Decomposition of the US Black/White inequality in life expectancy

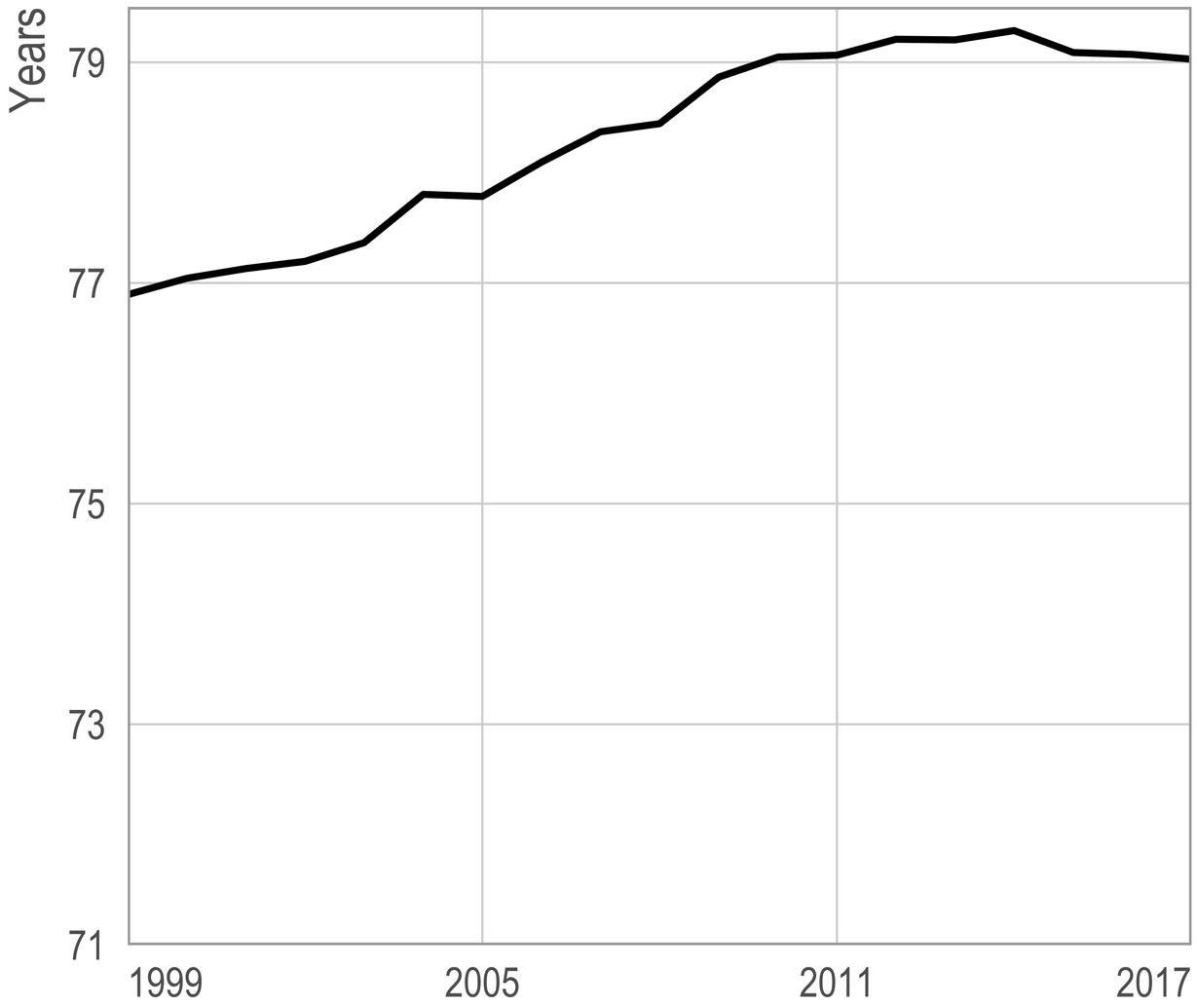
Quantifying the impact of deaths of despair

Mathew Kiang, ScD
@mathewkiang
Postdoctoral Research Fellow
Center for Population Health Sciences
Stanford University

Monica Alexander, PhD
@monjalexander
Assistant Professor
Department of Sociology
Department of Statistical Sciences
University of Toronto

http://bit.ly/ser_2019

Life Expectancy in the US



- In 2017, US life expectancy declined for **3rd year in a row**[1]
- Has not happened **since 1918**[2]

1.Murphy, Xu, Kochanek, and Arias. 2018. “Mortality in the United States, 2017.” NCHS Data Brief.
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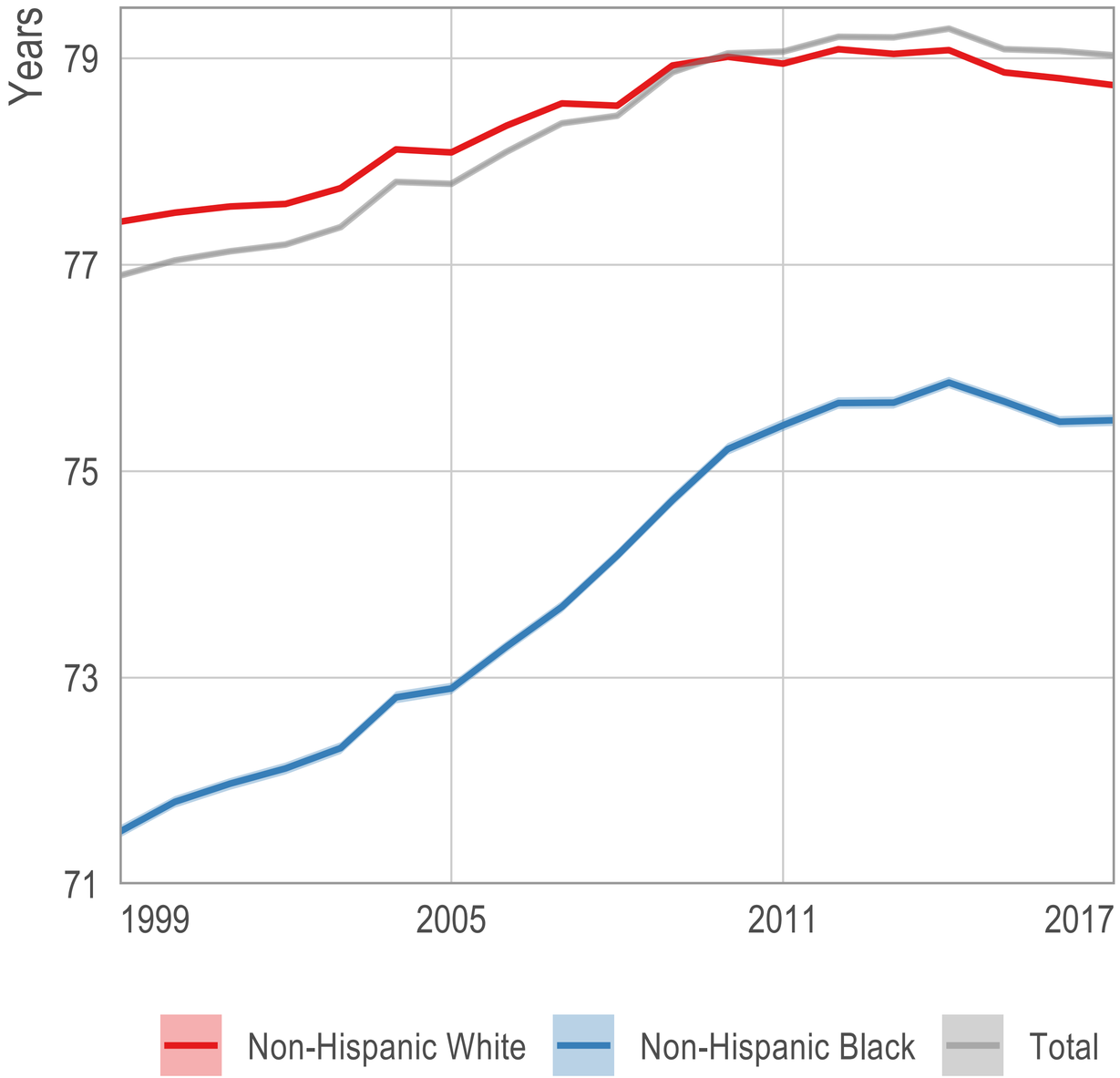
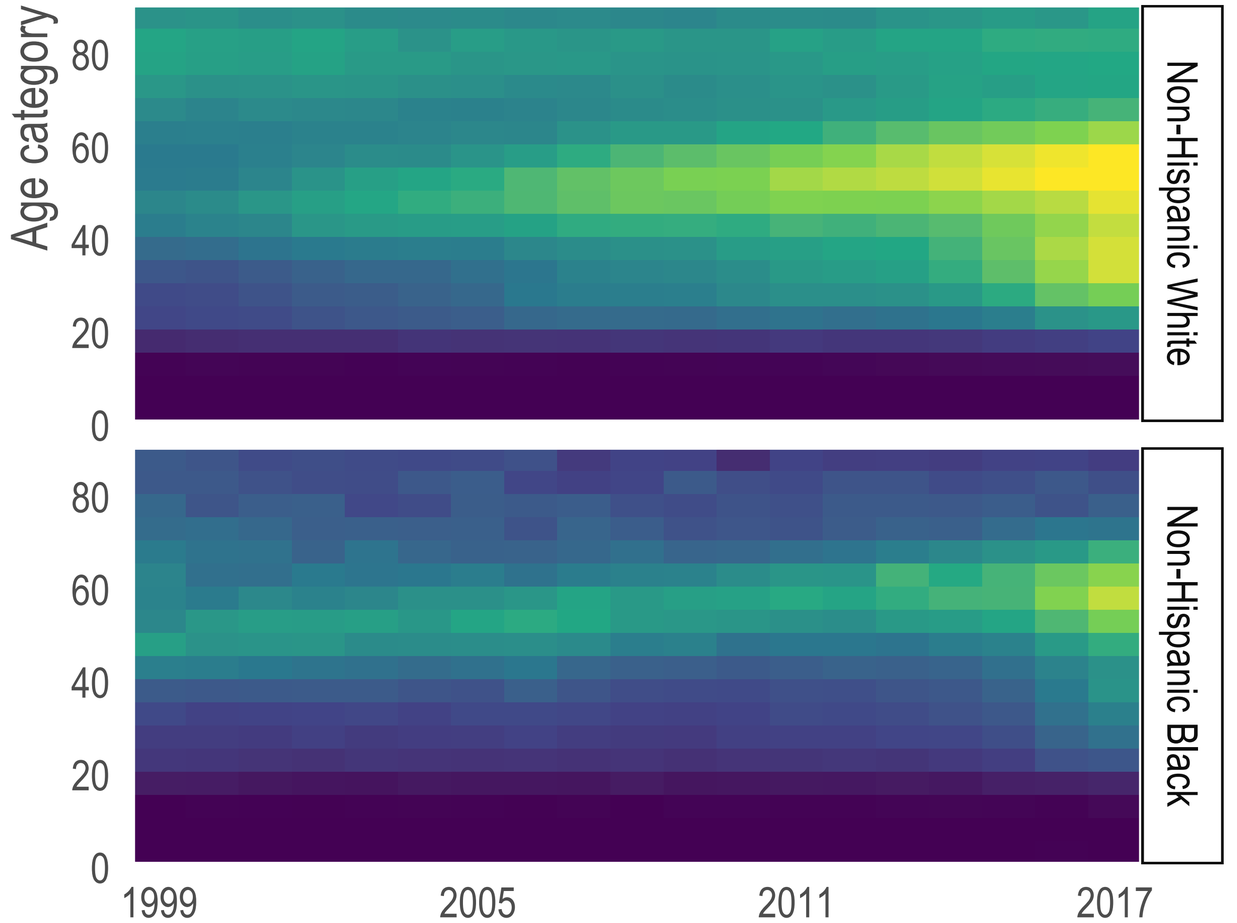


- In 2017, US life expectancy declined for **3rd year in a row**[1]
- Has not happened **since 1918**[2]
- Follows Case and Deaton 2015,[3] which observed higher rates of *deaths of despair* in middle-age non-Hispanic Whites

1.Murphy, Xu, Kochanek, and Arias. 2018. "Mortality in the United States, 2017." NCHS Data Brief.
2. Dyer. BMJ 2018. "US Life Expectancy Falls for Third Year in a Row."
3. Case and Deaton. PNAS 2015. "Rising Morbidity and Mortality in Midlife Among White Non-Hispanic Americans in the 21st Century."

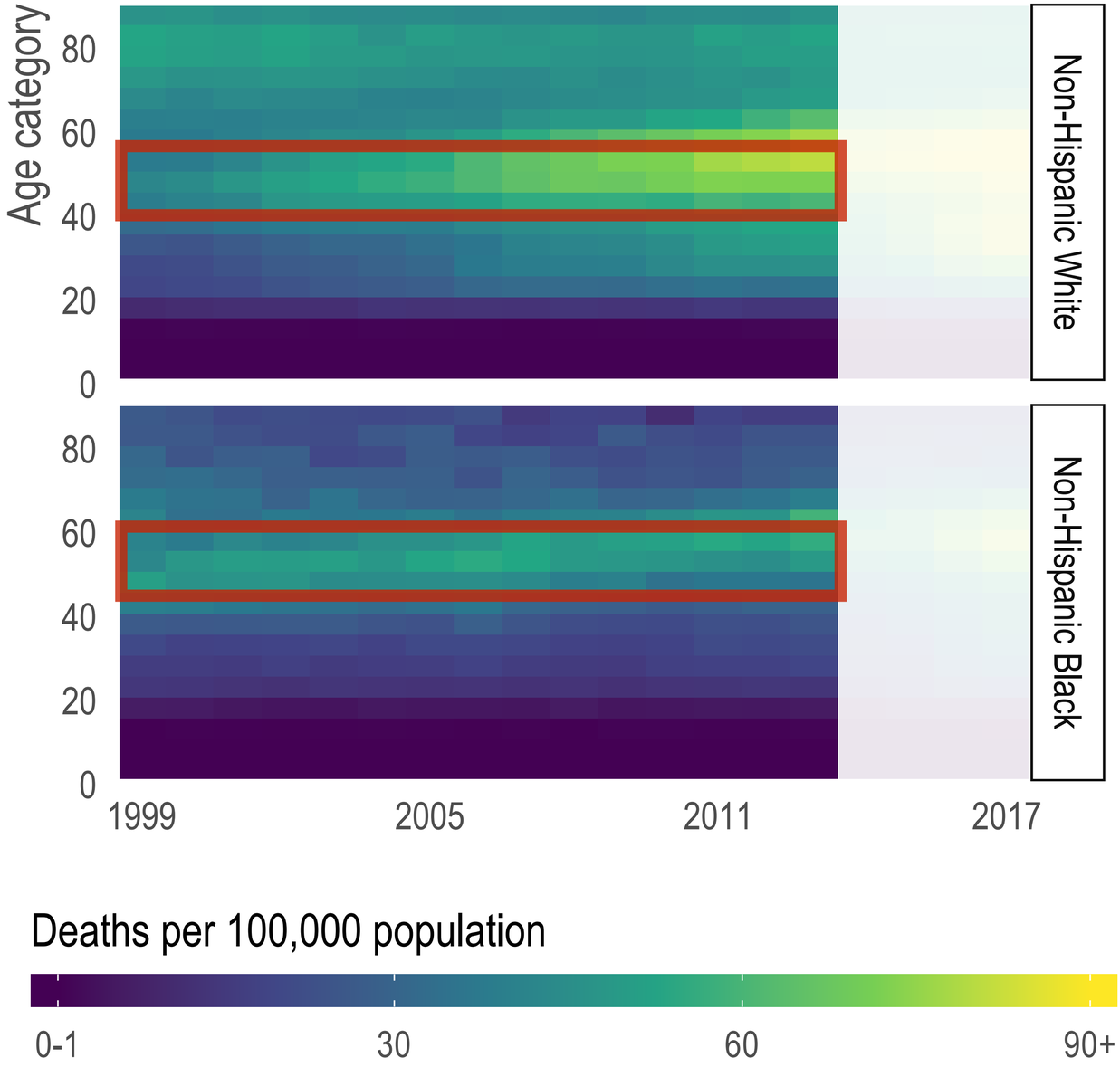
Deaths of Despair

- Alcohol-related liver disease, suicide, or drug overdose



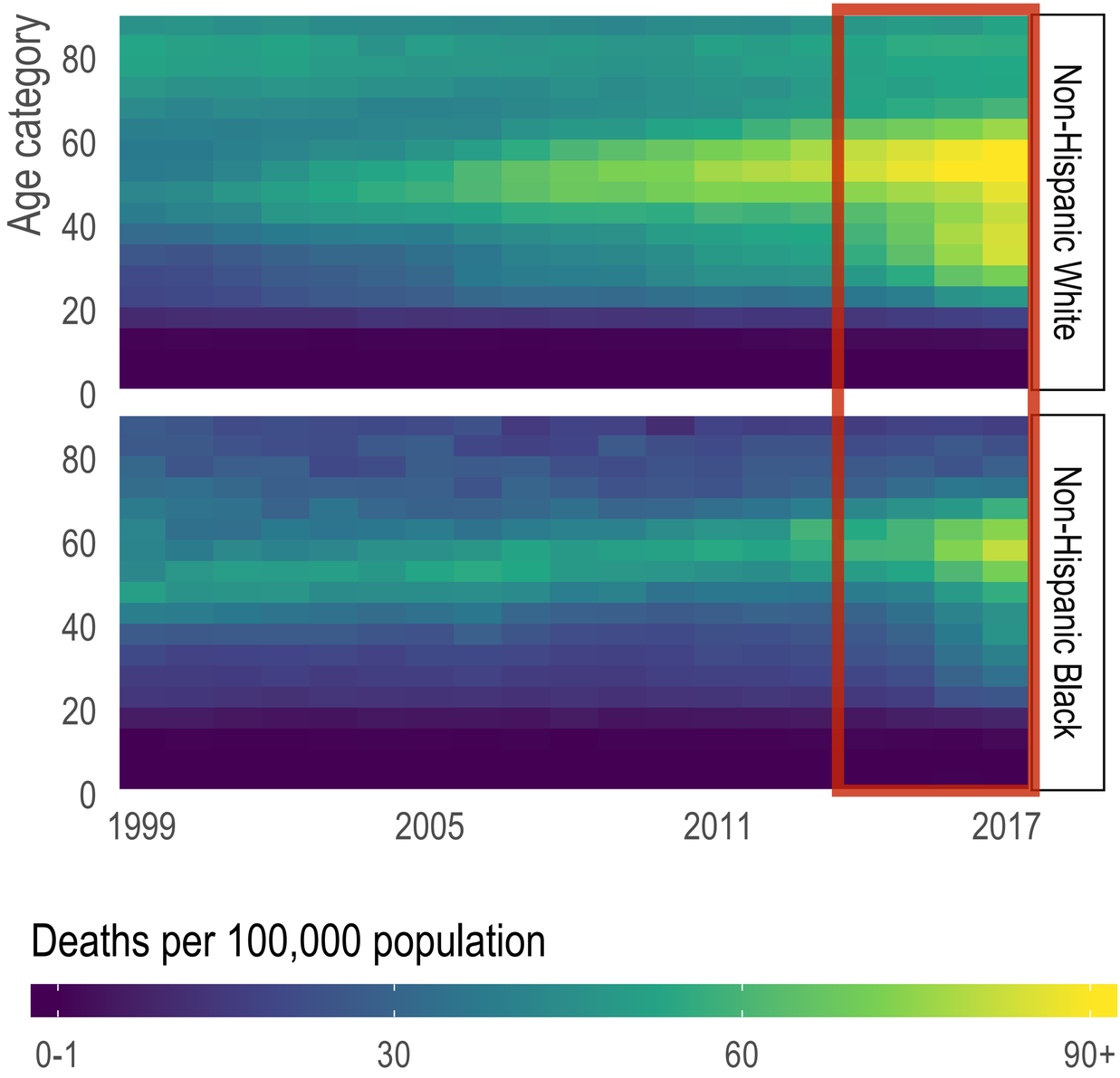
Deaths of Despair

- Alcohol-related liver disease, suicide, or drug overdose
- 1999–2013, increases in 40-54 year old non-Hispanic White (NHW) population



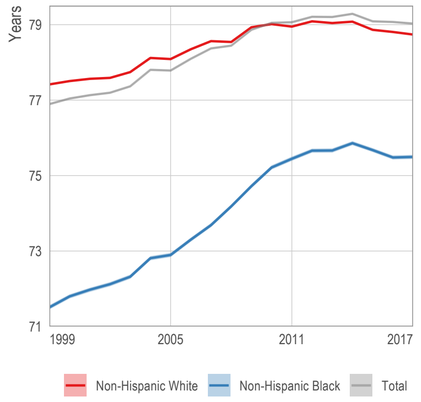
Deaths of Despair

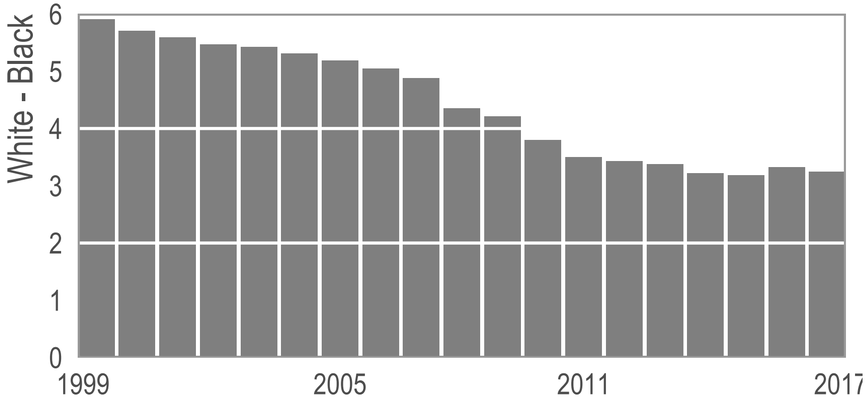
- Alcohol-related liver disease, suicide, or drug overdose
- 1999–2013, increases in 40-54 year old non-Hispanic White (NHW) population
- 2014–2017, affecting other ages and non-Hispanic Black (NHB) population

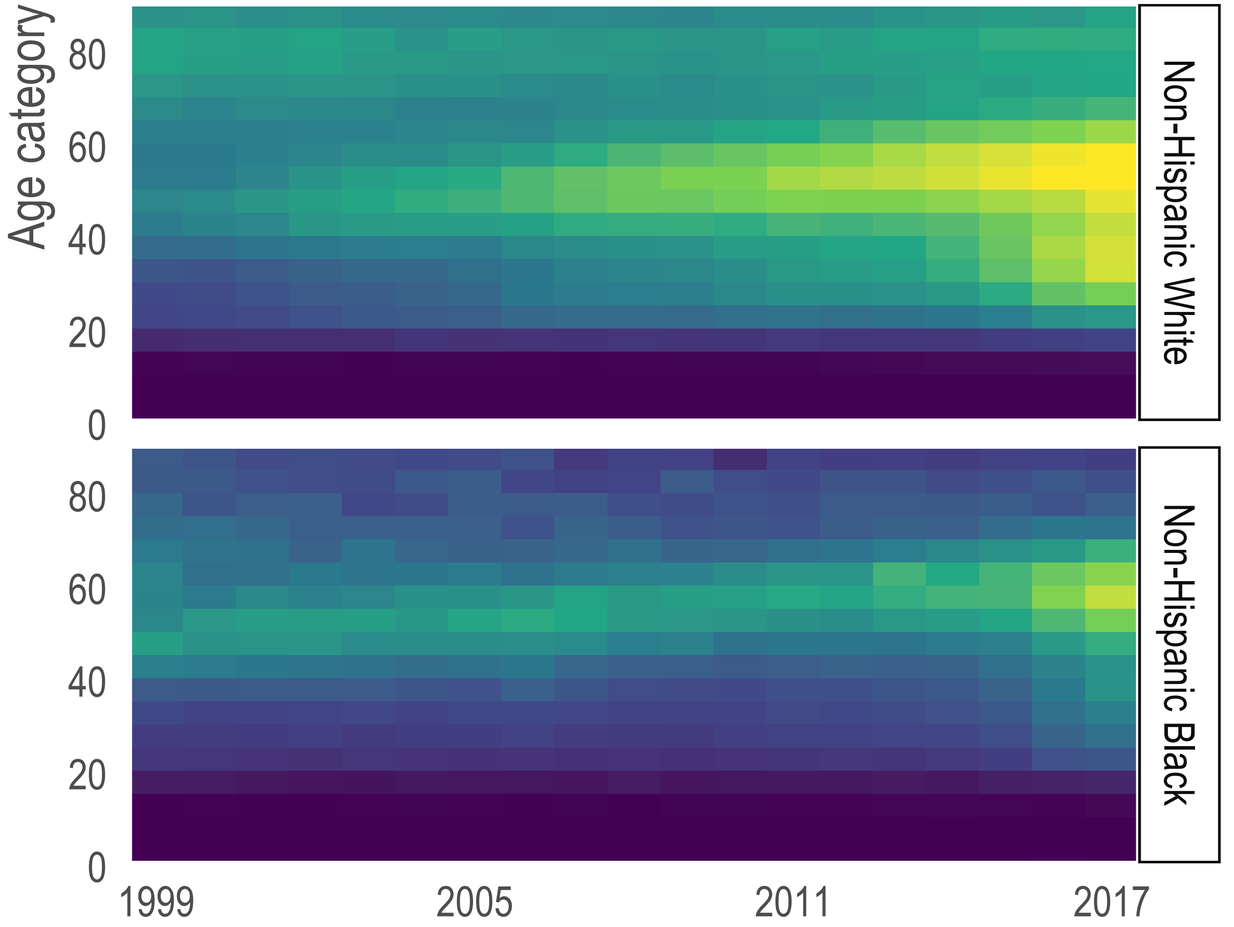


Racial/Ethnic Health Inequalities

- But health inequalities aren't new[1]
- And grow and shrink over time[2,3]
- Geographical variation yet spatially persistent[4]







1. Williams, and Sternthal. 2010. "Understanding Racial-Ethnic Disparities in Health: Sociological Contributions." J Health Soc Behav 51
2. Krieger, Rehkopf, Chen, Waterman, Marcelli, and Kennedy. 2008. "The Fall and Rise of US Inequities in Premature Mortality: 1960–2002." PLOS Med.
3. Krieger, Kosheleva, Waterman, Chen, Beckfield, and Kiang. 2014. "50-Year Trends in US Socioeconomic Inequalities in Health: US-born Black and White Americans, 1959–2008." IJE
4. Cossman, Cossman, Jackson, and Cosby. 2003. "Mapping High or Low Mortality Places Across Time in the United States: A Research Note on a Health Visualization and Analysis Project." Health Place

Quantify impact of deaths of despair on Black/White inequalities

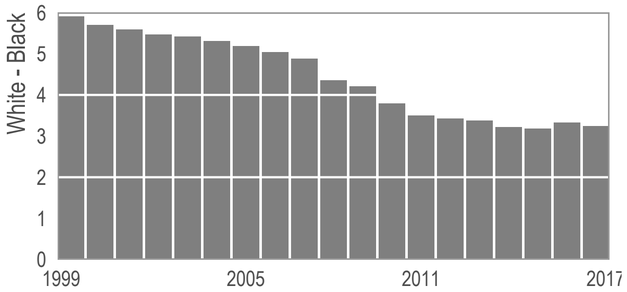
Data and Methods

- Restricted-access death and population data from the NCHS, 1999 to 2017 to create life tables
- Line integral model of decomposition from *Horiuchi, Wilmoth, and Pletcher. 2008. "A Decomposition Method Based on a Model of Continuous Change."* Demography *45 (4). doi:10.1353/dem.0.0033*

$$f(p_2) - f(p_1) = \sum_{i=1}^{n} \int_{x(p_1)}^{x(p_2)} \frac{\partial f}{\partial x_i}$$

Data and Methods

- Interested in **decomposing** the **difference in life expectancy** between two groups



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- Express **White LE** and **Black LE** as a function f of n covariates denoted $\boldsymbol{x} = [x_1, \ldots, x_n]$

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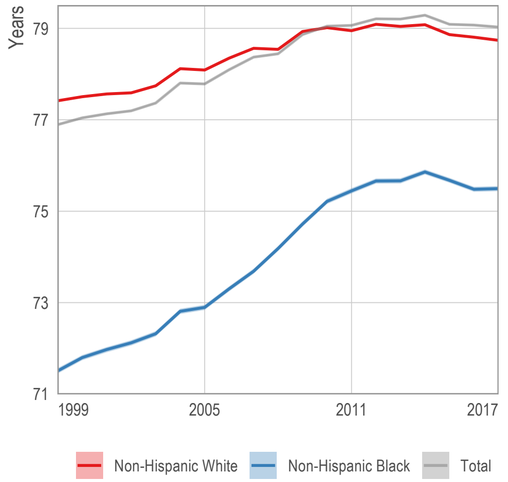

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Data and Methods

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- Express **White LE** and **Black LE** as a function f of n covariates denoted $\boldsymbol{x} = [x_1, \ldots, x_n]$
- Here, life expectancy (f) is a function of **mortality rates by age** (x_1) **and type of death** (x_2)

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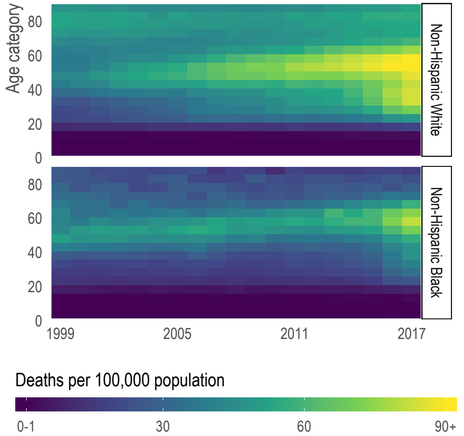

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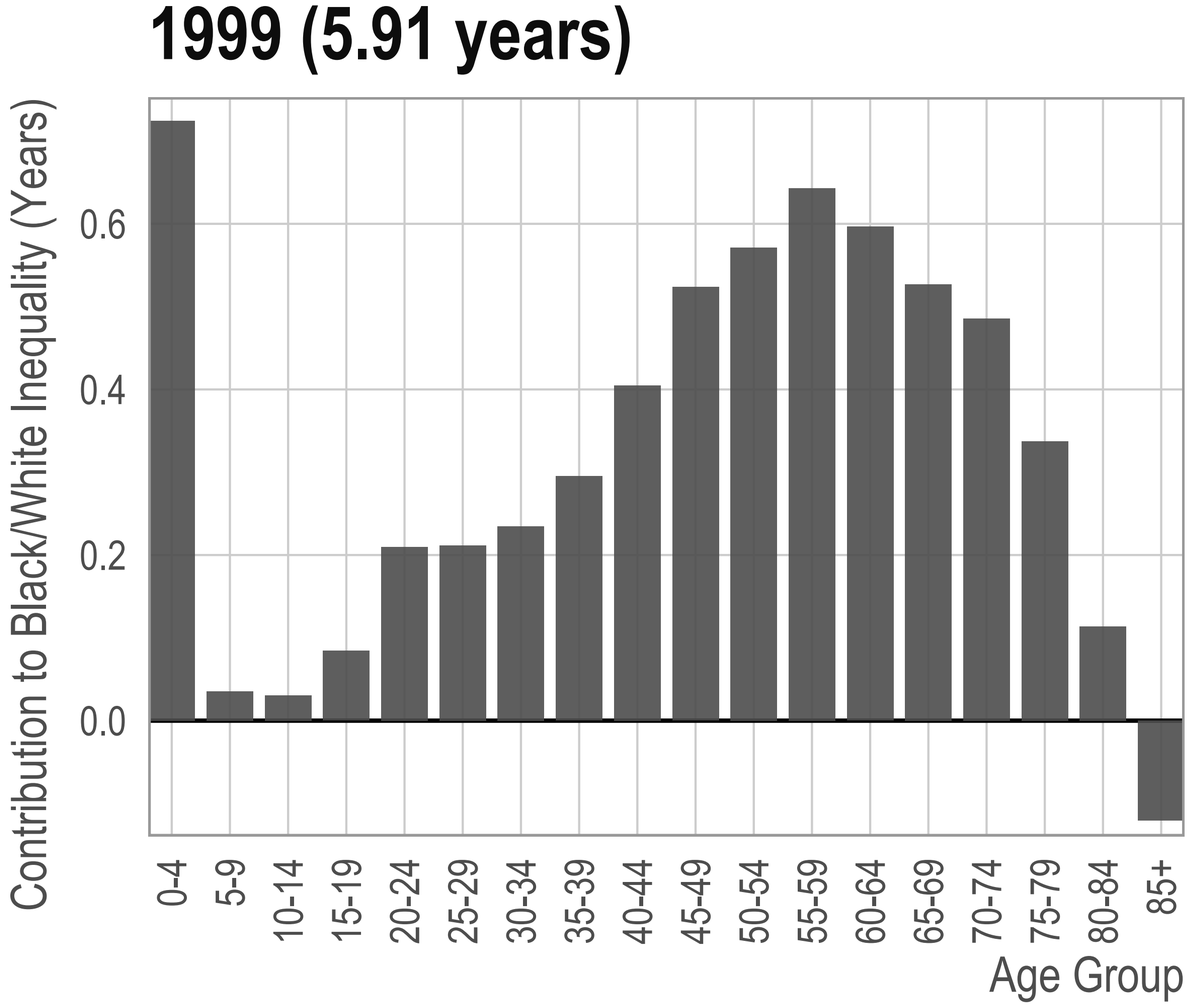
Decomposing Black/White Inequality



- In 1999, NHW outlived NHB by ~6 years
- Negative values indicate NHB mortality rate is lower than NHW mortality rate *in that age group*
- NHW lower mortality in nearly every age group except 85+

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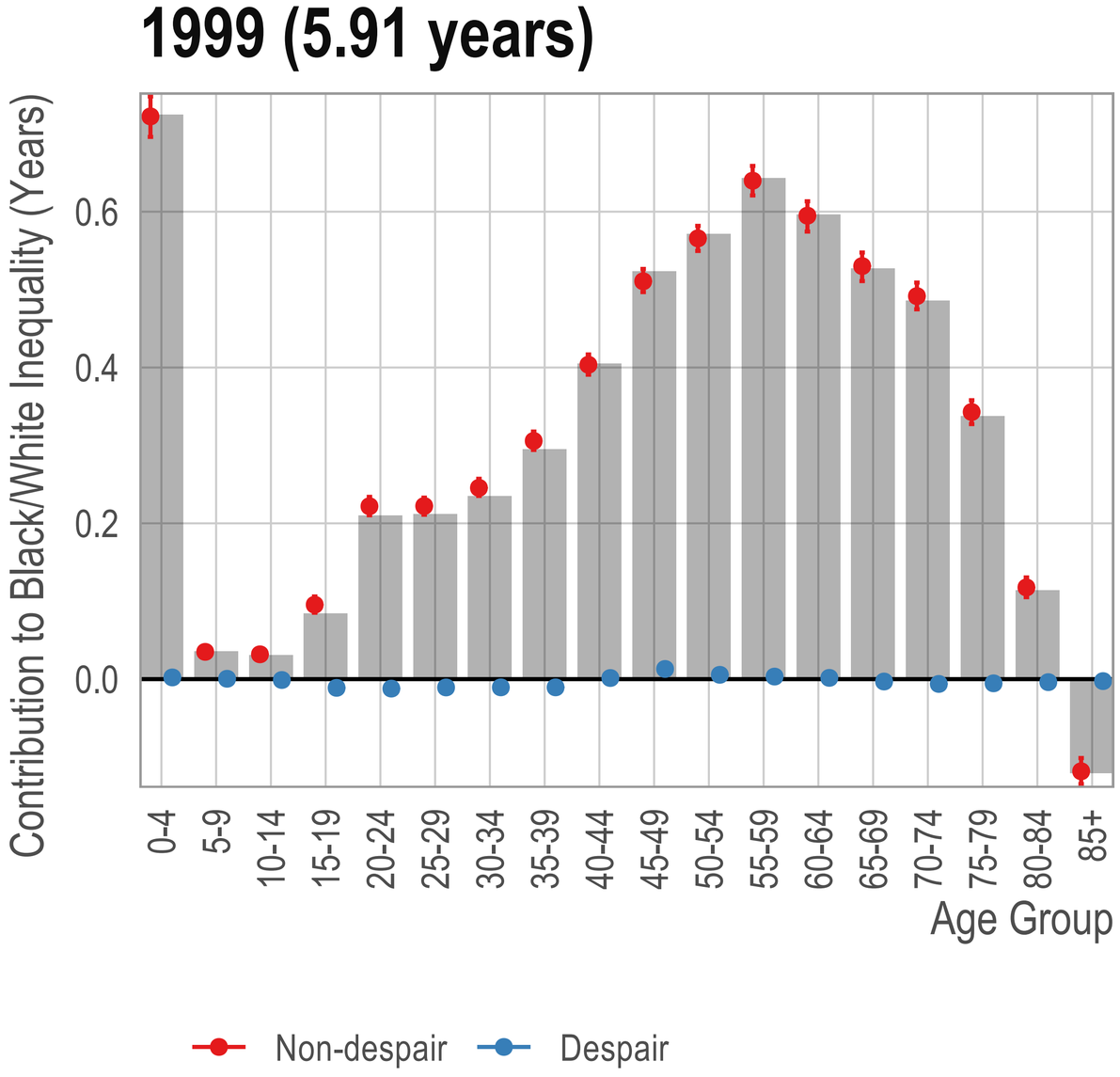
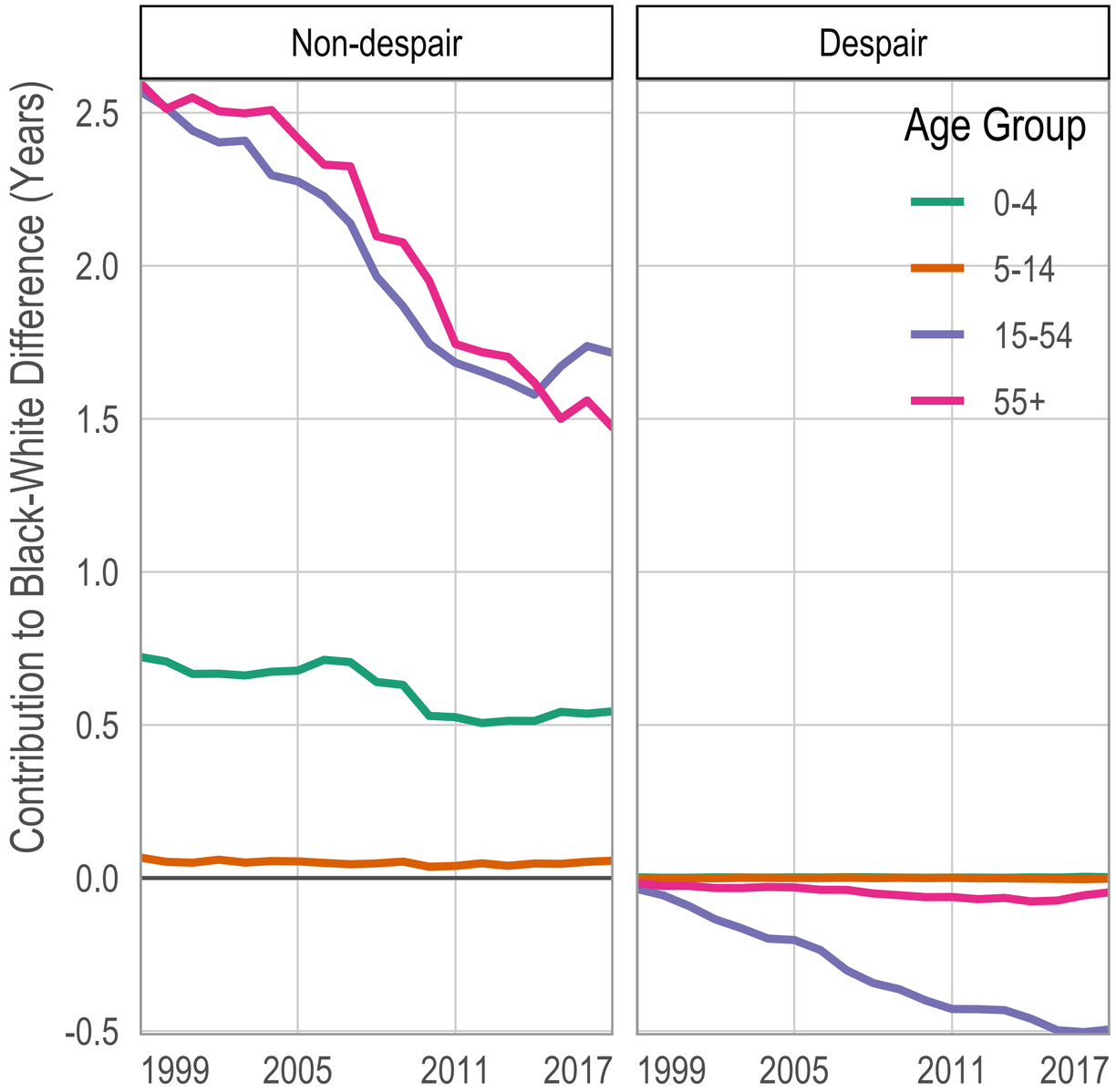


- In 1999, deaths of despair accounted for less than **1%** of the Black/White inequality in life expectancy (-0.05 years)
- Non-despair, under-5 mortality was the single largest contributor at **12%** (.72 years)

Two main results

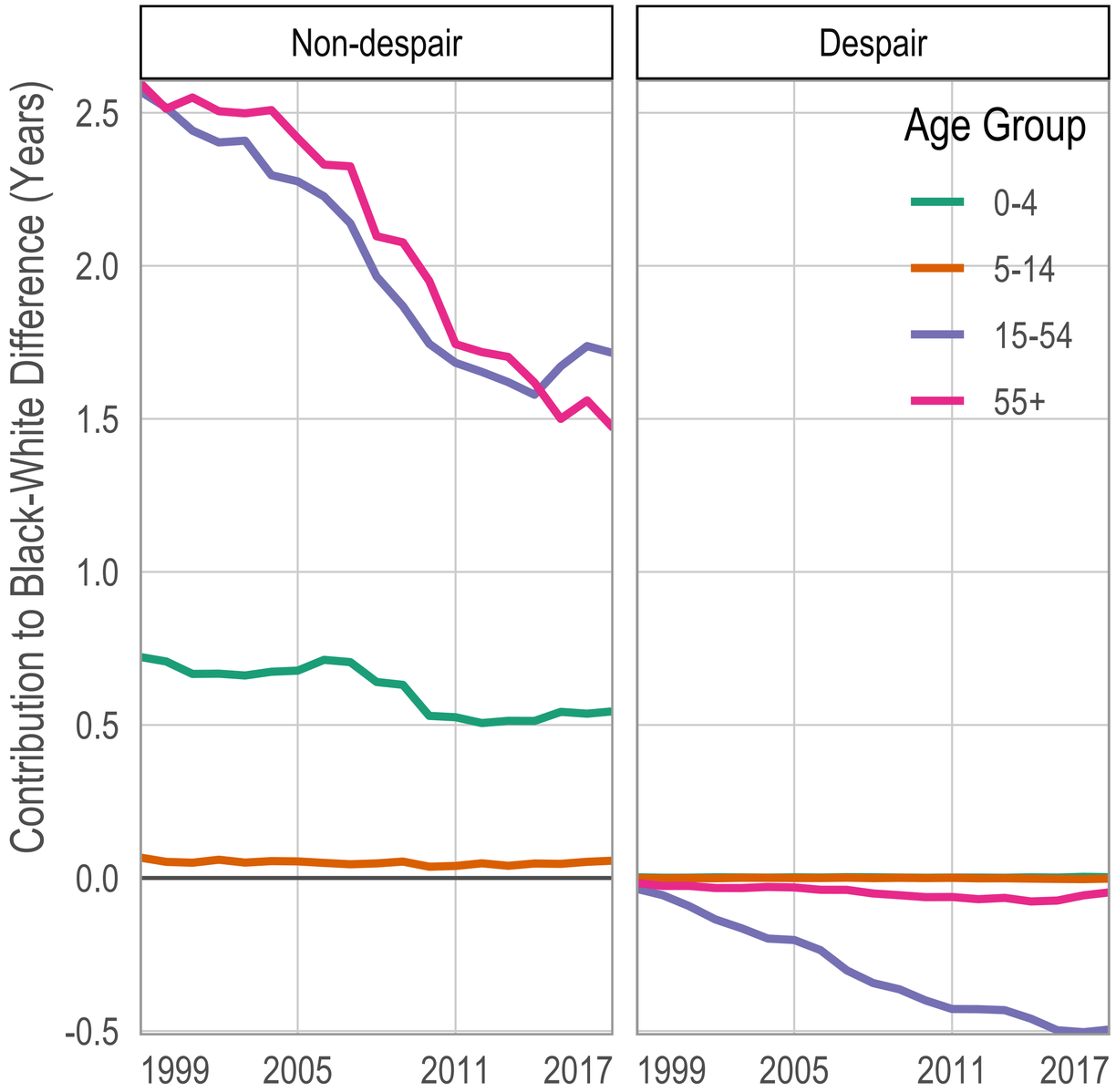
(+ one bonus)

Convergence Mainly from Non-despair Deaths



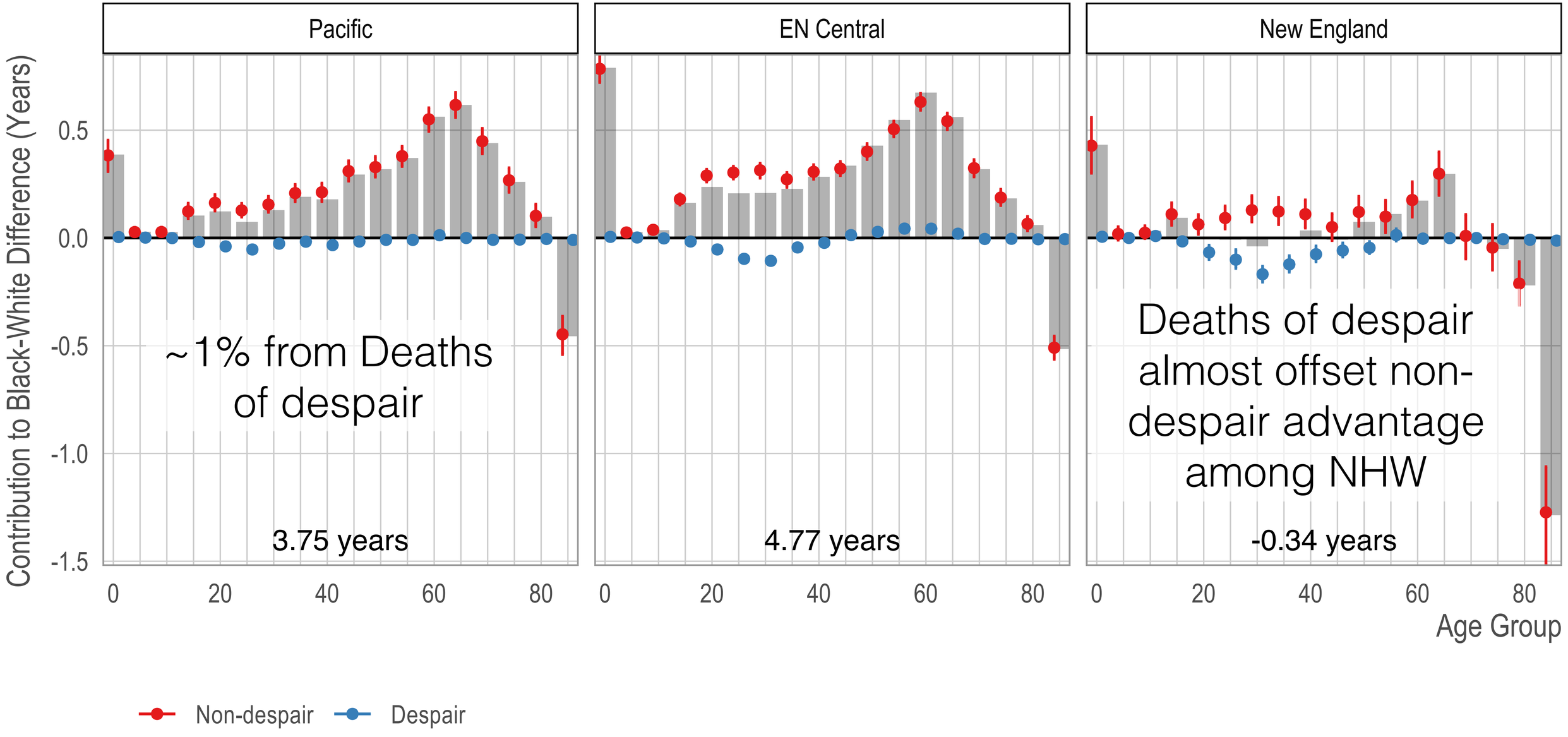
- **Majority** of the lower inequality is due improvements in NHB **15-54** and **55+**, non-despair mortality (5.17 to 3.18 years)
- **Small contribution** from **15-54** deaths of despair (albeit, growing: -0.04 to -0.49 years)

We Need to Reduce Under-5 Deaths

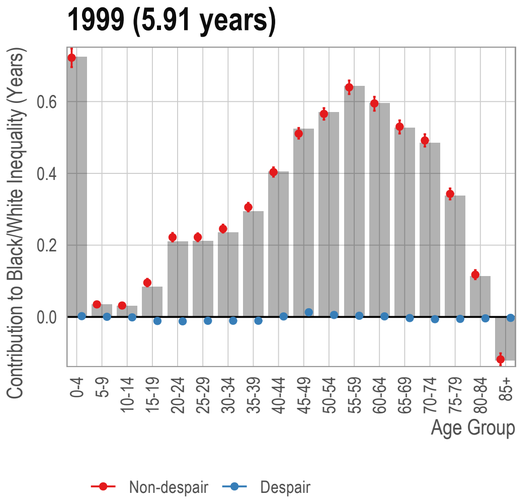


- **Under-5** inequality has <u>not improved since 2010</u> (0.53 years)
- **Under-5** inequality has <u>only modestly declined</u> since 1999 (0.72 years)
- In every year, non-despair **under-5** mortality is single largest contributor

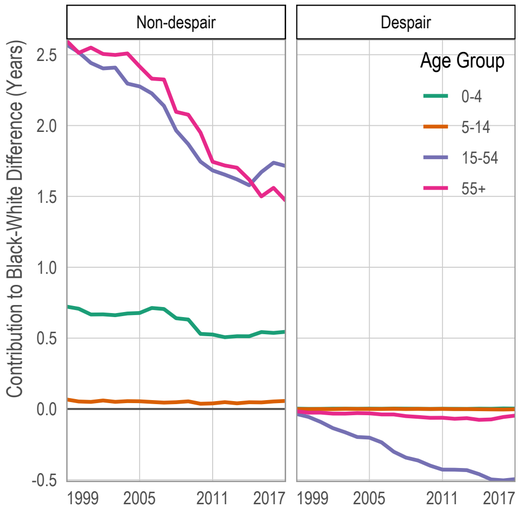
There is Substantial Geographic Variation



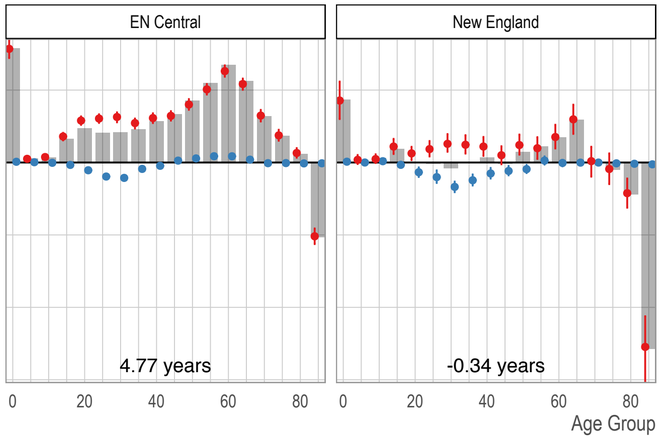
Conclusion



Decomposition methods are useful and flexible — nuanced view of inequalities.

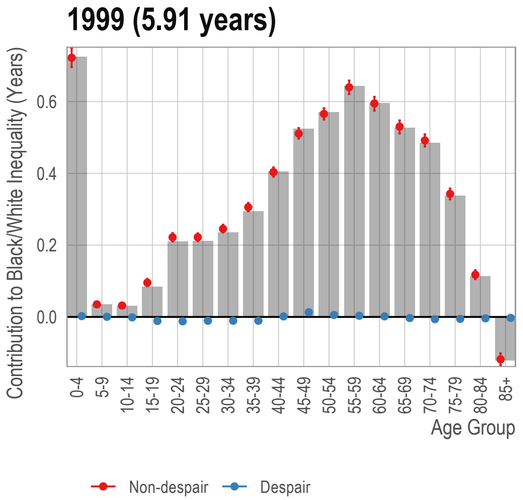


We <u>need</u> to address under-5 mortality. Deaths of despair minor relative to under-5.



Geography cannot be ignored. Interventions must be local.

Thank you



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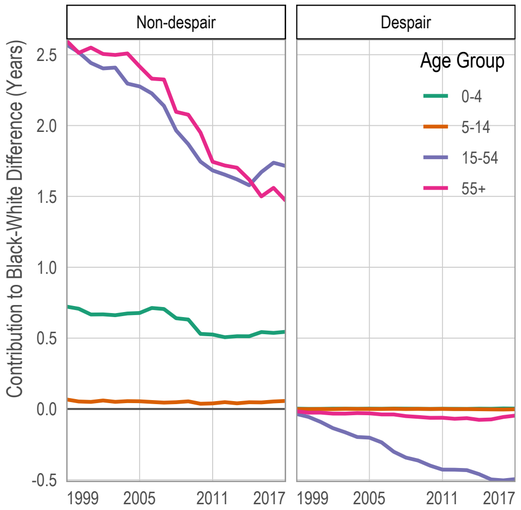

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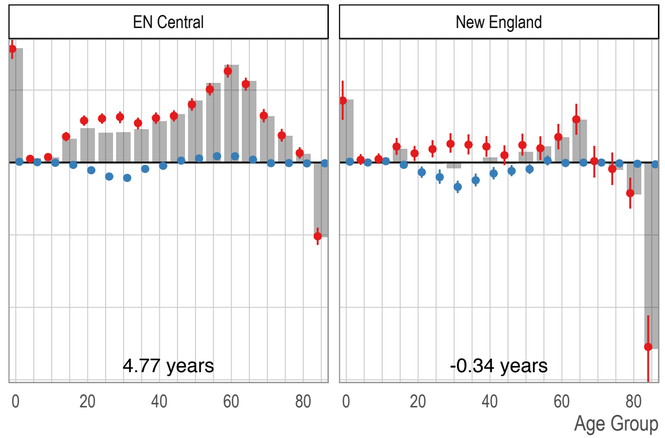

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Slides available at: `http://bit.ly/ser_2019`

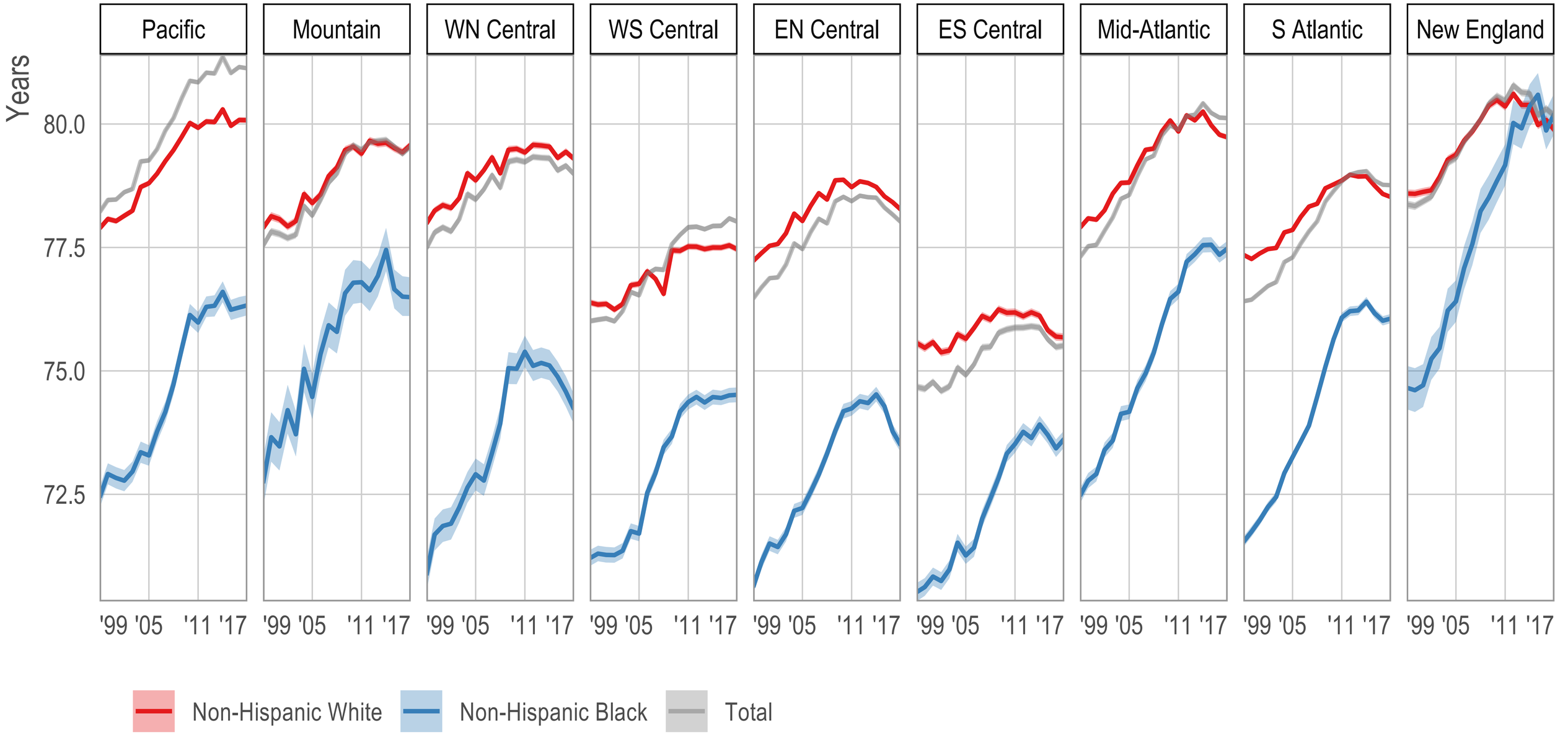
Mathew Kiang, ScD
T32 Postdoctoral Fellow
@mathewkiang
mkiang@stanford.edu

Stanford | Center for Population Health Sciences

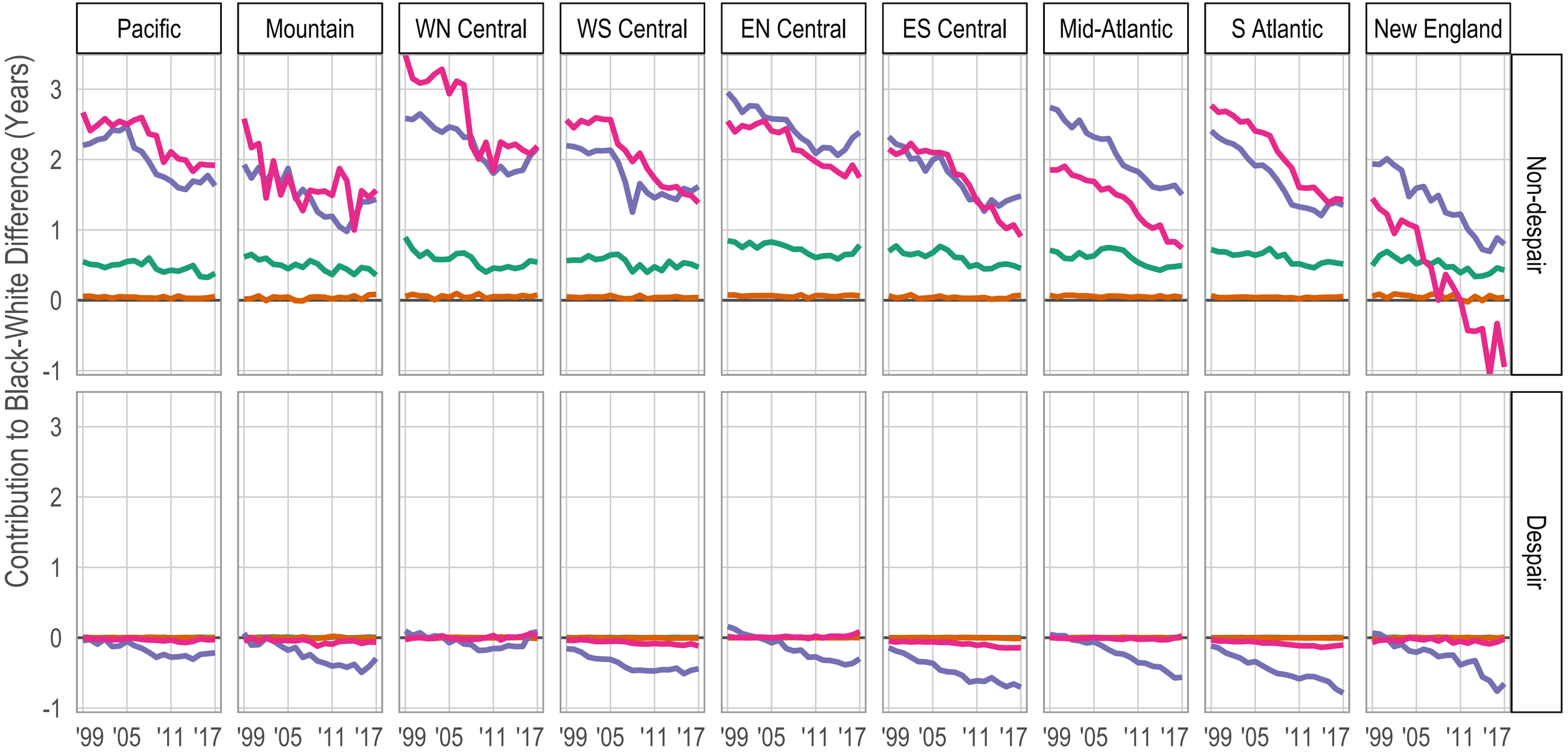
Support:
NIMHD (DP2MD010478)
NIDA (T32DA035165)
PHS DataCore and SRCC for computational resources.

Additional slides

Life Expectancy by Division



Contributions by Division



Data and Methods

- We can find the solution using numerical integration (i.e., calculating small steps between observations)
- This assumes a smooth continuous function (i.e., differentiable but not necessarily monotonic)
- While deaths are discrete events at the individual level, death *rates* at the population level are (generally) smooth

$$f(p_2) - f(p_1) = \sum_{i=1}^{n} \int_{x(p_1)}^{x(p_2)} \frac{\partial f}{\partial x_i}$$

Data and Methods

- We performed numerical integration in R 3.6.0 using 20 integration steps as outlined in Horiuchi, Wilmoth, and Pletcher. 2008. “A Decomposition Method Based on a Model of Continuous Change.” *Demography* 45 (4)

$$f(p_2) - f(p_1) = \sum_{i=1}^{n} \int_{x(p_1)}^{x(p_2)} \frac{\partial f}{\partial x_i}$$

Data and Methods

- Used simulation to estimate uncertainty intervals
- Assume deaths are Poisson distributed and use observed age- and death-type-specific mortality rates as the mean of the distribution
- Create a simulated life table
- Estimate the quantity of interest
- Repeat 1,000 times and report 2.5th and 97.5th percentiles

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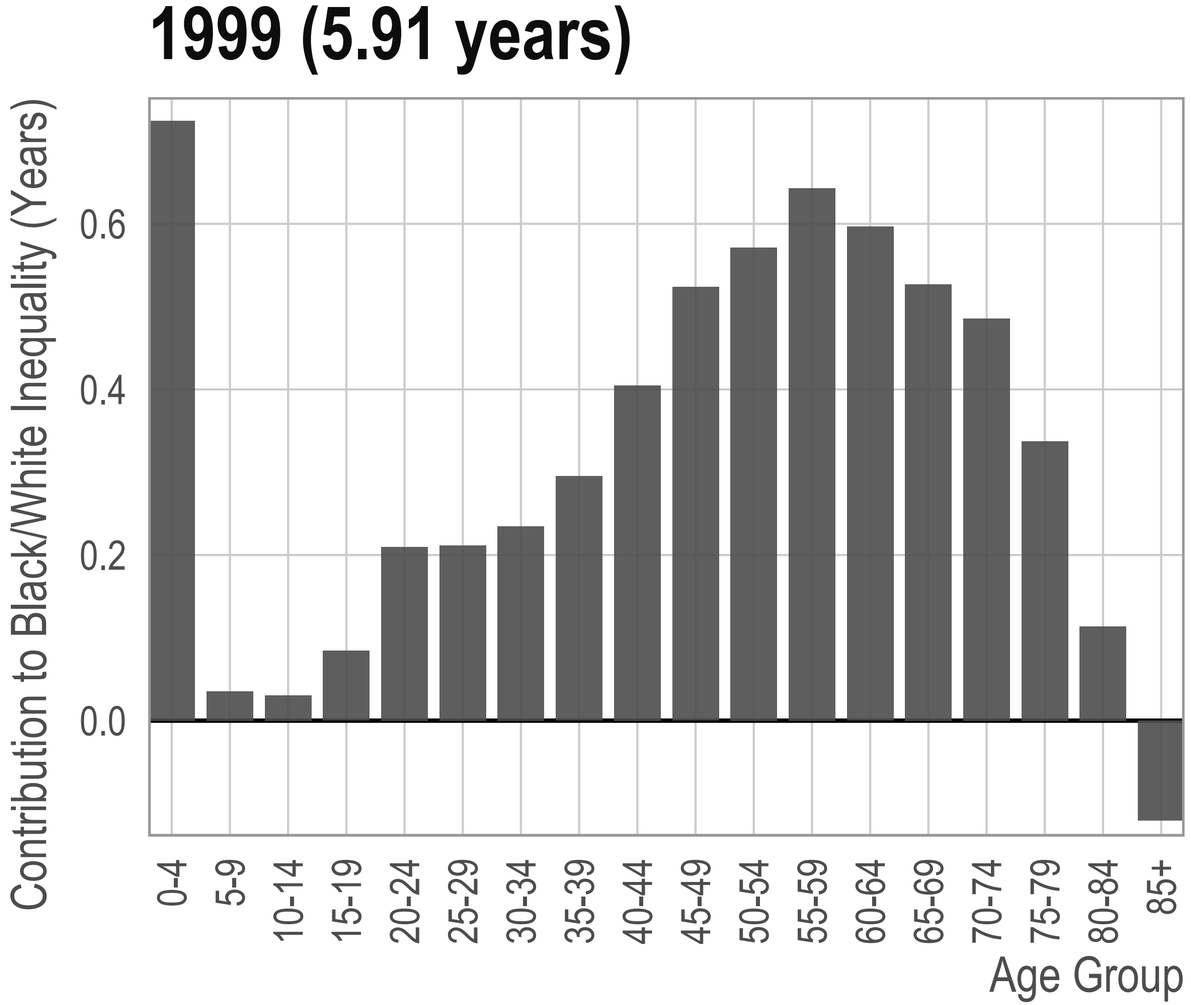
Decomposing Black/White Inequality



- In 1999, NHW outlived NHB by ~6 years
- Negative values indicate NHB mortality rate is lower than NHW mortality rate *in that age group*
- NHW lower mortality in nearly every age group except 85+*

*Not clear this is real.

See: Nam 1995 in *Social Biology* (doi: 10.1080/19485565.1995.998889)

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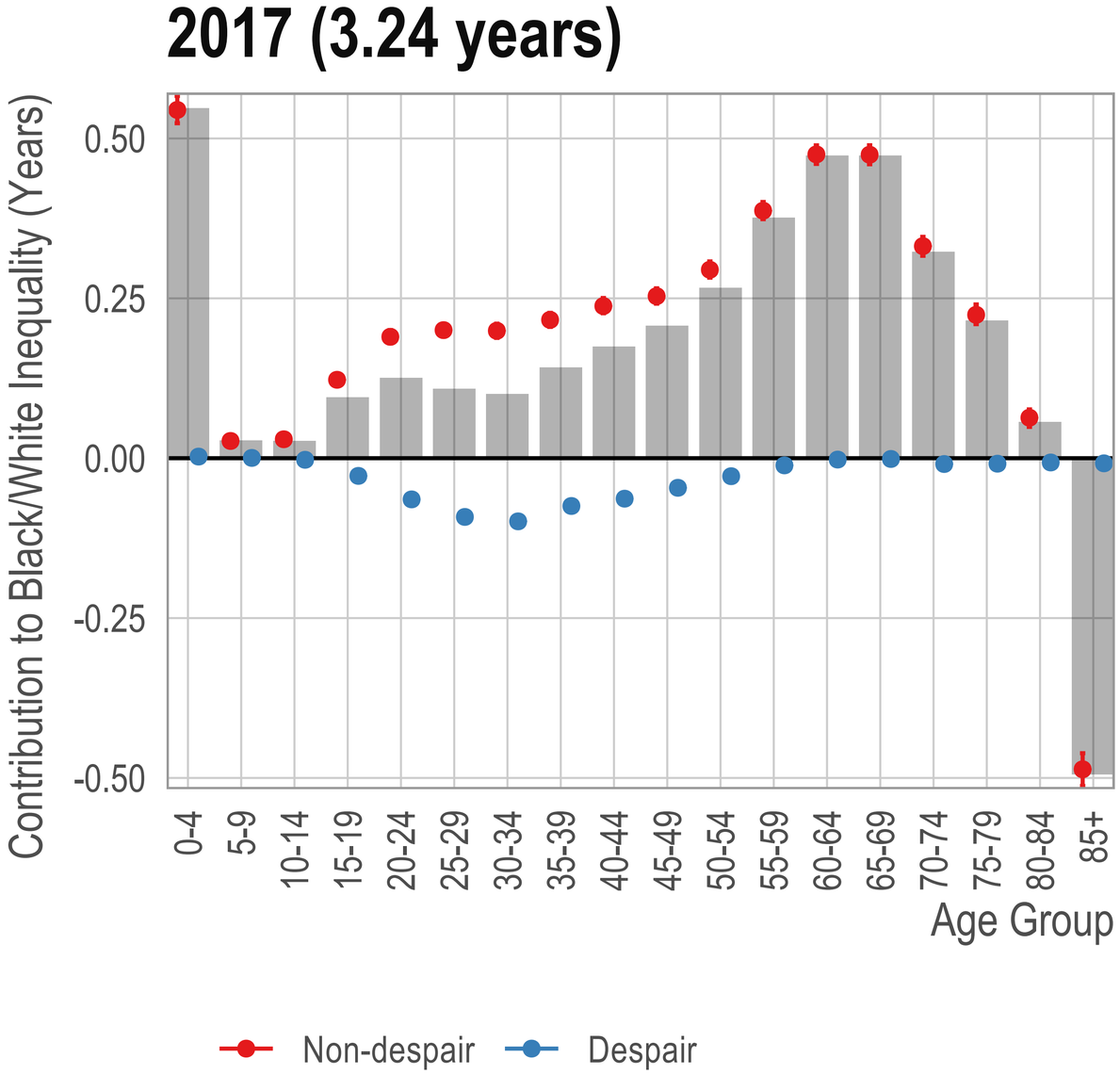

- By 2017, Black/White inequality dropped to 3.24 years

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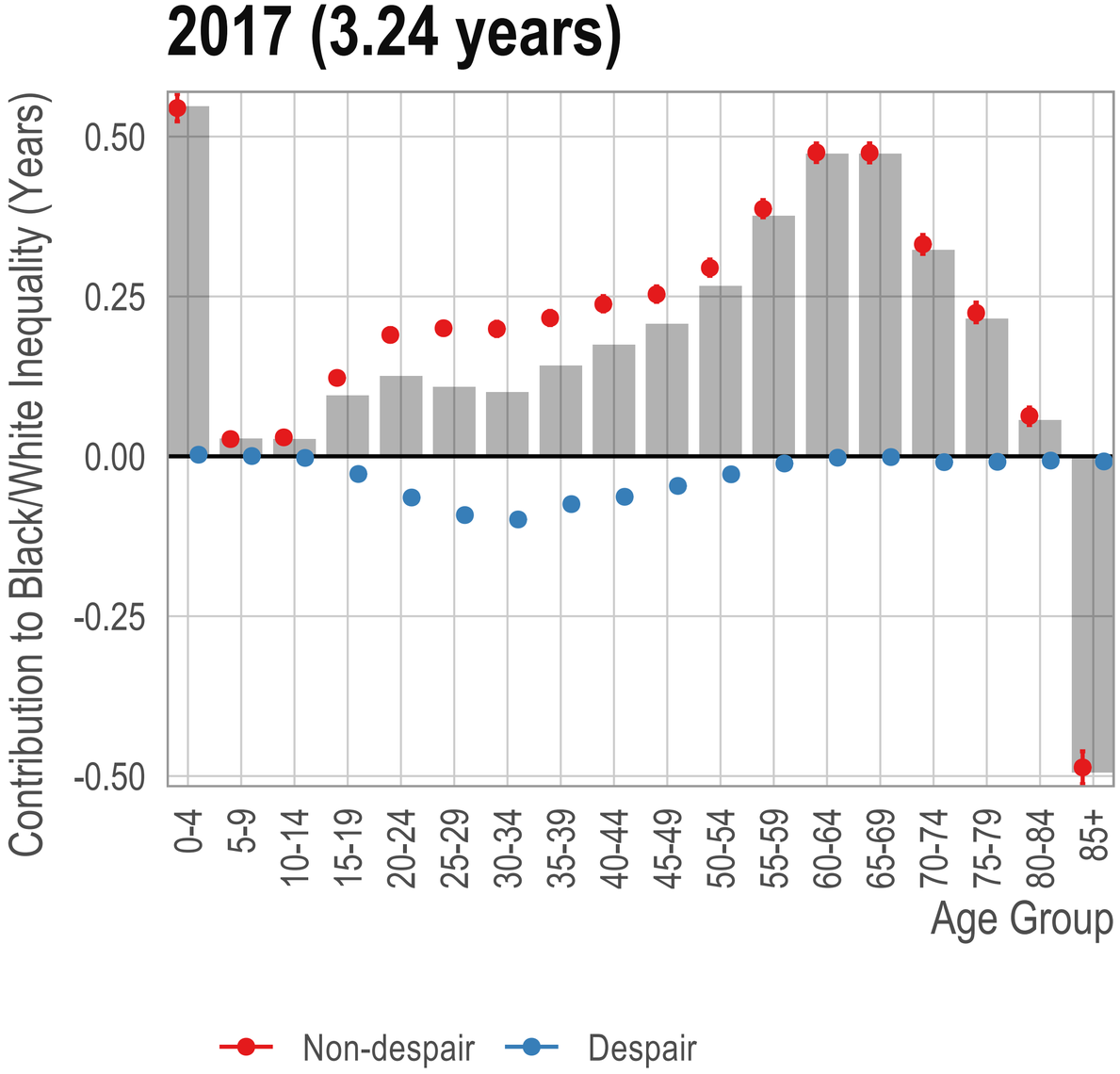

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- **17%** of gap is due to deaths of despair (-0.54 years)

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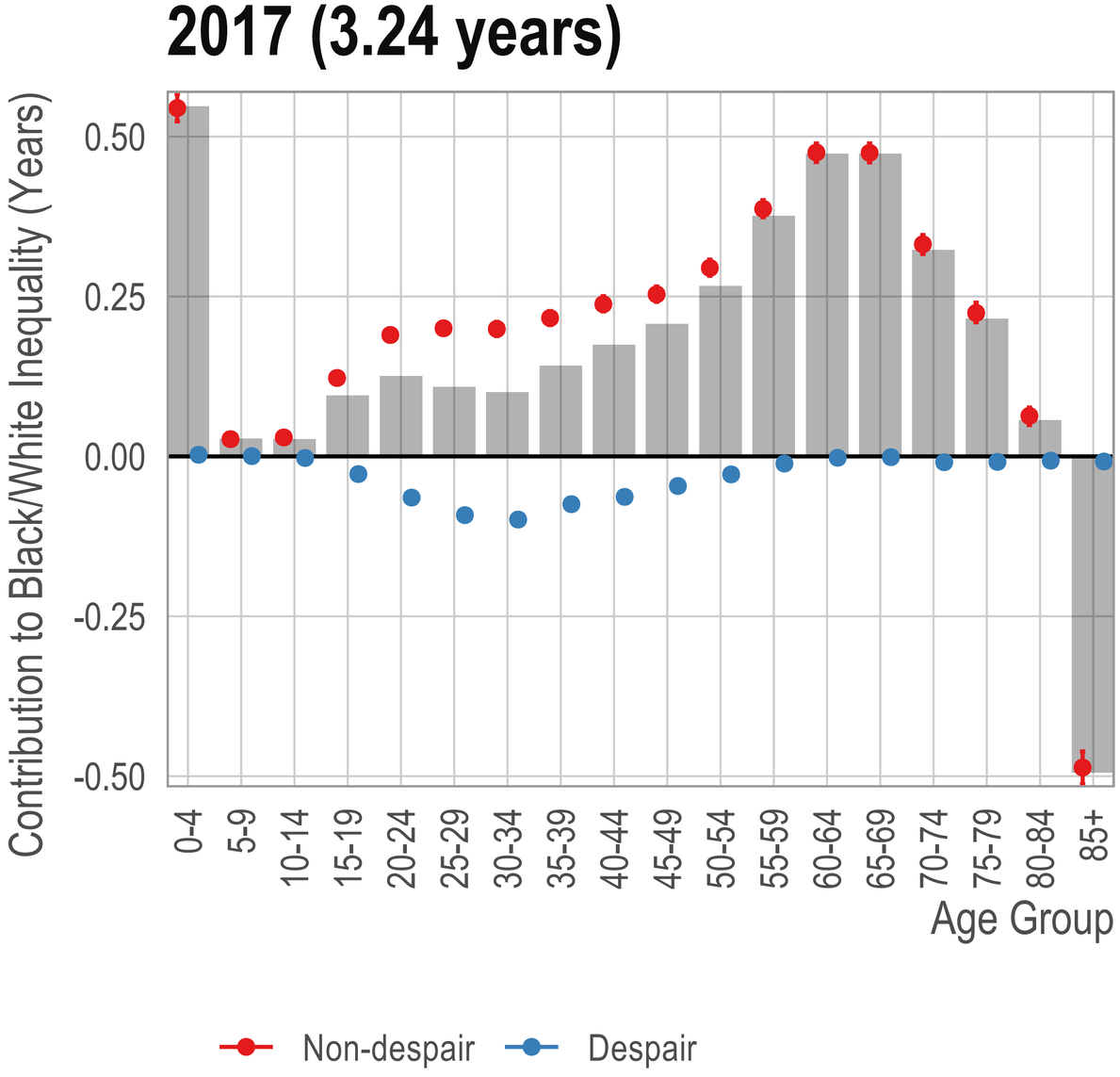
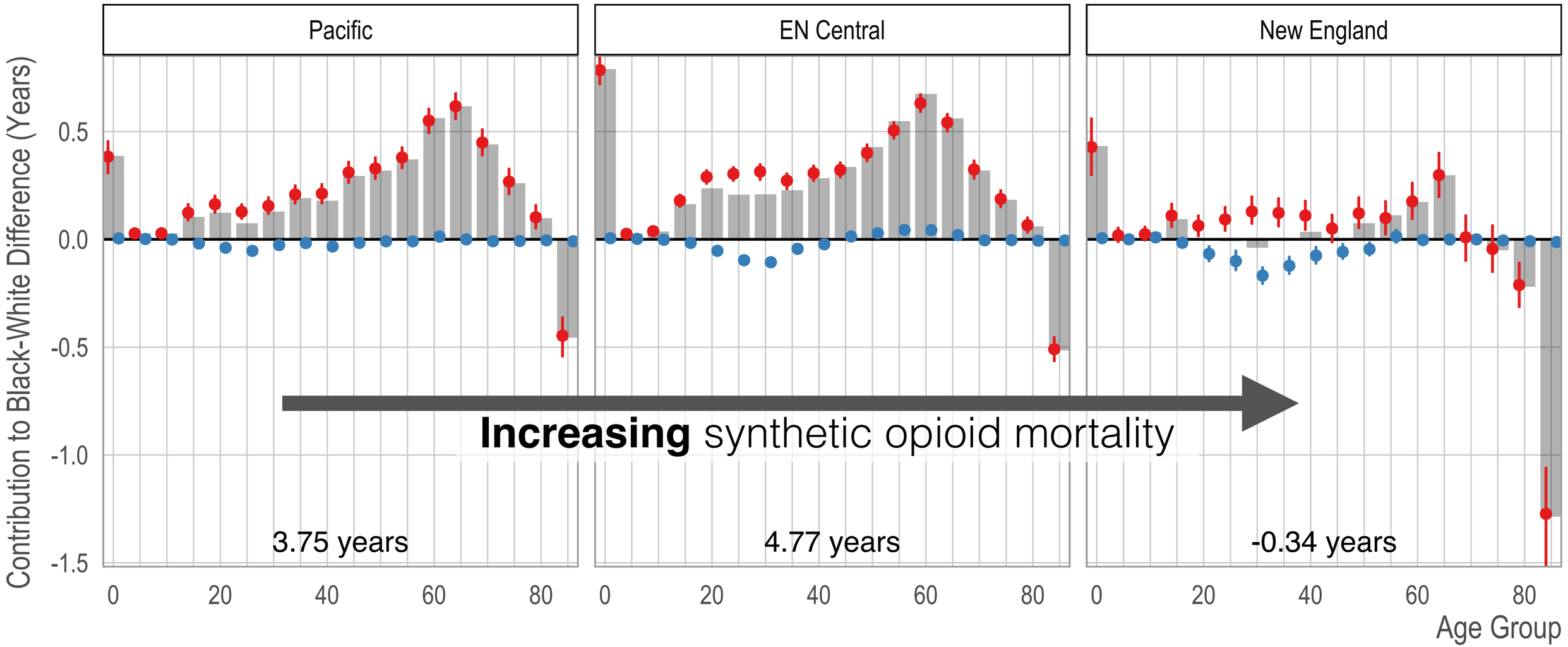


- By 2017, Black/White inequality dropped to 3.24 years
- **17%** of gap is due to deaths of despair (-0.54 years)
- Non-despair, under-5 mortality **still** the largest contributor **17%** (0.55 years)

There is substantial geographic variation



Kiang, Basu, Chen, Alexander. Assessment of Changes in the Geographical Distribution of Opioid-Related Mortality Across the United States by Opioid Type, 1999-2016. *JAMA Network Open.* doi:10.1001/jamanetworkopen.2019.0040