Weathering and social epigenetics: racial disparities in biological aging

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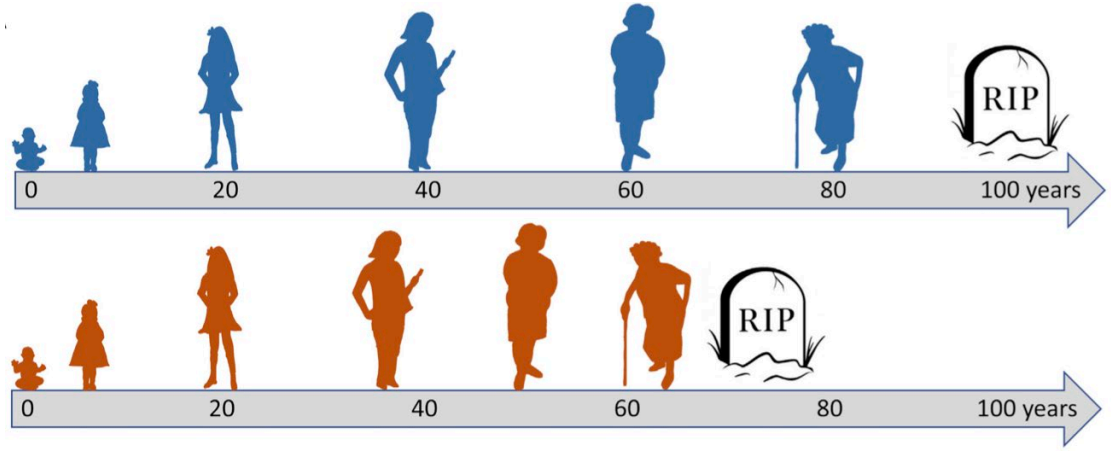
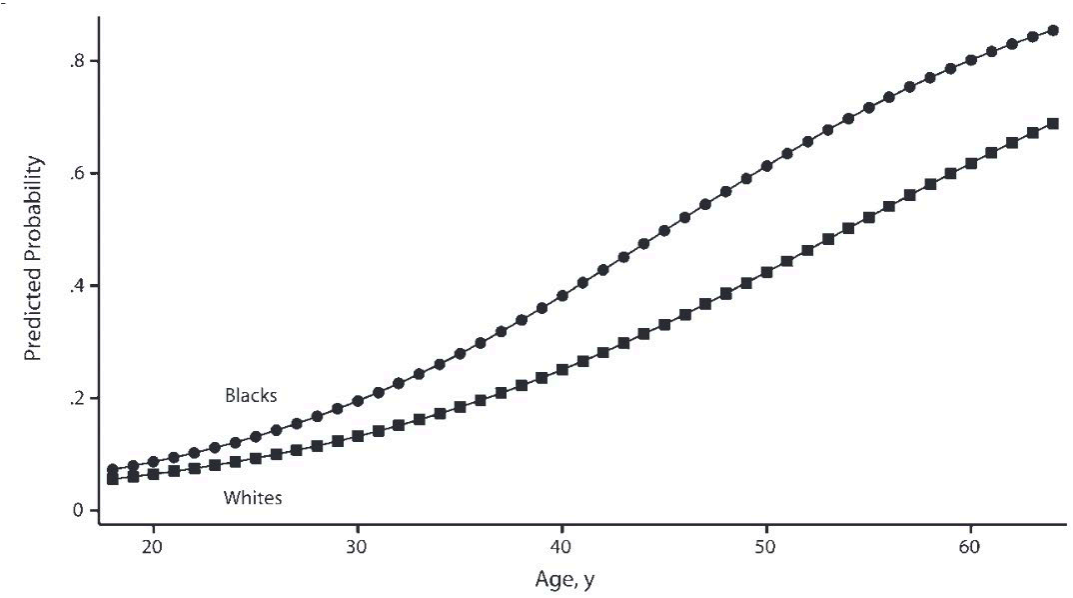
Racial disparities in age-related health are mediated by biological aging

Weathering: “Blacks experience early health deterioration as a consequence of the cumulative impact of repeated experience with social or economic adversity and political marginalization.”

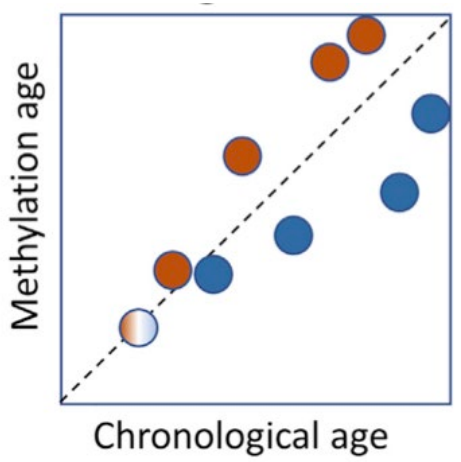


Probability of having a high allostatic load score



Geronimus AT, et al. 2006

DNA methylation aging



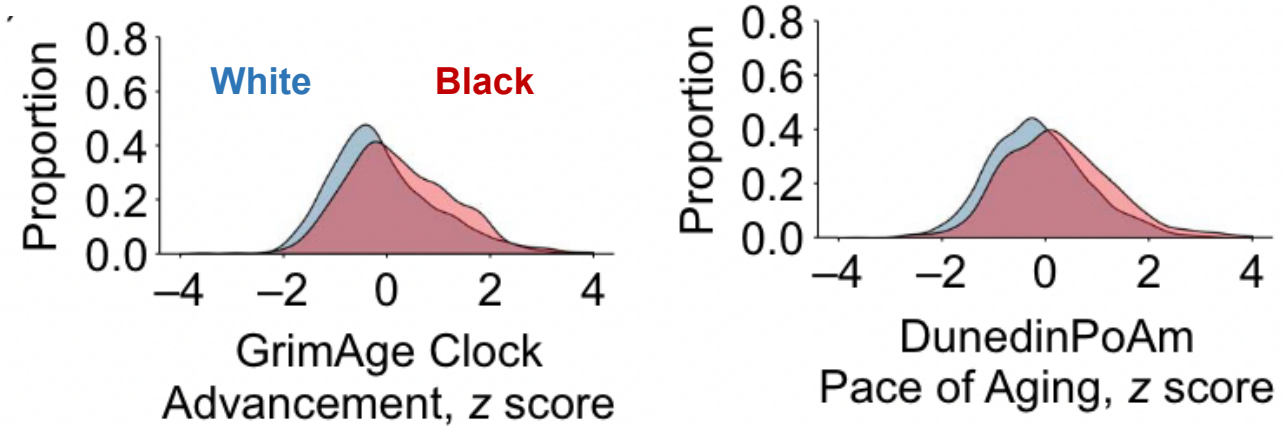
Field A, et al. 2018

Racial disparities in age-related health are mediated by biological aging

GrimAge and Dunedin Pace of Aging Methylation (DunedinPoAm) are robust markers of biological aging

Associated with:

- Mortality
- Cognitive decline
- Functional decline
- Age-related disease (heart, lung, diabetes)

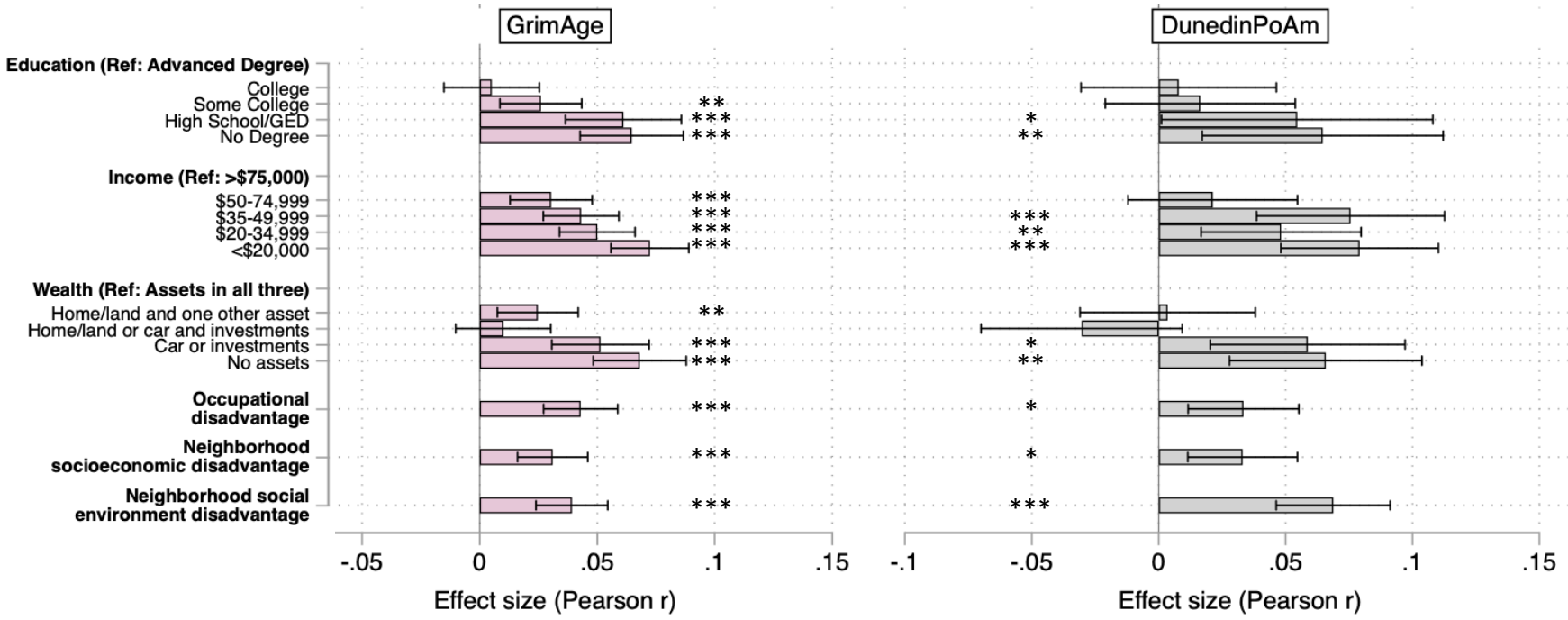


Biological aging mediates racial disparities in

- Mortality
- Functional decline
- General health

Graf GH, et al. 2021

Individual SES and neighborhood social environment are associated with biological aging



*** p<0.001; ** p<0.01; * p<0.05

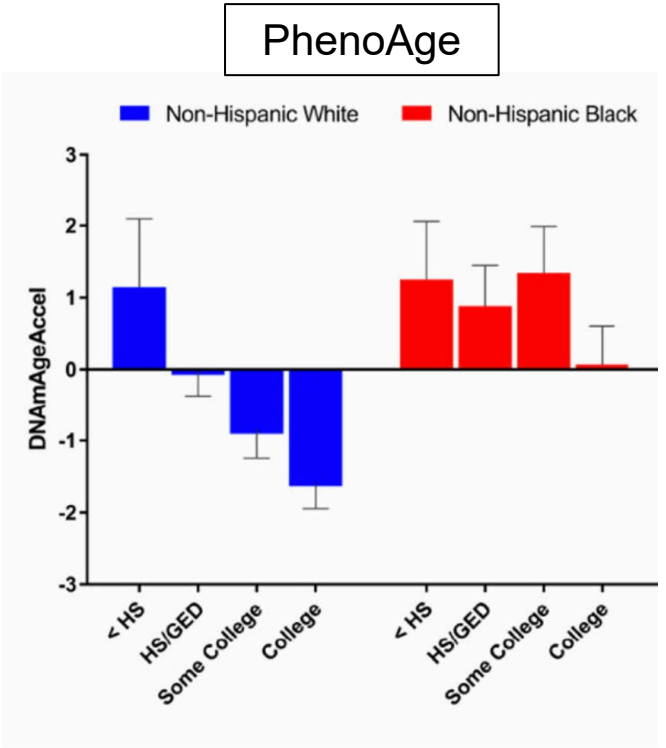


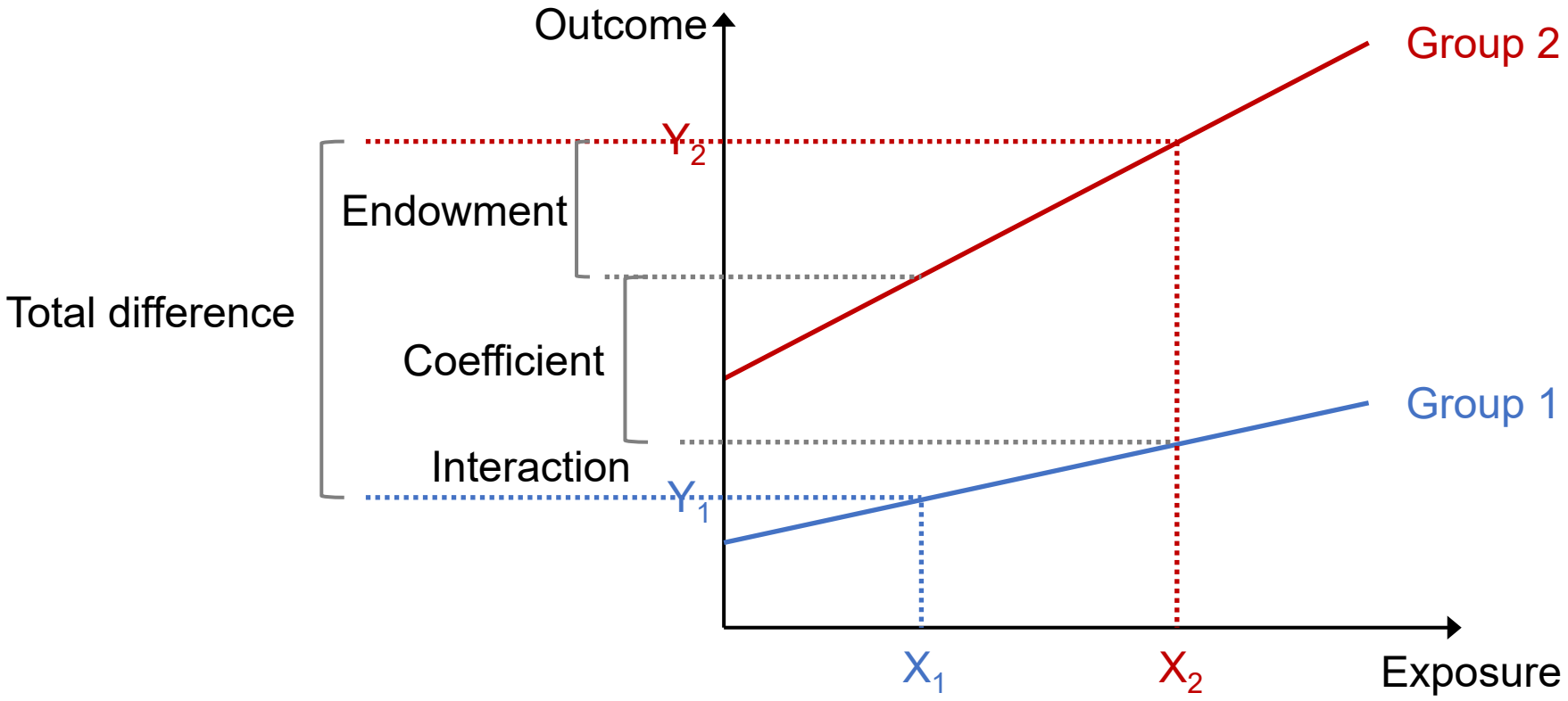
Fig. 1. Levine DNAmAgeAccel by race/ethnicity and education.

Similar associations found in other studies (e.g. MESA and FACHS)

Schmitz LL, et al. 2021

Liu Z, et al. 2019

Threefold decomposition: quantify contribution to disparities



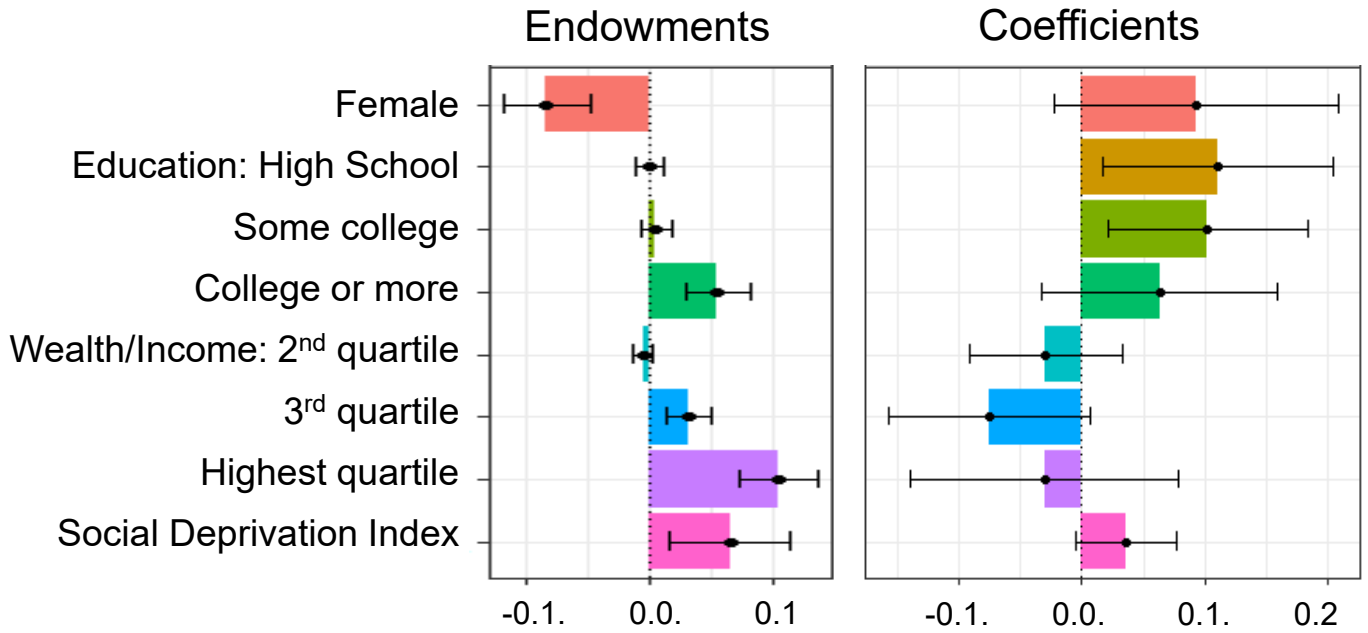
Hlavac, M. “Oaxaca: Blinder-Oaxaca Decomposition in R.” 2014.

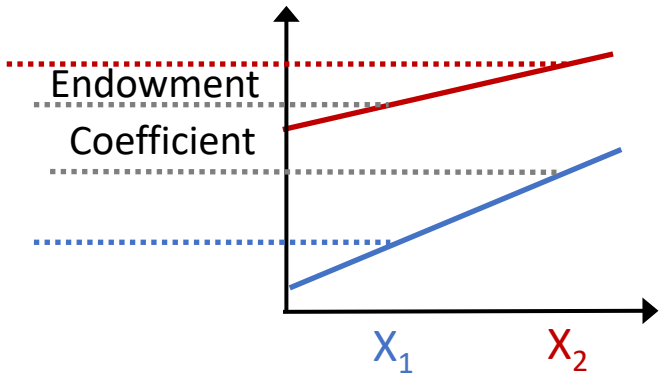
Higher neighborhood deprivation for Black Americans contributes to disparity in GrimAge

Characteristic	Overall, N = 2,960[1]	White, N = 2,438[1]	Black, N = 522[1]	p-value[2]
Age	71.33 (9.53)	72.08 (9.54)	67.81 (8.69)	<0.001
Gender				<0.001
Male	1,218 (41%)	1,051 (43%)	167 (32%)	
Female	1,742 (59%)	1,387 (57%)	355 (68%)	
GrimAge aging	0.03 (1.00)	-0.02 (0.99)	0.28 (1.03)	<0.001
DunedinPoAm aging	0.03 (1.00)	-0.03 (0.98)	0.31 (1.04)	<0.001
Education				<0.001
< High School	374 (13%)	251 (10%)	123 (24%)	
High School	974 (33%)	803 (33%)	171 (33%)	
Some College	773 (26%)	644 (26%)	129 (25%)	
College +	839 (28%)	740 (30%)	99 (19%)	
Quartile Wealth/Income				<0.001
1	704 (24%)	443 (18%)	261 (50%)	
2	803 (27%)	644 (26%)	159 (30%)	
3	751 (25%)	671 (28%)	80 (15%)	
4	702 (24%)	680 (28%)	22 (4.2%)	
Social Deprivation Index	-0.12 (0.98)	-0.32 (0.89)	0.79 (0.80)	<0.001

[1]Mean (SD); n (%)
[2]Wilcoxon rank sum test; Pearson's Chi-squared test

Data from Health and Retirement Study DNAm subsample
Included non-Hispanic Black and White participants with complete data





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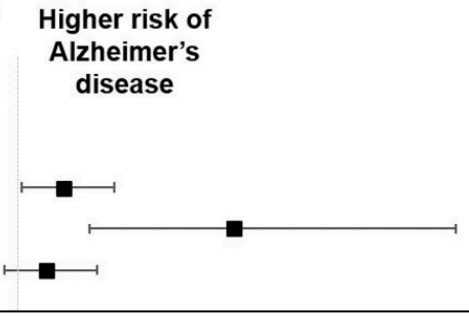
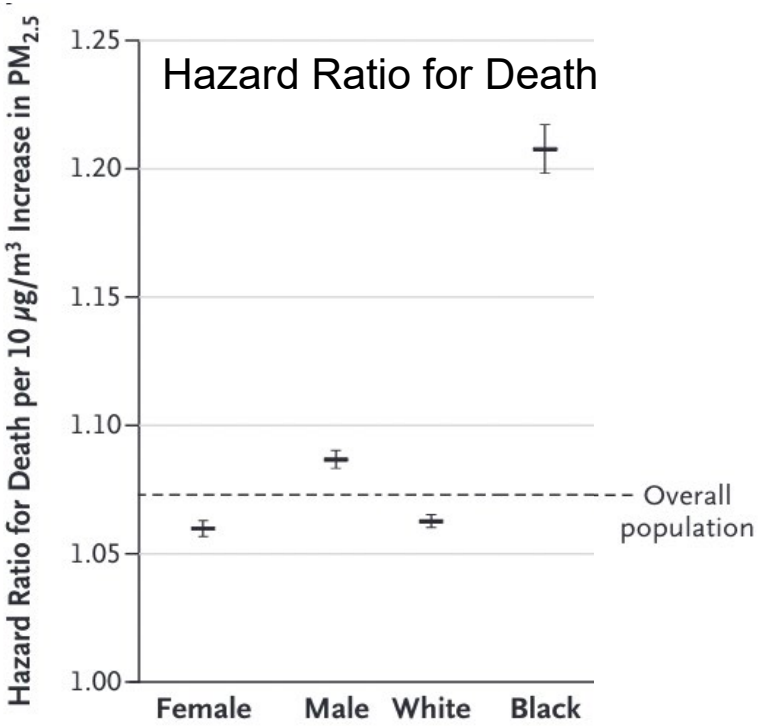
Vulnerability to PM2.5 exposure is higher for Black than White Americans

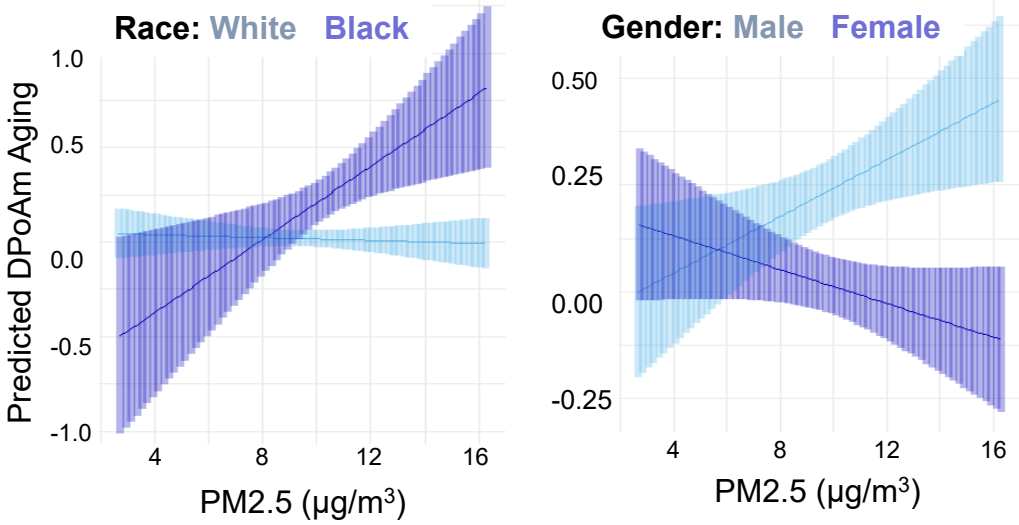
	N (cases)	$HR_{PM2.5}$ (95% CI)
Crude[a]		
All participants	6485 (158)	1.24 (1.02, 1.51)
Black participants	481 (21)	2.14 (1.38, 3.31)
White participants	6004 (137)	1.15 (0.93, 1.42)



	Race	Gender
Race		
White	—	—
Black	-0.81 (-1.5,-0.09)	0.21** (0.09,0.33)
PM2.5	0.00 (-0.02,0.01)	0.03 (0.01,0.06)
Race * PM2.5	0.10* (0.03,0.17)	
Gender		
Male	—	—
Female	-0.20*** (-0.27,-0.13)	0.30 (-0.05,0.65)
Gender * PM2.5		-0.05* (-0.09,-0.02)

Beta (95% confidence intervals)
*p<0.05; **p<0.01; ***p<0.001



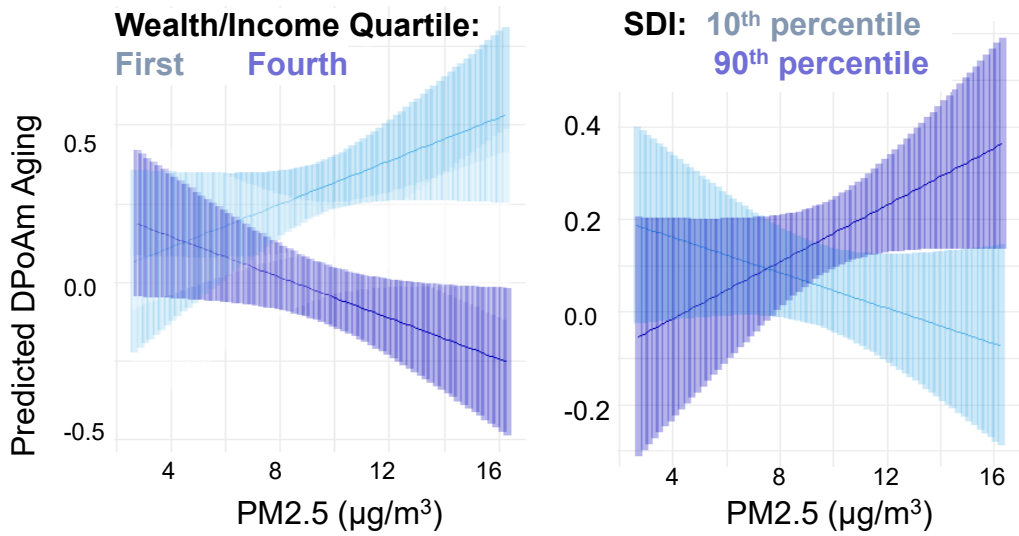


Di Q, et al. 2017 Younan D, et al. 2021 Yannatos, I. In preparation

Individual- and neighborhood-level SES may play a role in PM2.5 vulnerability

	Individual SES	SDI
Race		
White	—	—
Black	0.19** (0.07,0.32)	0.16 (0.03,0.29)
PM2.5	0.03 (-0.01,0.07)	0.01 (-0.01,0.03)
Quartile Wealth/Income		
1	—	—
2	0.23 (-0.30,0.76)	-0.12 (-0.22,-0.01)
3	-0.22 (-0.73,0.29)	-0.24*** (-0.35,-0.13)
4	0.30 (-0.19,0.79)	-0.30*** (-0.42,-0.18)
Quartile Wealth/Income * PM2.5		
2 * PM2.5	-0.04 (-0.09,0.02)	
3 * PM2.5	0.00 (-0.06,0.05)	
4 * PM2.5	-0.07 (-0.12,-0.02)	
Social Deprivation Index		-0.14 (-0.32,0.05)
Social Deprivation Index * PM2.5		0.02 (0.00,0.04)

Beta (95% confidence intervals)
*p<0.05; **p<0.01; ***p<0.001



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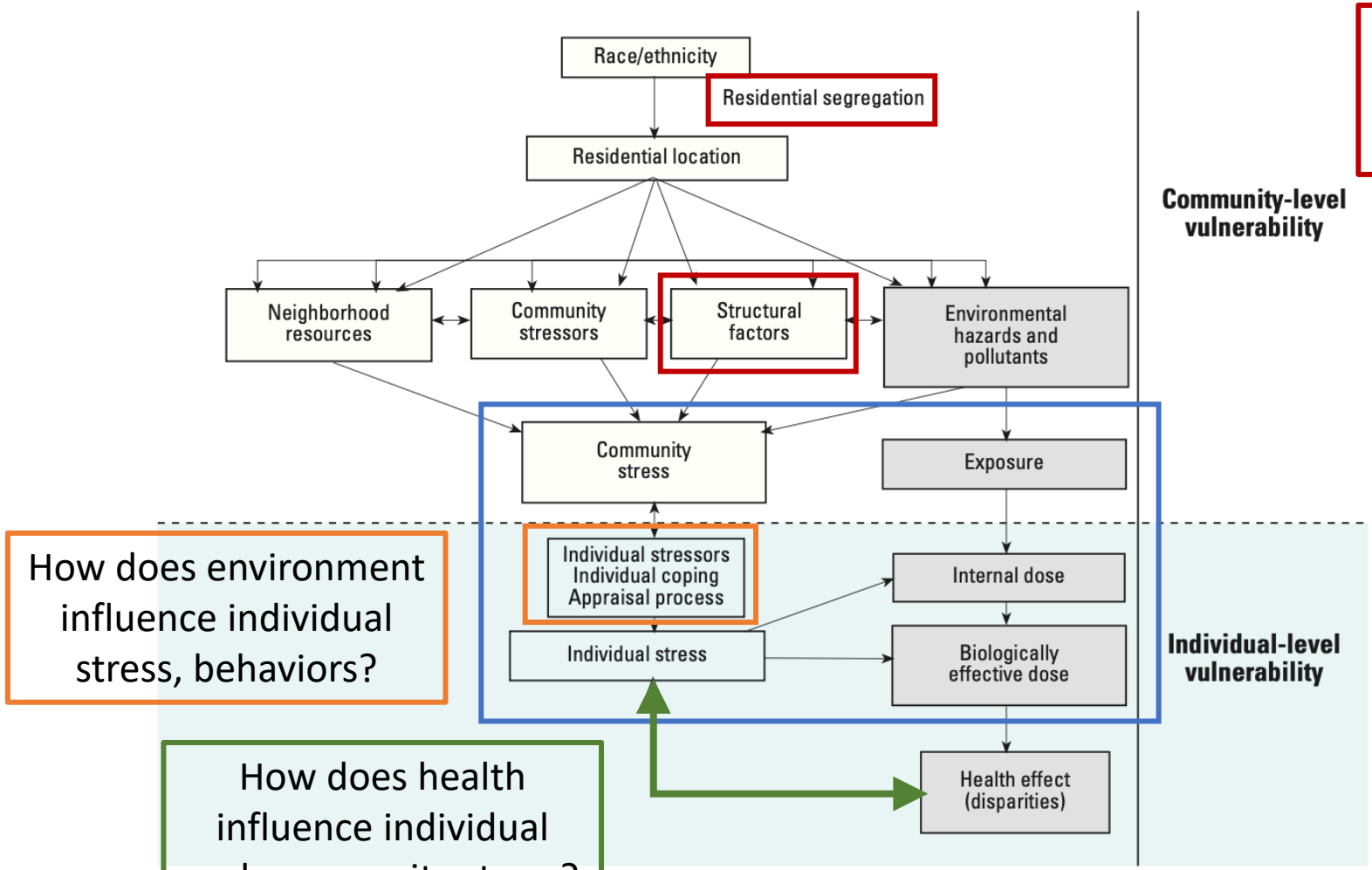
Opportunities

- Use of decomposition to quantify how factors contribute to disparities in biological aging
- Further work to determine which social determinants influence vulnerability to PM2.5 exposure
  - Need for measures of psychosocial stress
- Need for longitudinal data
- Multidisciplinary questions:
  - Which aspects of neighborhood are salient for health?
  - How is the environment translated to health?
  - How does health operate as a resource or stressor?
  - Protective individual and neighborhood factors?

Environmental Health Disparities Framework



Race is a proxy for historical and structural systems
How to measure racism?

How does environment influence individual stress, behaviors?

Which factors influence exposure and vulnerability to pollutants?
Need for psychosocial data to better measure stress

How does health influence individual and community stress?

Causality and life-course: need for longitudinal data

What neighborhood and individual factors are protective?

Gee, GC and Payne-Sturges, DC. "Environmental Health Disparities: A Framework Integrating Psychosocial and Environmental Concepts". 2004