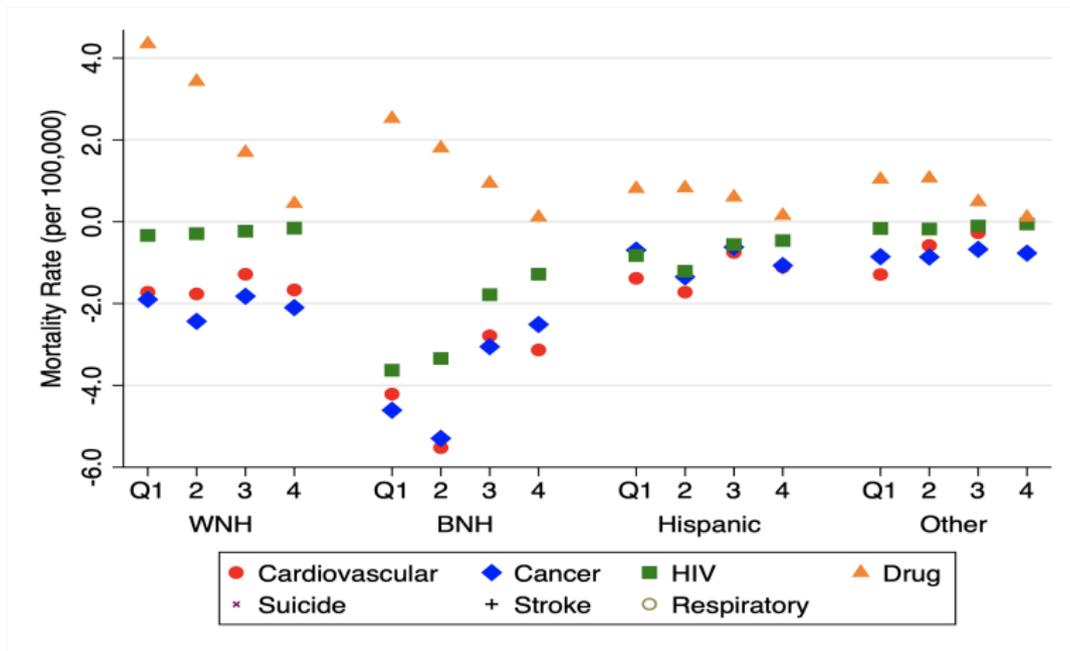
- more monotonic in education than for males

## Cardiovascular mortality: males



- no education pattern for whites
- biggest ↓ for less educated Blacks (possibly Hispanic & other)

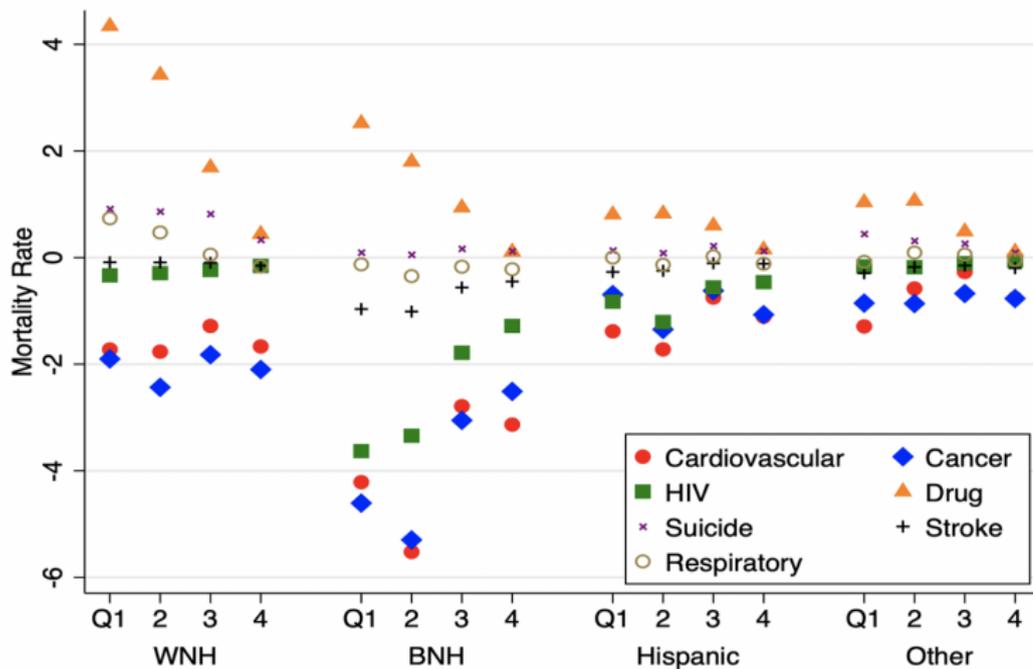
## Major causes: males



- drugs monotonic; biggest ↑
- CVD, cancer, sometimes HIV; biggest ↓, especially Q1/Q2 Blacks

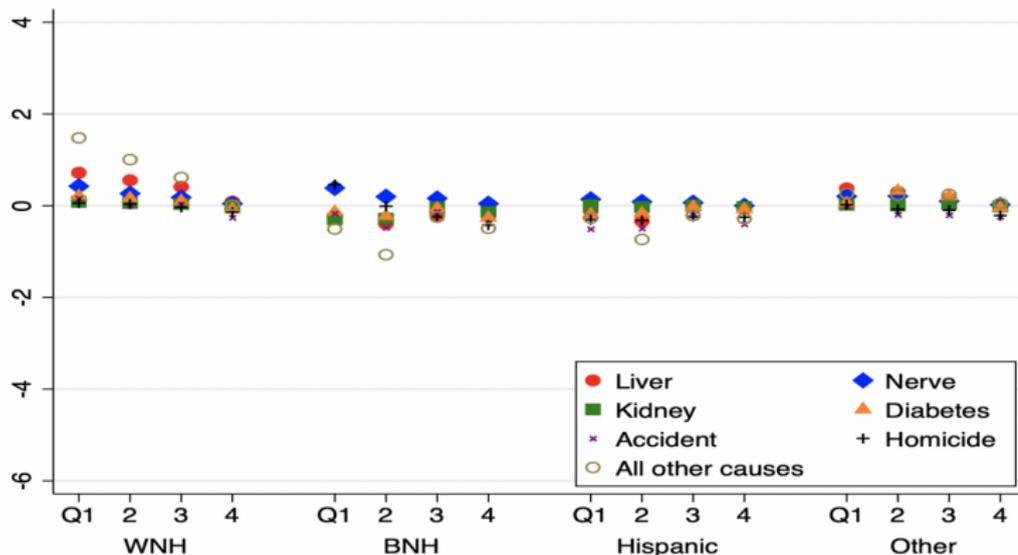
# All major causes: males

(a) Major causes



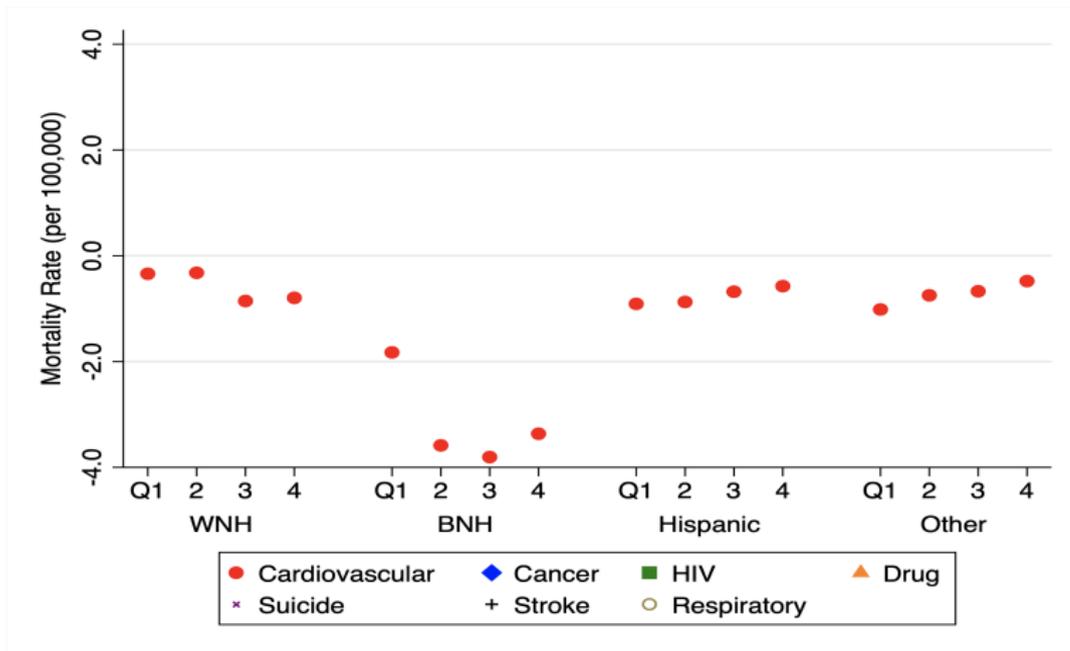
## Minor causes: males

(b) Minor causes



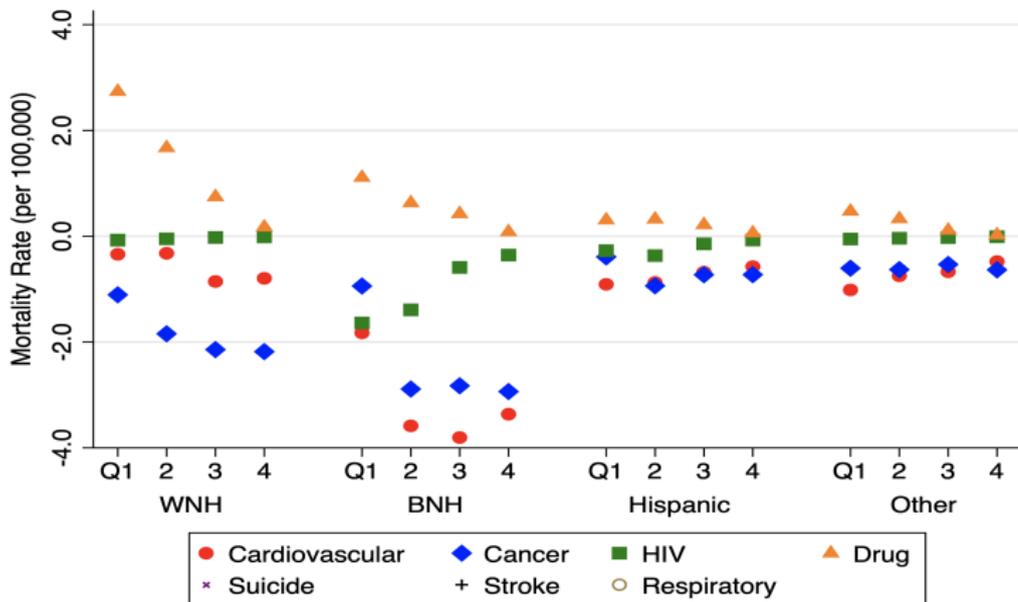
- minor causes: trend coefficient  $< 0.8$  (absolute value)
- liver disease a minor cause for most groups
- residual fairly important for less educated whites

## Cardiovascular mortality: females



- very different for Black females vs males
- no general education gradient

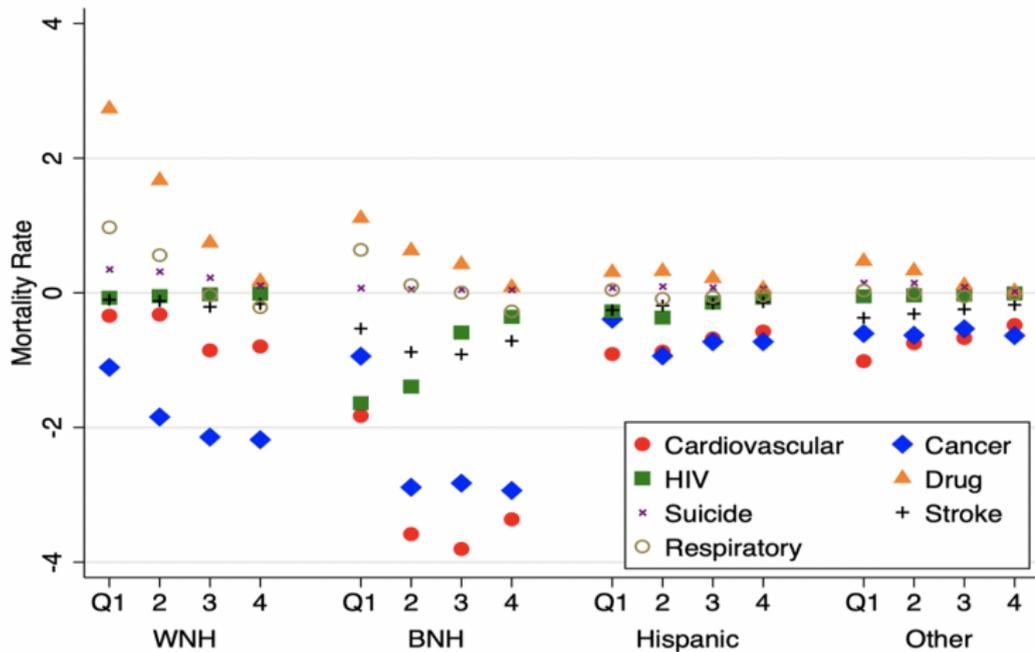
## Major causes: females



- drugs monotonic; biggest ↑
- females: cancer ↓ for Q3/4 whites; Q2-Q4 Blacks; CVD for Q3/4 Blacks
- few clear education patterns

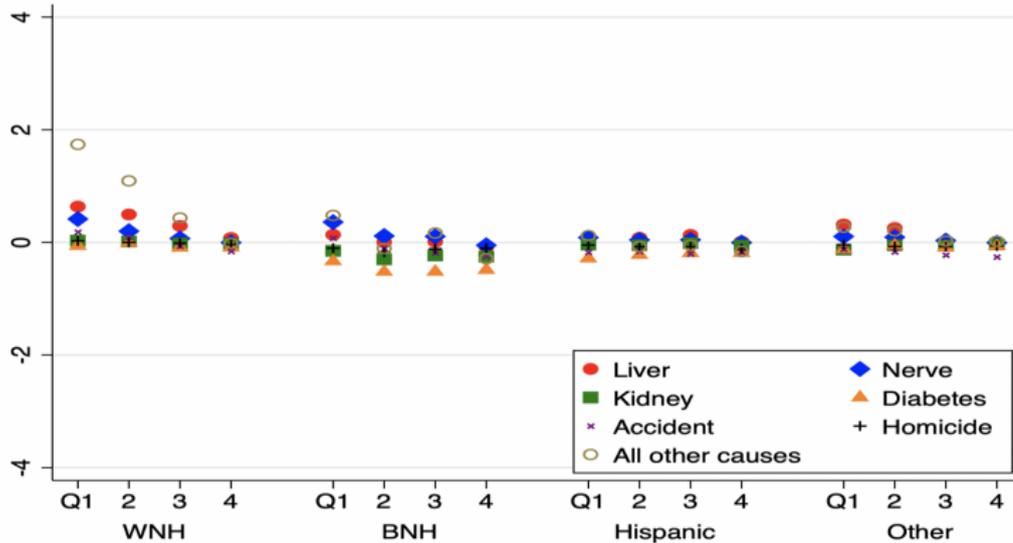
# All major causes: females

(a) Major causes



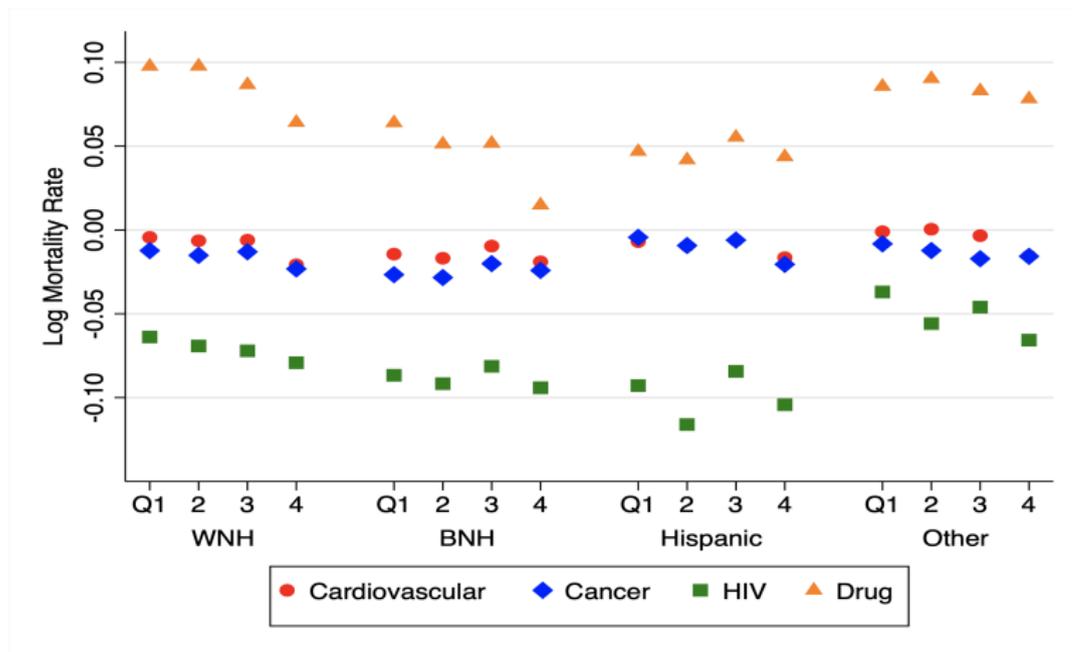
# Minor causes: females

(b) Minor causes



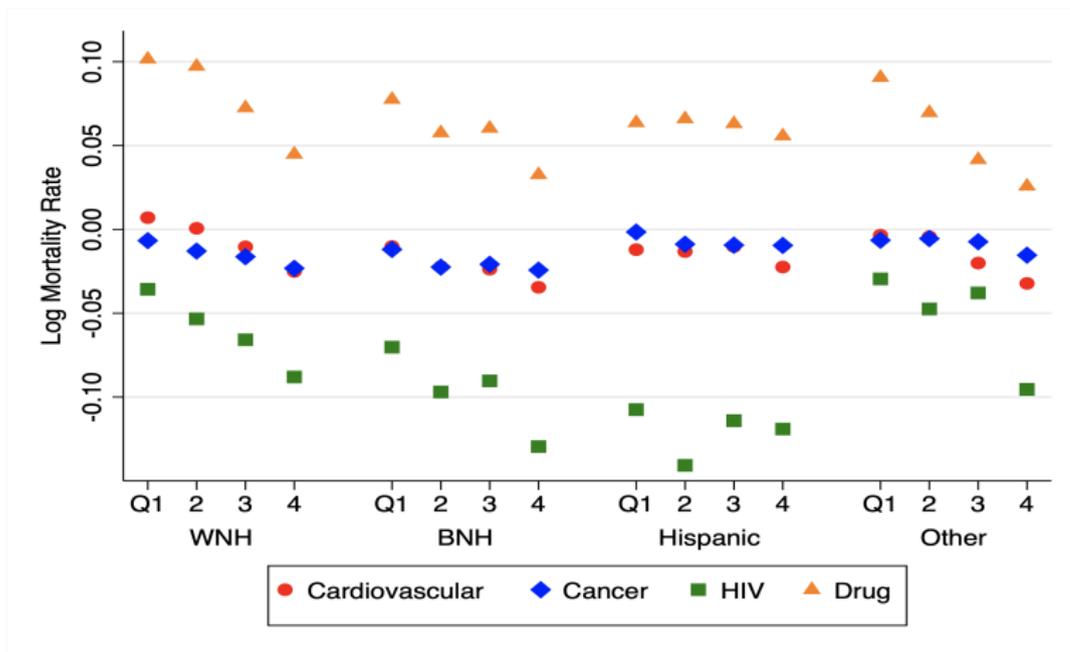
- similar to males

## Log mortality rates: males



- Largest % increases (decreases) for drugs (HIV)
- Sometimes more favorable  $\Delta$  for Q4

## Log mortality rates: females



- Largest % increases (decreases) for drugs (HIV)
- More monotonic in education

## Review of Key Results

- Drug Deaths: most important source of mortality ↑
  - particularly for whites
- Cardiovascular disease, cancer, HIV most important for mortality ↓
- Other mortality trends also important
  - Q1/2 white females: limited CVD/cancer ↓
  - Blacks: exceptional HIV, CVD, cancer ↓
    - Q1/Q2 males; Q2/Q4 females
  - smaller drug ↑ for Blacks than whites
- Hispanic/other nonwhite trends have small magnitude
  - hard to evaluate

## What We Have Learned

Unidimensional explanations unlikely to explain mortality trends

Must explain tremendous heterogeneity in  $\Delta$ 's by sex, race & age

- Total mortality  $\Delta$ 's mix effects of different causes
- Mortality  $\uparrow$  dominated by drugs
- Liver disease a “minor” cause (e.g. larger effect of respiratory)
- Mortality  $\downarrow$  by Cancer, CVD, sometimes HIV
- Large differences by sex, race & education

Need to focus on specific causes of death

THANK YOU

## Complicating Factors

Education on death certificates often categorical

- After 2002: some states report categories
  - $\leq 8$ th grade, 9-12 no diploma, high school grad, some college, bachelor's degree, master's degree, doctorate/professional degree
  - Calculate single years of education (where provided) for broader categories (e.g.  $\leq 8$ , 9-11 grade)
  - Regress these % on trend, age, sex, race/ethnicity (& interactions)
  - Predict probability of single years of education for categories

## Complicating Factors (cont.)

### Education-Specific Populations

- *SEER Population*  $\times$  *ACS Education Share*
- After 2007: ACS reports single education years: 1-12
- Before 2008: 0-4, 5-6, 7-8 grades combined, split based on 2008-2017 distribution
- H.S. grad = 12
- College: No Degree/ Associates Degree = 14
- College Degree = 16
- Beyond College = 17