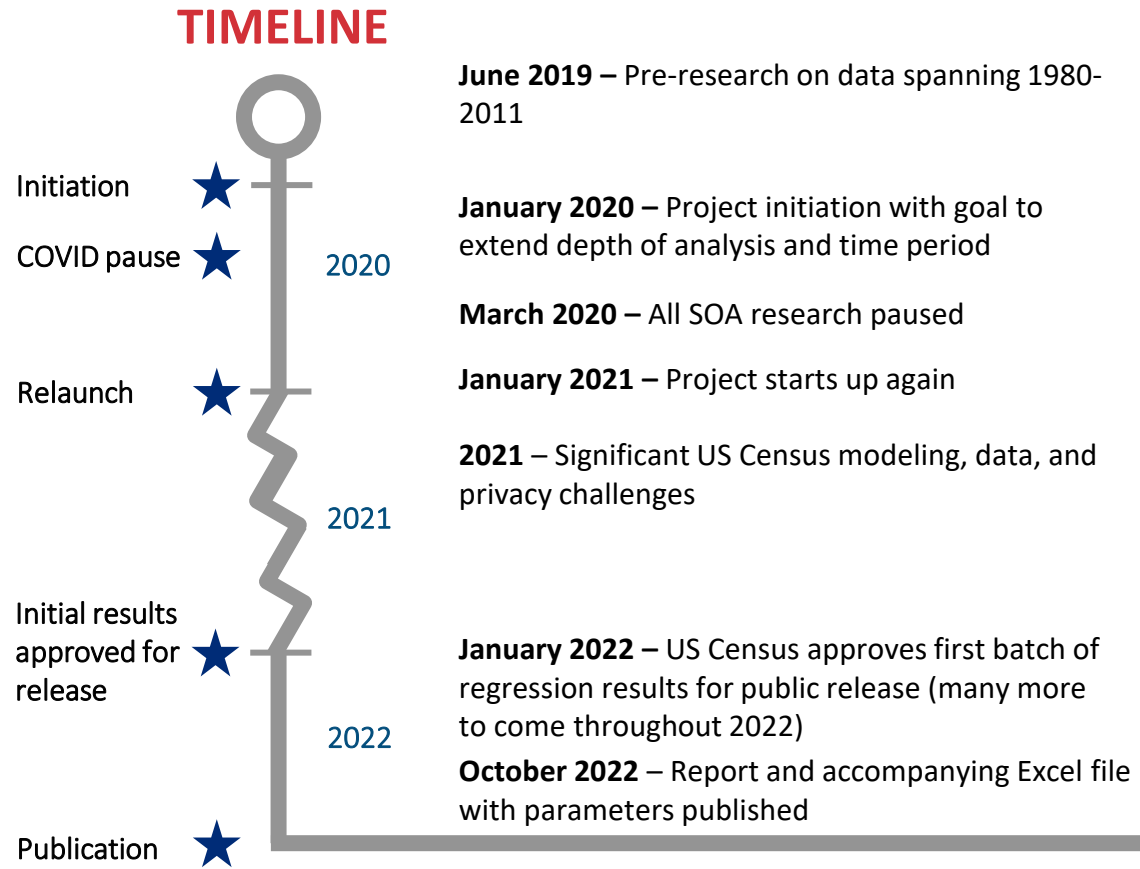


# **MORTALITY IMPROVEMENT TRENDS BY SOCIOECONOMIC DRIVERS**

May 16, 2023  
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# JOURNEY TO PUBLICATION



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**Mortality Improvement Trends**  
SEPTEMBER | 2022

**SOA Research INSTITUTE**

# THESIS: THE LONGEVITY GAP ACROSS SOCIOECONOMIC VARIABLES IS GROWING BUT QUESTIONS REMAIN

1. How does mortality improvement differ across socioeconomic variables?
2. Are these differences changing over time?
3. What are the drivers (i.e., causes of death) for these differences?
4. Are the patterns likely to continue in the future?

Expected explanatory power	Explanatory variables
High	Attained age
	Gender
	Smoker status
	Calendar year regime
	Household income (deciles)
	Education (5 groups)
	Race/Ethnicity (4 groups)
	Employment status
	Marital status
Low	Occupation (5 groups)

# DATA: GENERAL US POPULATION SURVEY-BASED DATA MATCHED WITH DEATH CERTIFICATES INFORMATION

	NLMS <sup>1</sup>	MDAC <sup>2</sup>
<b>Time span of interviews</b>	1980-2011	2008
<b>Maximum follow-up time</b>	11 years from interview	Less than 11 after interview
<b>Time span of mortality data from NCHS</b>	1980-2011	2008-2015
<b>Records</b>	1.26 million	2.28 million
<b>Deaths</b>	193,000	296,000
<b>Person-years of exposure</b>	30 million p-y	35 million p-y
<b>Person Information</b>	Current Population Survey	American Community Survey
<b>Death Information</b>	National Center for Health Statistics	National Center for Health Statistics

Total observation period = 1980-2015 (No COVID-19 experience)

Total deaths = 489,000

1. National Longitudinal Mortality Study (NLMS) - <https://www.census.gov/topics/research/nlms.html>
2. Mortality Disparities in American Communities (MDAC) - <https://www.census.gov/topics/research/mdac.html>

# APPROACH: MULTIPLE REGRESSIONS

- Grouped the data into nine cohorts by entry year into the survey
- Ran a Cox (proportional hazards) regression on each cohort for 5 causes of death
  - All-cause
  - Cancer
  - Heart disease
  - Stroke
  - Pulmonary disease
- Calculated the implied mortality from the regression parameters
- Calculated the mortality improvement between periods

Variables and parameters are linear within the exponential. This allows us to have a baseline set of variables and then change one variable and measure the delta associated with that variable while controlling for other variables.

$$h(t; x_1, x_2, \dots, x_p) = h_0(t) * e^{(B_1x_1+B_2x_2+\dots+B_px_p)}$$

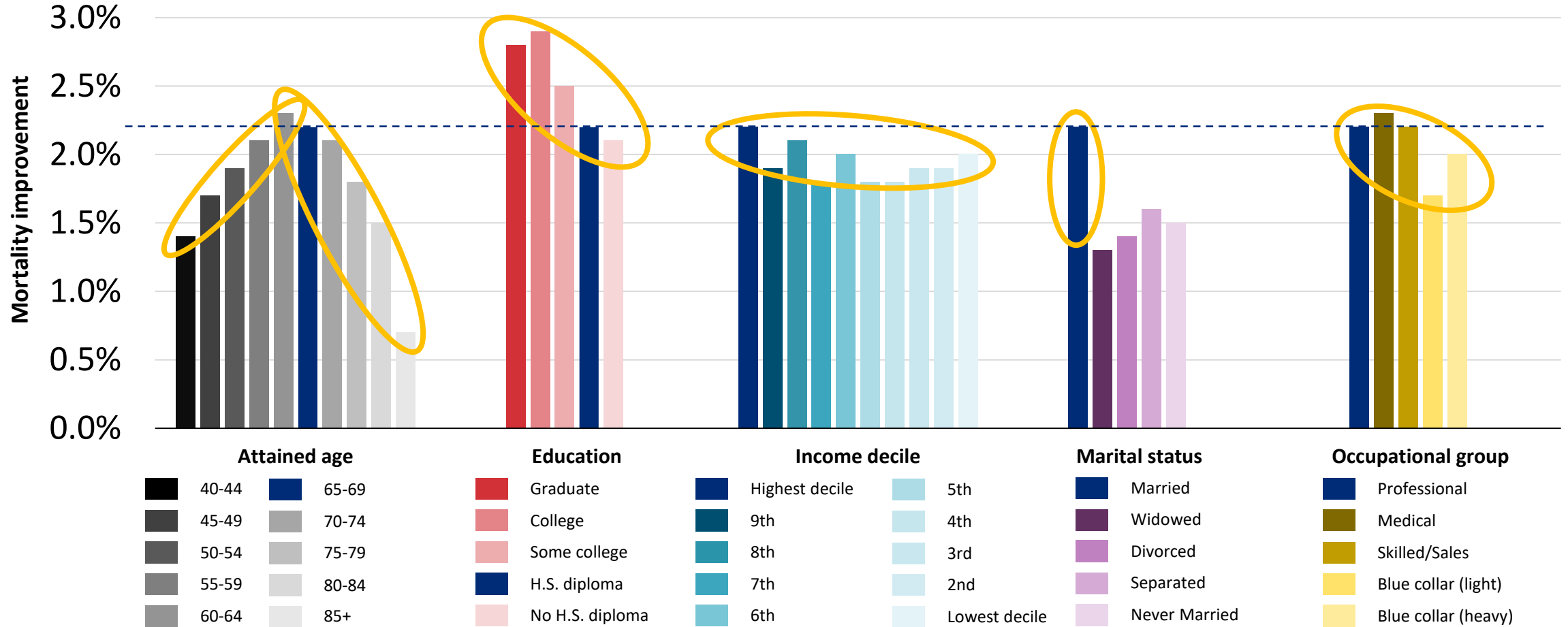
$x_i$  = indicates the presence of an explanatory variable

$h_0(t)$  = baseline hazard rate (all  $x_i = 0$ )

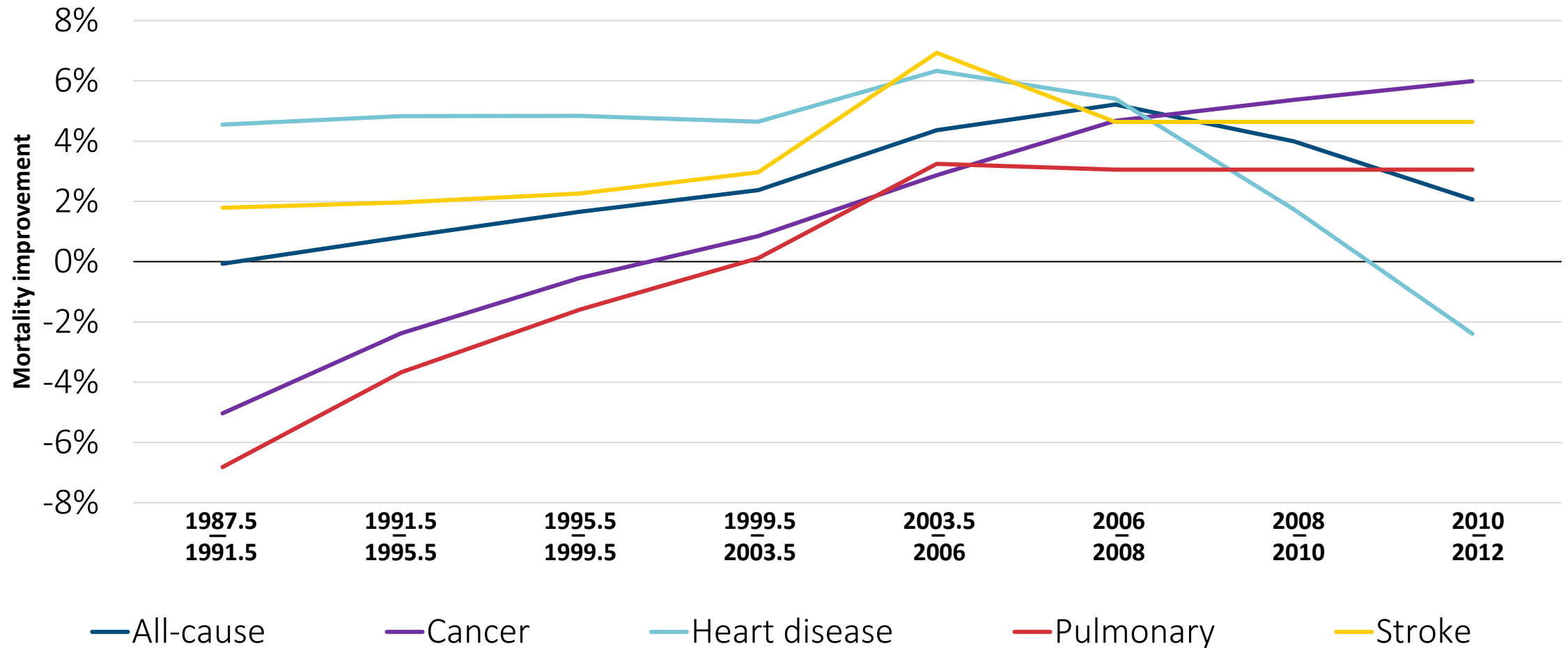
$$q(x_1, x_2, \dots, x_p) = q(means) * \frac{h(t; means)}{h(t; x_1, x_2, \dots, x_p)}$$

41 regressions with 50 parameters each

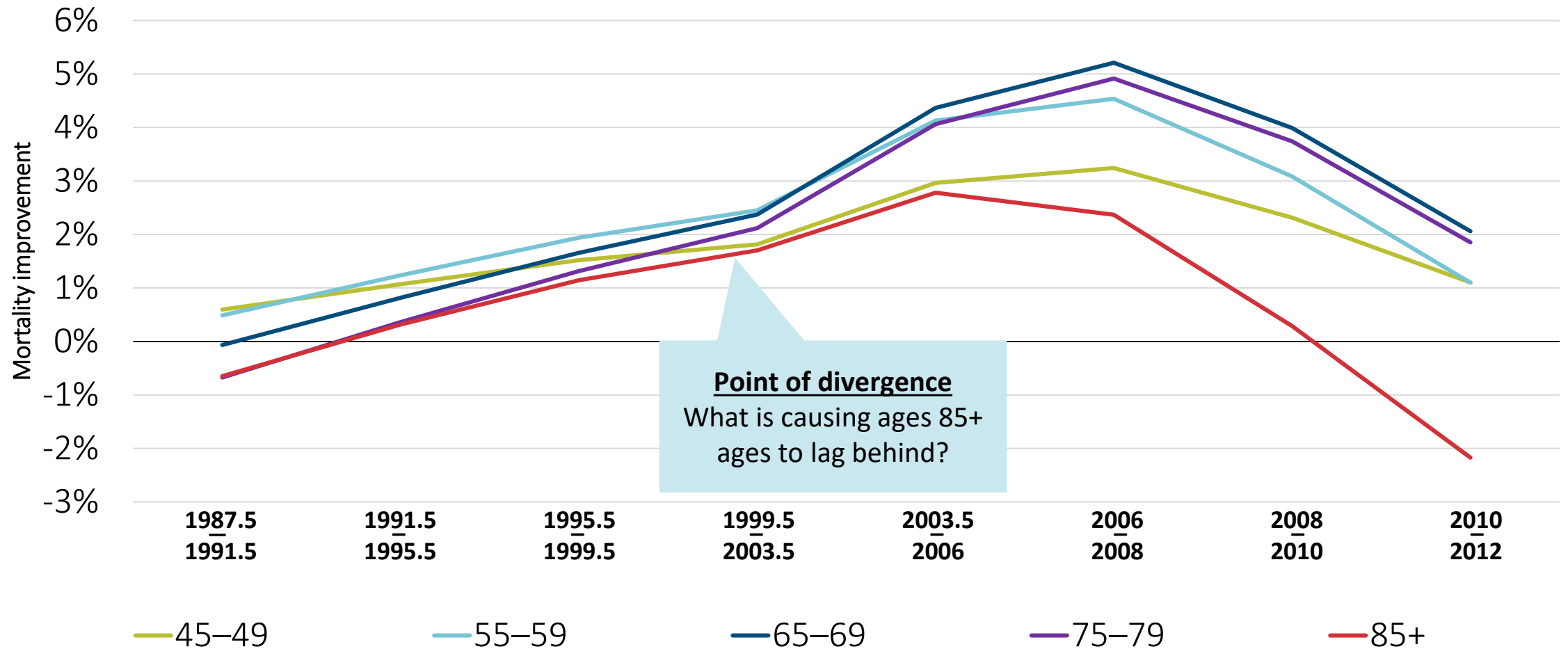
# ANNUALIZED MORTALITY IMPROVEMENT DIFFERENTIALS 1980 TO 2015



# BASELINE RESULTS FOR ALL-CAUSE, CANCER, HEART DISEASE, PULMONARY DISEASE, AND STROKE

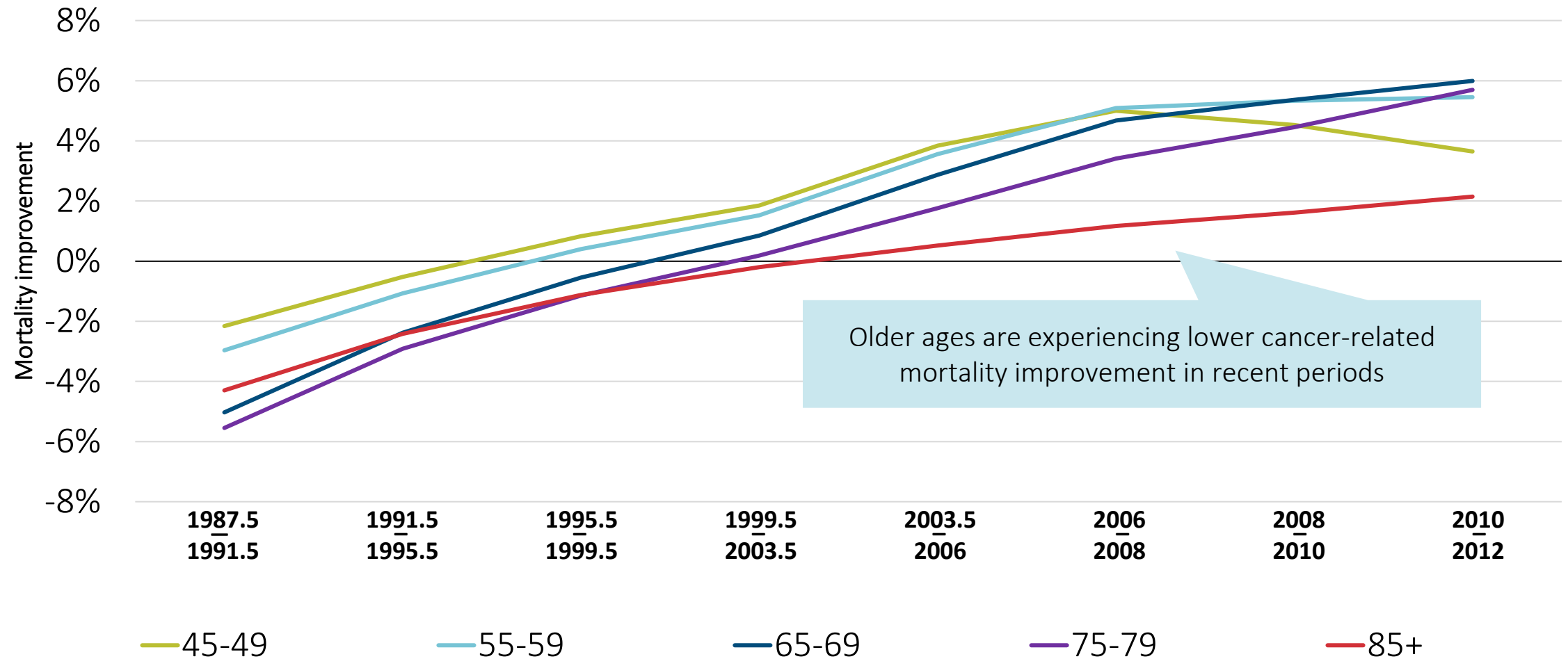


# ATTAINED AGE RESULTS - ALL-CAUSE

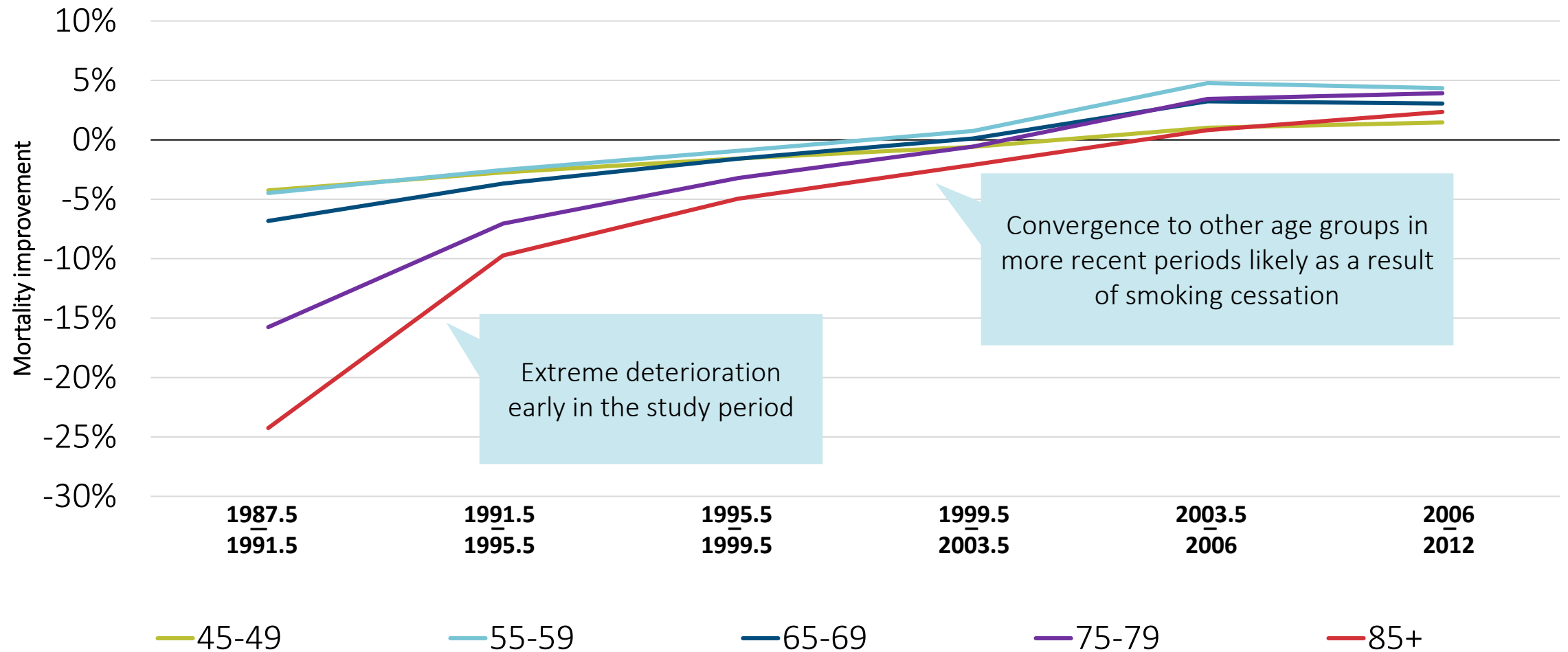




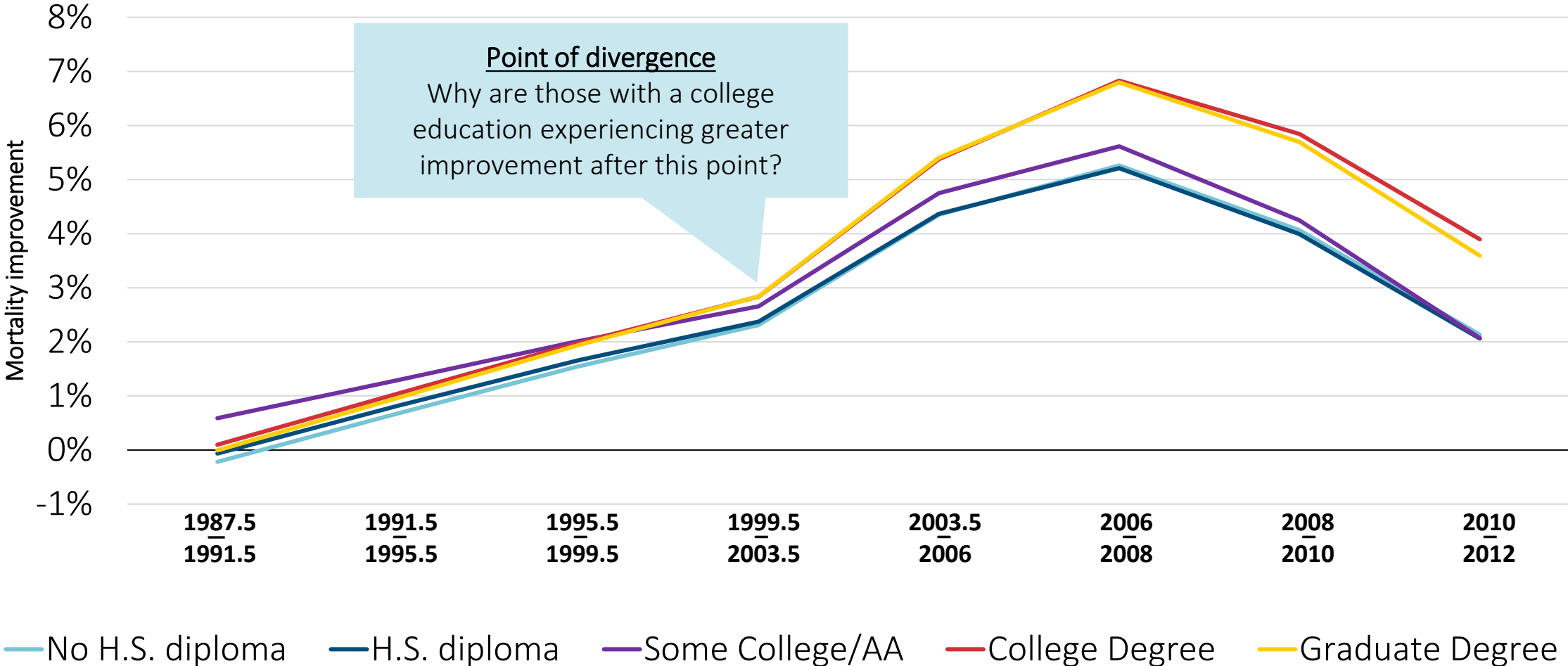
# ATTAINED AGE RESULTS – CANCER



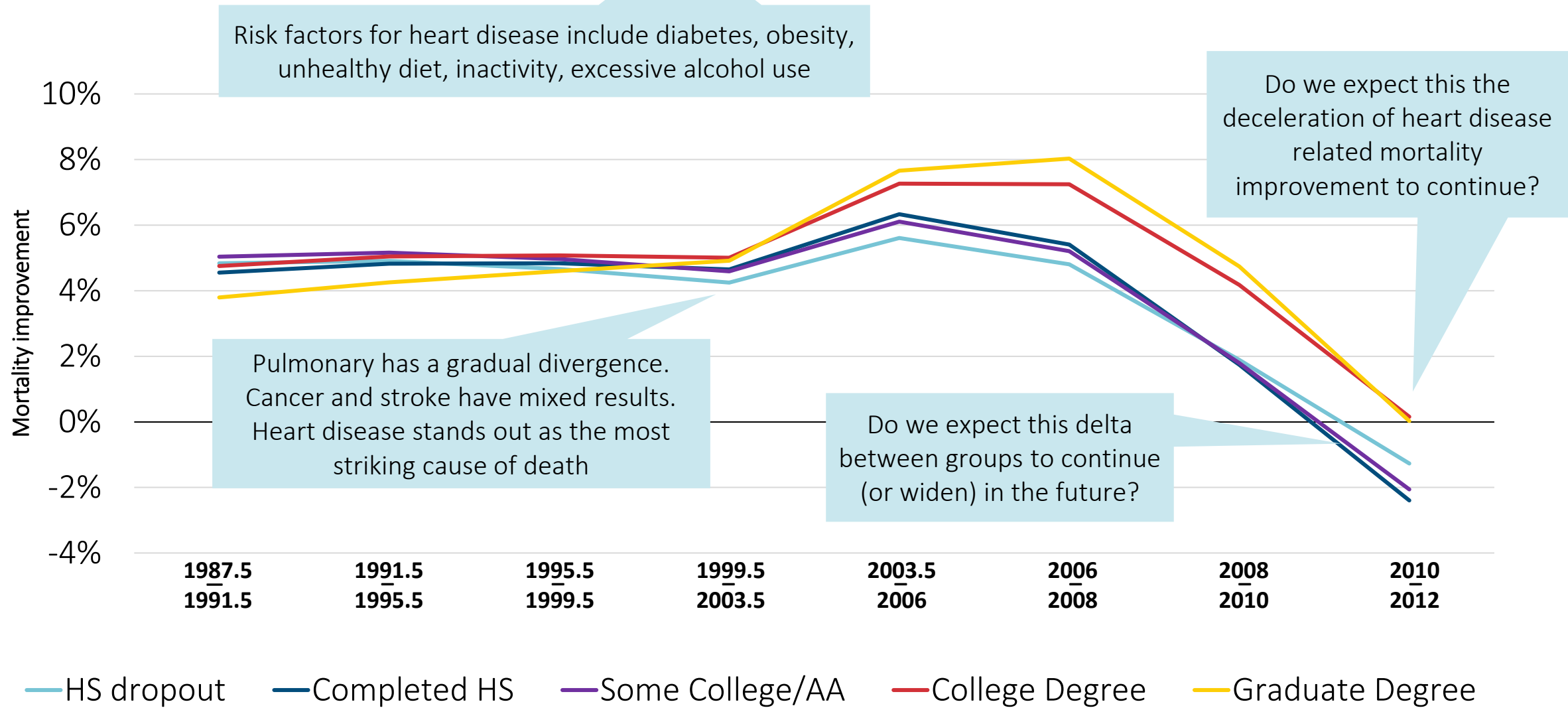
# ATTAINED AGE RESULTS – PULMONARY



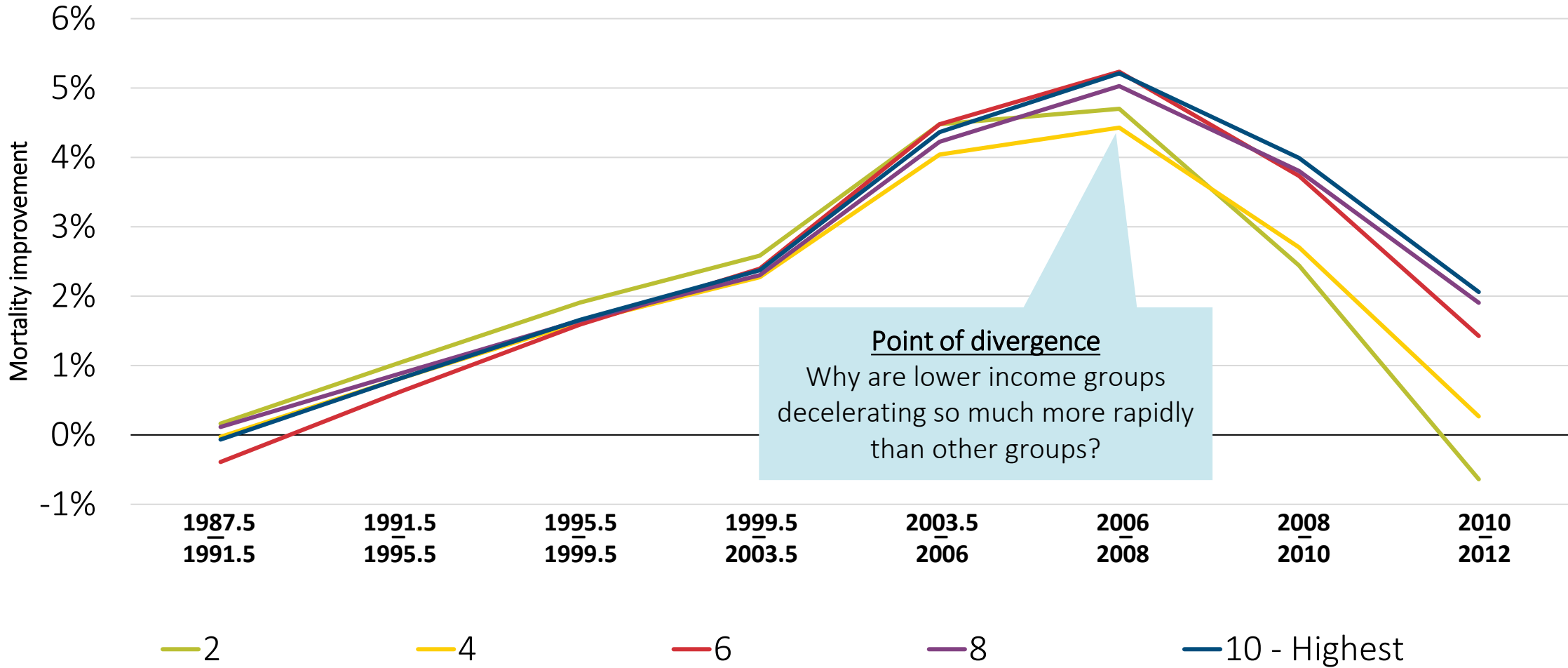
# EDUCATIONAL ATTAINMENT RESULTS – ALL-CAUSE



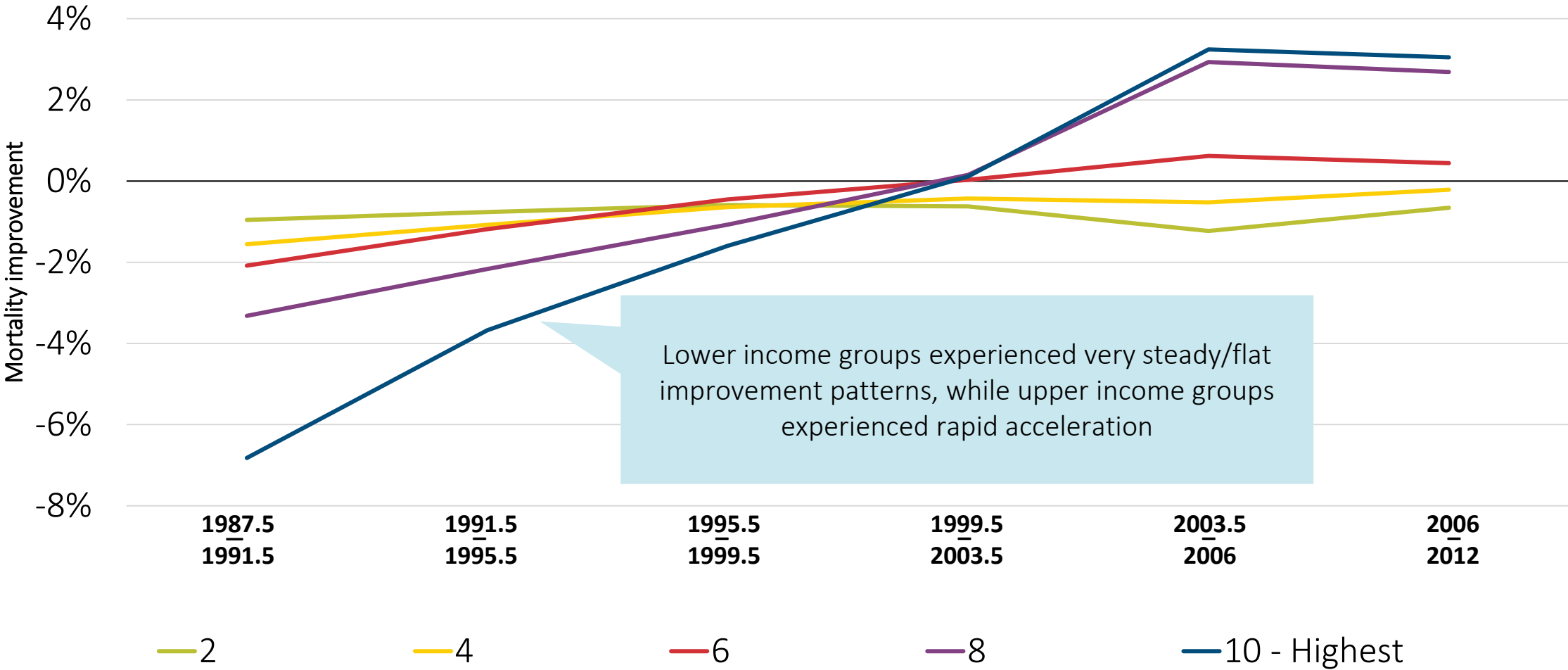
# EDUCATIONAL ATTAINMENT RESULTS - HEART



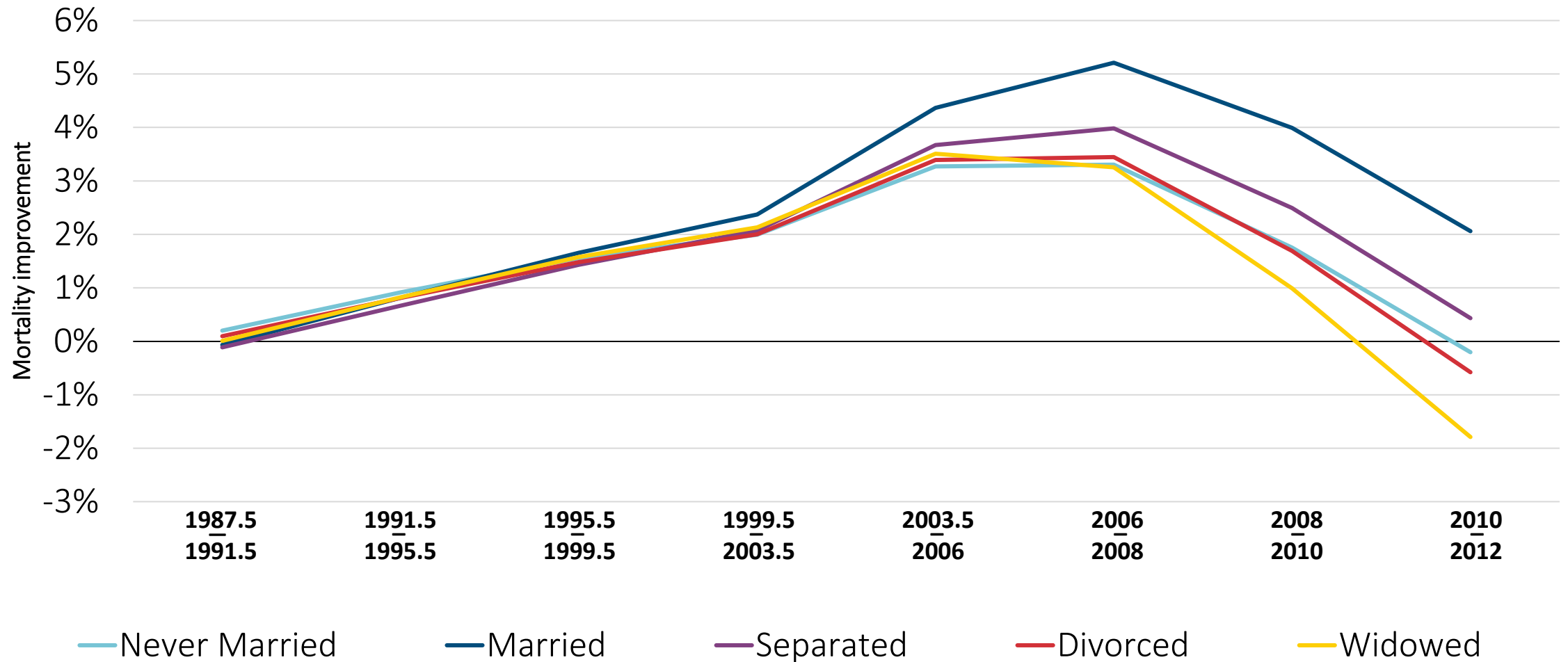
# INCOME DECILE RESULTS - ALL-CAUSE



# INCOME DECILE RESULTS - PULMONARY

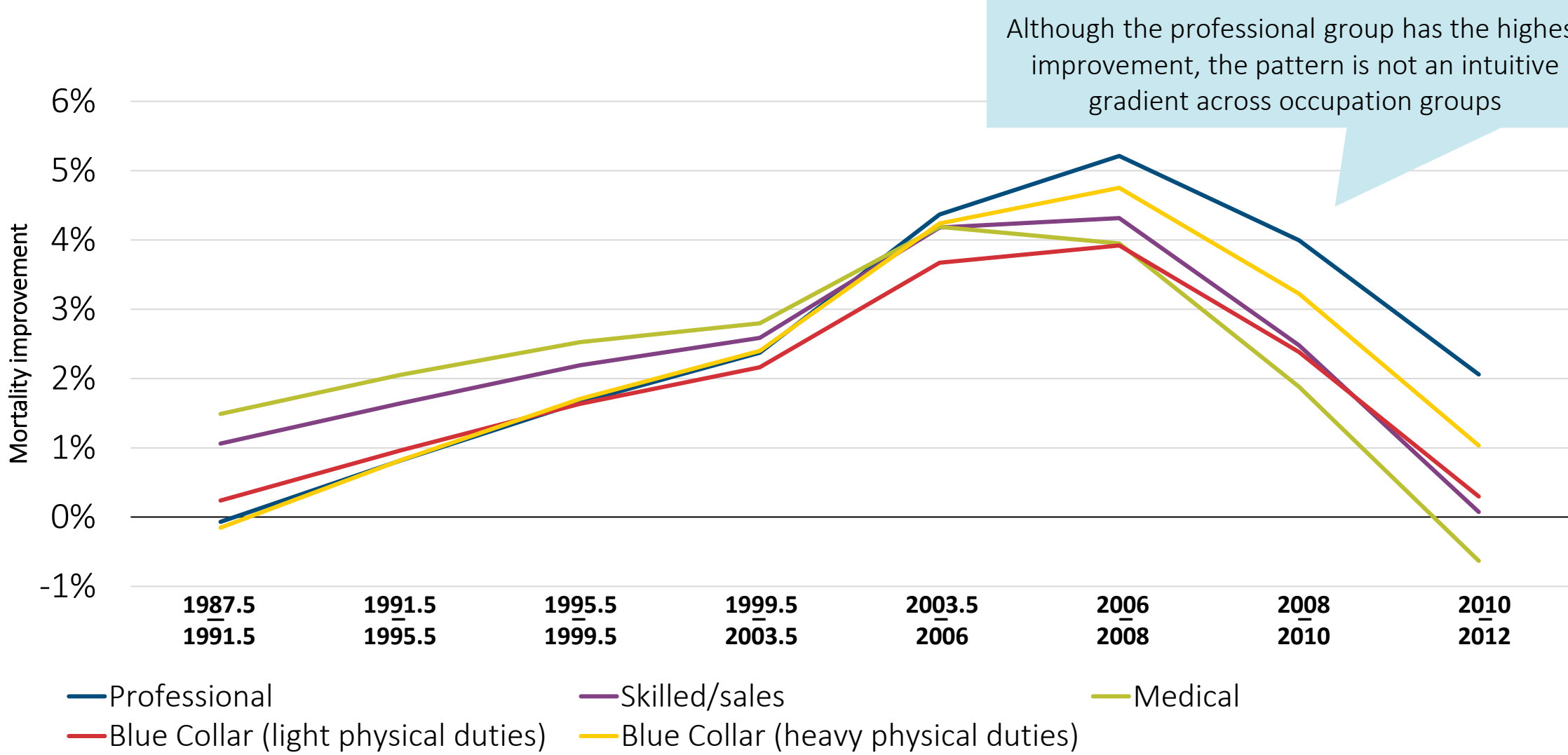


# MARITAL STATUS RESULTS - ALL-CAUSE



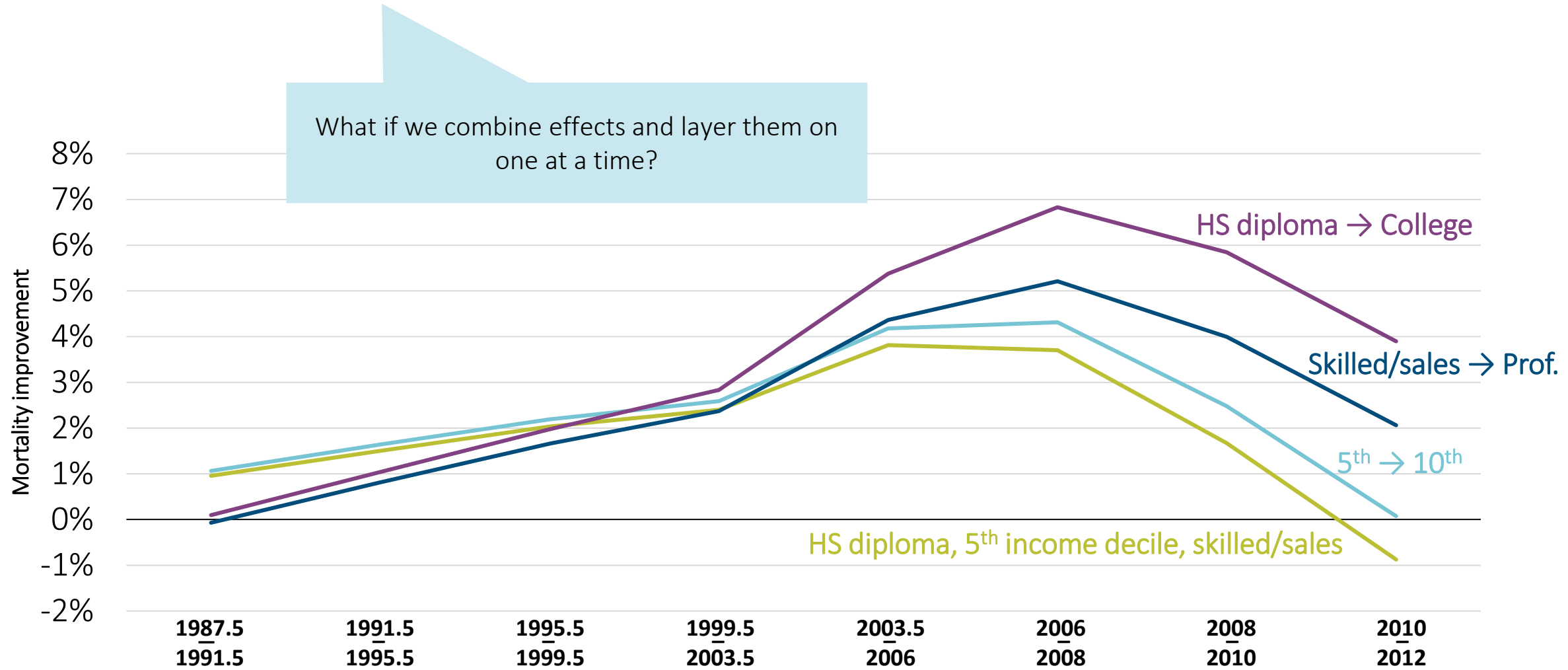
# OCCUPATION RESULTS - ALL-CAUSE

Although the professional group has the highest improvement, the pattern is not an intuitive gradient across occupation groups





# APPLICATION FOR PRACTITIONERS – ALL-CAUSE



# FOR MORE INFORMATION:

<https://www.soa.org/resources/research-reports/2022/mortality-improvement-trends/>

- Report
- Parameter Excel file
- Smoothing dynamic link library (.dll)



User input	
Sex	Male
Smoker Status	Not Asked
Income Decile	10
Education	High School diploma
Race/Ethnicity	White Non-Hispanic
Employment Status	Employed
Marital Status	Married
Occupation	Professional
Cause of Death	All cause

Users can select input values and observe the resulting improvement values based on regression results



Also included are confidence intervals, death counts, and parameters provided by the US Census

Any opinions and conclusions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. The statistical summaries reported in this document have been cleared by the Census Bureau's Disclosure Review Board release authorization numbers CBDRB-FY22-CES004-012, CBDRB-FY22-CES004-014, CBDRB-FY22-CES004-015, CBDRB-FY22-CES004-016, CBDRB-FY22-CES004-037, and CBDRB-FY22-CES004-038.

Mortality improvement	1987.5-1991.5	1991.5-1995.5	1995.5-1999.5	1999.5-2003.5	2003.5-2006	2006-2008	2008-2010	2010-2012
40-44	0.31%	0.86%	1.34%	1.63%	2.64%	2.87%	2.03%	1.01%
45-49	0.60%	1.07%	1.52%	1.82%	2.96%	3.24%	2.31%	1.10%
50-54	0.83%	1.44%	2.00%	2.37%	3.74%	3.71%	1.95%	-0.27%
55-59	0.49%	1.24%	1.94%	2.45%	4.13%	4.54%	3.09%	1.10%
60-64	0.58%	1.35%	2.11%	2.69%	4.59%	5.04%	3.31%	0.87%
65-69	-0.07%	0.81%	1.66%	2.37%	4.37%	5.21%	3.99%	2.06%
70-74	-0.47%	0.49%	1.38%	2.14%	4.14%	5.31%	4.69%	3.52%
75-79	-0.67%	0.36%	1.31%	2.12%	4.06%	4.92%	3.74%	1.85%
80-84	-0.97%	0.21%	1.24%	2.05%	3.87%	4.43%	2.89%	0.63%
85+	-0.65%	0.31%	1.15%	1.70%	2.78%	2.37%	0.29%	-2.17%

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