Session 113: Mortality Gaps by Socioeconomic Status

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SOA Presentation Disclaimer

Session 113 – Mortality Gaps by Socio-economic Status

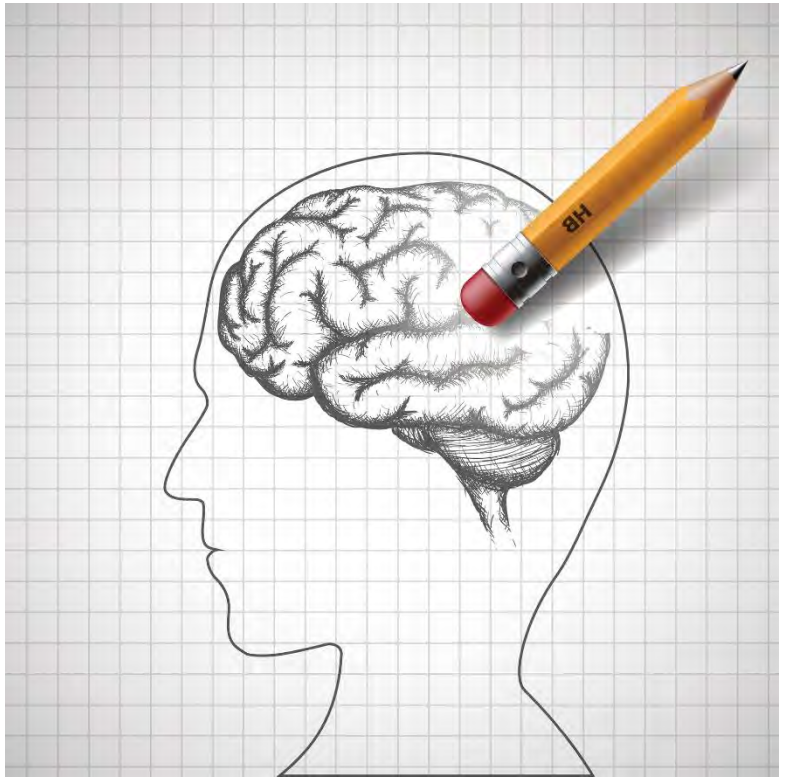
Some scene-setting thoughts

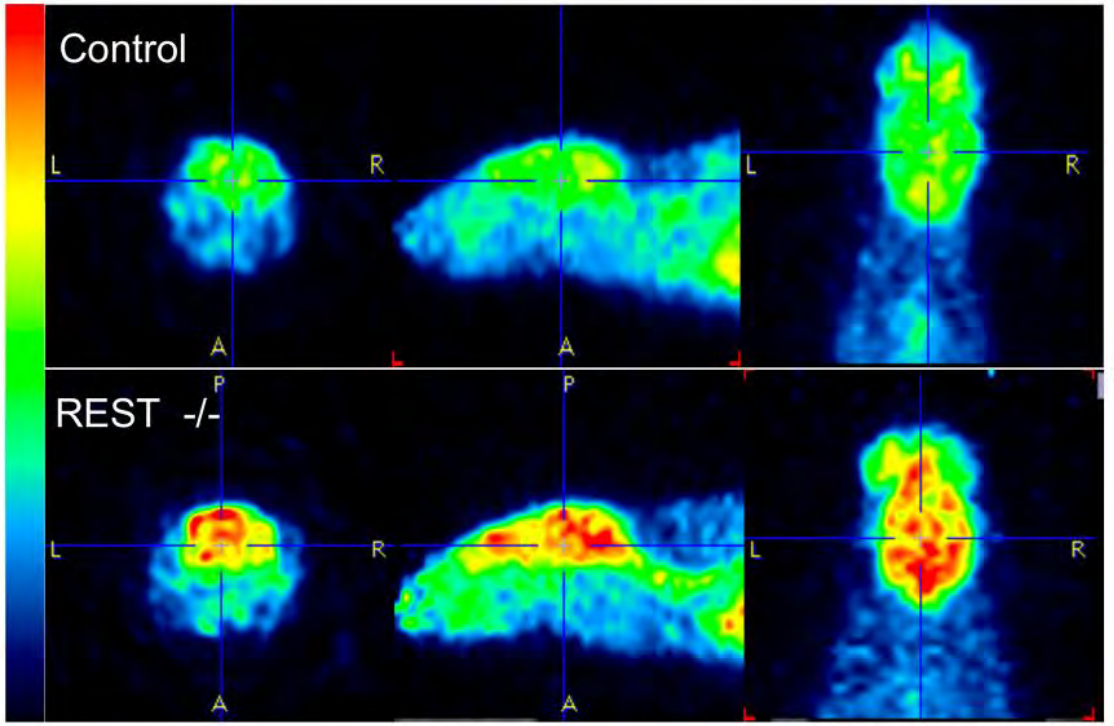
Steven Baxter

October 29, 2019

Apologies…

This talk may impact your longevity…





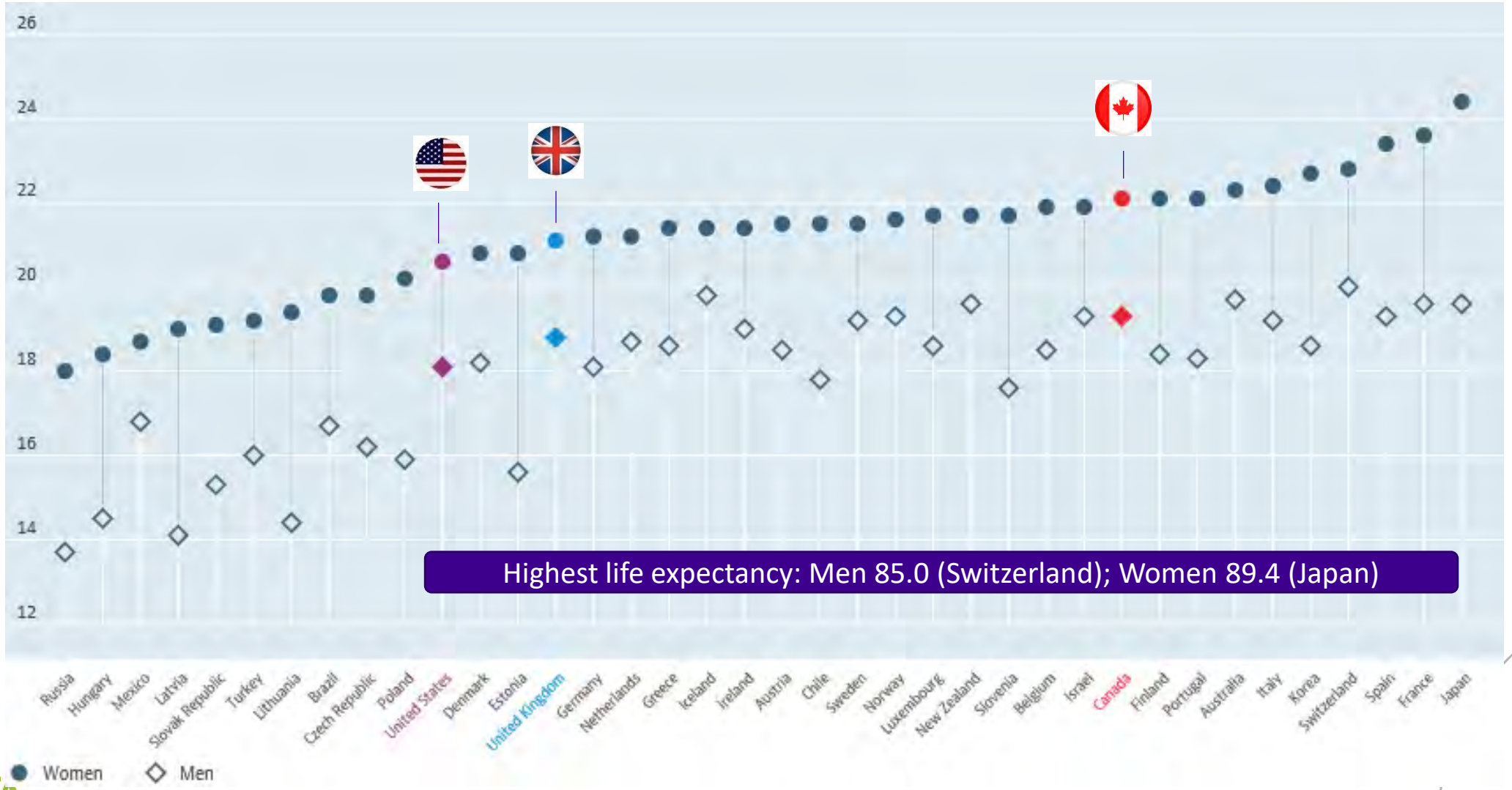
Mice lacking the protein REST (bottom) showed much higher neural activity in the brain (red) than normal mice (top). Image: Yankner Lab/Nature

Source: https://hms.harvard.edu/news/new-player-human-aging

Current longevity (“Baseline”)
Socio-economic variations

International longevity comparisons

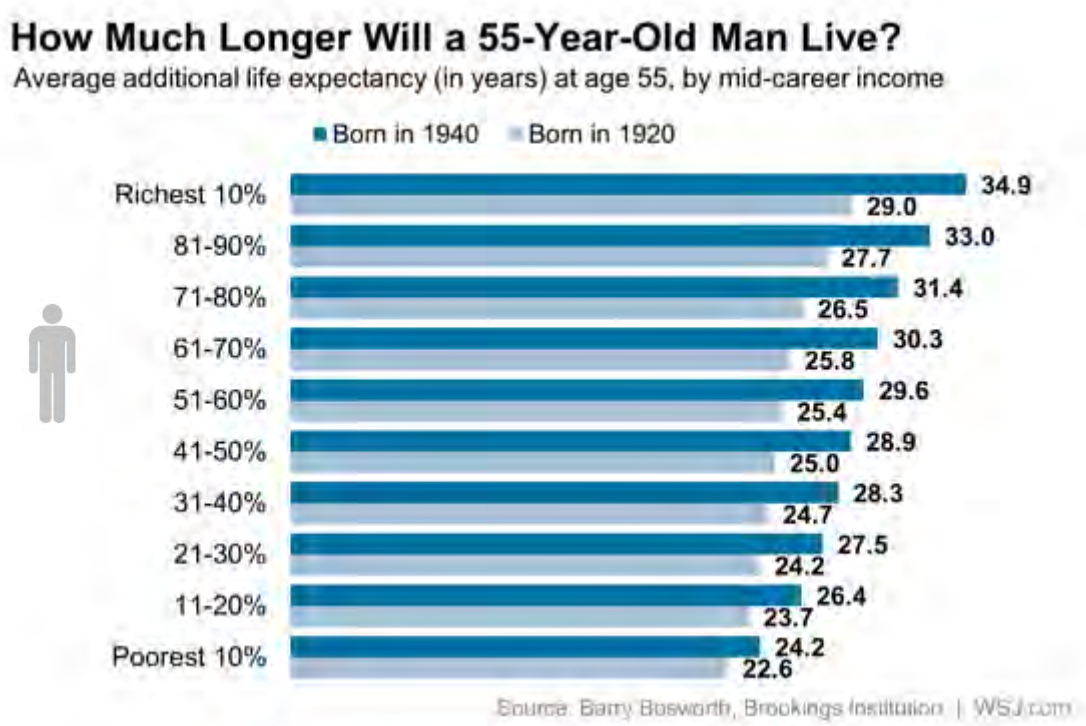
Life expectancy from age 65, OECD countries

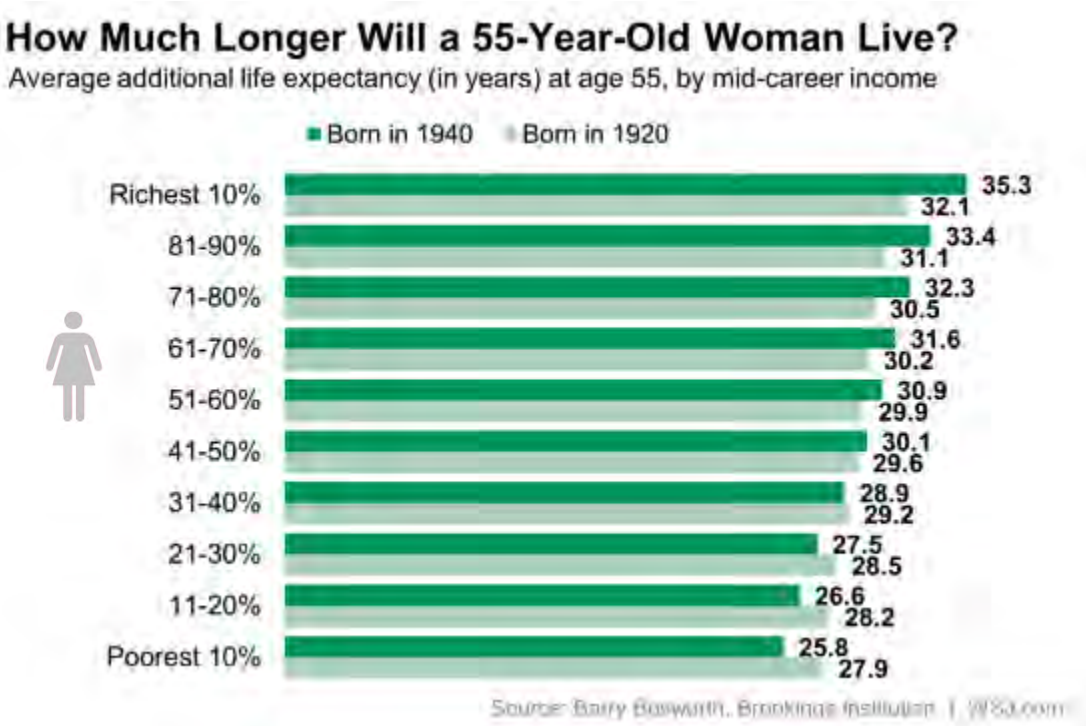


Source: OECD Data, 2017 or latest available (https://data.oecd.org/healthstat/life-expectancy-at-65.htm)

"The Richer You Are the Older You'll Get"

Wall Street Journal; Apr 18, 2014





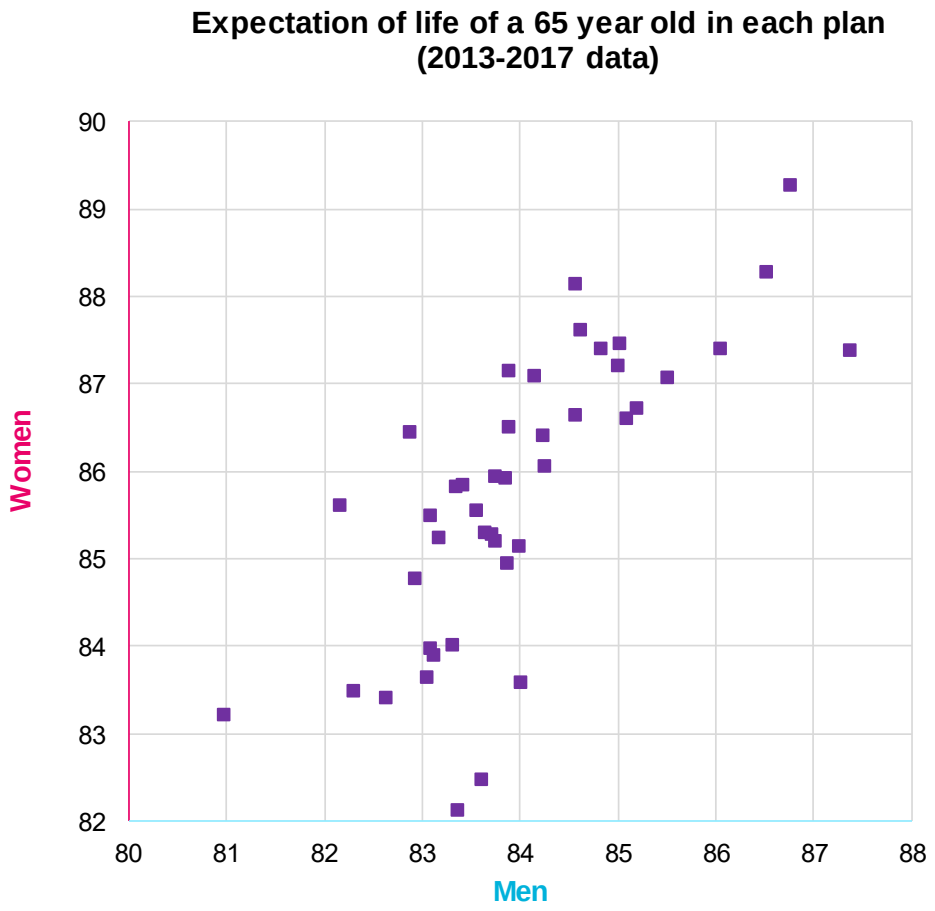
Socio-economic differences associated with **clear** and **widening** longevity gaps in the US

The US is not alone: Countries with higher Gini coefficient tend to have higher longevity inequality

Source: Graphics from https://blogs.wsj.com/economics/2014/04/18/the-richer-you-are-the-older-youll-get/

Not all pension plans are alike…

Source: Club Vita analysis of experience data from over 200 UK pension plans. Life expectancies calculated on a period basis and only shown for plans with sufficient data (volume and span of ages) to enable calculation of period life expectancy



Source: Club Vita analysis of experience data from over 100 US pension plans. Life expectancies calculated on a period basis and only shown for plans with sufficient data (volume and span of ages) to enable calculation of period life expectancy

CLUB VITA

…not all pension plan participants are alike

Men, life expectancy from age 65 based on socio-economic "factor" modelling

Total Spread	10.4 years	7.1 years	8.7 years
Retirement health	2½ - 3 years		
"Normal" health annuitants	8 years	6.7 years	7.7 years
Lifestyle	c. 4¼ years	c. 2¾ years	c. 3¼ years
Affluence	c. 3½ years	c. 2 years	c. 3¼ years
Occupation	c. ¼ year	c. 1¼ year	c. 1¼ year

Club Vita factor based modelling based upon data from over 100 US pension plans. Effects shown are the impact of changing one rating factor in isolation. Precise impacts depend on order of changing variables and so above reflects broad quantum and therefore relative importance of each variable. In practice a more affluent person will tend to have greater propensity to a healthier lifestyle and so do not reflect the impact as measured on a univariate basis. Estimate for impact of retirement health is omitted for Canada and US as currently the ill health / disabled retiree group not spit out by additional rating factors.

…not all pension plan participants are alike

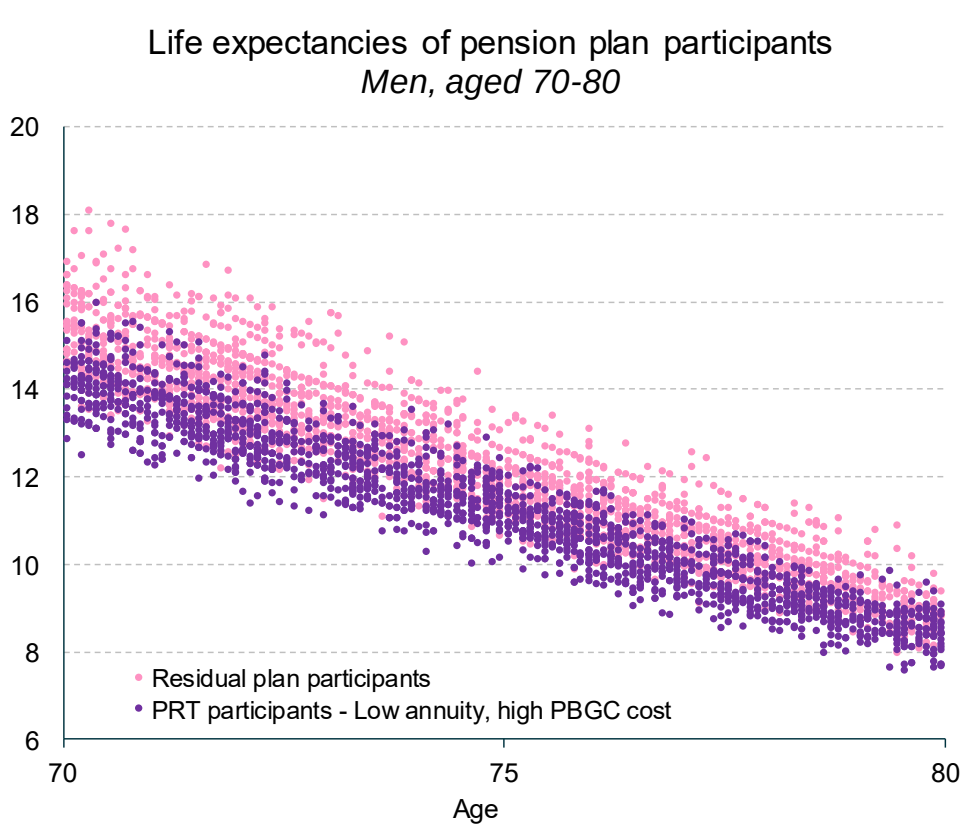
Women, life expectancy from age 65 based on socio-economic "factor" modelling

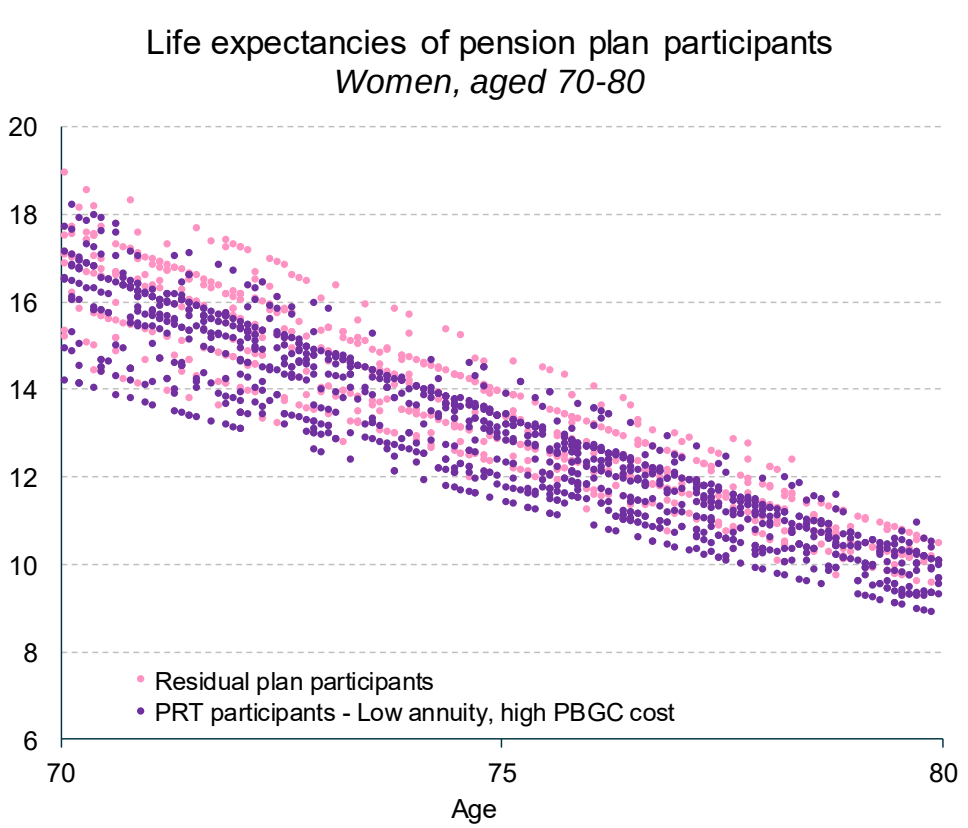
Total Spread	8.7 years	7.5 years	6.8 years
Retirement health	c. 3 years		
"Normal" health annuitants	5.7 years	5.7 years	5.9 years
Lifestyle	c. 4½ years	c. 3½ years	c. 3½ years
Affluence	c. ½ year	c. 2½ years	c. 1½ years
Occupation	c. ½ year		c. 1 year

Club Vita factor based modelling based upon data from over 100 US pension plans. Effects shown are the impact of changing one rating factor in isolation. Precise impacts depend on order of changing variables and so above reflects broad quantum and therefore relative importance of each variable. In practice a more affluent person will tend to have greater propensity to a healthier lifestyle and so do not reflect the impact as measured on a univariate basis. Estimate for impact of retirement health is omitted for Canada and US as currently the ill health / disabled retiree group not spit out by additional rating factors.

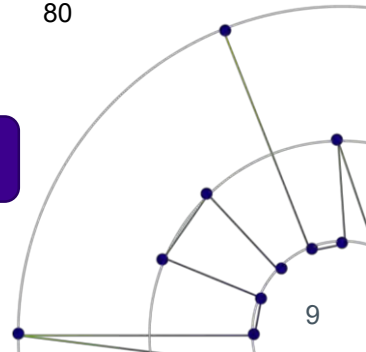
Why does this matter?

A PRT case study





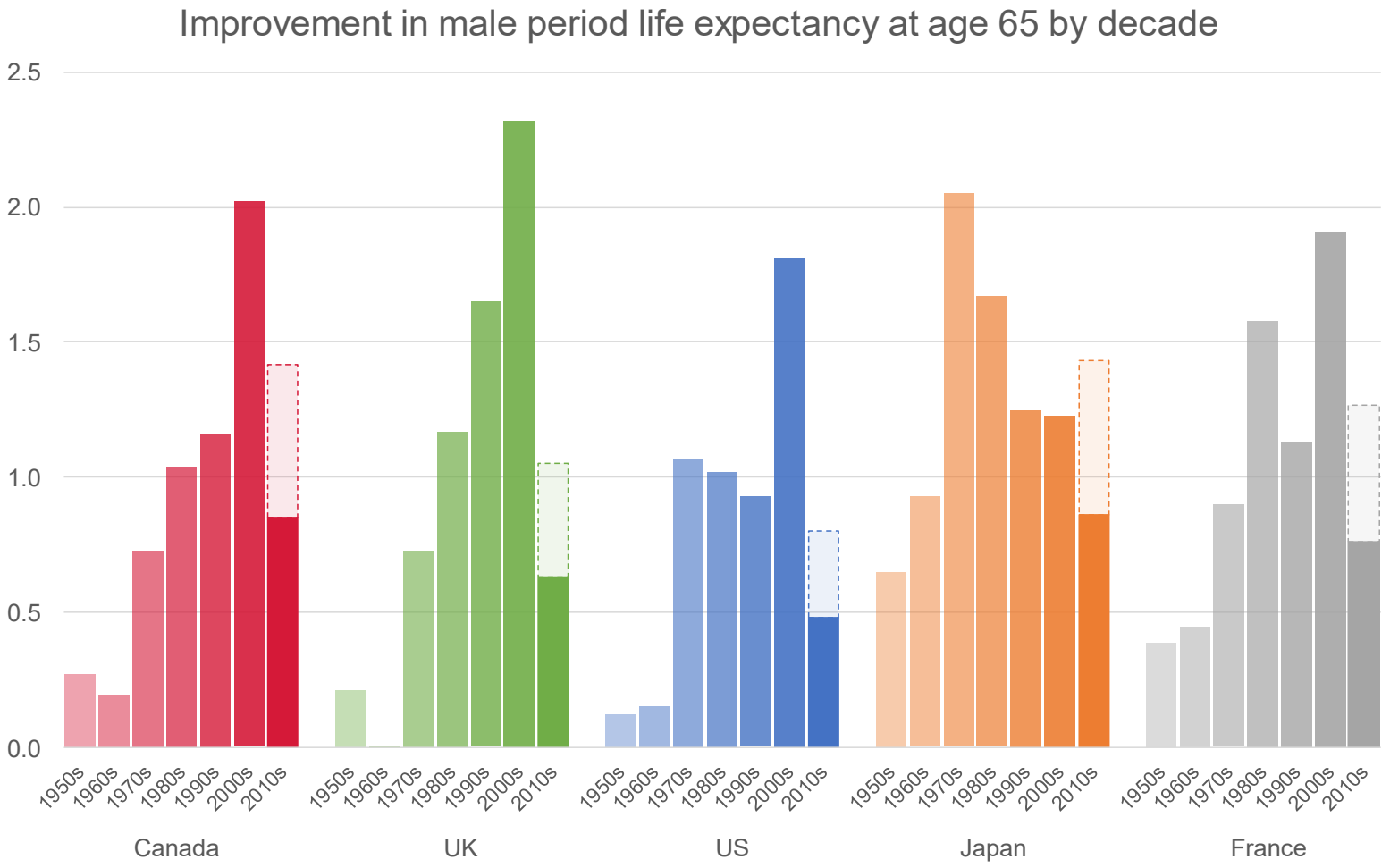
Understanding the socio-economics of modest annuity participants key to efficient risk transfer



Mortality Improvement
International and socio-economic variations

International mortality improvements

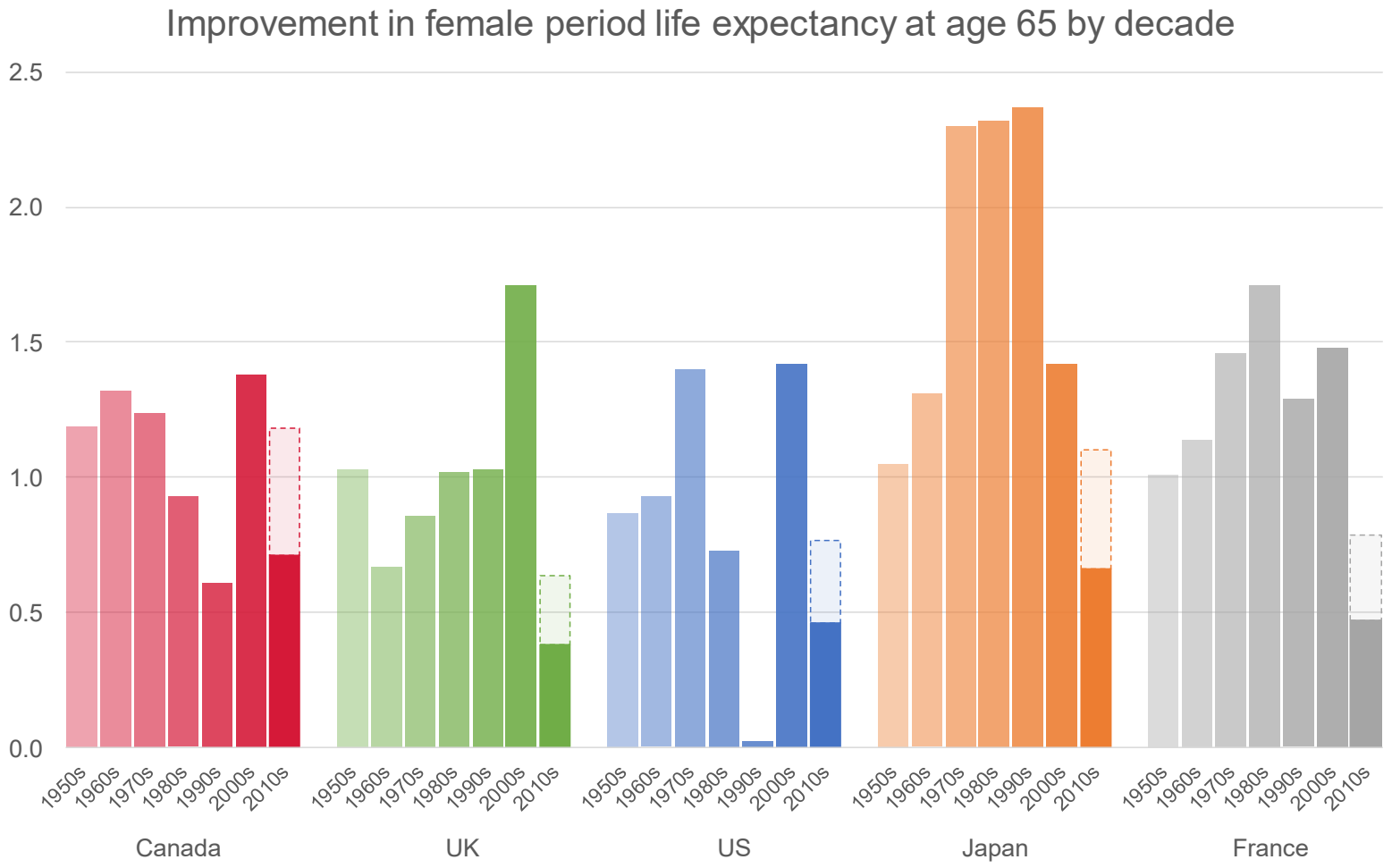
Men, life expectancy from 65



Notes: Club Vita calculations based on period life expectancies from the Human Mortality Database (www.mortality.org).
Lightly shaded area for the 2010s represents the estimated improvement for the decade based on extrapolating the experience over 2010 to 2016.

International mortality improvements

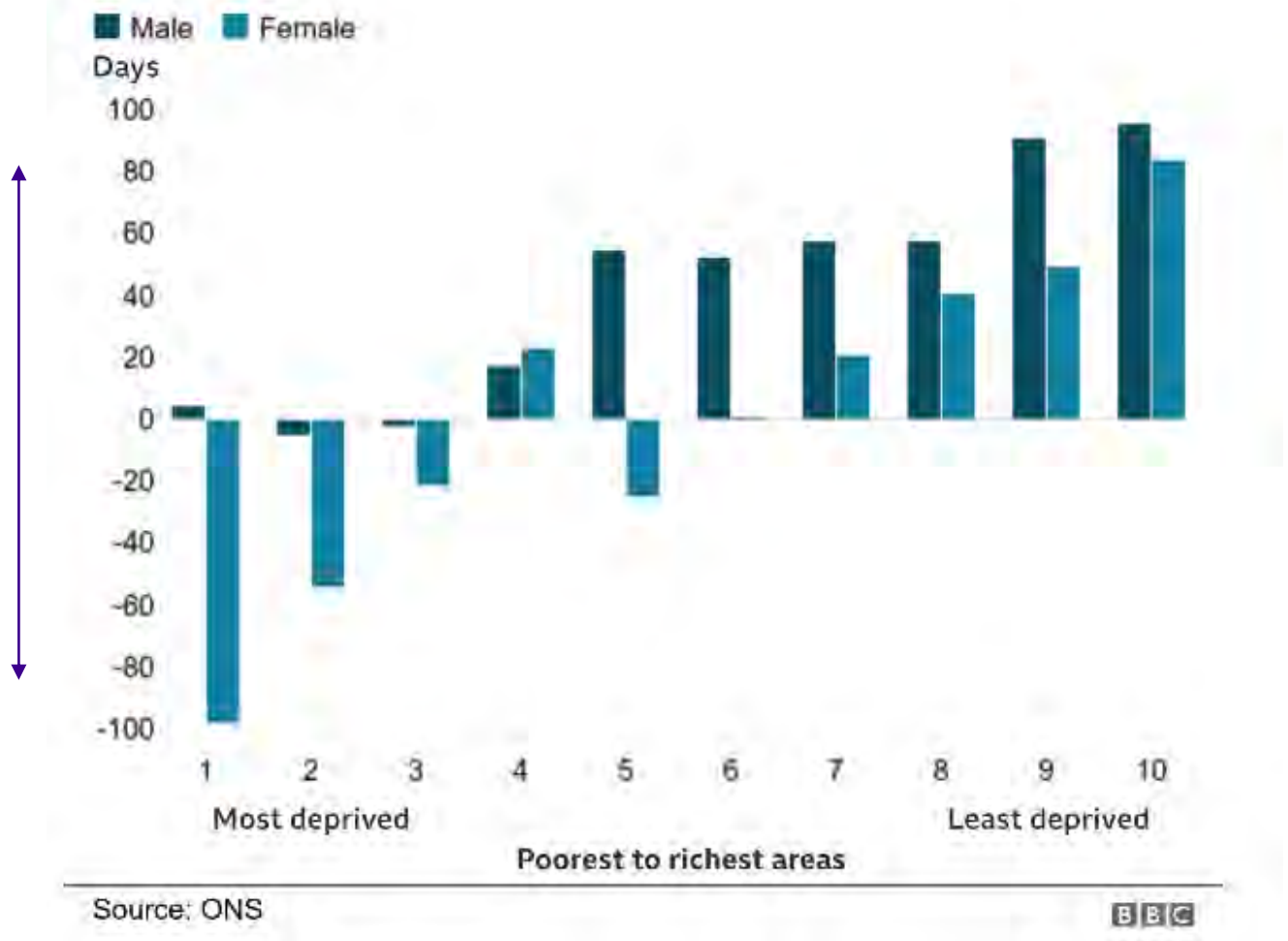
Women, life expectancy from 65



Notes: Club Vita calculations based on period life expectancies from the Human Mortality Database (www.mortality.org).
Lightly shaded area for the 2010s represents the estimated improvement for the decade based on extrapolating the experience over 2010 to 2016.

UK: Social inequality in longevity improvements

Change in life expectancy between 2012-2014 and 2015-2017



Longevity gap widened by

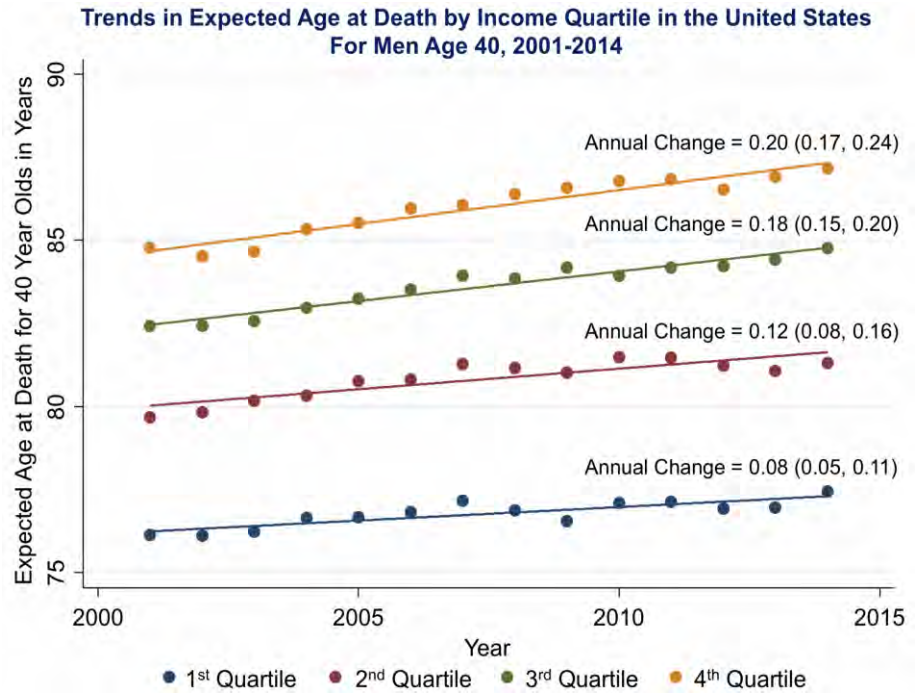
3 months

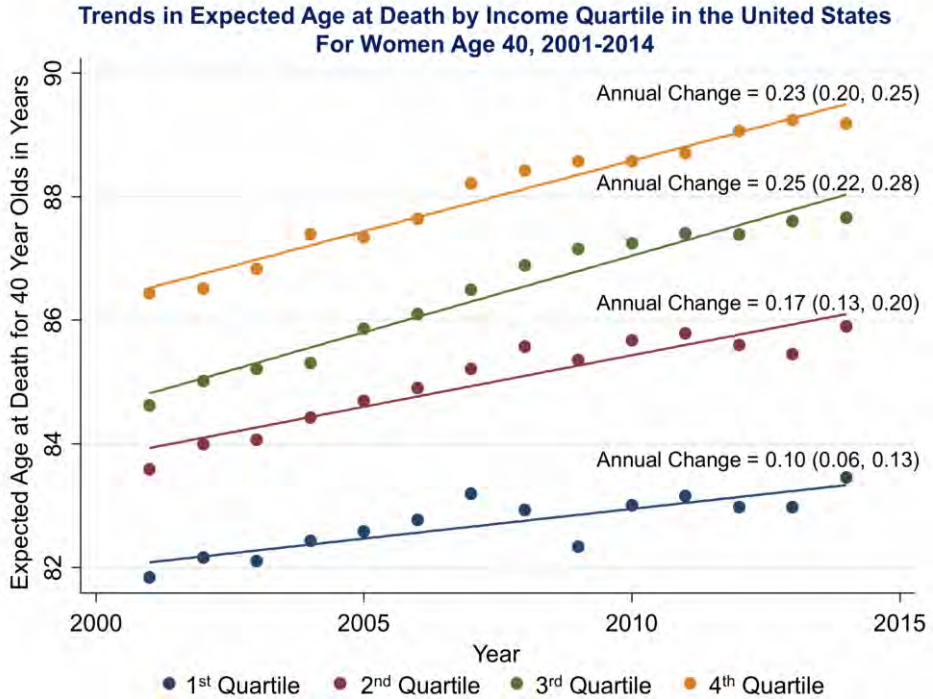
6 months

Source: BBC News version (https://www.bbc.co.uk/news/health-47721167) of ONS data analysis published on 27 March 2019
https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthinequalities/bulletins/healthstatelifeexpectanciesbyindexofmultipledeprivationimd/2015to2017

US: Widening gap between high and low income

Race adjusted life expectancy by income-quartile at age 40





Life expectancy increasing **6 weeks p.a. faster** amongst highest vs lowest income quartile

Source: Chetty et al, "The association between income and life expectancy in the United States, 2001-2014"
https://healthinequality.org/documents/paper/healthineq_slides.pdf

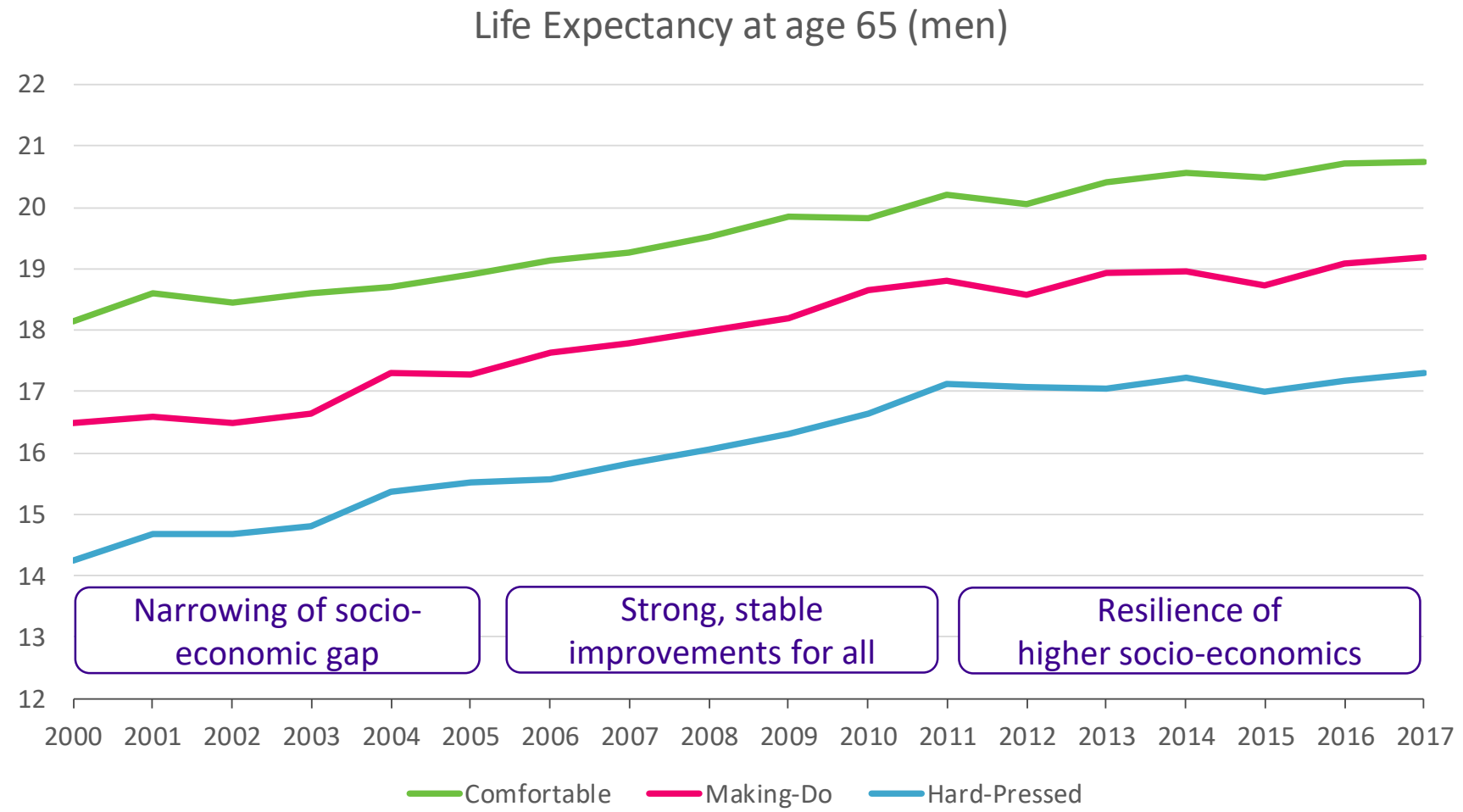
A "wave-based" phenomena?

UK periods of convergence and divergence

~ higher incomes

~ everyone else

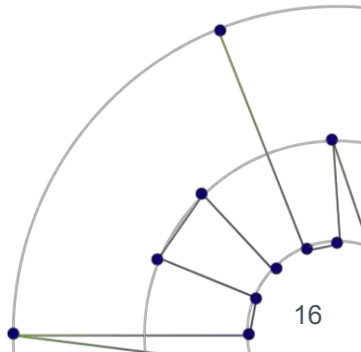
~ live in most deprived areas



Source: Club Vita UK

Concluding remarks…

- Socio-economic differences can be material
  - Impact plan participant valuations by 25%+
- Pension plans have a select bias
  - Typical wide mix of participants, but with
  - Concentrations of liability exposure amongst the more affluent socio-economic groups
- Mortality improvements internationally show socio-economic variations



Thank you

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Socioeconomic Segmentation in Cause of Death

SOA Annual Meeting, October 29, 2019
Dr. Donald Sampson, Ph.D. – Munich Re US Life

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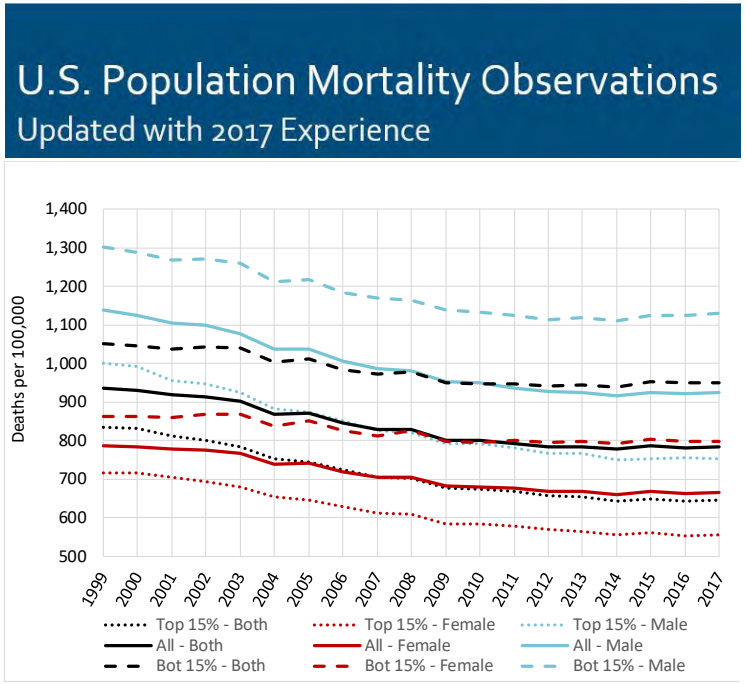
Socioeconomic Segmentation

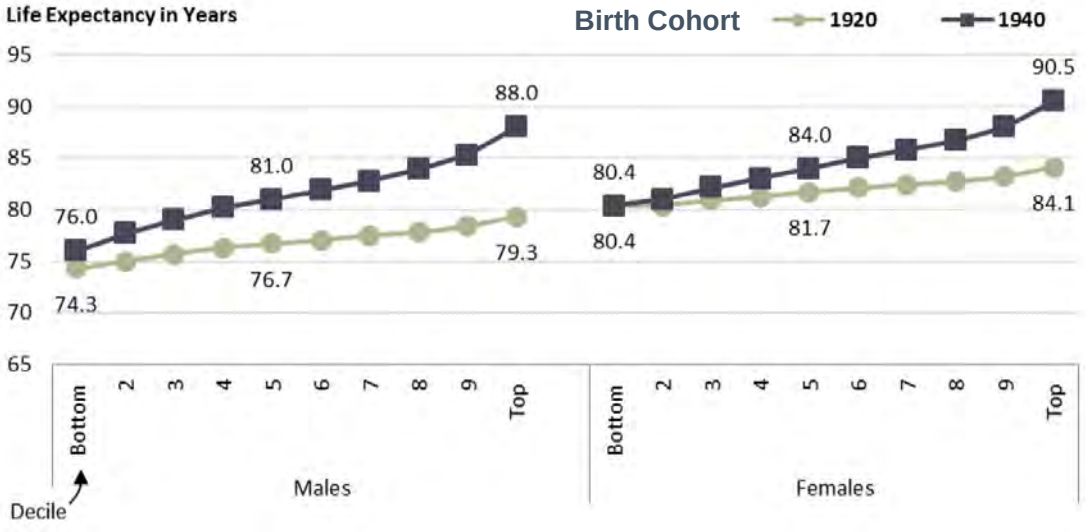
SOA:

SOCIETY OF ACTUARIES



US CRS:

Congressional Research Service
Informing the legislative debate since 1914



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Socioeconomic Segmentation

UK:

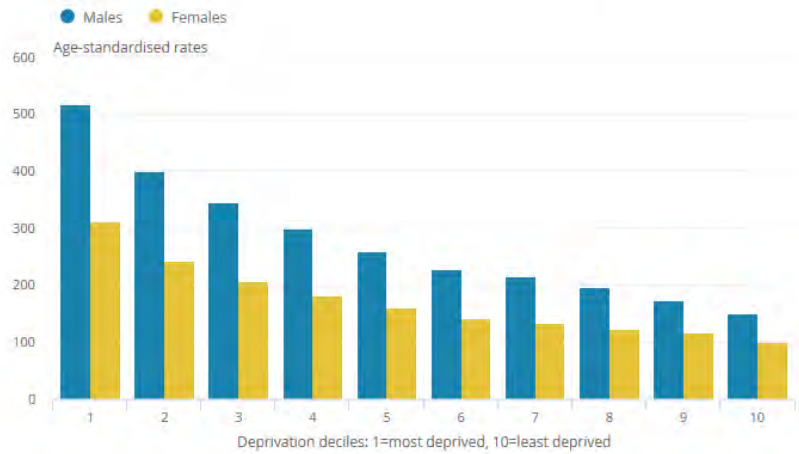
Office for National Statistics

Article

Socioeconomic inequalities in avoidable mortality, England and Wales: 2001 to 2017

Avoidable mortality in England and Wales, using measures of multiple deprivation to measure socioeconomic inequalities.

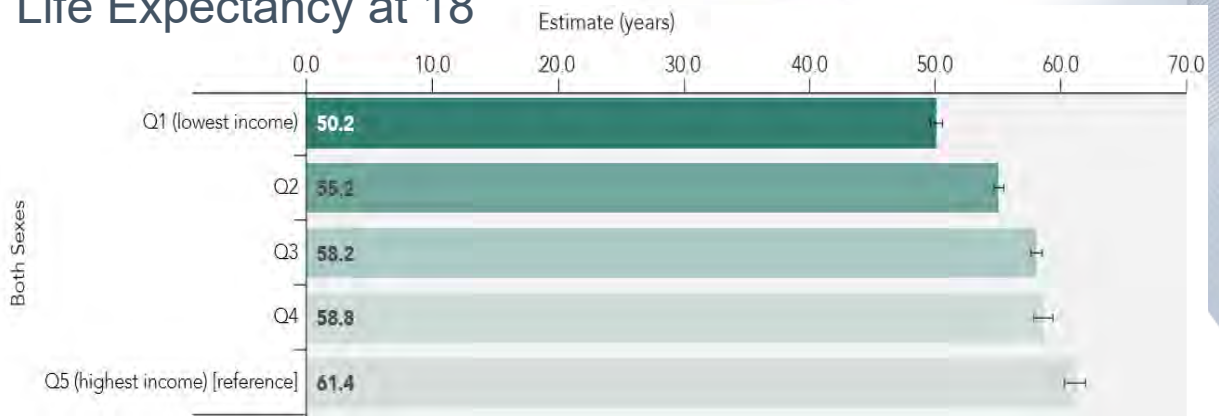
Figure 1: Age-standardised avoidable mortality rates, by sex, England, 2017



Canada:

Key Health Inequalities in Canada A National Portrait

Life Expectancy at 18



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Agenda

1. Data, Income, and Education
2. Relative Risk by Cause of Death
3. Drivers of Socioeconomic Segmentation
4. Impacts on Life Insurers

Data, Income, and Education

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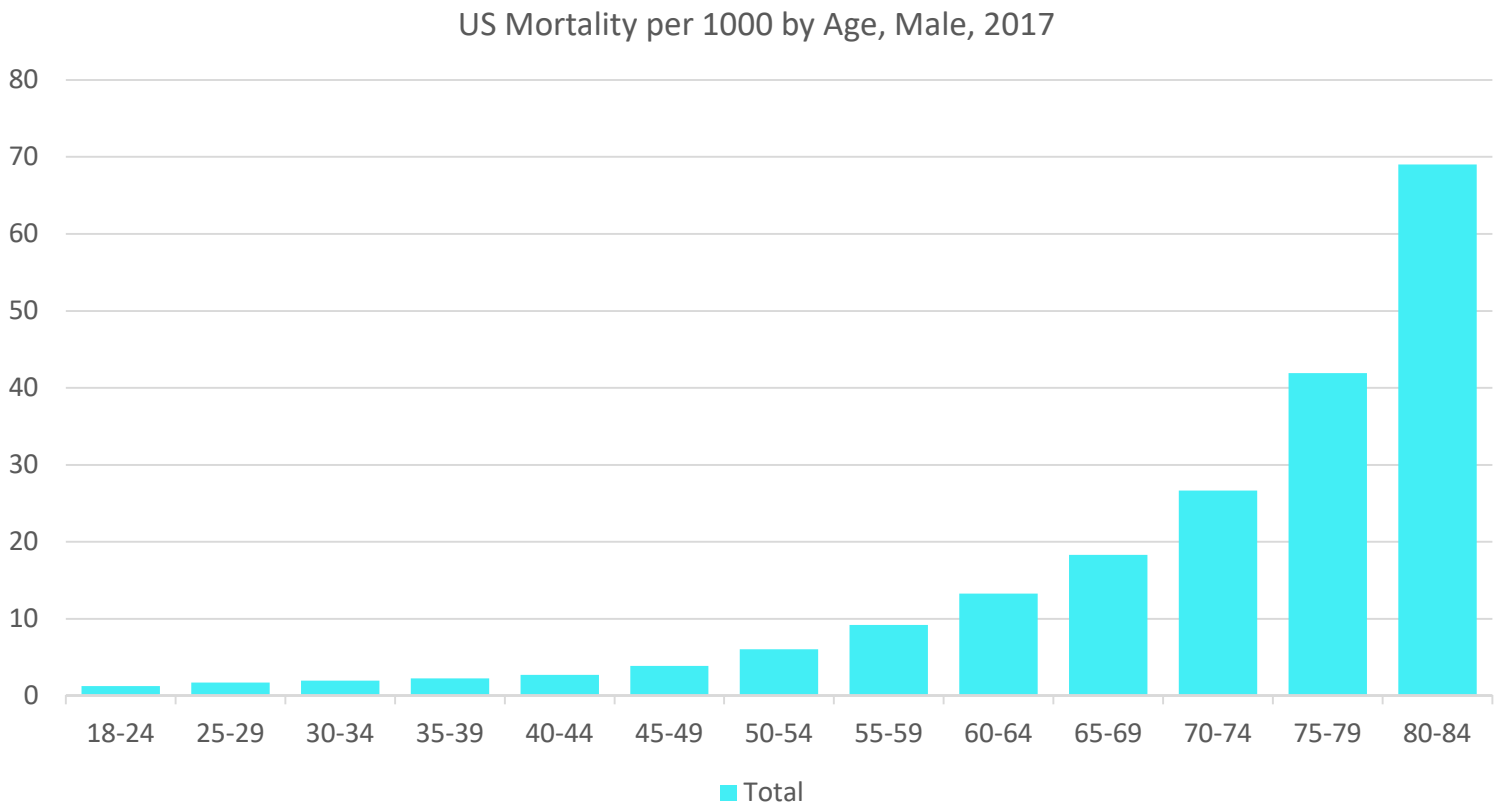
Cause of Death Studies



Source: CDC Wonder

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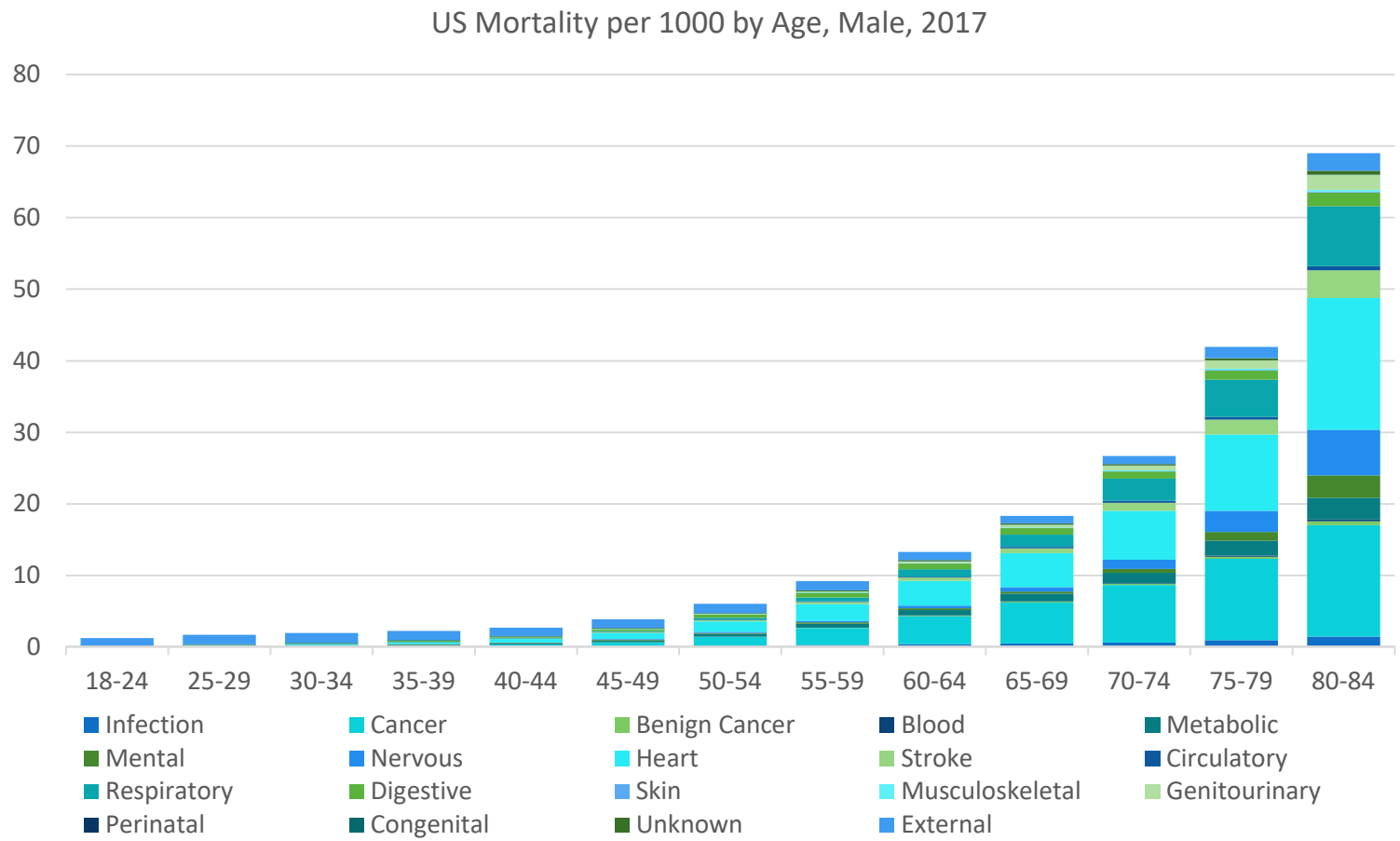
Cause of Death Studies



Source: CDC Wonder

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Getting Data

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Mortality Multiple Cause-of-Death Public Use Record

- National database detailing all death certificates recorded in the US

- Includes:
  - Demographics: age, gender
  - Primary cause of death
  - Algorithmically summarized secondary causes
  - County of death/residence
  - Education (since 1989)
  - Marital Status

- Same mortality data underlying CDC Wonder mortality databases and SOA Report

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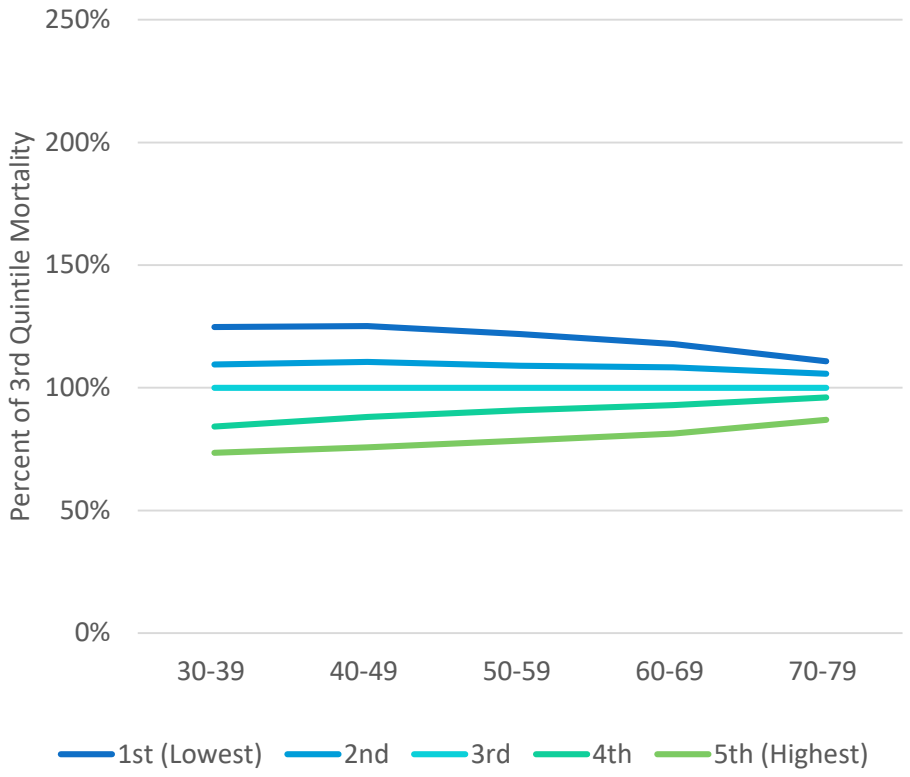
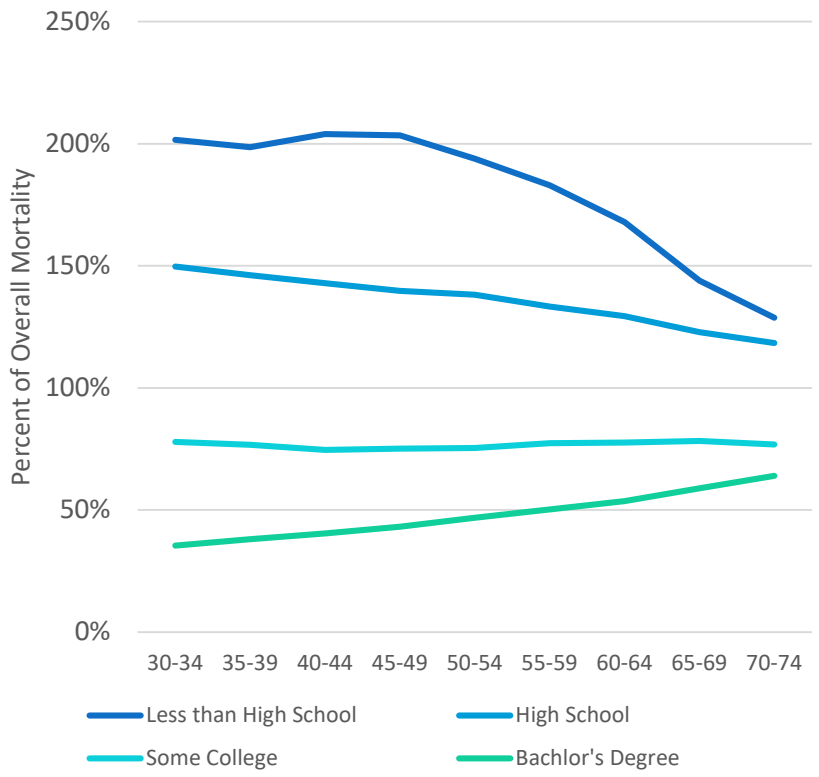
County-Level Income vs. Individual-level Education

Segmentation by County Income Quintiles



Segmentation by Education Attainment



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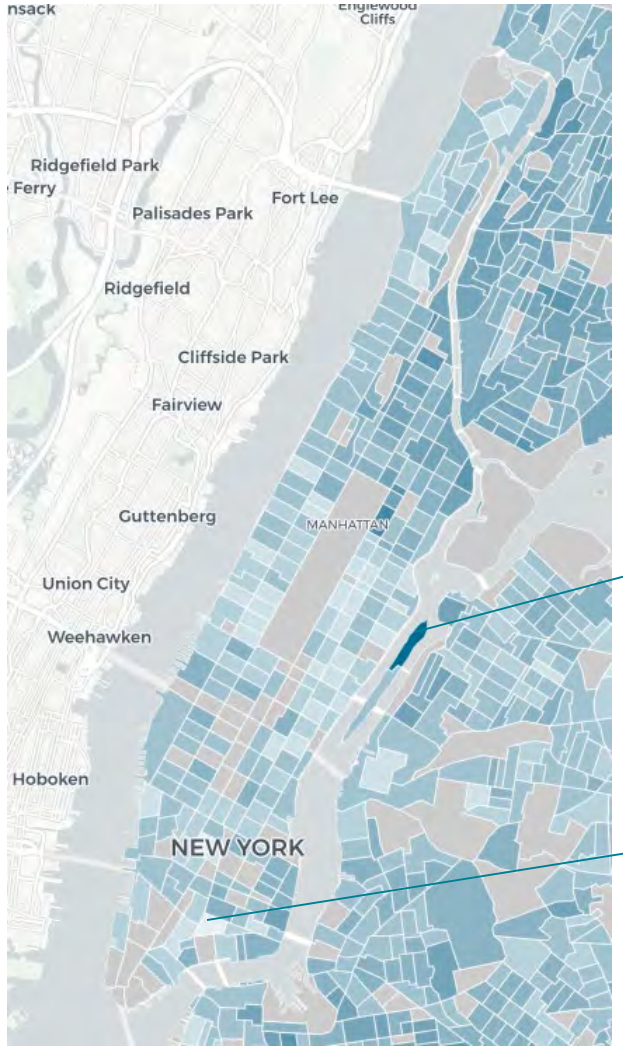
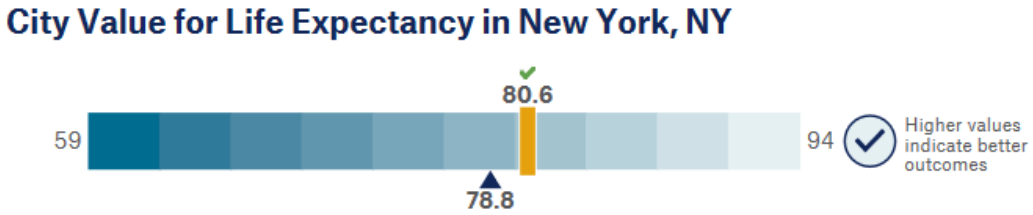
US Counties Are Too Large for Robust Segmentation





Zip Code 10044: 59 Years

Zip Code 10002: 93.6 Years

Source: City Health Dashboard by NYU Langone Health

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Study Data

- Male and Female
- Attained Age 25 – 84
- US Residents
- 1997-2017
- Standardized to 2017 population

Mortality:	Mortality Multiple Cause-of-Death Public Use Record, NCHS
Population:	Bridged-Race Resident Population Estimates, NCHS
Education:	Educational Attainment in the United States, US Census Bureau

Relative Risk by Cause of Death

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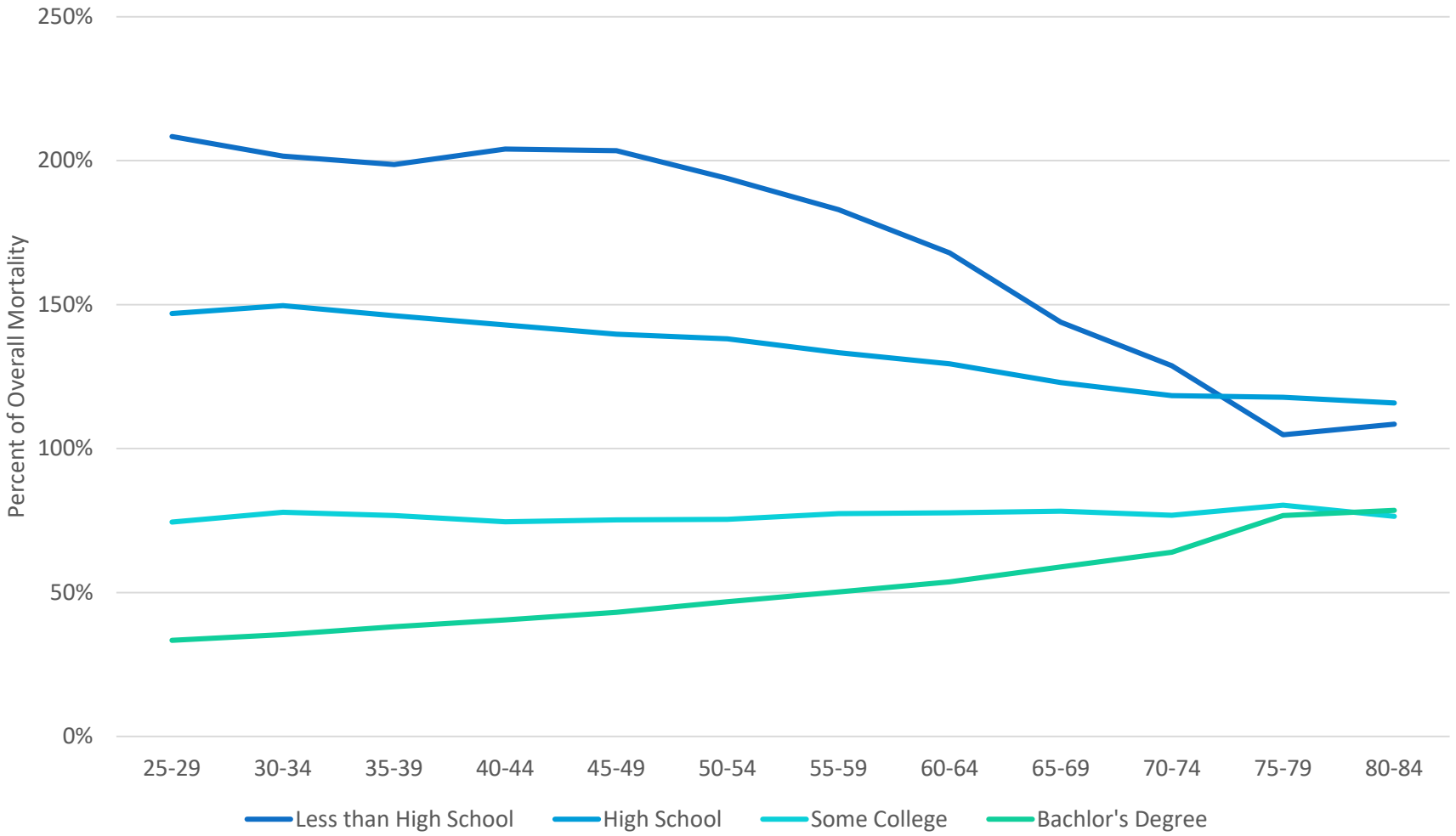
Relative Risk by Age



Relative Risk:

$$RR(A,B) = \frac{Q_x(A)}{Qx(B)}$$

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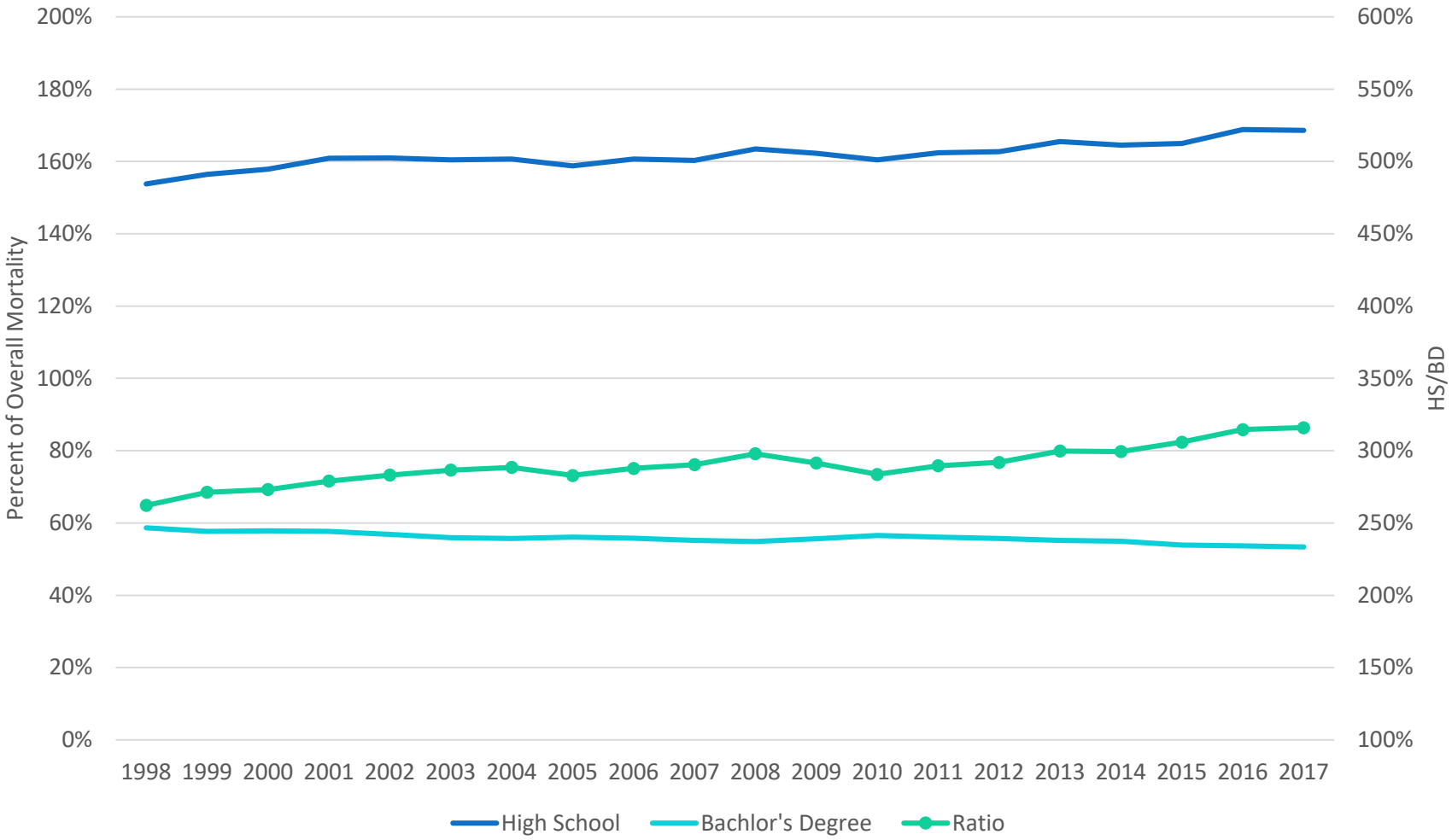
Relative Risk by Year



Relative Risk:

$$RR(A,B) = \frac{Q_x(A)}{Qx(B)}$$

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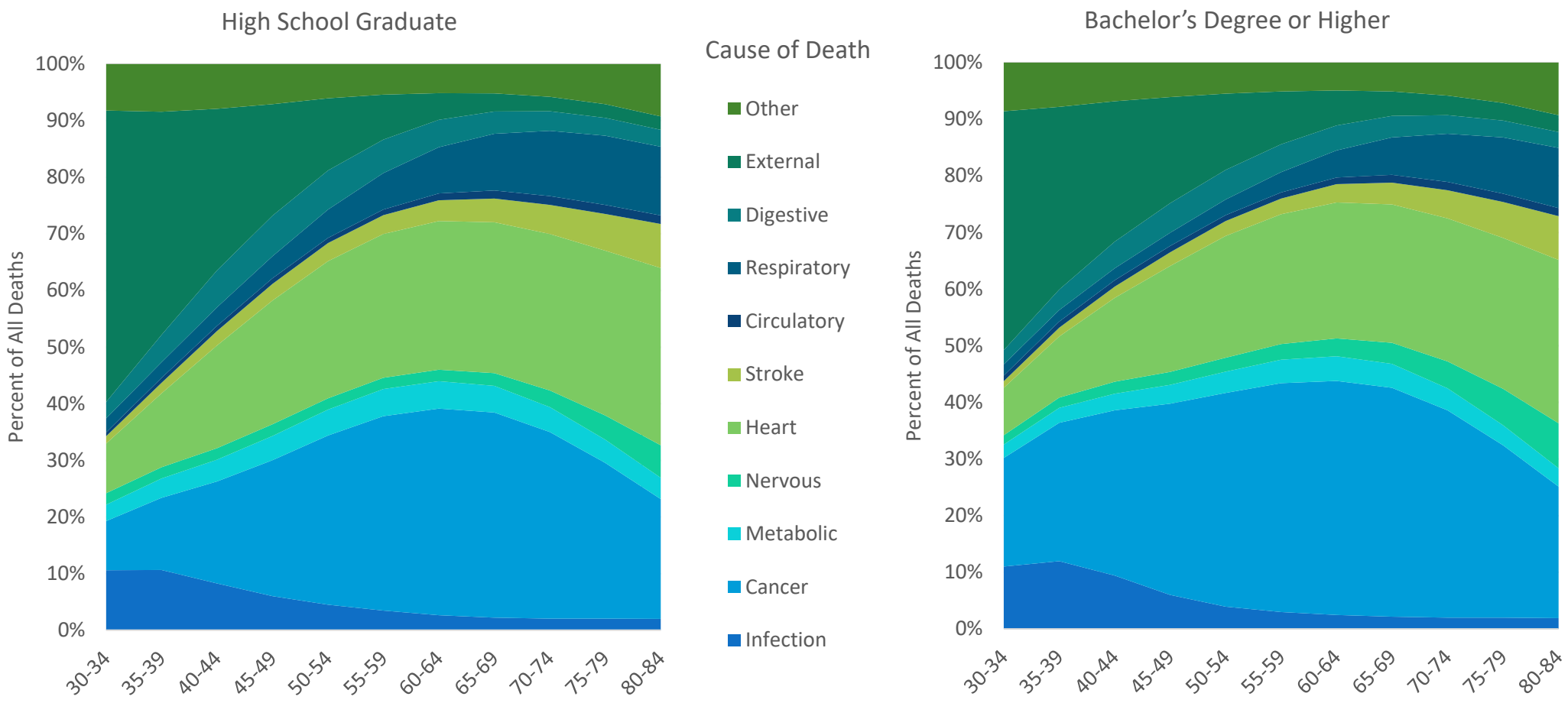
Cause of Death Distributions



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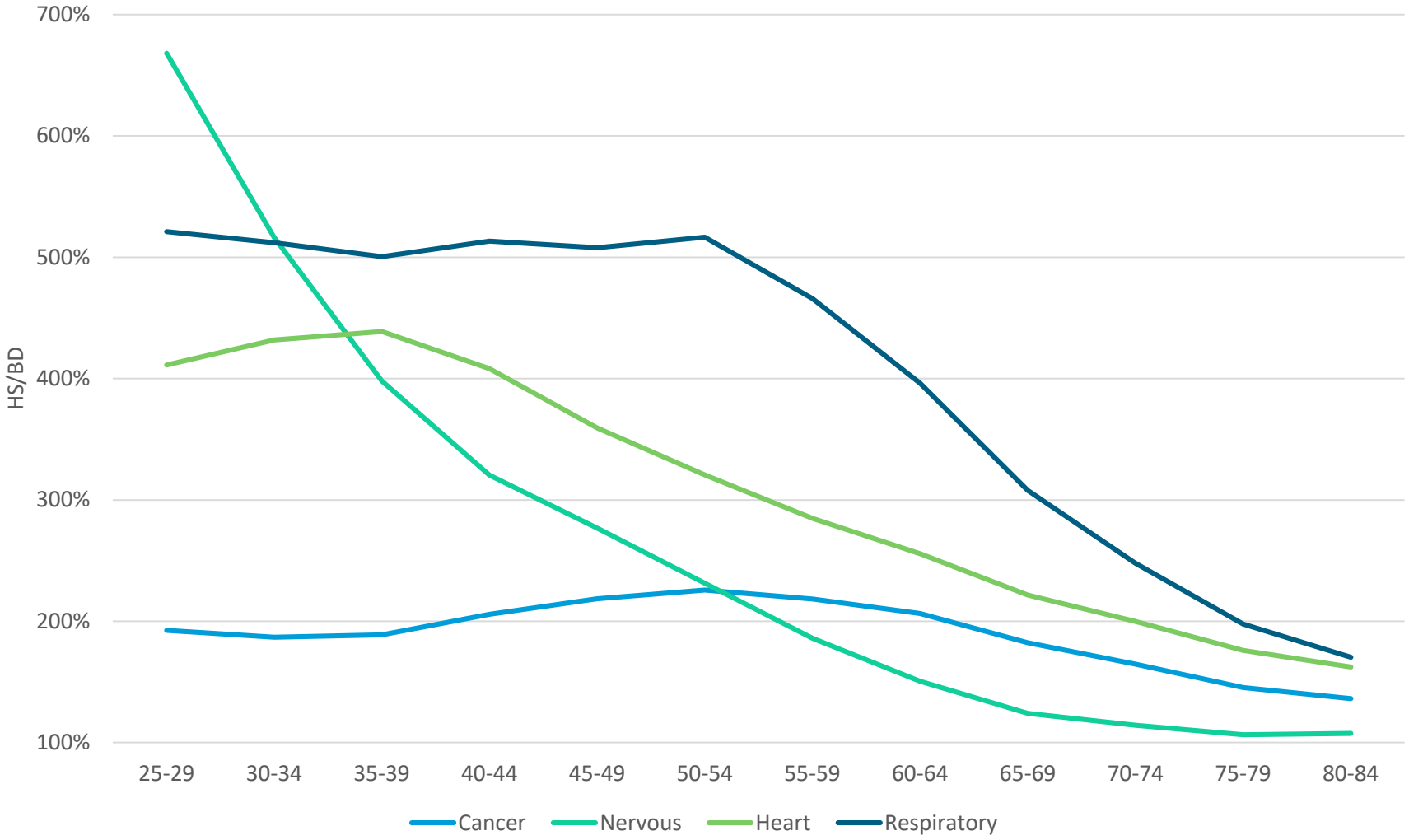
Relative Risk by Cause of Death



Drivers of Socioeconomic Segmentation

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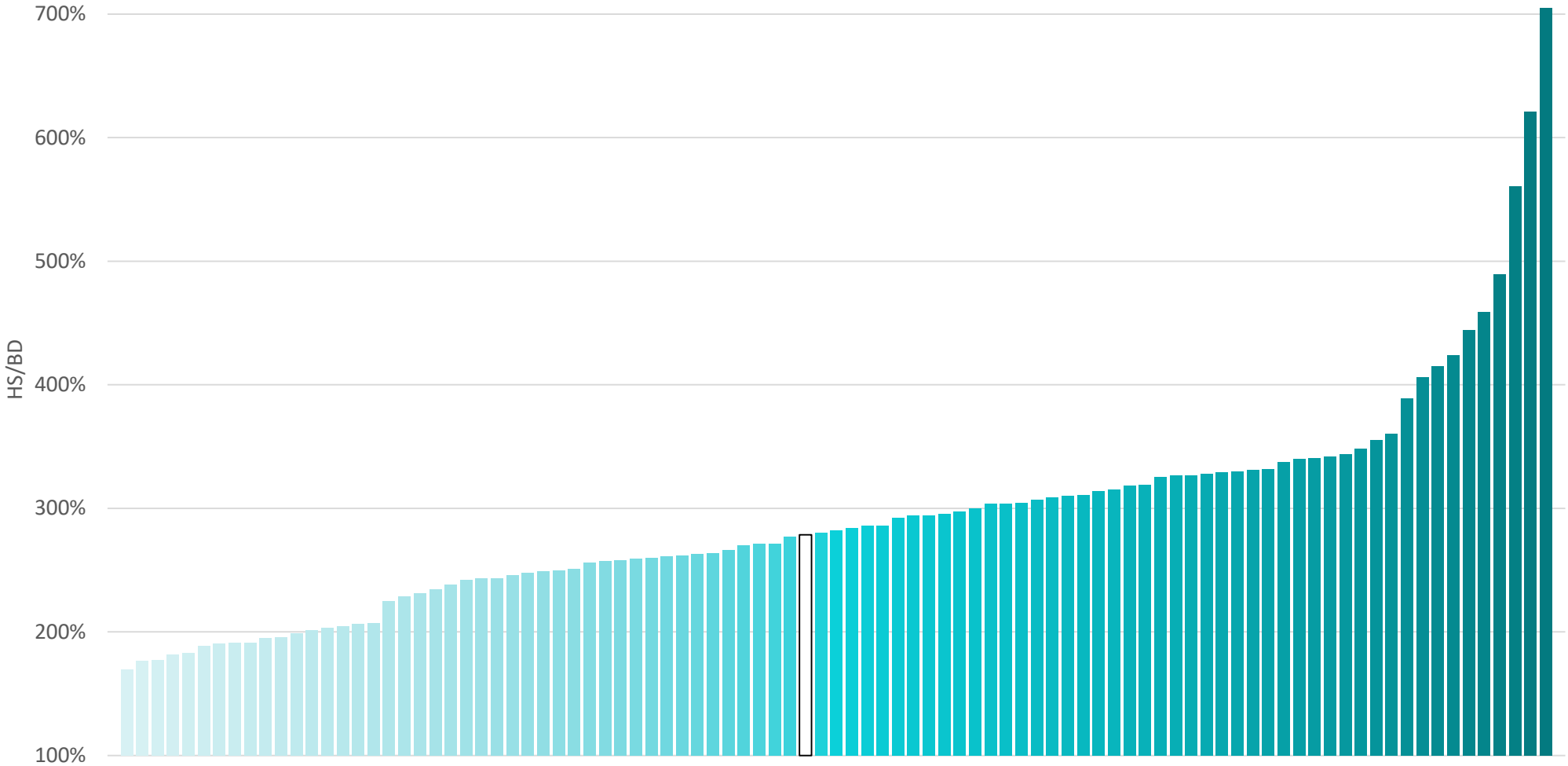
Relative Risks by Cause of Death



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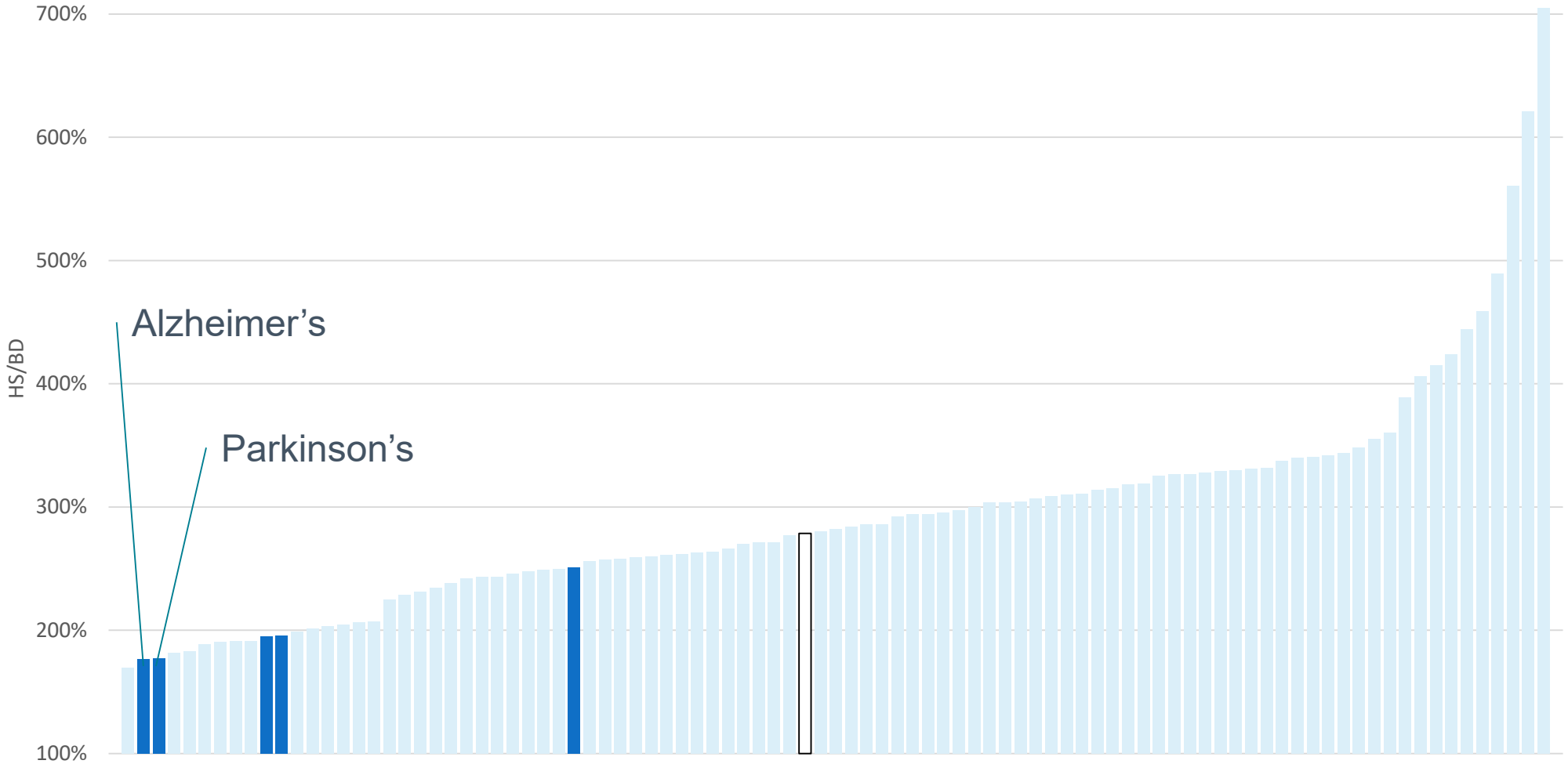
Relative Risks: Nervous System



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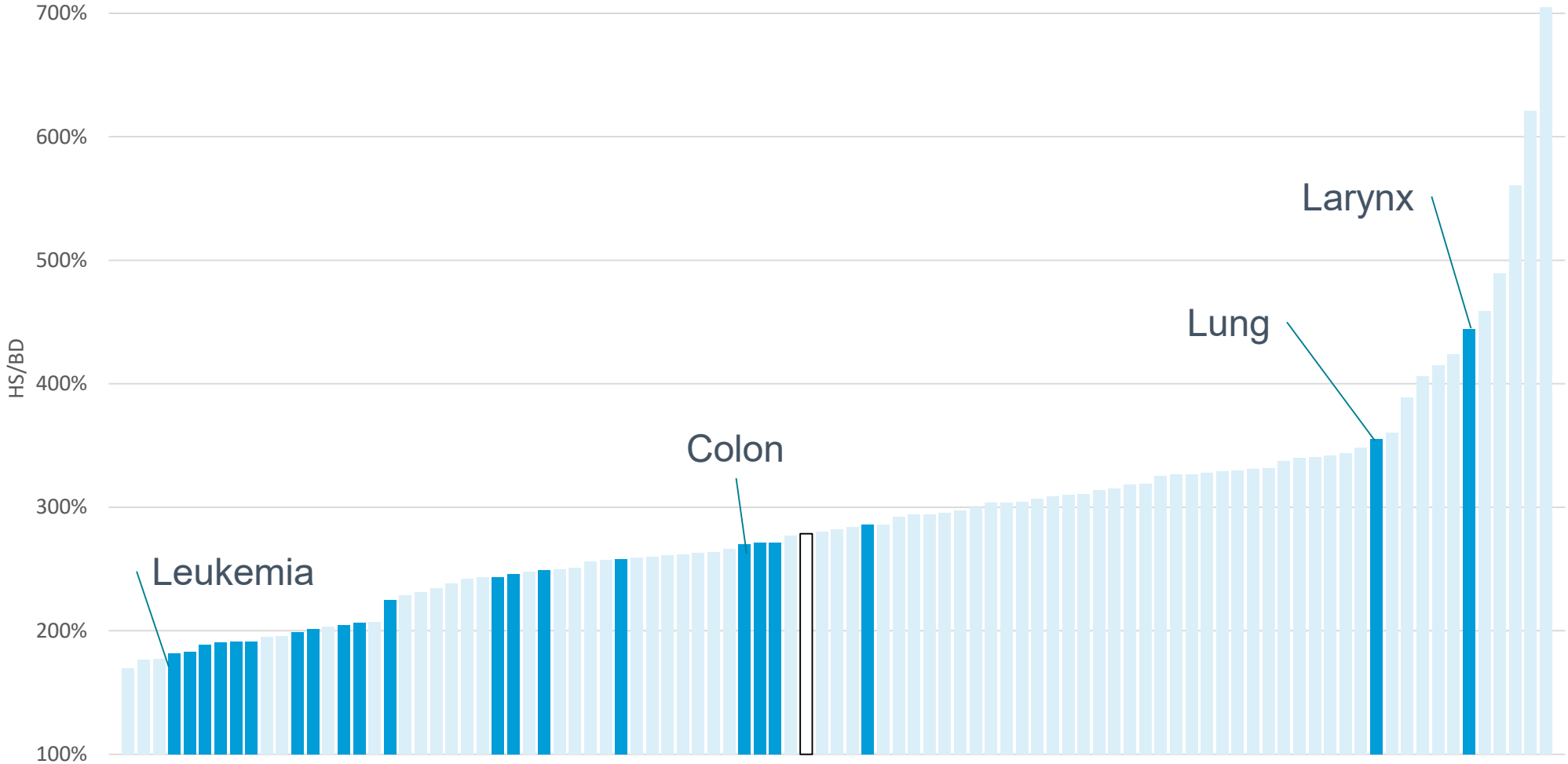
Relative Risks: Cancer



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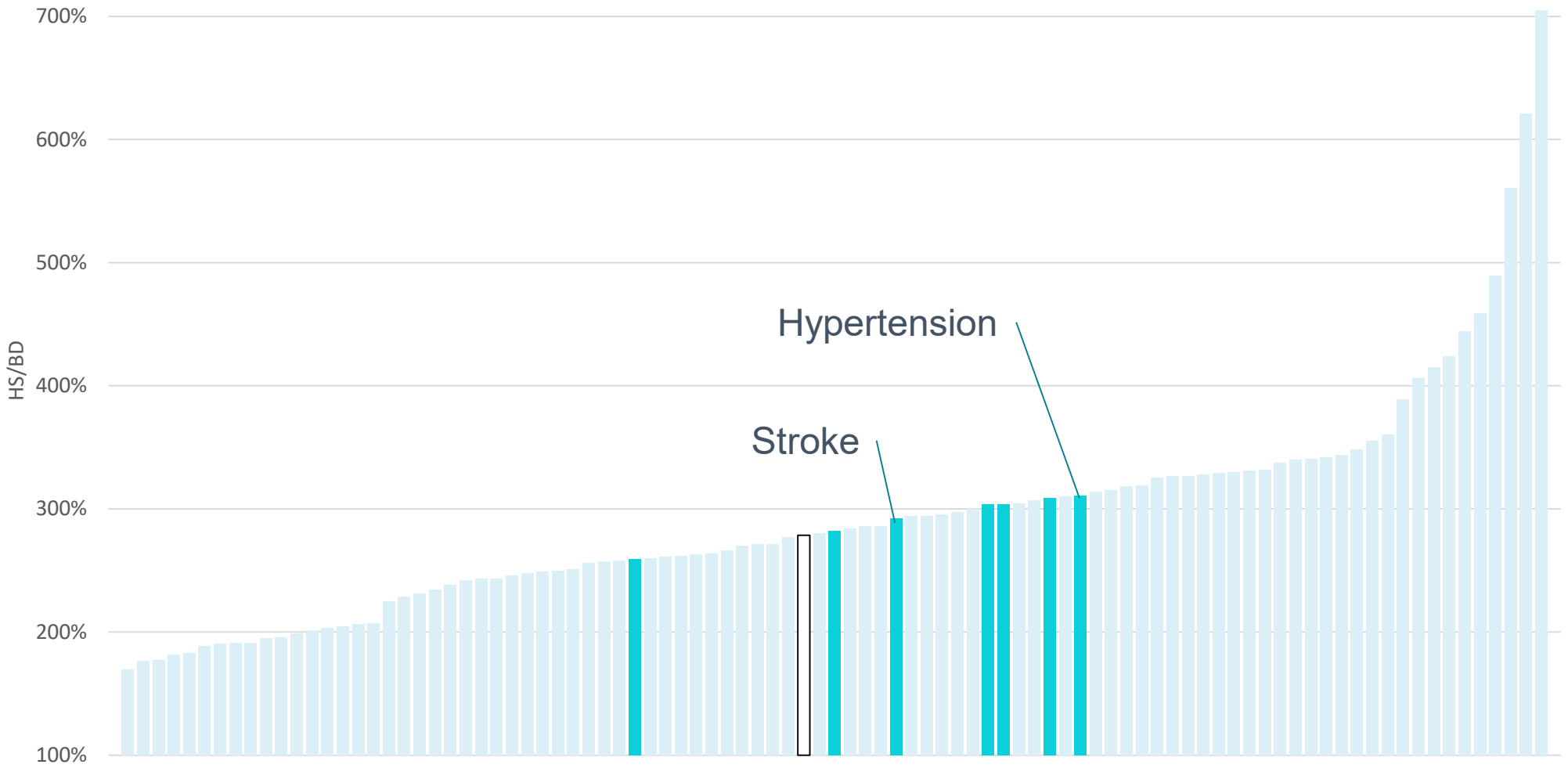
Relative Risks: Heart Disease and Stroke



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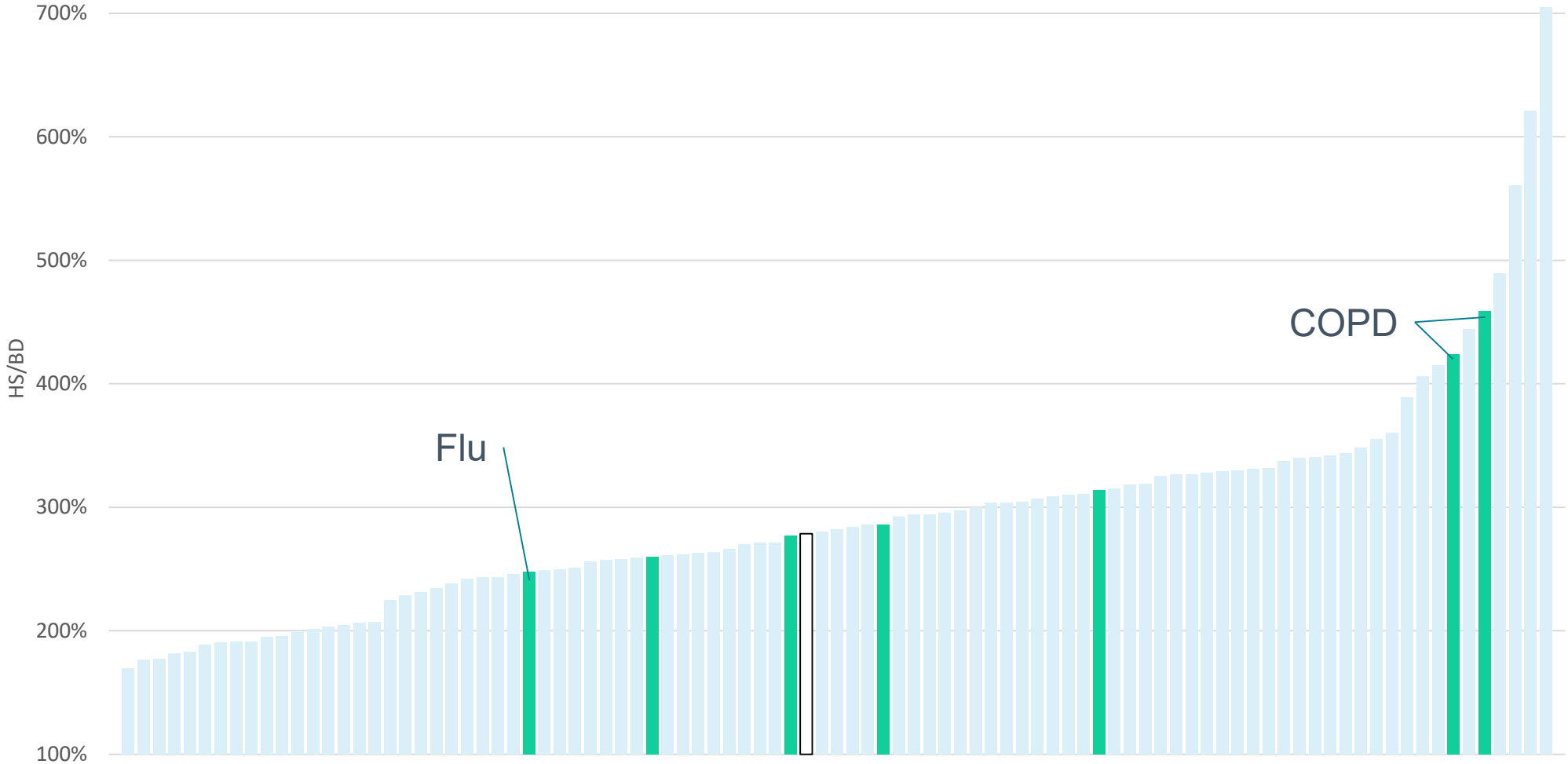
Relative Risks: Respiratory System



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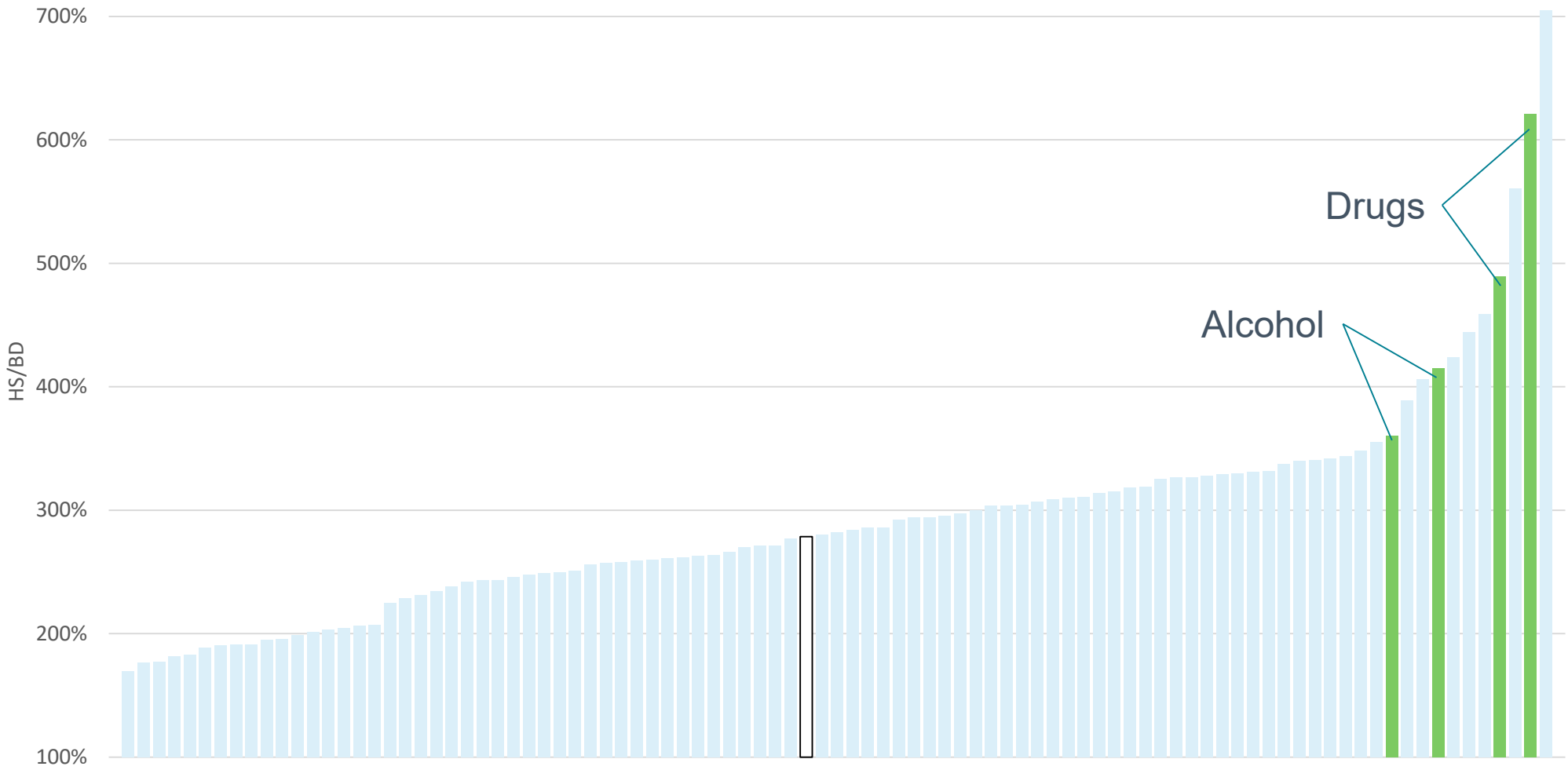
Relative Risks: Alcohol and Drug Abuse



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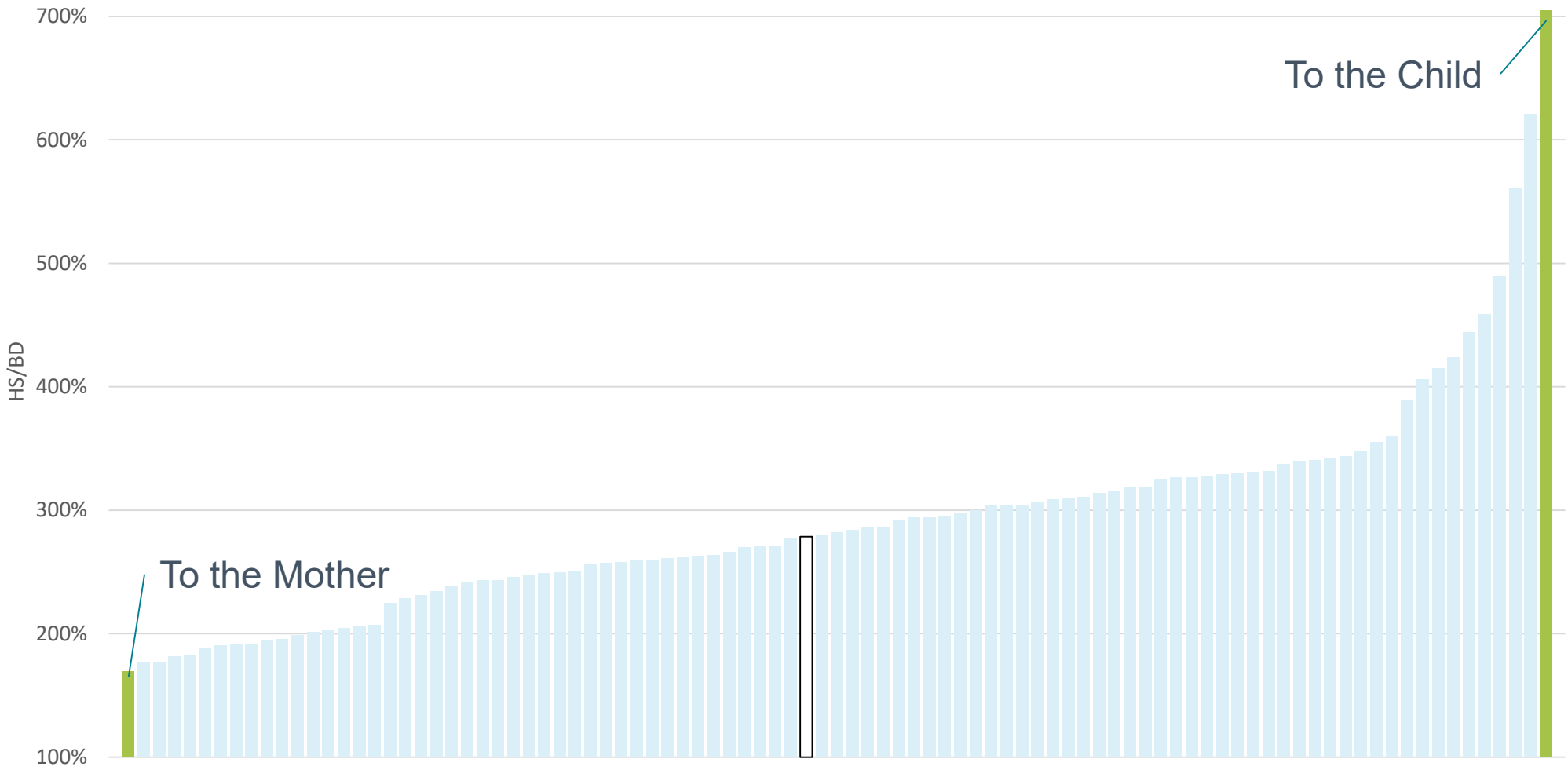
Relative Risks: Complications of Pregnancy and Childbirth



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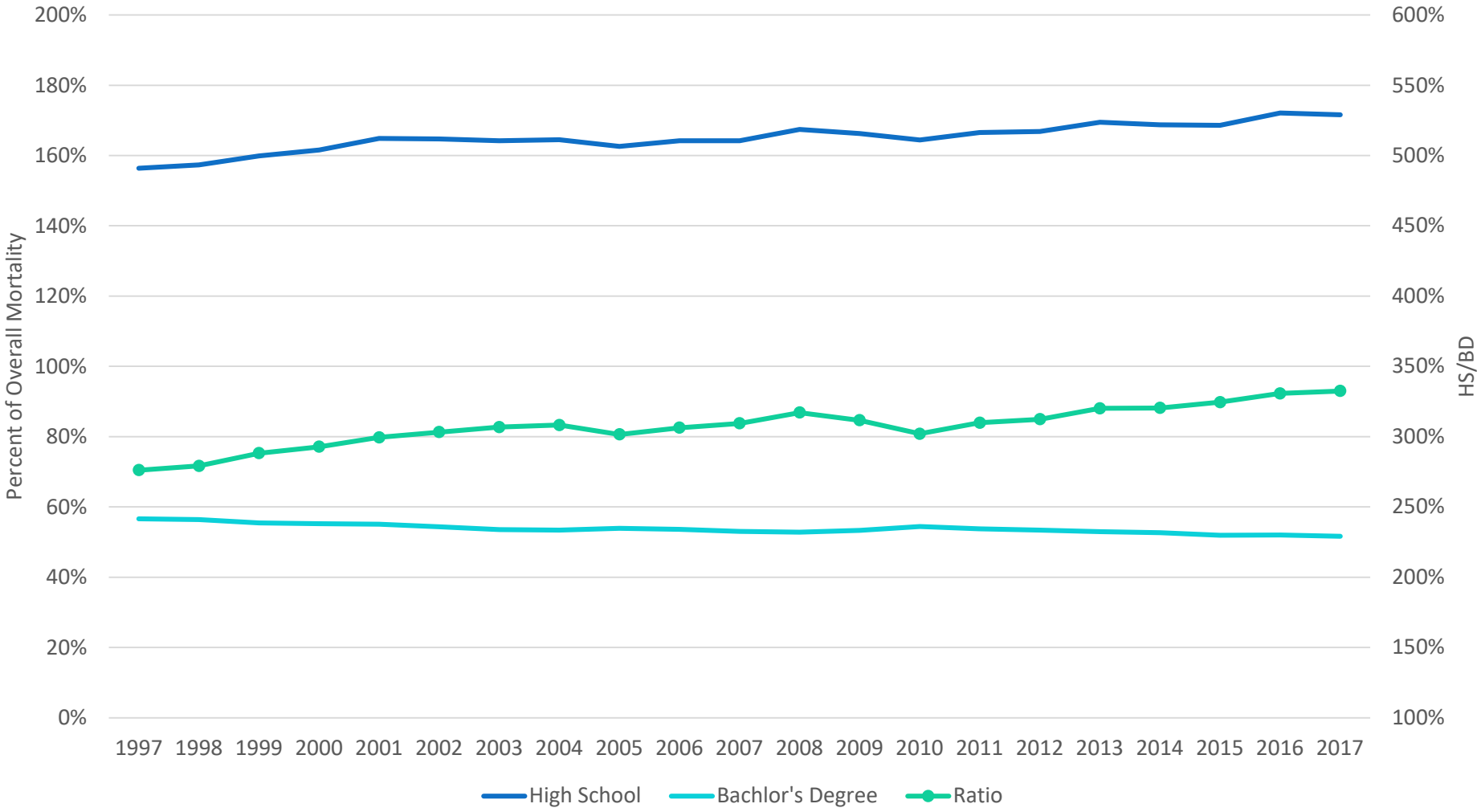
Heart Disease



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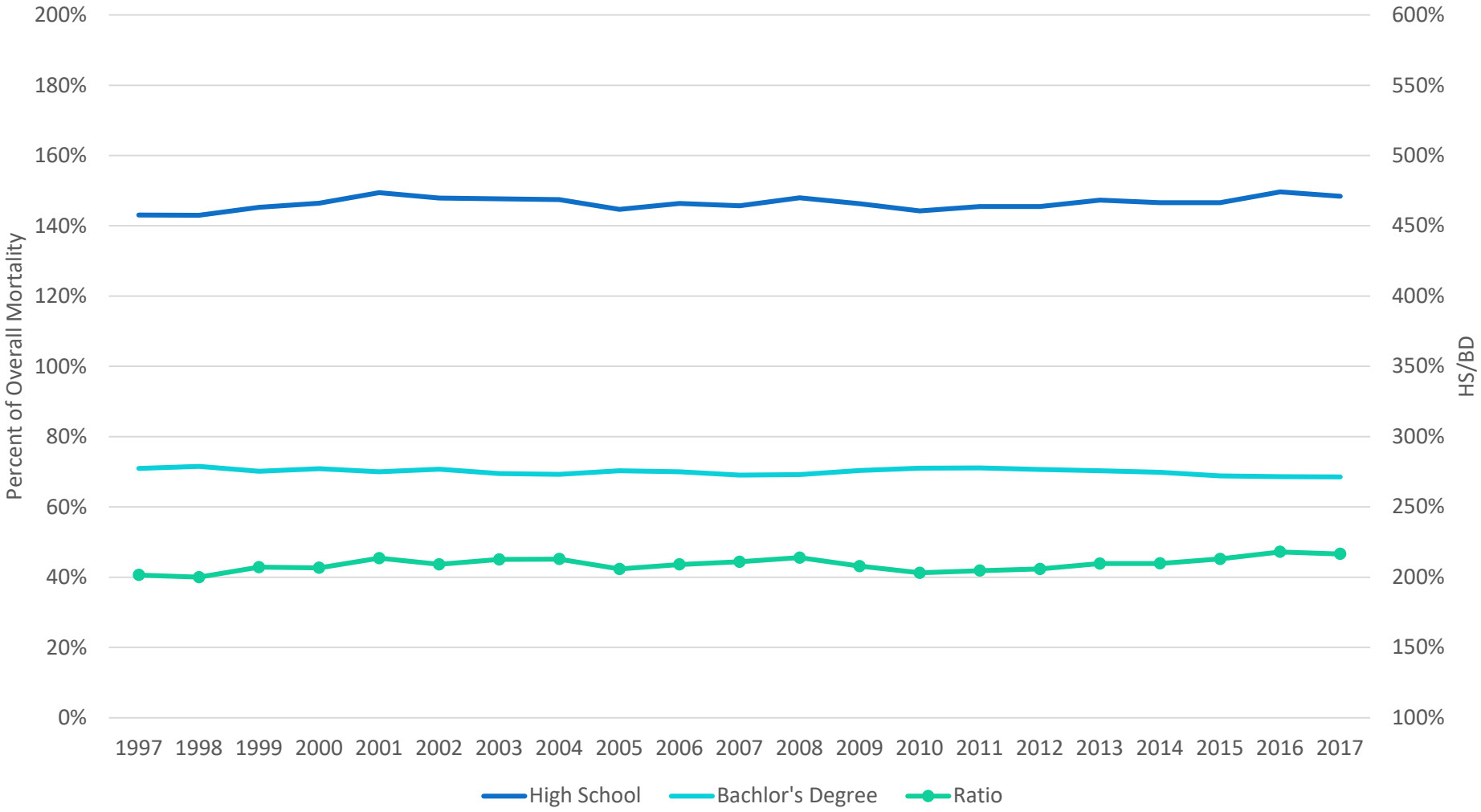
Cancer (Non-Lung)



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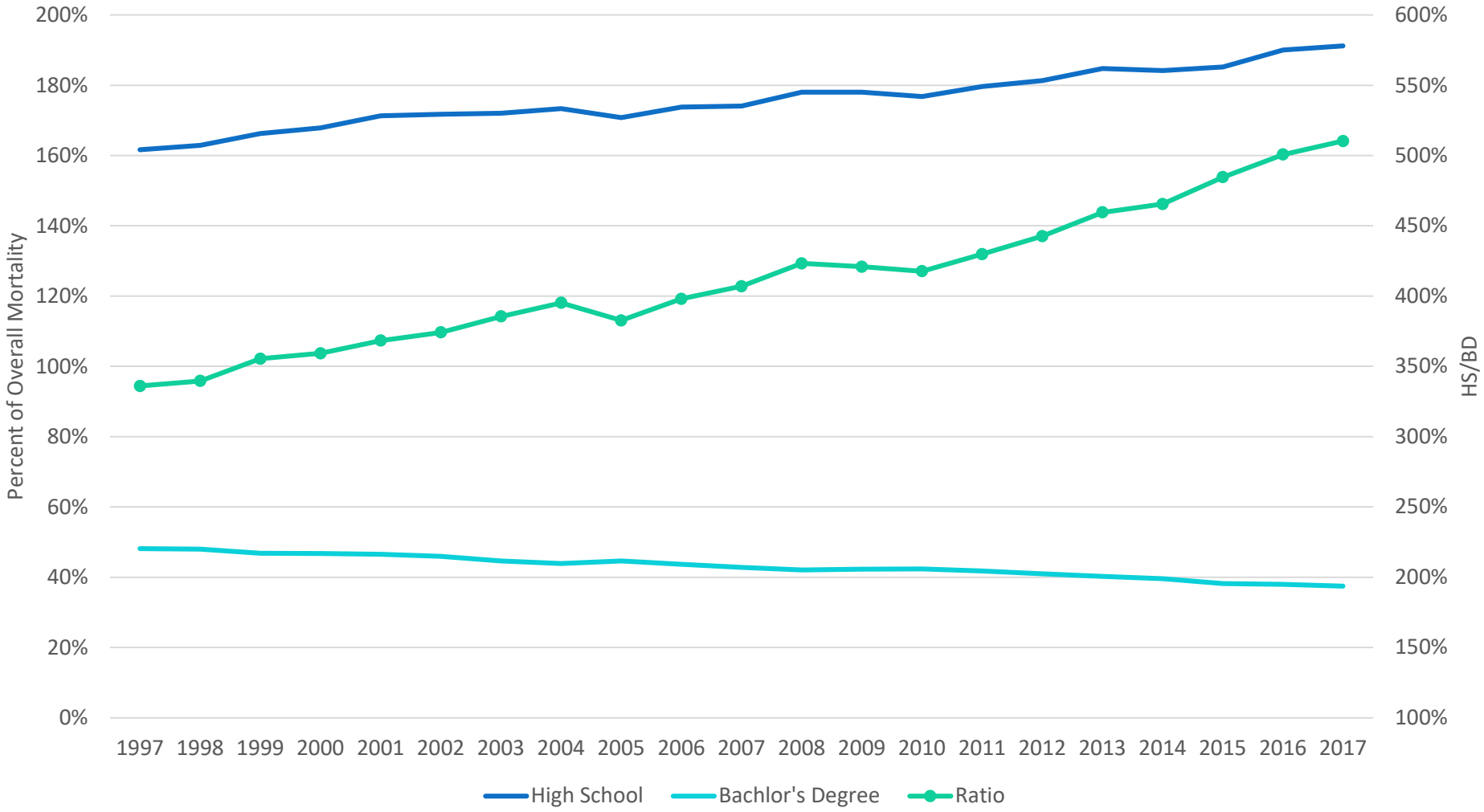
Smoking Related Conditions



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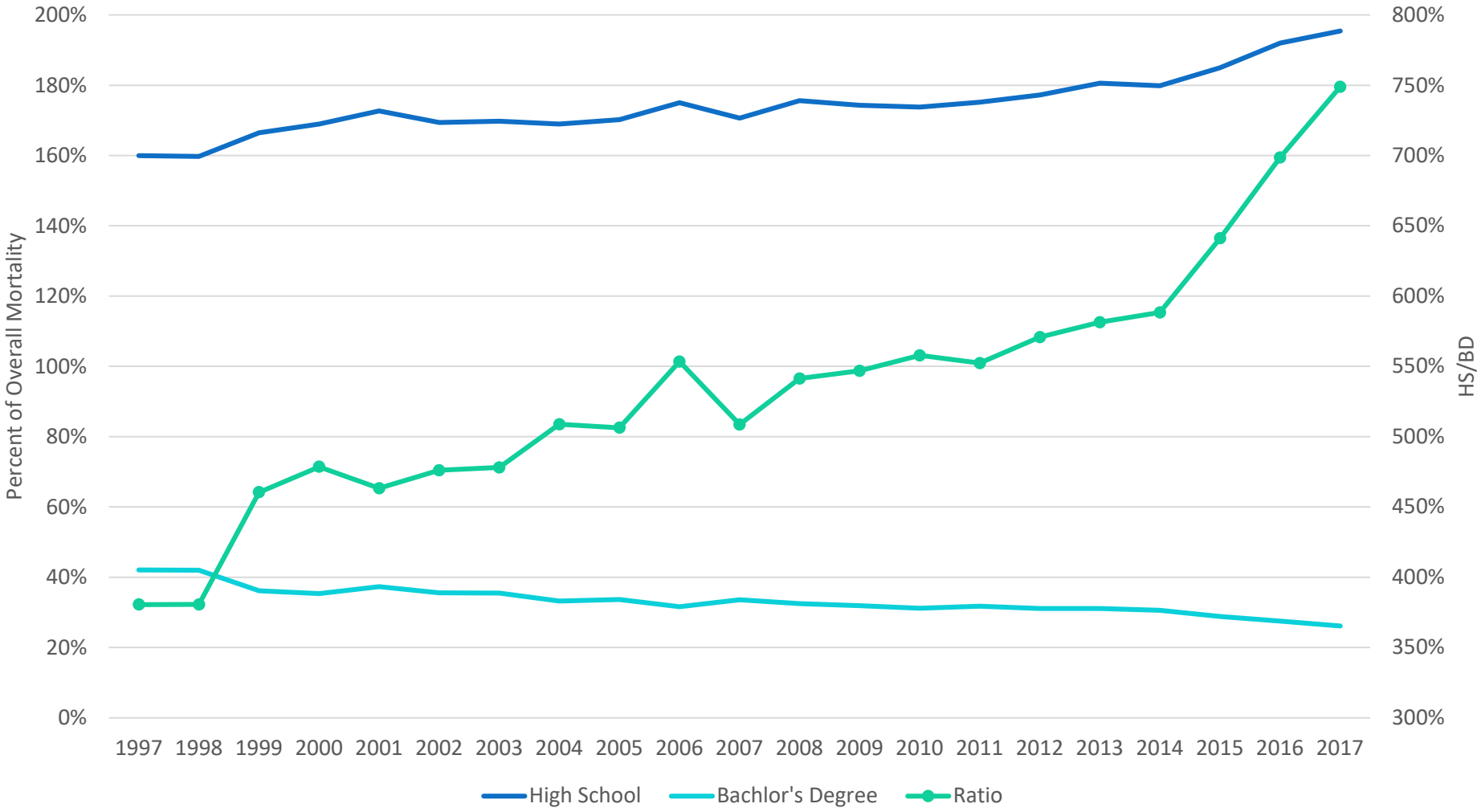
Alcohol and Drug Related Conditions



Impacts on Life Insurers

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Life Insurance Implications

Expanding Markets (AUW, Middle Market):

1. Smoking related underwriting is even more important
2. New risk dimensions not seen in previous experience

Using National Datasets in Assumption Setting

1. Some form of SES segmentation should be used to adjust national experience when approximating insured populations
2. Individual-level segmentation is far stronger than county-level segmentation

Key Takeaways

- Mortality segmentation by socioeconomic status is even stronger than reported by the SOA.
- Lifestyle differences are as impactful to mortality segmentation as access to care, if not more so.
- Lifestyle differences are the main divers of mortality improvement differentials by socioeconomic status.

Thank you.

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OLIVER WYMAN

MORTALITY GAPS BY SOCIOECONOMIC STATUS

OCTOBER 29, 2019

Mark Spong, FSA, CERA, MAAA
Senior Consultant

MARSH & McLENNAN COMPANIES

Today's approach

Overview of research into mortality improvement differences driven by socioeconomic factors and implication for reinsurers and direct writers

1. **What and why** – Origin and motivation for the research

2. **Data and methods** – Challenges for the industry, potential opportunities to use public data sources and research approach

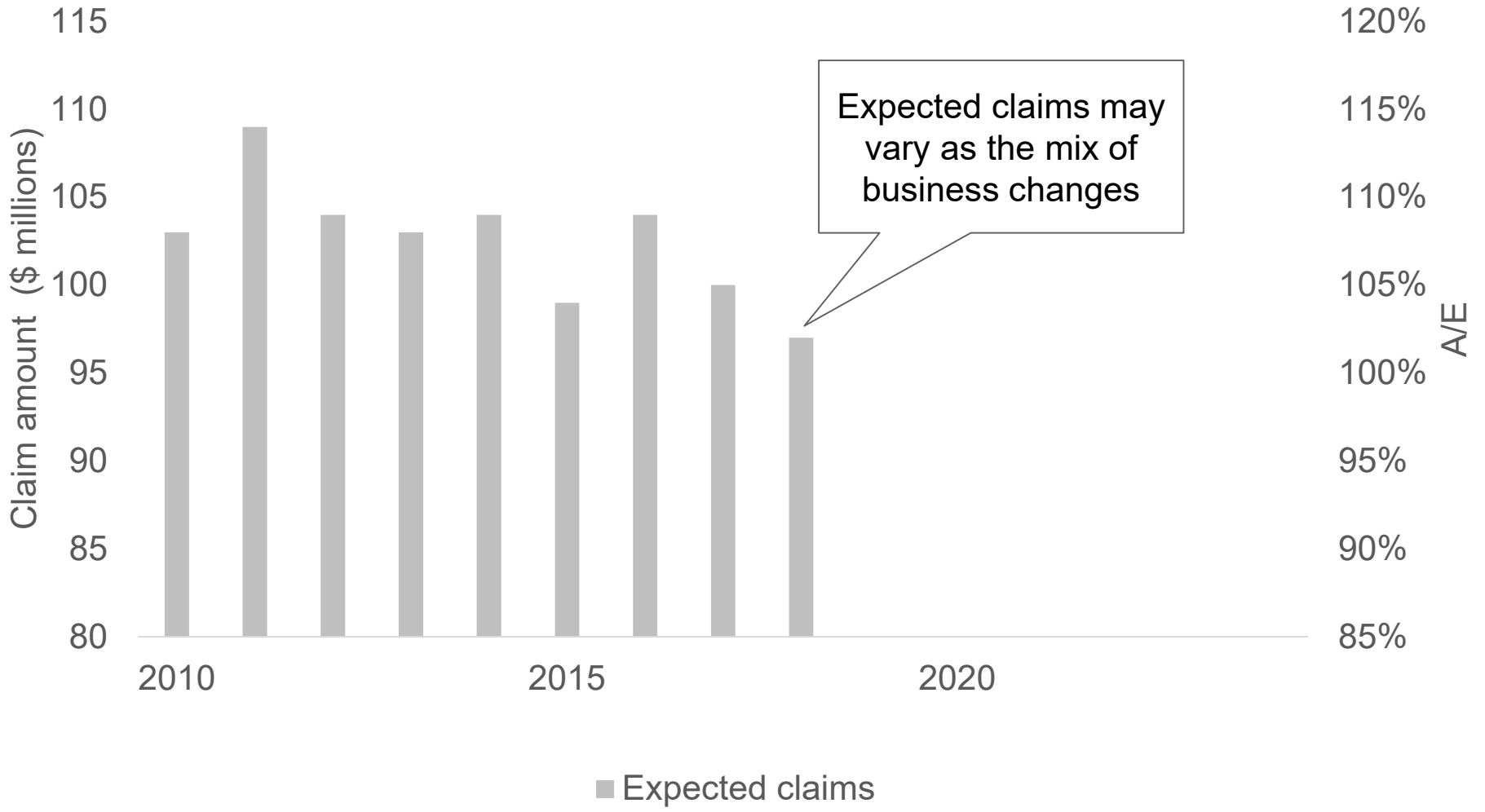
3. **Results** – Differentials for key socio-economic splits

4. **Next steps** – Practical issues for setting assumptions and next steps for research

1 What and why

What is mortality improvement?

Mortality improvement is a method to capture long-term mortality trends in actuarial models



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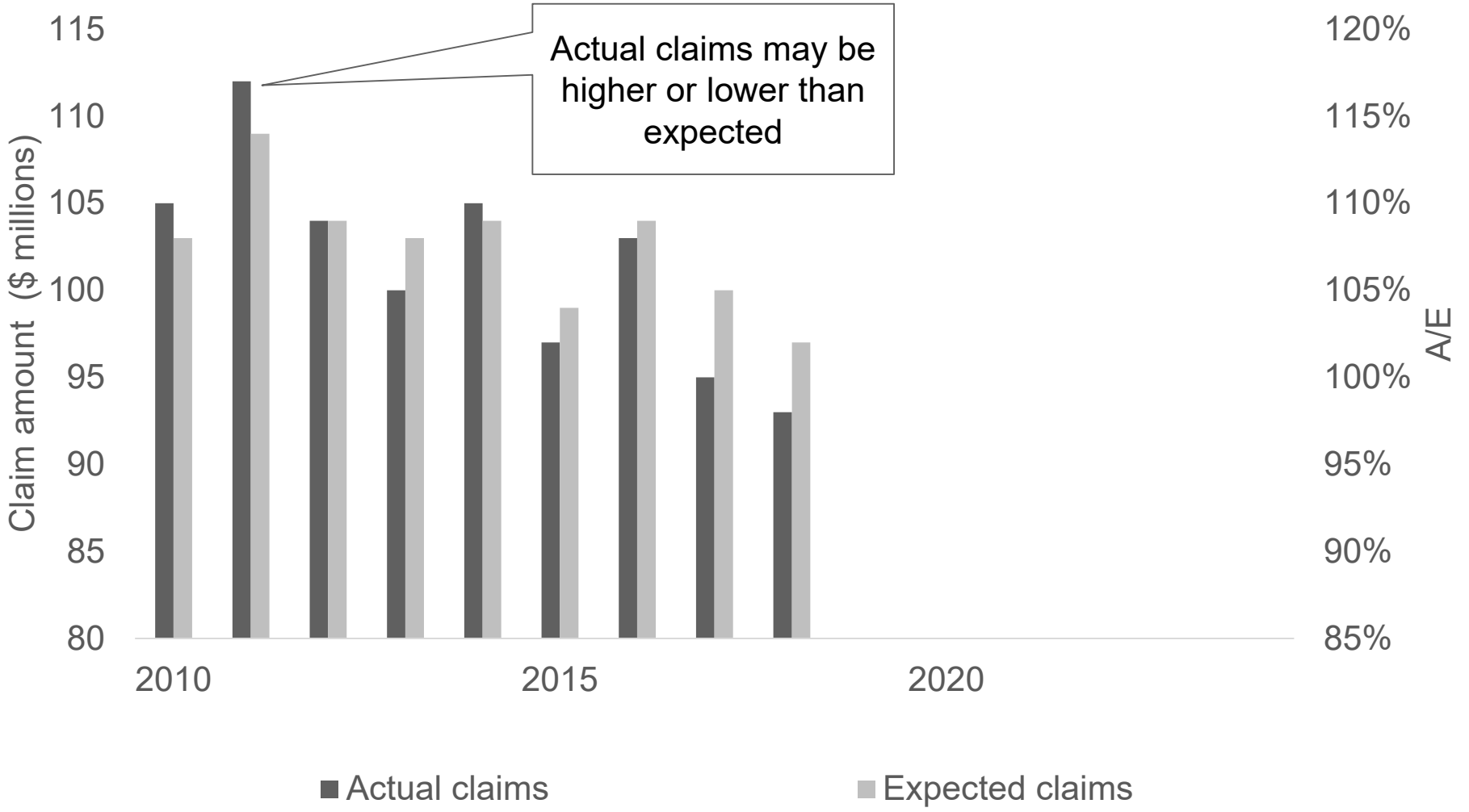

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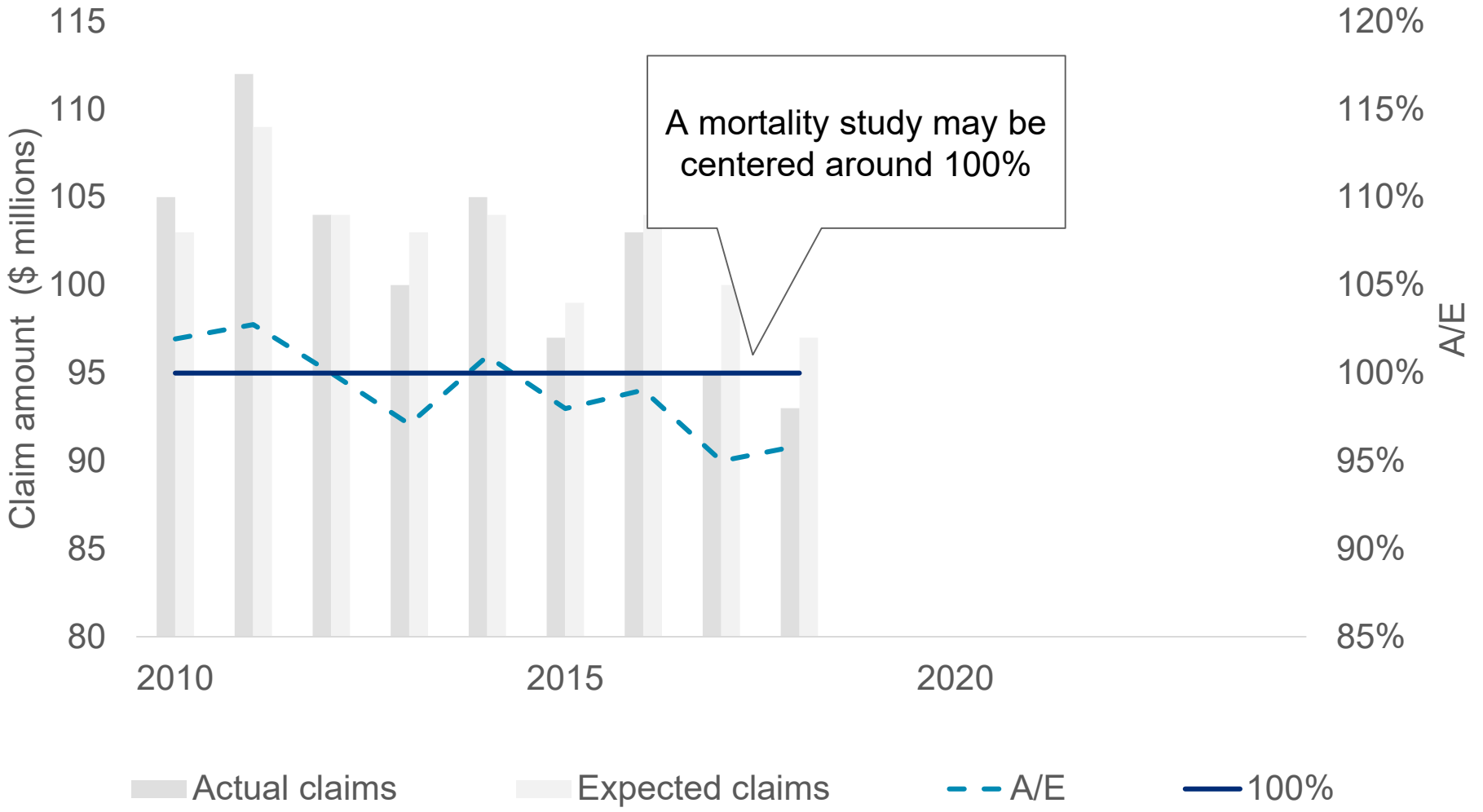

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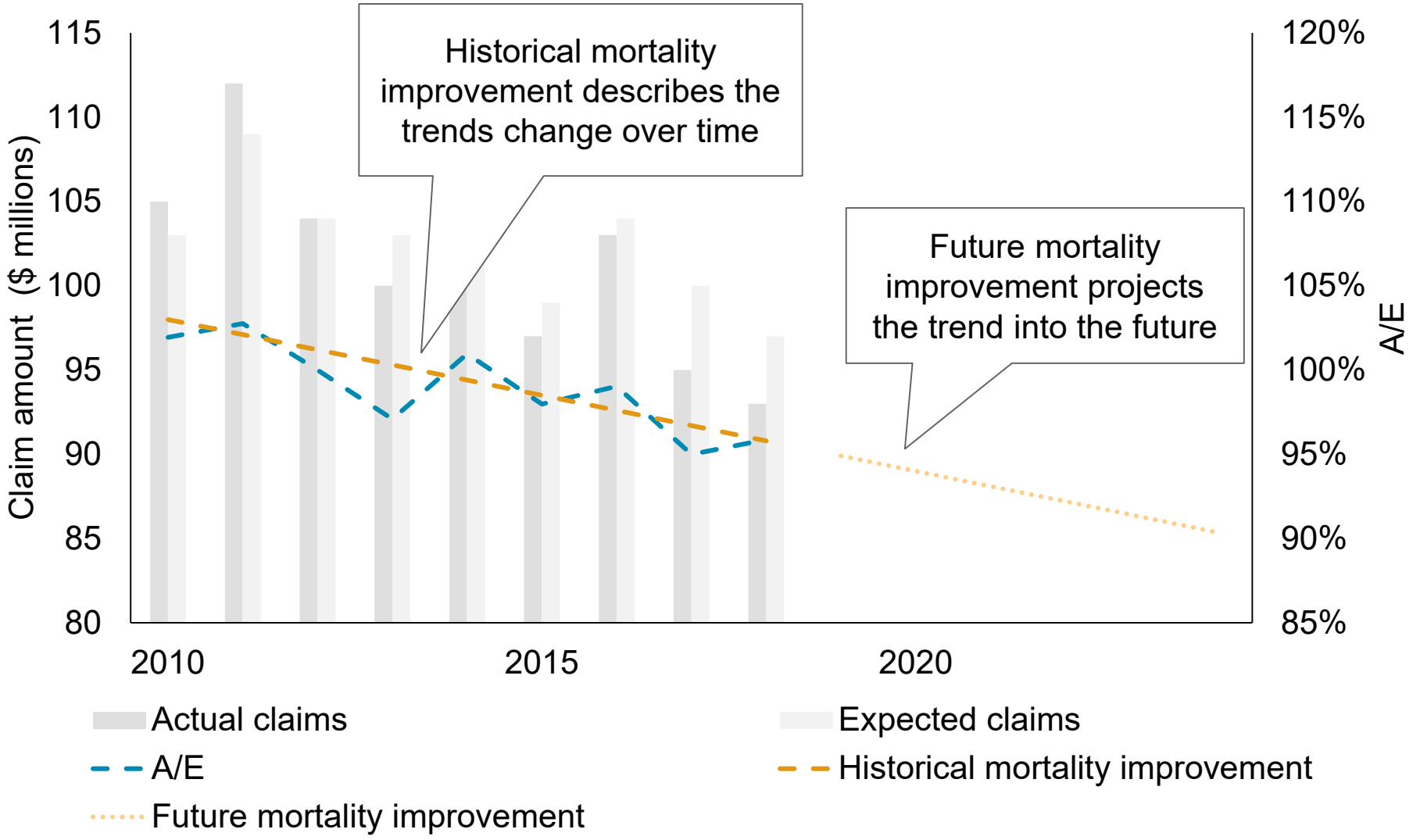

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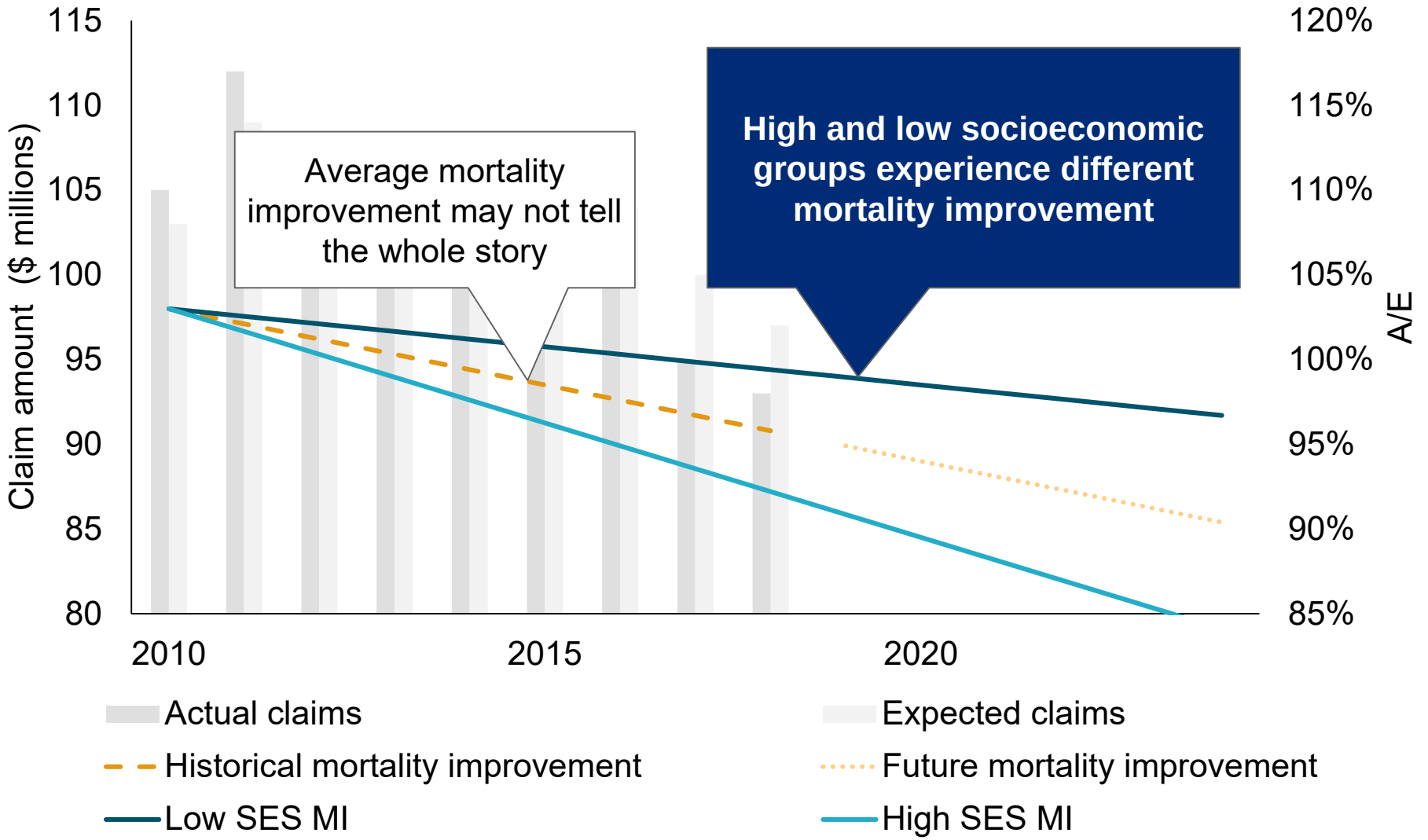


State of the industry

Socioeconomic factors are known to be key drivers of mortality improvement and the gap is expected to widen

*…**the most important driver** affecting U.S. mortality past the next 10 years [is] socioeconomic status inequity*[1]

*Recent evidence indicates that inequities in life expectancy in England have not only widened, but are **forecasted to widen further**.*[2]

*This study finds a difference in **both the level and the rate of change** in mortality improvement over time by socioeconomic status…*[3]

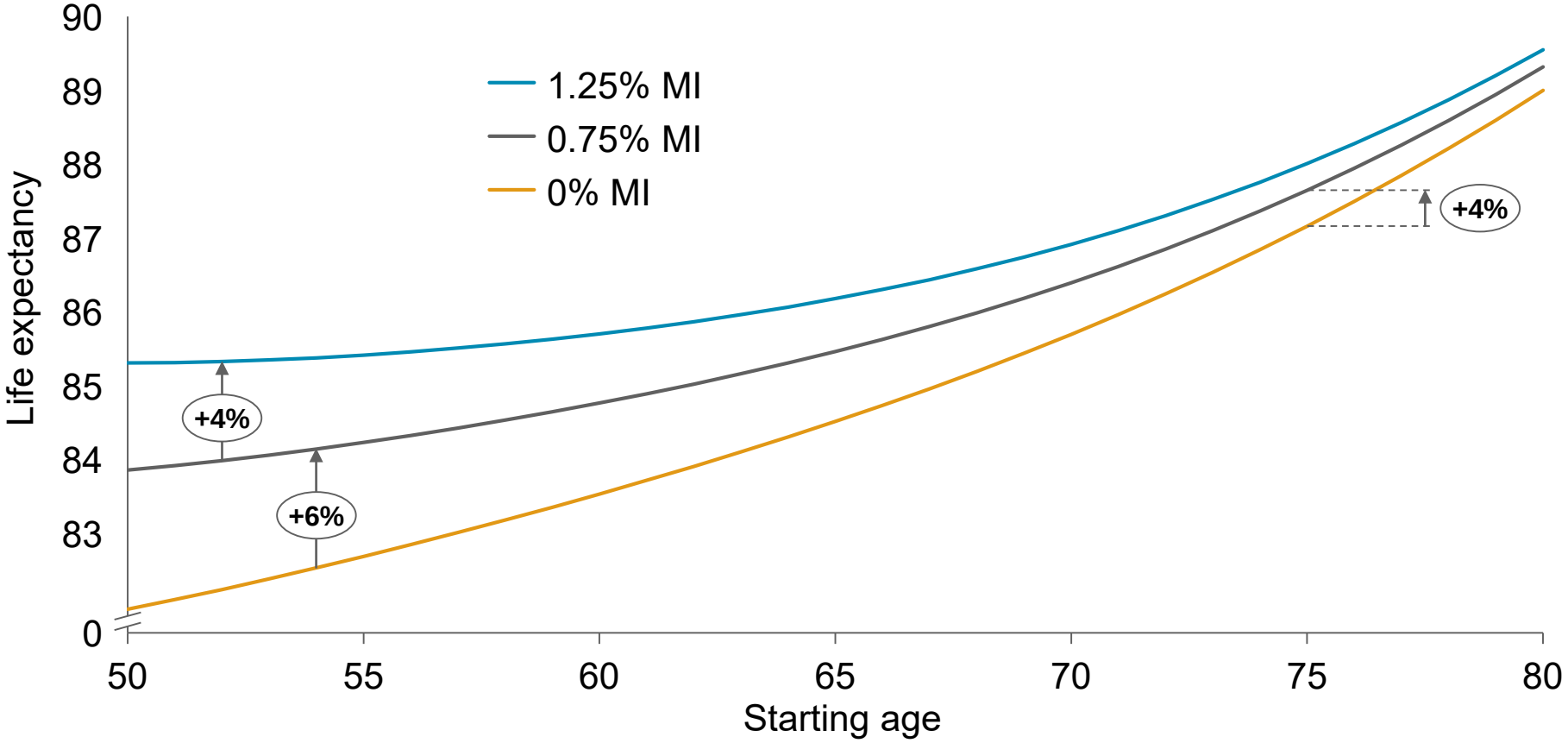
*…mortality inequality is increasing highlights a **growing relationship** between [socioeconomic status] and life expectancy.*[4]

*… a major increase in the availability of data … showing not only the existence of large inequities in the risk of death between those at the top and those at the bottom of the socioeconomic distribution, but also that **the gaps have been growing**.*[5]

1. SOA - Drivers of U.S. Mortality Improvement Expert Panel Forum Report, January 2019
2. Living to 100 - Causal Mortality by Socioeconomic Circumstances: A Model to Assess the Impact of Policy Options on Inequalities in Life Expectancy
3. Social Security Administration - Trends in Mortality Differentials and Life Expectancy, 2007
4. Center for Retirement Research at Boston College – Rising Inequality in Life Expectancy by Socioeconomic Status, 2017
5. Annual Review of Public Health – Increasing Disparities in Mortality by Socioeconomic Status, April 2018

Mortality improvement has a large impact on life expectancy

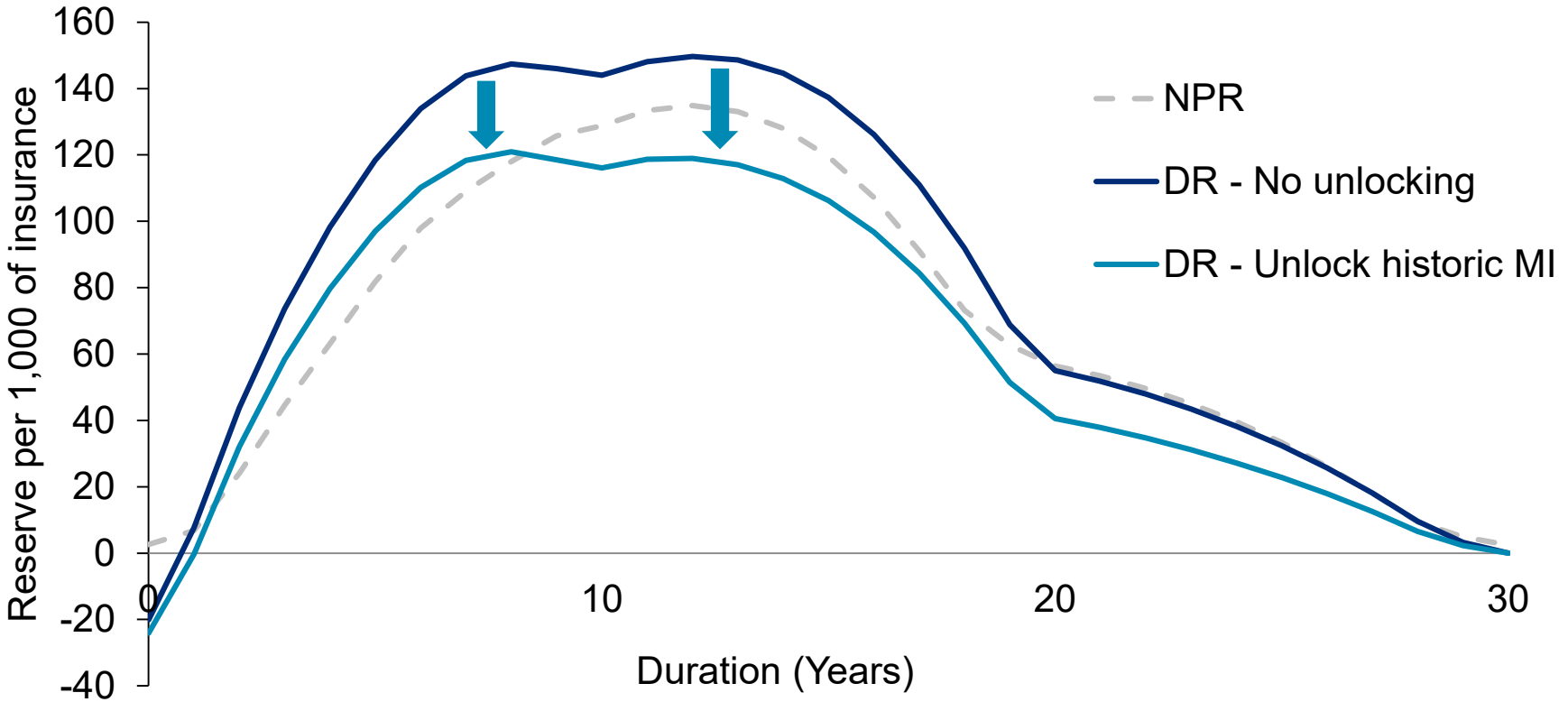
Moderate differentials in mortality improvement change remaining life expectancy by years, not months



Mortality improvement is a small assumption but has a large impact; getting it right is not merely an exercise in ‘sharpening the pencil’

PBR case study

The impact of unlocking the mortality assumption is material



DR with no unlocking creates the highest reserve. With unlocking, the NPR begins to take over at most durations.

State of the industry

Mortality improvement assumptions have become more sophisticated over time because longevity gains are not evenly distributed

Degree of sophistication

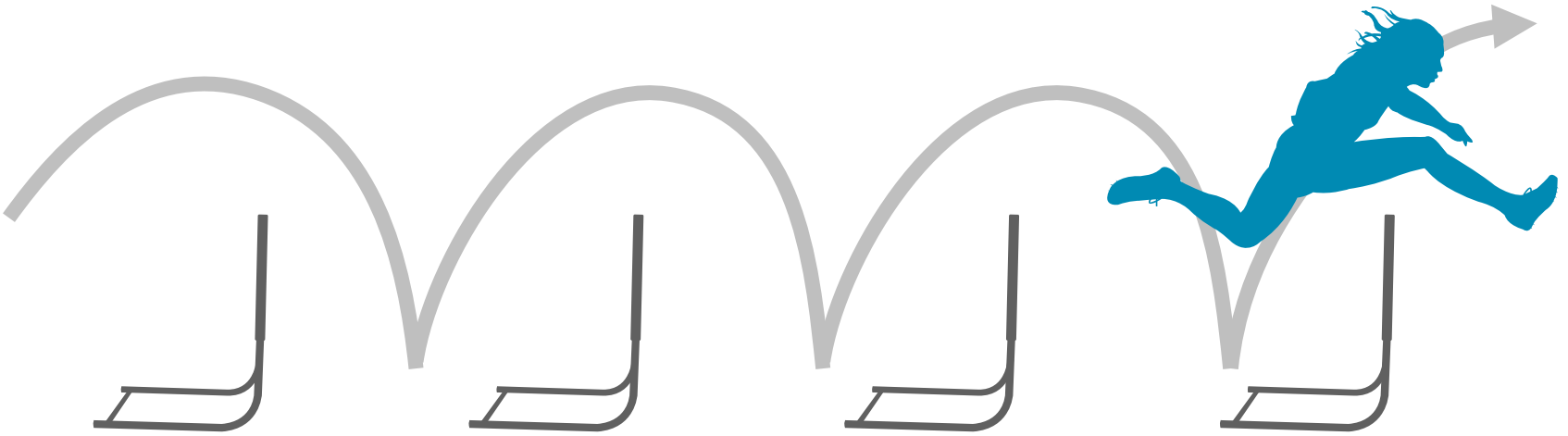
	BASIC (G2 2012)	ADVANCED (MP 2018)	NEXT GEN
Age	✓	✓	✓
Gender	✗	✓	✓
Calendar Year	✗	✓	✓
Income	✗	✗	✓
Education	✗	✗	✓
Occupation	✗	✗	✓

The next generation of mortality improvement assumptions will be further refined to differentiate by socioeconomic and other demographic variables

2 Data and methods

Data

Getting the right data has been a major barrier for reinsurers and direct writers



1 Public

- Many challenges to obtaining or sharing proprietary data

2 Large

- Needs more data because splitting by socioeconomic groups thins the data considerably
- Needs more data than base mortality since it measures changes over time

3 Long-term

- Improvement trends are inherently long term and data needs to span decades rather than years

4 Relevant

- Needs to contain mortality data as well as detailed demographic information
- Needs to pertain to general US population or represent insured/annuity population

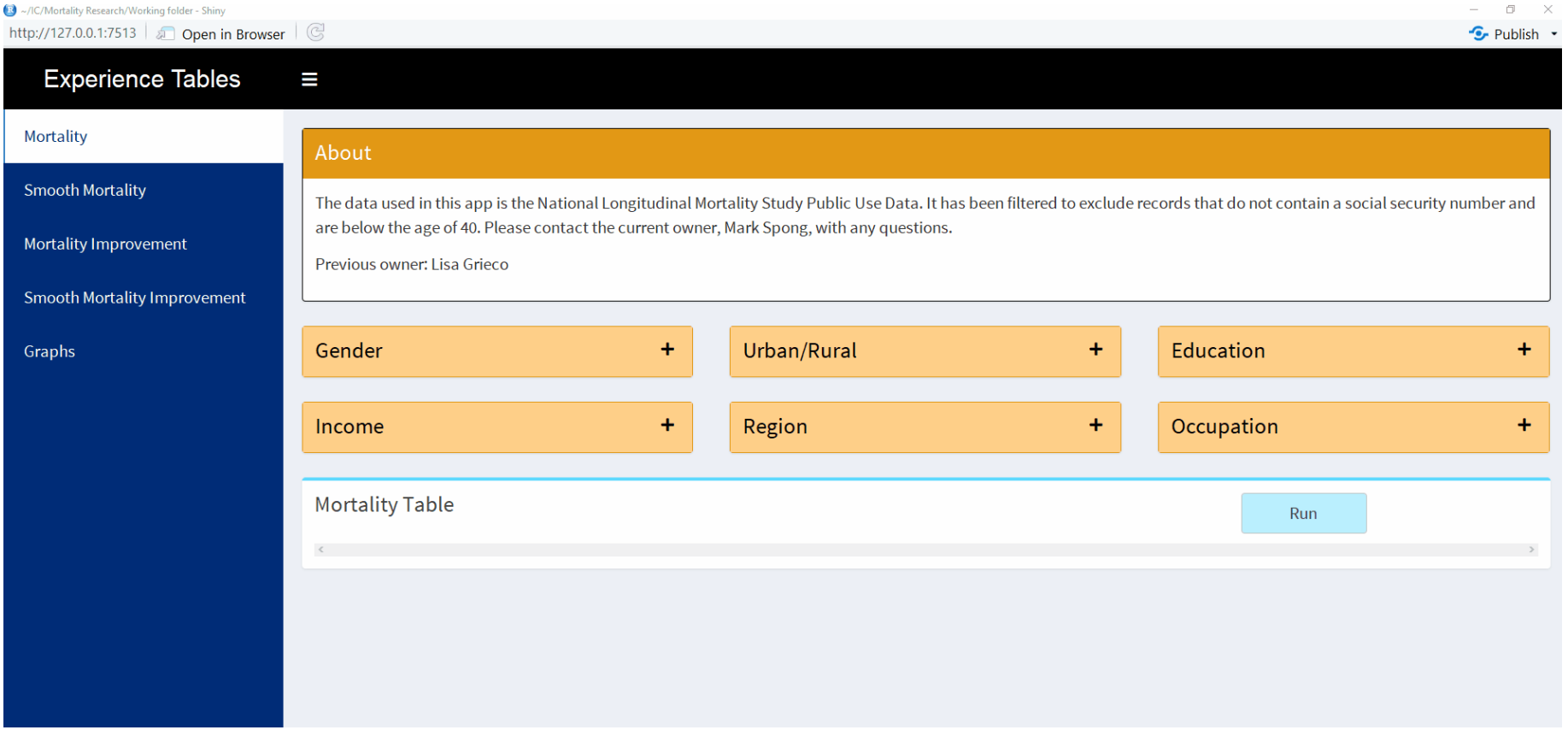
Data

Successfully obtained data from U.S. Census/CDC spanning 1980-2005 with 3.8 million records and over 550,000 deaths

- **DEATH, CAUSE OF DEATH**
- **GEOGRAPHY**
- **CITIZENSHIP, VET STATUS**
- **AGE, GENDER, RACE, TOBACCO**
- **OCCUPATION, INDUSTRY**
- **INCOME, EDUCATION**

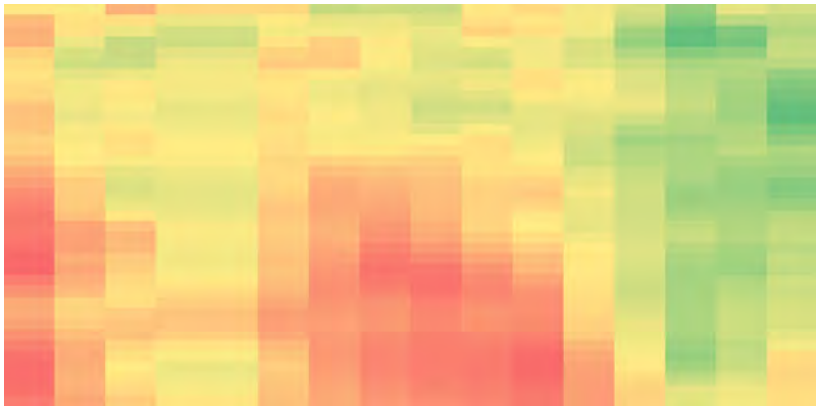
Dataset is explicitly for studying the effects of differentials in demographic and socioeconomic characteristics on mortality

Statistical tools and user interface



Dynamic validation vs MP-2018
Data follows general trend of MP tables

Female Data MI Rates



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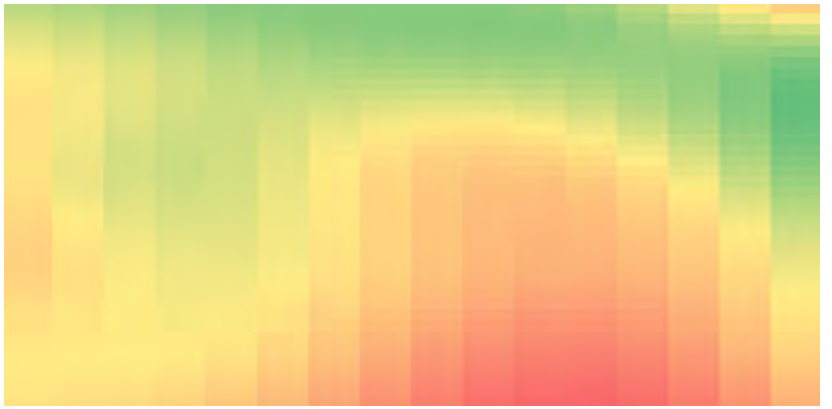
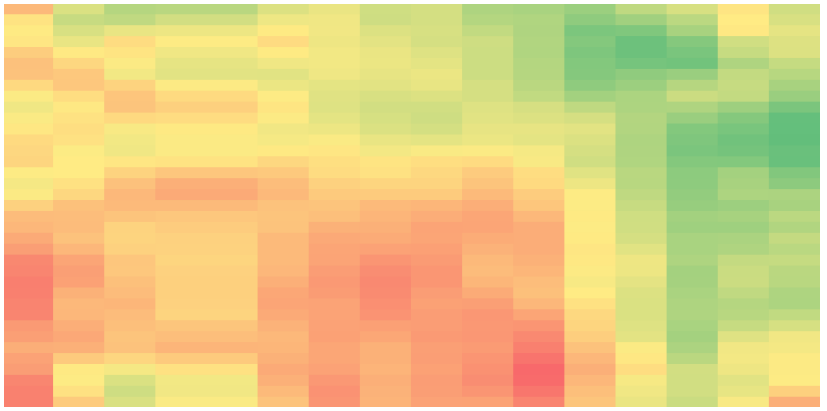


Male Data MI Rates



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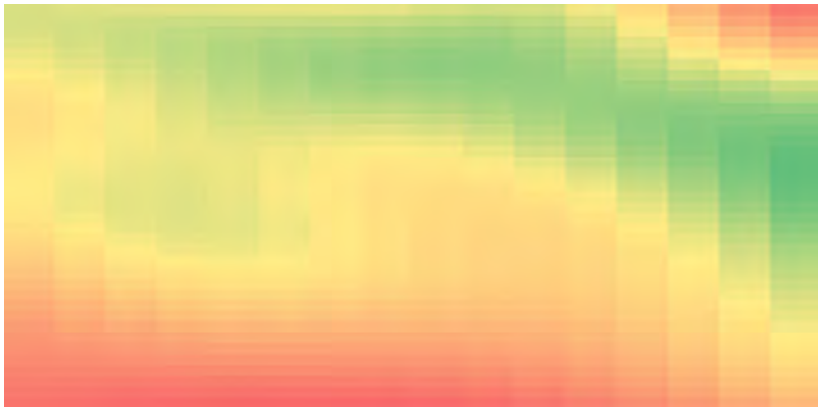
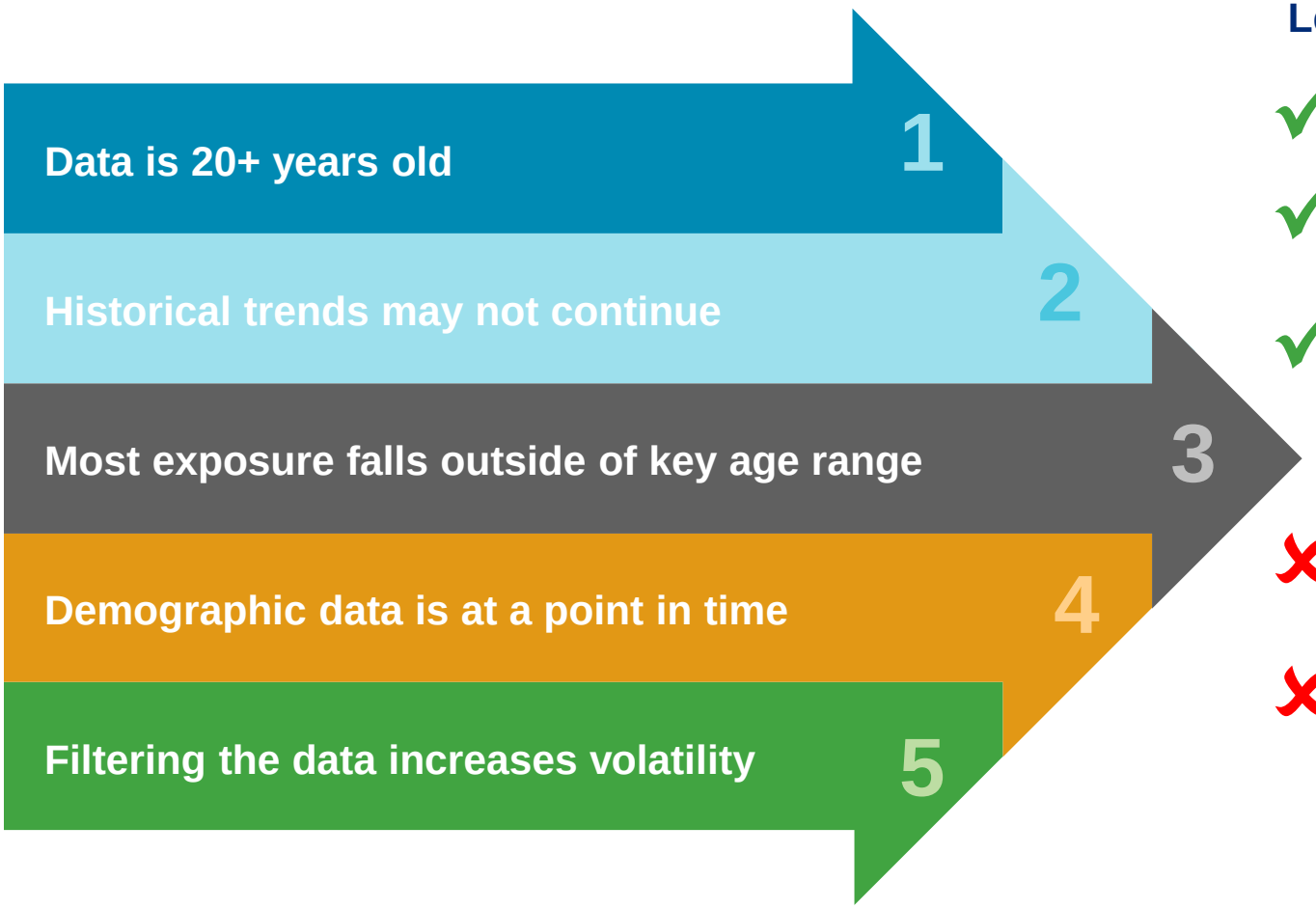


3 Results

What can the data actually tell us?



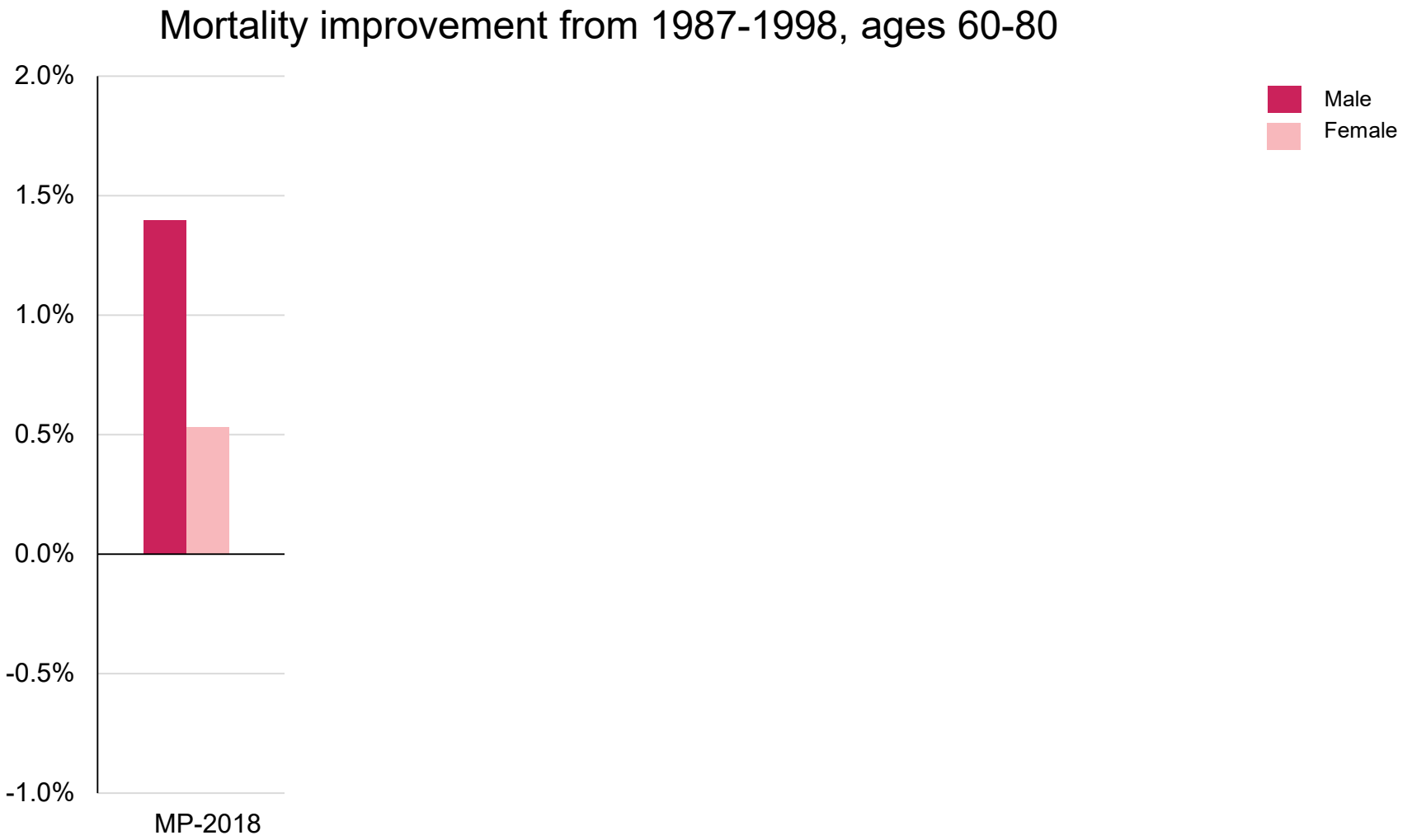
Level set expectations

- ✓ SES driving MI?
- ✓ Delta expected to continue?
- ✓ Rule of thumb?
- ✗ Advanced predictive model?
- ✗ Absolute MI expected to continue?

Absolute levels of future mortality improvement may vary, but evidence shows a delta between socioeconomic groups that we can reasonably expect to persist

Summary of results

A ‘rule of thumb’ approach shows deltas without getting lost in the weeds



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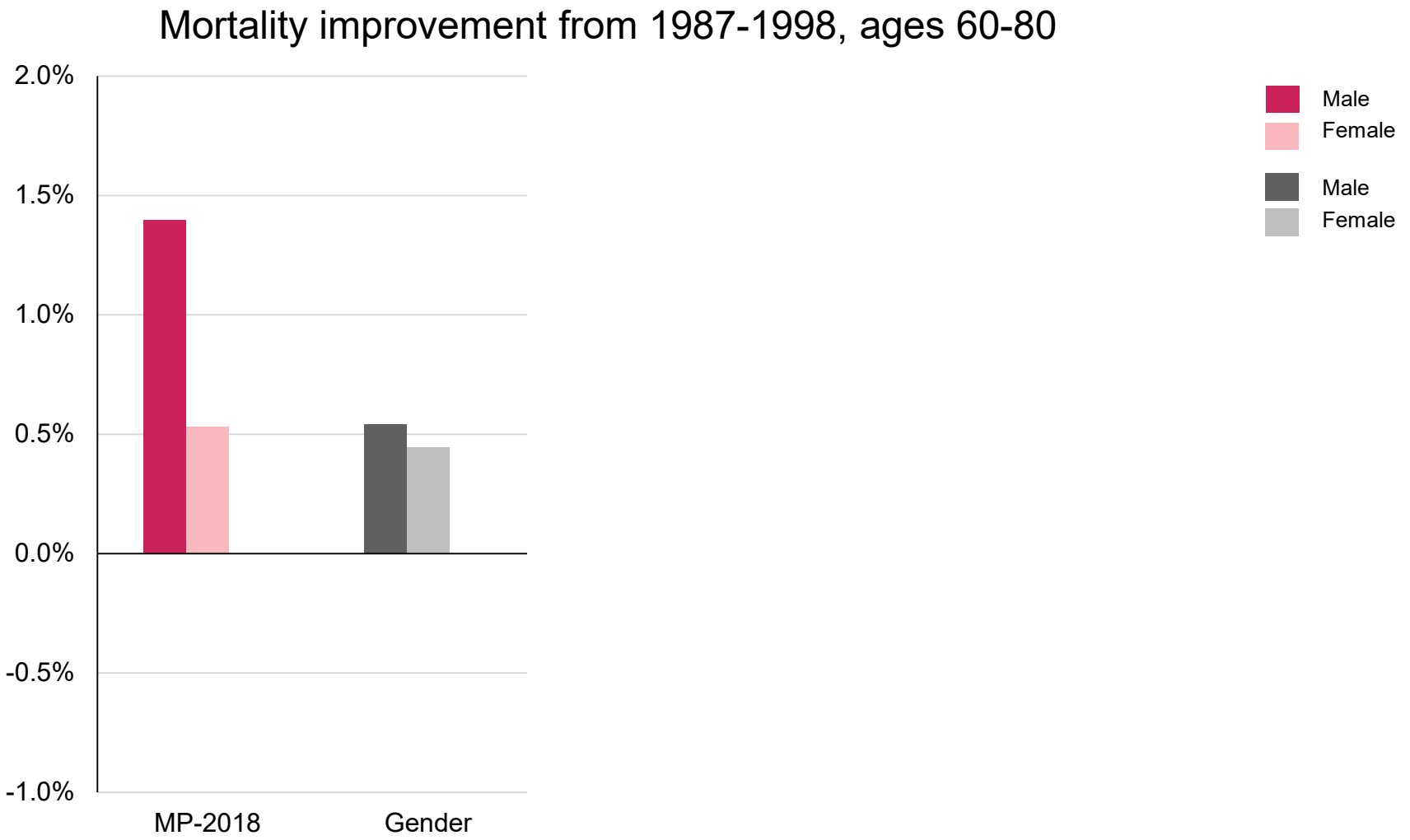

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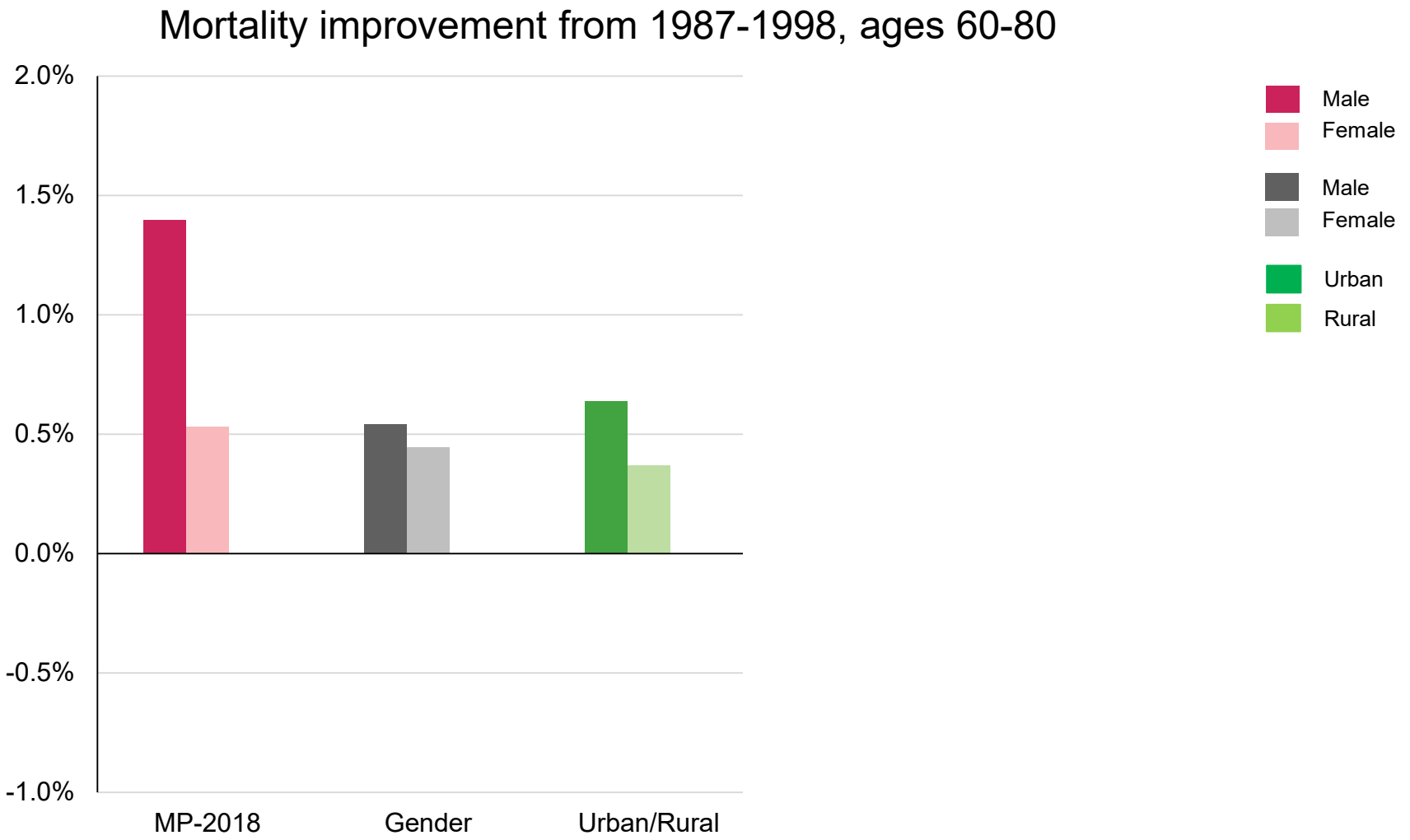

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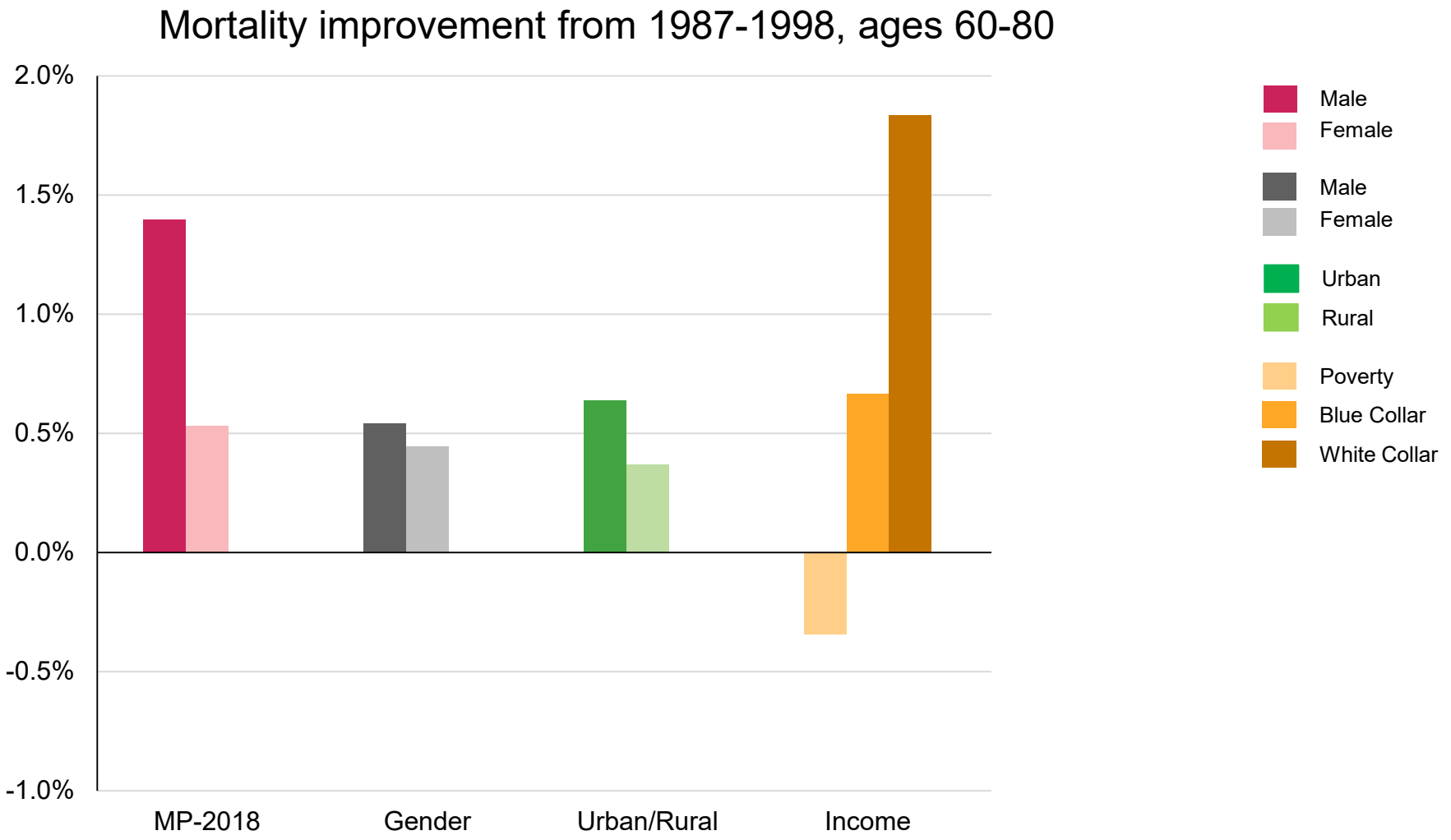

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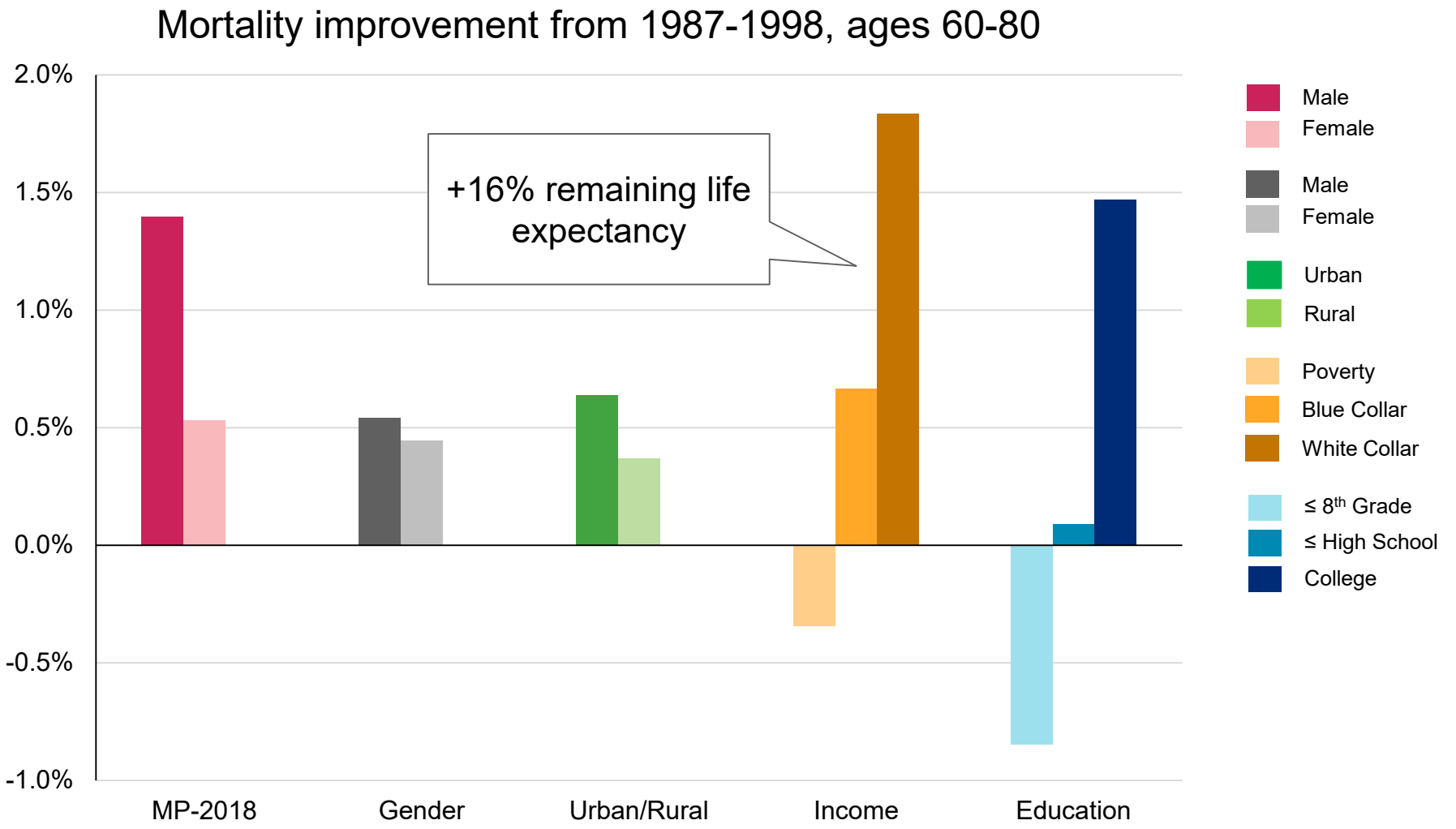

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4 Next steps

Next steps

Support implementation

- Determine haircut or delta in a given context
- Overcome practical challenges of modeling structure

Push for consistency

- Avoid spurious precision or unsupported granular assumptions
- Check for reasonability of differentiating MI set at the product level
- Address perception that MI is secondary with small impact

Research

- Access more recent dataset
- Address basis risk (e.g. general population vs insured population)
- Layer on a cause of death analysis


OLIVER WYMAN